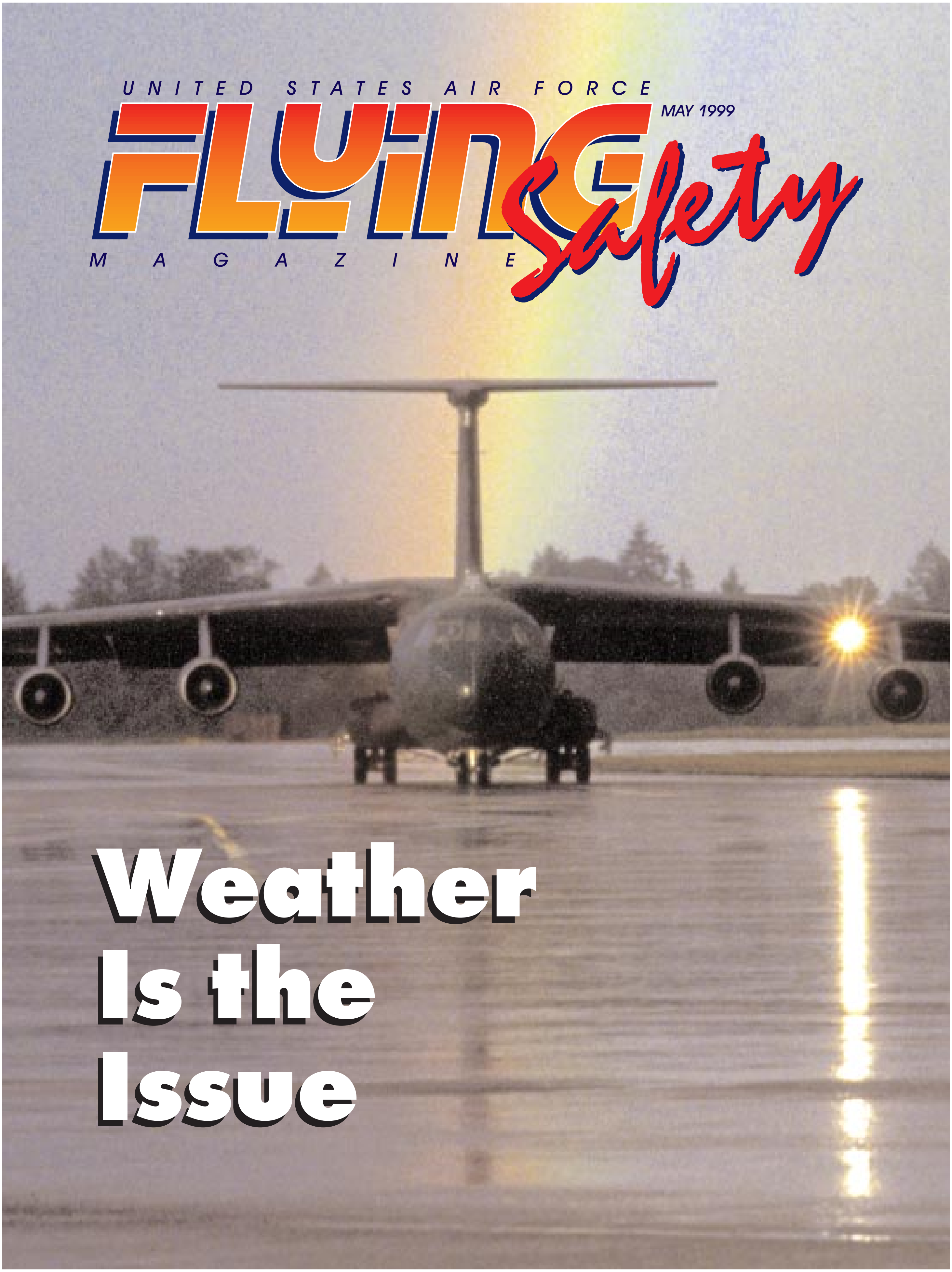
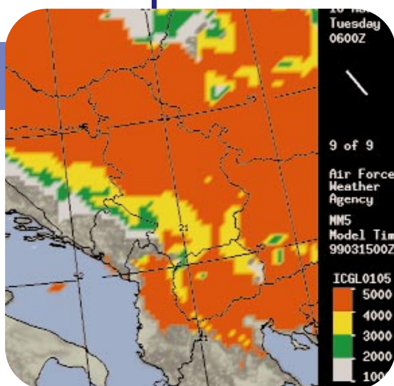
UNITED STATES AIR FORCE
FLYING Safety
MAGAZINE
MAY 1999



Weather Is the Issue

UNITED STATES AIR FORCE
FLYING Safety MAGAZINE
AIR FORCE RECURRING PUBLICATION 91-1
MAY 1999, VOL 55, NO 5

THE ISSUE:



Cover photo by SSgt Billy W. Johnston

Web page address for the Air Force Safety Center:
http://www-afsc.saia.af.mil
Then click on Safety Magazines.

Commercial Prefix (505) 846-XXXX
E-Mail — bakerm@kafb.saia.af.mil

24 hour fax: DSN 246-0931
Commercial: 505-846-0931

DEPARTMENT OF THE AIR FORCE — THE CHIEF OF SAFETY, USAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. SUBSCRIPTIONS — For sale by the Superintendent of Documents, PO Box 371954, Pittsburgh PA 15250-7954; $25 CONUS, $31.25 foreign per year. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments.
DISTRIBUTION — One copy for each three aircrew members and one copy for each six direct aircrew support and maintenance personnel.

POSTAL INFORMATION — *Flying Safety* (ISSN 00279-9308) is published monthly by HQ AFSC/SEMM, 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670. Periodicals postage paid at Albuquerque NM and additional mailing offices. **POSTMASTER:** Send address changes to *Flying Safety*, 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670.

CONTRIBUTIONS — Contributions are welcome as are comments and criticism. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

Stray Blue Sheet

Courtesy *ASRS Callback*, Jan 99

A corporate pilot reports one more bit of stray paper—a recent issue of CALLBACK—made an impression. Apparently not quite a big enough impression…

*I was just reading in the last CALLBACK about low altimeter settings. I thought that could never happen to me. Well, guess what? [As we were climbing out] Center had cleared us to FL270. They asked our altitude, as they showed us high. Sure enough, our altimeter was set on 2***8***.92. The previous crew had had a setting of 28.96. I had not even looked at the first two numbers. We had some other distractions, but that is no excuse. Never say never.*

The last two numbers of the altimeter setting were so close it didn't register with the reporter that the first two numbers were a problem—the 28 should have been a 2**9**.

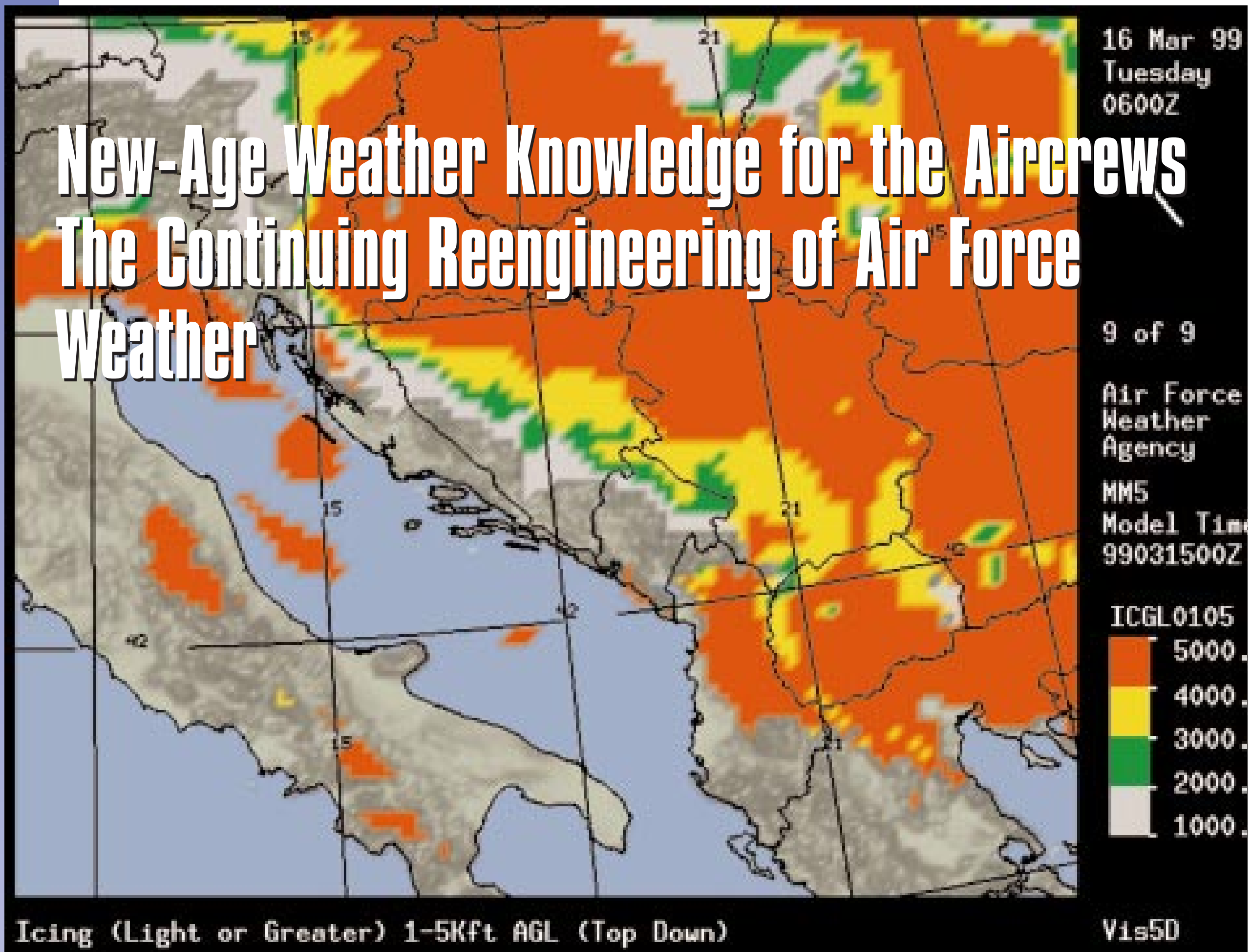
Not Good Form

The commuter crew was flying in VMC on an IFR flight plan, but both pilots were distracted from their flying and monitoring duties by Customs forms that could have waited until the flight had landed.

We were given a descent clearance to 14,000 feet. It was the First Officer's leg to fly, and I was filling out our crew declaration Customs form. I noticed the First Officer was also filling out the Customs form, so I occasionally looked up to monitor our flight situation. The autopilot was descending initially, but had somehow disengaged without us knowing why. The autopilot warning announcing disengagement only occurs below 2,500 feet AGL. Because our descent was shallow and we were filling out our Customs forms, no one noticed we had descended through our assigned altitude until we were 500 feet below it. It was a light traffic day…and no traffic was on TCAS II. Center didn't mention the altitude deviation. In the future, I will pay closer attention to monitoring the autopilot…and I will supervise my First Officer more closely during autoflight.

The captain filed this report to document the uncommanded disengagement of the autopilot. However, automation—the "magic"—is never a substitute for flying the aircraft. The reminder for all is that the crew's first priority should always be on flying duties, including altitude callouts, checklists, and traffic watch. Ground duties should be saved and performed on the ground. ■

New-Age Weather Knowledge for the Aircrews
The Continuing Reengineering of Air Force Weather



An icing graphic for the Bosnia region from AFWIN

BRIG GEN FRED P. LEWIS
Director of Weather, HQ USAF

We reported here last year *(June 1998—Editor)* on the end-to-end restructure of Air Force Weather. I'm back now to happily report that the promised dramatic changes are progressing forward positively.

Beginning in August 1996, we analyzed the strengths and weaknesses of a variety of operational support processes. Our goal was to learn and then leverage solutions from each in order to set a higher standard for twenty-first century aviation weather support to improve flying safety. We had to examine how to increase the effectiveness of our most important resource, our people, while simultaneously increasing their job satisfaction and reducing their burnout from higher-than-ever demands on their time and skills. We also had to look at the processes that generate and deliver weather information with an eye toward new technologies that can enable us to work smarter, better, and cheaper. Finally, we had to revamp an infrastructure that served us well through the Cold War but had to change to support today's environment.

To understand our transformation, you have to view weather operational support in terms of two parts: (1) a "kitchen" that creates and prepares fine-scale accurate weather products and (2) a weather "server" function that provides mission forecast weather support to our operational customers.

Our weather operations exist in many places where observations, pilot reports, and other data are recorded, assimilated, analyzed, fed into computer weather models, and scrutinized even more before being turned into operational products. The Operational Weather Squadron (our weather forecast "kitchen") is where we will create the fine-scale, highly accurate weather information that operational field units will use in supporting their customers.

This is also the part where the most powerful computer—the human brain—plays a key role in blending the science with the art. The training and experience of the people in this process are paramount to on-target operational weather support. This part is normally far less visible to our customers, but is a crucial ingredient in our ability to provide fine-scale, accurate, and relevant weather support. This information base is also key to helping the aviation community with safer flight operations.

The weather "server" briefing function is where our weather people provide the information to those who need it. Weather forecasting, like many disciplines, has very much been swept into the information age. Nonetheless, we will continue to invest in highly trained weather people for this part of the process so they can transfer their weather knowledge into the operations. While we will apply more "virtual" services where it makes sense, we still believe that weather people who know operations and the operator who knows the weather remain the keys to mission success and safer flying conditions. Our weather people are ready to provide on-target weather information anywhere, anytime, and our reengineering efforts are designed to improve their abilities to do just that!

Many commercial enterprises that "serve" weather information are able to do so with little investment in their own "kitchen" as they leverage the materials they need from public sources. As part of reengineering, Air Force Weather has also been aggressive at leveraging capabilities and information from other sources to reduce our operating costs while improving accuracy. We are working with the Navy, National Weather Service, and other agencies to build a national capability. However, as part of the national team, we are also a part of the "public source" of weather information and will continue to play a key role by sharing our information with these same agencies.

As we mentioned in last year's article, our business strategy is one of simplifying, streamlining, and leveraging more into our "kitchen" while putting fewer, but more experienced and more mission-focused people in the information-delivery role. This new approach directly supports the Expeditionary Aerospace Force (EAF) concept and, in fact, the EAF will allow us to provide even better operational weather support. You, the operators and aircrews, are starting to see these changes, but there are more and better things to come. Here's a quick preview of where we're headed:

• ***People.*** This summer we embark on a single career track for our enlisted weather technicians (our "weather operators"). All of our new recruits will go from their technical training initial skills course at Keesler AFB, Mississippi, to one of our new Operational Weather Squadrons. These squadrons serve as regional, reach-back hubs (our weather forecast "kitchen") to accumulate meteorological knowledge for specific geographical areas at finer scales than we've done in the past. They then provide the information to operational weather units in their area via reach-back and common-user communications. These hubs will create the aerodrome forecasts and constantly watch weather threats within their assigned regions.

This summer we embark on a single career track for our enlisted weather technicians (our operators). All of our new recruits will go from their technical training initial skills course at Keesler AFB, Mississippi, to one of our new Operational Weather Squadrons.

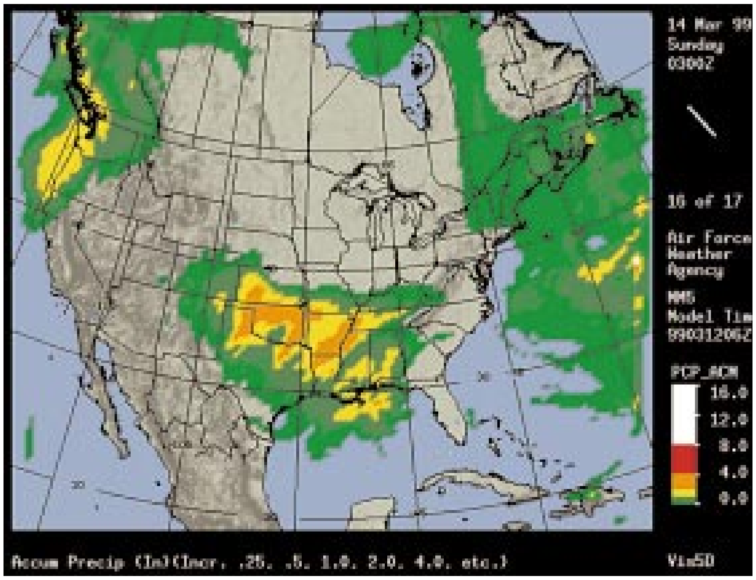
Significantly, these hubs will also serve as on-the-job training (OJT) "factories") where we place our least experienced people with our most experienced to produce highly trained people to go to front-line field units (our base weather stations). We're transitioning the base weather station of the past into a leaner mission-aligned team (the weather "servers"). These new weather units will contain only experienced people.

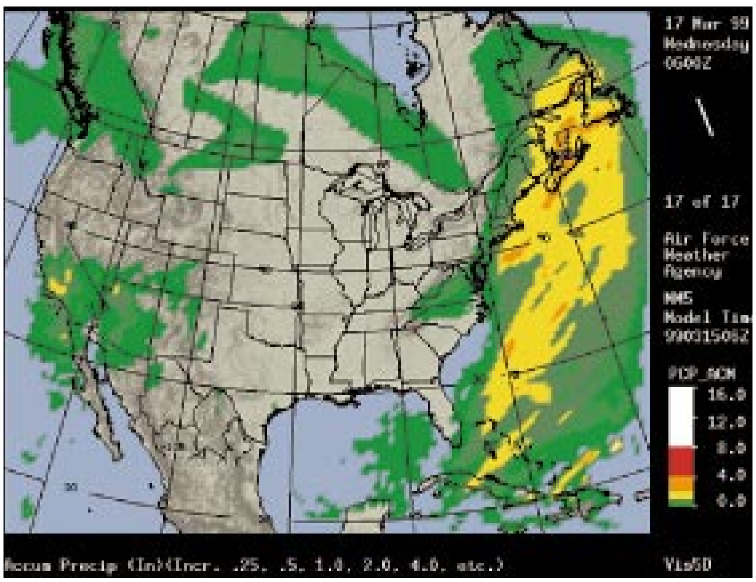
Further, we've simultaneously offloaded the basic weather OJT burden from the base units and have turned them into mission-aligned teams. These mission-aligned teams will focus more on the impacts of the weather. They will work more closely with operators, even right in the operational units in many cases, to optimize aviation support and help generate safer flight operations.

• ***Processes.*** We want to deliver weather information using the same processes in both peace and war. The information delivery style you've seen in contingencies is more of what you'll see everywhere now. You'll see more mass briefings, more updates within individual flying squadrons, and more direct interactions with the Supervisor of Flying—more up close and personal weather support!

You may see more automation added in our weather observing capability, but we must continue augmenting observing equipment with a person-in-the-loop dur-

continued on next page





Two sequential graphics from AFWIN covering a three day span tracking an easterly moving weather pattern.

ing flight ops. As we move forward, this person-in-the-loop will now be a forecaster taking observations—a "weather operator"—not an observer. This opens many possibilities for improving mission-critical weather support when weather is rapidly changing.

• ***Infrastructure.*** We're using our hubs and centralized facilities to concentrate our expertise and more complex equipment at fewer sites. These sites will provide very accurate weather information to field units in their region while at the same time lowering our equipment costs. You'll see our field units begin to use more off-the-shelf computers and use web-technologies to collect and deliver information. We're also fielding better means of communications, such as commercial VSAT technologies and alphanumeric pagers, to get the information moved faster, better, and cheaper to the people who need it most.

We believe our changes are on target to improve weather support for operations and this has and will remain the main goal! We took note during our reengineering studies that in the face of tough fiscal pressures, major airlines are maintaining their own meteorology departments to work with their flight dispatchers and airfield managers. Many airlines found it was good business to invest in the infrastructure needed to provide the weather information their aircrews use to plan and fly on because it gave them a competitive advantage.

Focused weather information also gives the military an advantage—the ability to "anticipate and exploit" the weather in the battle space to provide another edge over any adversary. Our new capabilities also let us help the Air Force team better prepare and protect our war-fighting resources from severe weather—contributing to overall force readiness and safer operations.

As our Air Force Weather reengineering continues, we're already seeing a leaner weather organization emerging that is devoted to providing the best mission-scale aviation weather information in the world. Information that will provide our aircrews with the weather knowledge needed to conduct and sustain safer, on-target military operations anywhere in the world, anytime. This whole effort is designed with you—the warfighter, the operator, and the trainer—in mind. I encourage your help in continuing to make our vision a reality. If you would like to provide us with your thoughts on how we can continue to become even better, please feel free to contact me at lewisf@pentagon.af.mil.

"Weather on Target for safer operations!" ✈

Boomers and a Bad Radar

LT MARK E. SCHIMPF
Courtesy *Approach*, Nov 93

No one plans to fly into a thunderstorm. I'd been through all the weather lectures that stress avoiding turbulence, icing, and lightning around convective activity, but the point wasn't truly driven home until I experienced it first hand.

The day was going to be a long one. I was flying the P-3C on a round-robin from NAS Moffett Field, California, to Wright-Patterson AFB, Ohio, then to NAS Glenview, Illinois, and back to Moffett. In all, it would be about a 16-hour day if we had no delays.

The weather brief at Moffett made it clear there would be some interesting flying in the Midwest where we were headed. A strong cold front was making its way through the Great Lakes states, creating some powerful thunderstorms. The weather was clear and calm in California, as it is almost every day in the summer. The weather remained clear until we reached the Mississippi River on our way to Wright-Pat. We were soon requesting deviations from track to avoid the weather, and ATC gave us radar vectors to avoid a line of cells between us and our destination. Everything went smoothly, and we made it safely into Wright-Pat.

On the ground, my second pilot and I went into weather for a thorough update on what to expect on our way to Glenview. The line was forecast to be past Chicago by the time we arrived, but first we would have to circumnavigate a group of cells crossing Indiana. The weather at Wright-Pat wasn't exactly CAVU (clear and visibility unlimited), either. The sky had grown dark, and cells were poised just northwest of the field. We decided to jump back into the plane and try to make our way before the cells reached the field.

As we taxied, I talked to Metro for an update. The cells were about 3 miles west of the field, but clouds had darkened the sky, and we needed to decide whether to take off. The flight engineer and the second pilot said they wanted to wait out the storm. However, the third pilot and I were sure we could safely take off to the south and then navigate our way around the cells visually, using the aircraft's radar and taking radar vectors from Center.

The decision was ultimately mine, and I decided to go. As it turned out, we were able to navigate our way around the storms in the vicinity of Wright-Patterson AFB and head toward Glenview.

The first 25 minutes of the leg were uneventful. We visually navigated our way around the cells, requesting deviations to avoid the weather. We also checked with the radar operator in the tube of the aircraft to confirm the headings. At times, his calls of the clouds ahead did not seem to jibe with what we saw, but with clouds all around, I assumed he was looking at another cloud. I had no reason to think we might have a problem with our radar. Unfortunately, we did.

The radar azimuth was no longer locked into alignment, and what the radar operator saw on the screen as being straight ahead was actually at the 8 o'clock position. The radar was 120 degrees out of slew!

Flying at FL240, we soon entered some thin clouds surrounding the larger cell. I could no longer depend on visual means to circumnavigate the boomers. So what did I put my faith in for storm avoidance? A radar system that was out to lunch.

"Sensor Three," I called the P-3 radar operator, "what's the best heading to avoid these cells up ahead?"

"It looks good straight ahead, sir. You should be out of this stuff in about 3 miles."

It sounded good to me, so I continued ahead. But the weather did not improve. We soon found ourselves in moderate icing conditions, and the air was getting a little bumpy. The third pilot did an excellent job of flying the aircraft while I tried to find our way out of the mess.

"Three, Flight, are we going to break out of this stuff soon? It's getting kind of ugly up here. Let's set conditions 5, guys."

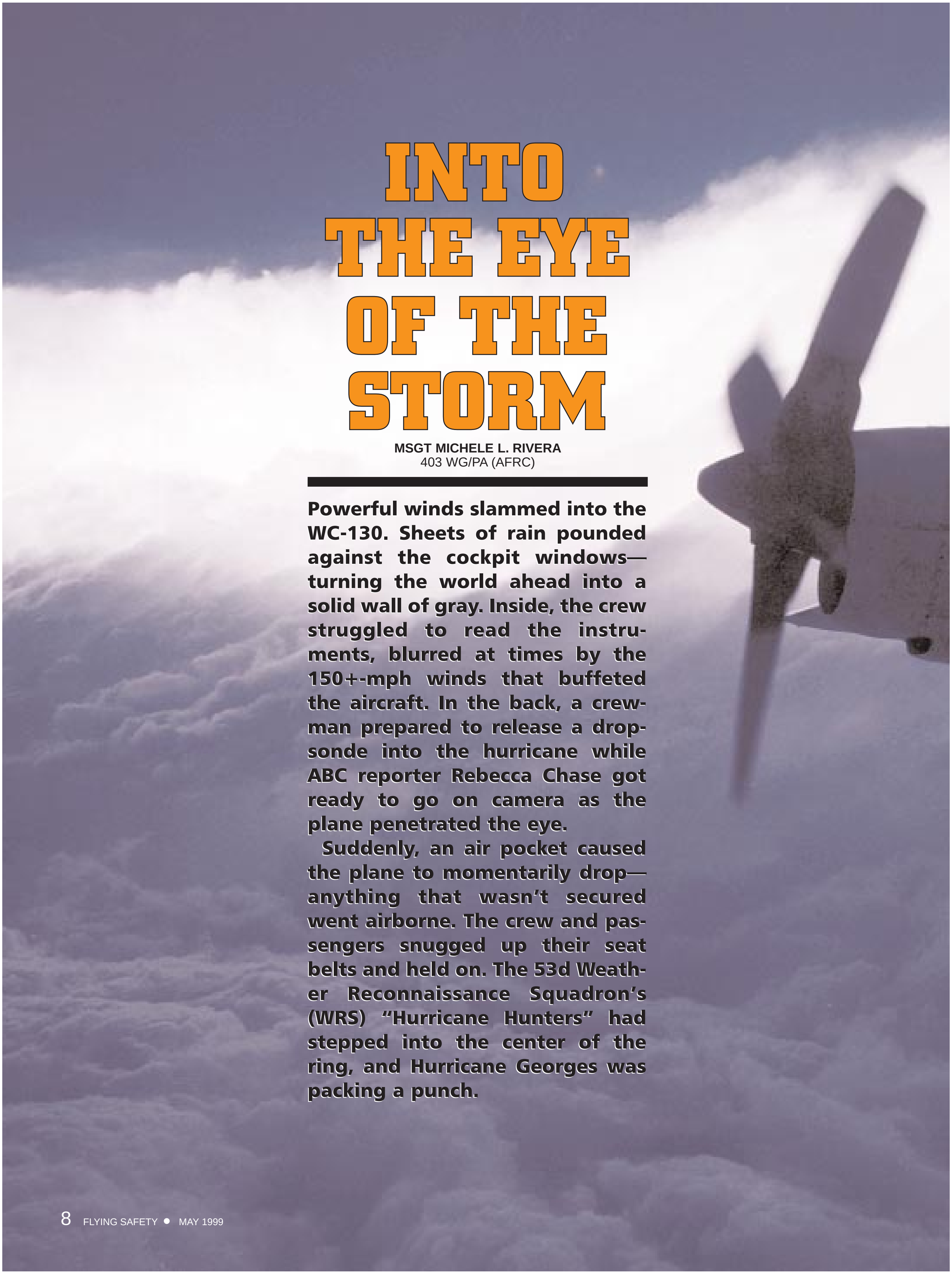
"Flight, Three, you should be breaking out of this stuff any second."

According to his radar scope, we should have broken out, but what he saw as straight ahead was actually a clear signal caused by the radar blanket (which protects the inside of the aircraft from the radar energy). It was now becoming apparent this radar was having a tough day and couldn't be trusted. By this time, the icing was heavy, and communication with ATC was almost impossible because of static caused by the icing. We were in moderate turbulence, and we could see lightning. What scared me the most, though, was that I had no idea what lay ahead. Stories of aircraft dropping 20,000 feet and suffering Class A damage in storms ran through my head. Was this to be *our* fate?

Fortunately, it was not. I finally established comm with Center and asked for radar vectors out of the cell. At first, they reported they weren't painting us on radar, which didn't make me feel real good. But they picked us up again and told us to continue on course. In a minute or two, we were out of the bad weather and continued on to Glenview without incident. We spent the night at Glenview while we tried to repair the radar and, more importantly, repair our nerves.

The aircraft made it through with only some chipped paint on the nose radome and the leading edges of the wings. It could have been a whole lot worse.

The P-3C's radar isn't designed for weather avoidance, but many radar operators have learned to use the system to give the flight station a good heads-up on the weather ahead. This breeds a certain level of false confidence that we can depend on the radar to bail us out of a bad situation. In my case, the radar was more of a detriment than a help. I think the entire crew gained respect for the danger of a storm cell, and you can bet I'll keep a safe distance in the future. ✈



INTO THE EYE OF THE STORM

MSGT MICHELE L. RIVERA
403 WG/PA (AFRC)

Powerful winds slammed into the WC-130. Sheets of rain pounded against the cockpit windows—turning the world ahead into a solid wall of gray. Inside, the crew struggled to read the instruments, blurred at times by the 150+-mph winds that buffeted the aircraft. In the back, a crewman prepared to release a dropsonde into the hurricane while ABC reporter Rebecca Chase got ready to go on camera as the plane penetrated the eye.

Suddenly, an air pocket caused the plane to momentarily drop—anything that wasn't secured went airborne. The crew and passengers snugged up their seat belts and held on. The 53d Weather Reconnaissance Squadron's (WRS) "Hurricane Hunters" had stepped into the center of the ring, and Hurricane Georges was packing a punch.

For 9 days the 53 WRS had tracked the powerful storm from the western Atlantic, through the Caribbean, and into the Gulf of Mexico. It was all too obvious that Georges was bearing down on Biloxi. Now it was the Hurricane Hunters and their families' turn to be the "hunted." When the storm roared ashore on 28 September 1998, some crewmembers took to the skies with mixed feelings.

"Before we left, we knew there was a good probability of it hitting here. I looked around the house and wondered if there was anything I wanted to keep," said Capt Arnold Michels, a 53 WRS aerial reconnaissance weather officer. "But I didn't take anything with me—it was too hard to carry everything."

But that didn't stop Michels from wondering what he would find when he returned. "When you deploy in a case like this, there is a possibility that you will come back to total havoc," he said.

One thing Michels didn't have to worry about was leaving family members behind to have to cope for themselves. "I'm single, but a couple of crewmembers certainly were concerned. It was tough for them to go fly the mission, knowing their families were down there."

MSgt Roy Cloud, a flight engineer, was one of those who had to leave family behind in Mississippi.

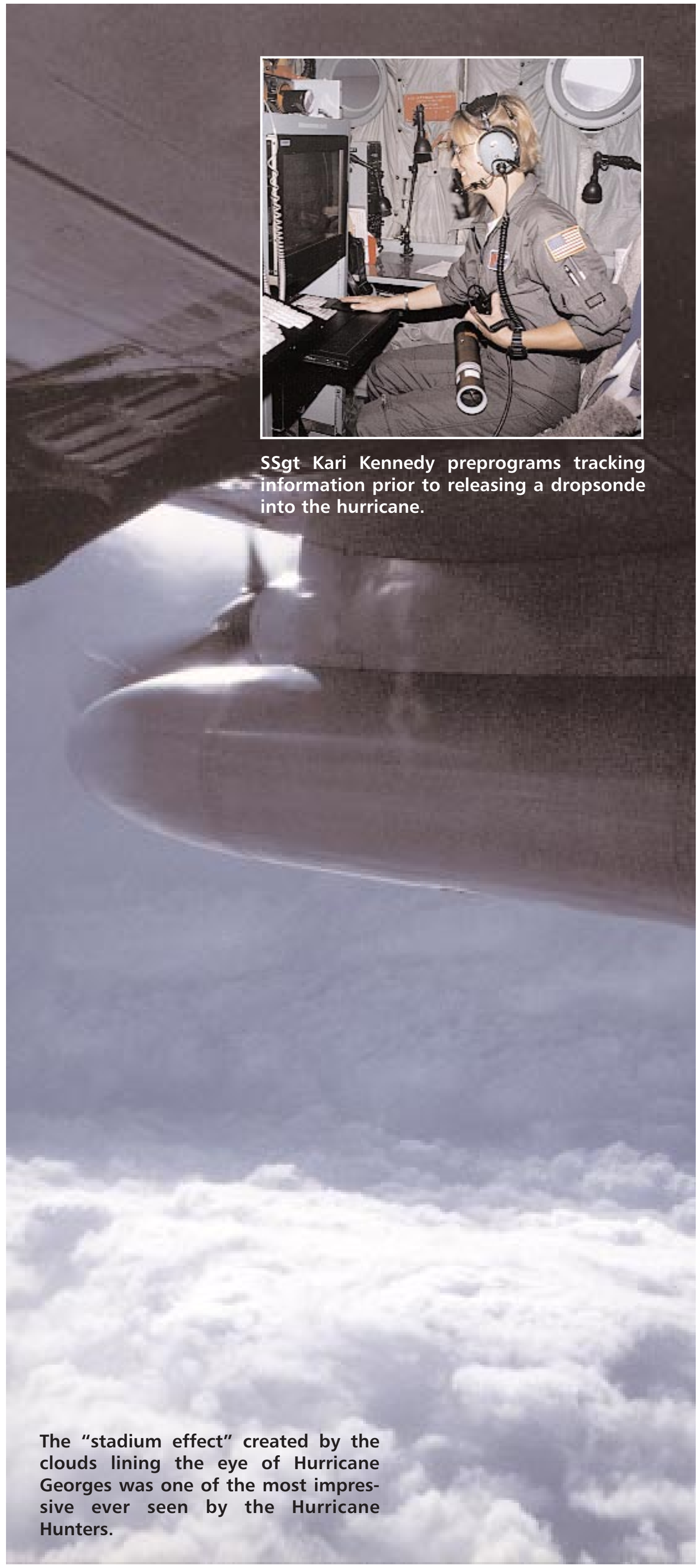
"That's the bad part of the job and the reason we like to get back as soon as we can," said Cloud. "We're out there doing a humanitarian mission and trying to help save lives, but at the same time we're worried about the families we're leaving behind while we're flying."

Had Hurricane Georges hit the Gulf Coast at its peak, the crewmembers would have had even more to worry about. On 19 September, during the first mission flown, meteorologists on board the WC-130 aircraft found winds as high as 148 mph and pressure dropping rapidly from 949 to 938 millibars. This made Georges a strong Category 4 storm at the time.

The well-defined eye seen on satellite images was even more impressive when seen up close from the inside of the eye. The wall of clouds lining the eye creates what crews call the "stadium" effect.

"This stadium effect is so good you can even count the bleachers," said Maj Dallas Englehart, one of two pilots steering the aircraft carefully through the storm. "Visually,

continued on next page



SSgt Kari Kennedy preprograms tracking information prior to releasing a dropsonde into the hurricane.

The "stadium effect" created by the clouds lining the eye of Hurricane Georges was one of the most impressive ever seen by the Hurricane Hunters.

All photographs by MSgt Michele L. Rivera

Maj Dan Darbe (left) computes windspeed on the surface of the water.

CMSgt Mike Scaffidi (above) has just finished charging the dropsonde battery in preparation for releasing the dropsonde into Hurricane Georges.

Dropsonde operator TSgt Scott Denham (right) assists the weather officer by taking surface observations.

this is the storm of the century," added dropsonde systems operator CMSgt Mike Scaffidi.

As the week progressed, the Hurricane Hunters flew 17 missions into Georges, providing the National Hurricane Center in Miami with vital information around the clock on the storm—information the center uses to predict the storm's path.

The group of reservists is called any time a tropical system threatens land in the Western Hemisphere. With a fleet of 10 WC-130s, they are responsible for tracking storms in the Atlantic, Caribbean, Gulf of Mexico, and eastern Pacific. Depending on the severity of the hurricane season, which lasts from June through November, it's possible to have crews flying reconnaissance in two or three systems at a time.

Storm reconnaissance frequently starts as a low-level hunt, below 1,000 feet, looking for the pressure and wind readings that would categorize the system as a tropical storm. As wind speed and turbulence increase, so does the altitude at which the Hurricane Hunters fly—from 1,000 to 5,000 feet in a tropical storm, to 10,000 feet in a fully developed hurricane. They fly at the different levels for two reasons: to provide the National Hurricane Center (NHC) with data at prescribed pressure altitudes; and for safety. In a fully developed hurricane, 10,000 feet allows the aircraft to adjust for pressure changes and the sudden updrafts and downdrafts that frequently occur in the thunderstorms that make up hurricanes.

A typical mission can last up to 12 hours, depending on the time it takes to reach the storm. Each mission consists of crossing the storm four times in a figure-X pattern, starting 105 miles from the center, crossing the eye, then proceeding 105 miles straight out the other side. As the aircraft crosses the four different quadrants, onboard sensors gather data the NHC needs to make its predictions—temperature, pressure, humidity, and wind speed and direction.

Each time the aircraft passes through the eye of the storm, the dropsonde systems operator releases a cylindrical dropsonde from the aircraft that measures the same data as the on-board sensors as it descends to the surface of the ocean. Information gathered from the dropsonde is particularly valuable in determining the central pressure, and thus the strength, of the storm. The NHC combines that data with information gathered from the outer edges of the storm to determine where to post hurricane warnings.

"The National Hurricane Center has determined that our data helps increase the accuracy of their forecasts by at least 25 percent," said Maj Doug Lipscombe, an aerial reconnaissance weather officer. "Also consider the fact that it costs about $1 million per mile of coastline every time an evacuation is ordered. If our data can help reduce the overall warning area, we help the American taxpayers save money every time we fly a storm.

"Our motto is Pro Bono Publico—for the public good. That's the whole reason we're out there—to help save lives and money." ✈

Readers interested in obtaining more information on the Hurricane Hunters' mission can visit their home page at http://www.hurricanehunters.com/welcome. htm. Clicking on "Cyberflight Into the Eye" will allow readers to join the crew of Teal 41 as they fly a weather reconnaissance mission into Hurricane Opal.

Editor's Note: *MSgt Michele Rivera is an Air Reserve Technician assigned to the 403d Wing Public Affairs Office at Keesler AFB, Mississippi. She has served with the unit for 10 years and has flown on numerous hurricane reconnaissance flights assisting media in covering the Hurricane Hunter's mission.*

LT GEN GORDON A. BLAKE
AIRCRAFT SAVE AWARD

4TH QUARTER, CY98

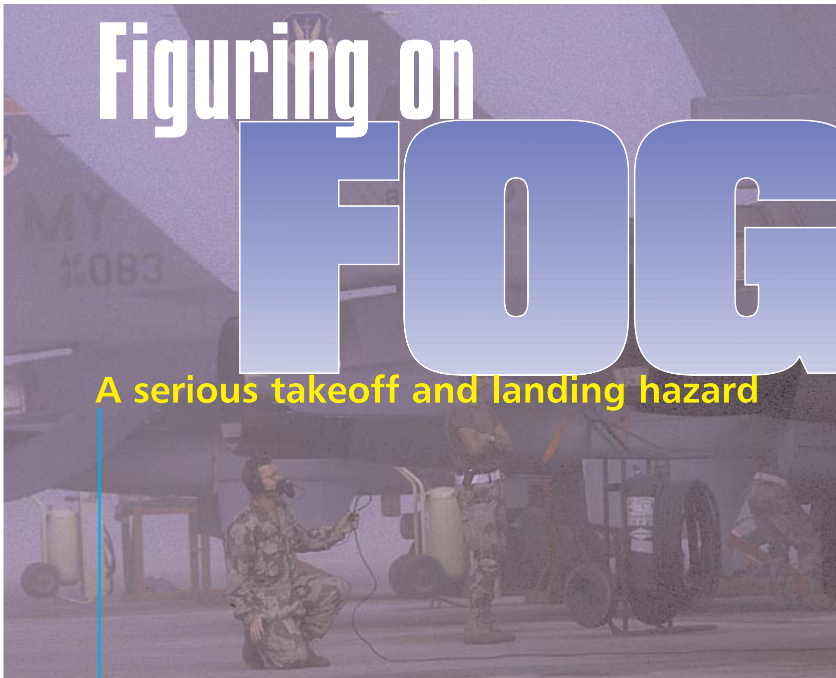
SSgt Timothy (Shane) Watts, (NATCF, Lee Radar Controller), 57th Operations Support Squadron, Nellis AFB, Nevada. After observing a 7700 beacon code, SSgt Watts coordinated with Salt Lake Center to identify the aircraft and immediately get the pilot on his frequency. After the civilian pilot checked in with SSgt Watts, the aircraft went into a tailspin due to severe turbulence. Once the pilot regained control of the aircraft, SSgt Watts calmed him and issued flight instructions that would ensure the aircraft remained above the mountainous terrain. With the aircraft encountering severe winds, he provided the pilot with precise radar vectors towards the most suitable airport. When the pilot reported the airport in sight, SSgt Watts gave him landing information, instructed him how to operate the airport lighting system, and then switched him to unicom. SSgt Watts' personal experience as a pilot and his knowledge of the Nellis Range Complex allowed him to prevent a possible disastrous situation for a disoriented pilot and his wife.

TSgt Stephen M. Browning, (Tower), 314th Operations Support Squadron, Little Rock AFB, Arkansas. Just after being relieved from his position, TSgt Browning noticed a blue Air Force vehicle and a forklift proceeding onto a taxiway. The vehicles didn't appear to be slowing down as they approached the active runway. Due to the busy tower pattern and abundance of taxiing aircraft, the local and ground controllers were focused on controlling their own traffic and apparently didn't notice the unauthorized vehicles. TSgt Browning alerted the tower crew of the imminent incursion, and the local controller immediately activated the red light on an aircraft that was over the numbers. The aircraft was in the flare, but the GCA controller was able to send the aircraft around just as the vehicles entered the runway. TSgt Browning likely saved the lives of several personnel and $20 million in Air Force assets due to his situational awareness and attention to the local flying environment.

SSgt William F. Conley, (Tower, Watch Supervisor), 14th Operations Support Squadron, Columbus AFB, Mississippi. SSgt Conley noticed a T-37 in the RSU pattern on short final descending to land with no gear. He immediately brought attention to its condition, and the ground controller keyed up Guard frequency to send the aircraft around. SSgt Conley's aggressive actions and attention to detail prevented the possible loss of two Air Force personnel and a valuable Air Force trainer aircraft. ✈

Figuring on FOG

A serious takeoff and landing hazard



USAF Photo by MSgt Perry J. Heimer

A recent analysis of 761 fatal general aviation mishaps in the U.S. indicated fog ranked fourth among the 10 most frequently cited causes/factors. It was determined to have been a cause/factor in 112 (14.72 percent) of the fatal mishaps studied.

ROBERT I. STANFIELD
Business Aviation Safety Journal, Vol 10, 1995

Everyone is familiar with the weather—rain, snow, clouds, warm and cold fronts, and wind. For the pilot who flies in the "weather factory," the changing conditions aloft are extremely important. Wind movement may carry the plane off course, rain may freeze on the wings, strong vertical currents may toss the aircraft around, and clouds or fog may cover the ground.

Fog is not only one of the most common weather hazards, it also is among the more dangerous because it's encountered during takeoff and landing. The basic difference between it and a low cloud is that the cloud bases must be at least 50 feet above the ground.

Fog can be defined as a condition of poor visibility at the ground due to suspended water droplets or ice particles. It generally reduces visibility to less than 3 miles and, in many cases, to zero. Conditions most favorable to the formation of fog are light surface winds, high relative humidities, and an abundance of condensation nuclei. Light winds tend to thicken fog but, as wind speeds increase, depending upon the stability and type of fog, the fog either dissipates or lifts to become low stratus clouds. All fogs and low stratus are classified as air mass or frontal.

Air Mass Fogs

Air mass fogs are produced principally by the cooling of moist air until it's saturated. Cooling may be produced by contact cooling or by radiation. There are several types of air mass fogs.

Advection fog is produced by advection (movement) of air of different properties over a surface that may be colder or warmer than the air moving in.

Monsoon fog is produced by warm, moist air blowing from land onto relatively cool water. It depends upon the temperature contrast between land and sea and often occurs in late spring and early summer. It's found chiefly over water, but since it forms close to shore, the afternoon sea breeze may bring it inland. It's a persistent fog and may last for several days.

Sea fog is produced by air flowing from over a relatively warm ocean surface to over another, colder, surface. It may be found in any season, but it's most common during the spring. Sea fog is common around the Newfoundland Banks where the warm Gulf Stream meets cold northern coastal waters.

There is a similar region off the eastern coast of Asia involving the Japanese Current. Rotating clockwise around the northern Pacific, it moves warm water northward along the Asian coast before moving cold water from the Arctic southward along the western coast of North America.

Most advection fogs are produced by the movement of warm air onto a cold surface. But fog can also form if the condition is reversed. This fog usually occurs on bodies of water in the fall and is sometimes called "autumn steam mists." In the Arctic region it's known as "Arctic sea smoke."

Up-slope fog: If an east wind carries sufficiently moist air across the Great Plains, it will be forced skyward by the rising terrain and will be cooled approximately at the adiabatic lapse rate. This is the rate at which the atmospheric temperature cools as altitude increases. The average change per 1,000 feet is 2°C. Since the air cools as it moves up the slope, it eventually reaches saturation.

In a **radiation fog**, the cooling of moist air to the point of condensation takes place by radiation; the air above it is cooled by contact with the ground. Fog that is of a local rather than a widespread nature forms in low places, since elevated locations spill rather than collect cold air.

Ground fog is generally shallow and doesn't totally obscure the sky; the moon and brighter stars are visible through it. Since the fog is formed by the conduction of heat from the air to the ground, the depth to which the fog can form under calm conditions is dictated by the vertical distance through which conduction cooling can extend—3 to 4 feet in depth under ordinary circumstances. If there is a slight amount of turbulence, ground fog can be much thicker because it stirs the saturated air a bit.

Unless the formation is very deep and solar heating is slow, ground fog usually dissipates shortly after sunrise. Fogs of this type are found in the central and western United States, but not usually in the eastern sections. This type also forms frequently in western Europe.

Frontal Fogs

As a rule, frontal fogs are of limited extent, compared to air mass fogs, and are dependent upon phenomena associated with fronts.

Prefrontal warm front fog is found in the cold air ahead of a warm front where precipitation is taking place. The region of precipitation becomes saturated with moisture, and any cooling of the air is sufficient to produce a fog.

The following factors favor formation of this fog:

- Cold ground.
- High moisture content of cold air.
- Winds in cold air that have an up-slope component over the ground.
- Snow-covered ground.

This fog is common in the eastern U.S., especially during winter.

Prefrontal cold front fog is formed if a cold front advances against a mountain slope. The air in front is pushed to altitudes by the cold air until fog formation in the warmer air results.

Forecasting fog is difficult, and only a few general rules can be formulated. The formation of fog depends on the occurrence of conditions described and, therefore, depends upon the forecasting of the general weather features. Here are the fog-favorable factors that should be considered in a weather briefing:

1. Type of air mass (moist in lower levels)
2. Character of locality (up-slope motion)
3. Season of the year (cold ground surface)
4. Path the air mass has followed (flowing over colder surfaces)
5. Wind velocity (low but not calm)
6. Dew point (at or near air temperature)
7. Radiation conditions (ground surface)
8. Moisture content aloft if available (dry air aloft)

The dissipation of fog is assumed to be due to heating from below caused by sunlight that filters through the fog or stratus layer. The time after sunrise necessary to dissipate fog is assumed to be longer the greater the thickness of the cloud. Also, this length of time is assumed to be longer the greater the height of the inversion.

Haze

Haze is generated when the dust and/or salt particles normally dispersed in the atmosphere are trapped and concentrated into a stable atmospheric layer.

Most pilots have flown through haze in which distant objects appear to be veiled in pale blue, if they are dark, and yellow if they are light. The intensity of haze increases as the stability of the air increases. On occasion, surface-based haze layers may extend to altitudes of up to 15,000 feet.

Haze layers are frequently associated with high-level inversions because the air is stable, and the top of the haze layer is usually located near the top of the inversion. While air-to-air visibility is good above the inversion, air-to-ground visibility in and above a haze layer, however, can be practically nil. At times, visibility is good straight down but practically nonexistent horizontally.

The greatest restriction to visibility in haze occurs when looking into the sun. Here, the visibility most often is zero, making it hazardous to land an aircraft into the sun when haze conditions exist.

Smoke

Usually concentrated on the downwind side of industrial areas, smoke normally restricts visibility when it's trapped beneath an inversion. The surface, slant, and horizontal visibilities while flying in it are similar to those in haze.

Smoke generated by forest fires is frequently transported over great distances at high levels. In such cases, pilots may encounter very poor horizontal and slant range visibilities in dense smoke at flight altitudes, although the lower levels are free of smoke.

Since smoke particles are nuclei upon which water vapor condenses, smoke and fog often occur together in industrial areas, resulting in "smog."

Fog and other natural restrictions to visibility aren't just common weather hazards—they can be deadly. ✈

Editor's Note: Permission to reprint this article from the Business Aviation Safety Journal was provided courtesy of the Flight Safety Foundation.

Fog is not only one of the most common weather hazards, it also is among the more dangerous because it s encountered during takeoff and landing. The basic difference between it and a low cloud is that the cloud bases must be at least 50 feet above the ground.

Thunderstorms—A

MR. GARY WICKLUND
SSGT BRIAN McDONALD
SRA LANCE FISCHER
377 ABW/OTW
Kirtland AFB, New Mexico

The severe thunderstorm season has returned, and now's as good a time as any to talk about how you can prepare to "weather" it safely.

Aviators often see thunderstorms in the central United States reach 60,000 to 65,000 feet in height during the summer months, with average heights of around 40,000 feet most of the year. These heights normally mean rethinking an intended route to avoid the thunderstorms (protecting both pilot and aircraft from the effects of hail, lightning, turbulence, etc.) or postponing the flight altogether.

When assigned to, or visiting, an airfield poleward of 48° north latitude, most severe thunderstorms rarely exceed 35,000 feet, with the average height of most storms topping out at 20,000 to 25,000 feet. This explains why aviators in northerly latitudes often fly regardless of weather forecasts of severe thunderstorms along their route of flight. To understand why this is true requires a short review about the atmosphere.

The sun heats the atmosphere more at the equator, producing a thicker amount of atmosphere than at the poles. A rule-of-thumb used by many weather folks says to subtract about 2,000 feet from the central US maximum cloud tops for every degree poleward of 35° north latitude. Thus, the farther north one flies the greater the possibility of flying *over* most thunderstorms without incurring their wrath.

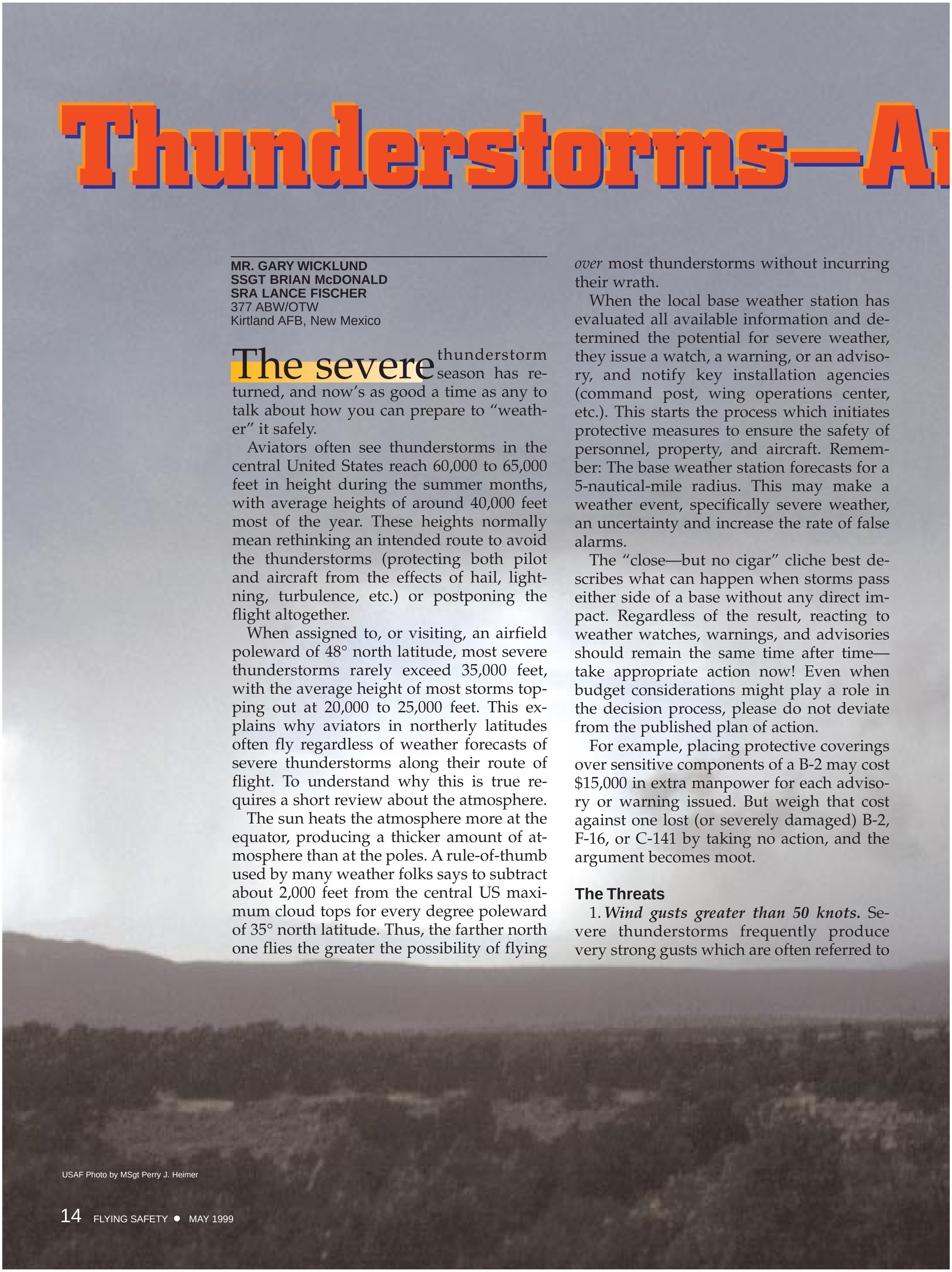
When the local base weather station has evaluated all available information and determined the potential for severe weather, they issue a watch, a warning, or an advisory, and notify key installation agencies (command post, wing operations center, etc.). This starts the process which initiates protective measures to ensure the safety of personnel, property, and aircraft. Remember: The base weather station forecasts for a 5-nautical-mile radius. This may make a weather event, specifically severe weather, an uncertainty and increase the rate of false alarms.

The "close—but no cigar" cliche best describes what can happen when storms pass either side of a base without any direct impact. Regardless of the result, reacting to weather watches, warnings, and advisories should remain the same time after time—take appropriate action now! Even when budget considerations might play a role in the decision process, please do not deviate from the published plan of action.

For example, placing protective coverings over sensitive components of a B-2 may cost $15,000 in extra manpower for each advisory or warning issued. But weigh that cost against one lost (or severely damaged) B-2, F-16, or C-141 by taking no action, and the argument becomes moot.

The Threats

1. ***Wind gusts greater than 50 knots.*** Severe thunderstorms frequently produce very strong gusts which are often referred to



USAF Photo by MSgt Perry J. Heimer

n Operational View

as gust fronts, outflow boundaries, or down/microbursts. Regardless, a trash container can do considerable damage to aircraft or buildings. Even cargo pallets have been known to leap tall perimeter fences. It's important to remove items that could become damaging—or deadly—missiles.

2. ***Hail greater than 3/4 inch.*** Personal injury and structural damage can, and often do, occur. Ensure people have sufficient time to find shelter and that they stay clear of windows which could shatter and injure them.

3. ***Lightning.*** This brilliant display of electrical energy strikes the earth about 200 times every second. It kills, on average in the United States, more than 100 people a year and injures nearly 250 others. When lightning is a threat, people should seek shelter immediately, but NOT UNDER TREES! Please remember: Lightning can strike the ground while the storm producing the strike may be more than 5 miles away.

4. ***Flash flooding.*** Watch out for and avoid areas prone to flash flooding. Flood waters often hide washed-out roads and bridges and quickly increase in depth. Water 1 foot deep that is pushing against the side of a car can make a 2-ton vehicle weigh less than 1.5 tons. Water 2 feet deep often causes vehicles to take unexpected and often deadly side trips down arroyos, canyons, ditches, etc.

5. ***Tornadoes.*** A tornado is one of the most devastating weapons in Mother Nature's arsenal. Tornadoes have occurred nearly everywhere on earth, making everyone, to some degree, vulnerable. In the United States, the National Weather Service provides advance warning through the use of Tornado Watch Areas. These are typically broadcast on The Weather Channel, local television and radio stations, and NOAA Weather Radio. If caught out in the open when a tornado strikes, find a ditch or other low-lying area. Lay face down, and don't move until the tornado has passed. NEVER REMAIN IN A VEHICLE.

What Can You Do to Prepare?

A good first step comes with safety briefings. Invite a weather person to conduct a weather safety briefing prior to the start of the severe season in your area to remind everyone of severe weather signs and hazards.

Next, military installations make extensive use of various methods to notify personnel of severe weather, such as telephones, public address systems, closed circuit television, mobile radios, and web pages on the Internet. The key here is *everyone needs to know what to do and how to respond when notified.*

When threatening weather conditions appear, do your part, whether it's securing aircraft, removing loose objects from around buildings, or simply ensuring all doors and windows are closed. You are protecting yourself, your coworkers, and valuable property.

Finally, practicing what to do in the event of severe weather is a great way to prepare for the real thing. *Apply* those lessons learned from base/unit disaster preparedness exercises, and you'll be ready when Mother Nature strikes. ✈

USAF Photo by MSgt Perry J. Heimer

Pilot Fatigue Manageable, But Remains Insidious Threat

STANLEY R. MOHLER, M.D.
Wright State University School of Medicine
Dayton, Ohio
Courtesy Flight Safety Foundation
Human Factors & Aviation Medicine
January-February 1998

"Pilot fatigue is a major safety concern in long-haul flying," wrote David F. Dinges, Ph.D., and R. Curtis Graeber, Ph.D., in a paper presented at a Flight Safety Foundation (FSF) workshop. "Although today's automated flight systems prevent the sleeping pilot from losing control of the aircraft, the less extreme effects of fatigue can seriously jeopardize flight safety."

They went on to point out "Each month [the U.S. National Aeronautics and Space Administration] Aviation Safety Reporting System (ASRS) receives reports from long-haul flightcrews describing how fatigue and sleep loss have contributed to major operational errors such as altitude busts, track deviations, landing without clearance, landing on the incorrect runway, and improper fuel calculations. Such reports are not surprising to any pilot who has flown all night over the ocean while trying to stay awake and alert in the dim light and constant hum of the long-haul cockpit. The problem worsens during trips as the effects of jet lag and sleep loss begin to accumulate."

A pilot's duties in the cockpit require care, vigilance, and physical and mental well-being. Cockpit noise, vibration, long flights, irregular work schedules, or too little sleep can result in fatigue, which can compromise a pilot's performance.

The management of human fatigue in flight operations is the primary responsibility of the pilot, but responsibility also falls on the operator and on government authorities. Air carriers must provide sufficient time in schedules to allow for crew rest. Aviation regulations must provide for a proper balance between duty and off-duty periods for flightcrews.

Fatigue is defined as a subjective feeling of tiredness that makes concentration on a task difficult. John A. Caldwell, Ph.D., wrote, "As [the pilot's] fatigue levels increase, accuracy and timing degrade, lower standards of performance are unconsciously accepted, the ability to integrate information from individual flight instruments into a meaningful overall pattern is degraded, and a narrowing of attention occurs that leads to forgetting or ignoring important aspects of flight tasks.

"In addition, the fatigued pilot tends to decrease physical activity, withdraw from social interaction…and lose the ability to effectively divide his mental resources among different tasks."

Generally, performance becomes less consistent as sleeplessness increases. Problem-solving slows, motor skills degrade, and the ability to pay attention is impaired. A severely fatigued pilot may even have temporary perceptual illusions, such as seeing lights that are not present.

An example of the effects of pilot fatigue is the McDonnell Douglas DC-8 mishap at the U.S. Naval Air Station, Guantanamo Bay, Cuba, on 18 August 1993. This is the first major aircraft mishap in the United States in which the National Transportation Safety Board (NTSB) cited flightcrew fatigue as the probable cause. (See "Pilot Fatigue Cited in DC-8 Accident,"on page 18.)

Falling asleep is not a conscious act. Brief periods of sleep can occur involuntarily, after which the fatigued pilot will not remember falling asleep, or will not have any idea of how long the sleep lasted. Warnings of the onset of sleep include difficulty in focusing the eyes or holding the head up; frequent yawning; strange or disconnected thoughts; and erratic flight control, such as wandering off heading or altitude without becoming immediately aware of the variation.

Another common symptom of fatigue is a change of mood. Fatigued persons tend to be uncharacteristically argumentative or irritable.

Often, fatigued persons do not recognize their own impairments, but consider themselves to be fully alert and capable. These feelings may be enhanced if the fatigued person has tried to offset the effects of fatigue with stimulants, such as amphetamines.

The only way to avoid the effects of fatigue is to ensure that adequate, restful sleep takes place while off duty or between work cycles. There are steps that can be taken to slow the onset of fatigue, but once fatigue sets in, there is no substitute for sleep.

There are several causes for fatigue among pilots. One cause is nontraditional work schedules, especially night flying, which disturbs the pilot's circadian rhythms—the body's normal sleep and wake cycles that are attuned, respectively, to night and day—

USAF Photo by SSgt Andrew N. Dunaway, II

making it difficult for the pilot to get adequate, restful sleep.

Another cause for pilot fatigue is flight across several time zones—the "jet-lag" phenomenon. When flying in a westerly direction, the pilot's day is lengthened. When flying east, against the movement of the sun, the pilot's day is shortened. The pilot's biological clock and the clock on the wall can differ by several hours.

The effects of disturbing the circadian rhythm can be significant. One investigation showed that the ability to operate a flight simulator at night, when compared to normal daytime pilot proficiency, decreased to a level corresponding to that after moderate alcohol consumption.

Loss of sleep can be cumulative; it is possible to acquire a "sleep debt." Mark R. Rosekind, Ph.D., et al. wrote, "An individual who requires 8 hours of sleep and obtains only 6 hours is essentially sleep-deprived by 2 hours. If the individual sleeps only 6 hours [per night] over four nights, then the 2 hours of sleep lost per night would accumulate into an 8-hour sleep debt."

Sleeping late on weekend mornings is an example of repaying the sleep debt that has been acquired over several working days.

On average, a person needs 8 hours of sleep a night. During the remaining 16 hours of wakefulness, the level of alertness is affected by several external factors. These in-

continued on next page

Often, fatigued persons do not recognize their own impairments, but consider themselves to be fully alert and capable. These feelings may be enhanced if the fatigued person has tried to offset the effects of fatigue with stimulants, such as amphetamines.

Fatigue is also a personal matter. A pilot who exercises regularly, does not smoke tobacco, eats a healthy diet, drinks alcohol sparingly, and gets adequate sleep will be less susceptible to fatigue than a pilot who does not follow a healthy regimen.

clude sensory stimulation, cognitive (conscious) thought content, nutrition, general health, and the presence of an artificial stimulant such as caffeine.

High noise levels on ramps and in flight can contribute to fatigue. Earplugs can be worn to reduce noise levels while still allowing normal conversation. In the cockpit, noise can also be reduced by the use of high quality headsets, some of which are designed for noise suppression.

Unexpected flight delays, such as those caused by weather or maintenance problems, contribute to the development of fatigue. When these delays—downtime disruptions—occur during a series of flights, their cumulative effect can become serious. Flight delays may also result from improper scheduling. For example, a schedule that contains 4 hours of duty time, 4 hours of nonduty time followed by another 4 hours of duty time may, if there are not adequate rest facilities available, be very fatiguing.

Even extremes of temperature, such as would be encountered when taking off from Scandinavia in January, for example, and landing in Jamaica, can cause stress, and that may contribute to fatigue.

Fatigue is also a personal matter. A pilot who exercises regularly, does not smoke tobacco, eats a healthy diet, drinks alcohol sparingly, and gets adequate sleep will be less susceptible to fatigue than a pilot who does not follow a healthy regimen.

Several measures can be taken to encourage sleep. When daytime rest is necessary, a fully darkened room is highly desirable. If sunlight seeps around the window shade, masking tape can be used to make a better light seal. This technique is also useful at night if exterior lights illuminate the room enough to trigger night vision, which will promote wakefulness.

Carrying something from home—for example, a book to read before sleeping—may help the environs seem familiar. Setting more than one alarm clock or wakeup call will reduce concern about not awakening on time.

Request hotel rooms located away from traffic or other noises. The temperature in the room should be comfortable. Consider sleeping in the non-

continued on page 20

Pilot Fatigue Cited in DC-8 Mishap

The McDonnell Douglas DC-8 was making a daylight approach to Runway 10 at Leeward Point Airfield, U.S. Naval Station, Guantanamo Bay, Cuba, in visual meteorological conditions (VMC) when it struck level terrain in uncontrolled flight about 0.4 kilometer (0.25 mile) from the approach end of the runway.

The plane was destroyed by post–mishap fire. The three flight crewmembers, the only persons aboard the cargo aircraft, received serious injuries in the 18 August 1993 mishap.

The aircraft was cleared for a landing on Runway 28, which has an unobstructed approach. The reciprocal Runway 10 required a crosswind leg within 1.65 kilometers (1 mile) of Cuban national airspace, which was restricted from overflight. The Cuban airspace boundary was marked with a fence and a high-intensity flashing strobe light; the light was not operational on the day of the mishap, but the mishap flightcrew was not provided that information.

At 1641:53, when it was about 118 kilometers (70 nautical miles (nm) south of Guantanamo Bay, the mishap aircraft began its letdown from 6,710 meters (22,000 feet). At that time, the captain said, "Oughta make that one zero approach just for the heck of it to see how it is; why don't we do that, let's tell them we'll take [Runway] one zero; if we miss we'll just come back around and land on two eight."

The aircraft was cleared for landing on Runway 10, and a right-hand approach (from the south) was made.

The following conversation, quoted from the official cockpit voice recorder transcript, begins when the mishap aircraft was about 3.5 kilometers (2 nm) south of the runway.

Time	**Source**	**Content**
1652:22	Flight engineer	*slow airspeed*
1653:28	Captain	**where's the strobe**
1653:29	Flight engineer	*right over there*
1653:31	Captain	**where**
1653:33	First officer	right inside there, right inside there
1653:35	Flight engineer	*you know, we're not getting our airspeed back there*
1653:37	Captain	**where's the strobe**
1653:37	First officer	right down there
1653:41	Captain	**I still don't see it**
1653:42	Flight engineer	*[expletive] we're never goin' to make this*
1653:45	Captain	**where do you see**

		a strobe light
1653:48	First officer	right over there
1653:57	Captain	**where's the strobe**
1653:58	First officer	do you think you're gonna make this
1653:58	Captain	**yeah…if I can catch the strobe light**
1654:01	First officer	five hundred, you're in good shape
1654:06	Flight engineer	*watch the, keep your airspeed up*
1654:09	Sound similar to stall warning	
1654:10	Unidentified crew stall warning	
1654:11	Captain	**I got it**
1654:12	First officer	stall warning
1654:13	Flight engineer	*stall warning*
1654:13	Captain	**I got it, back off**

The conclusions of the U.S. National Transportation Board (NTSB) included:

"The flightcrew members had experienced a disruption of circadian rhythms and sleep loss, which resulted in fatigue that had adversely affected their performance during a critical phase of the flight;

"The captain did not recognize the deteriorating flightpath and airspeed conditions due to preoccupation with locating the strobe light on the ground. This lack of recognition was despite the conflicting remarks made by the first officer and the flight engineer questioning the success of the approach. Repeated callouts by the flight engineer stating slow airspeed conditions went unheeded by the captain; [and,]

"There was no loss of roll authority at the onset of the artificial stall warning (stick shaker) and no evidence to indicate that the captain attempted to take proper corrective action at the onset of stick shaker."

The NTSB accident investigation report determined that the probable causes of the mishap included "impaired judgment, decision-making, and flying capabilities of the captain and the flightcrew due to the effects of fatigue."

The report said, "There are at least three core psychological factors to examine when investigating the role of fatigue in an incident or accident."

The first is cumulative sleep loss. The second is the number of continuous hours of wakefulness prior the incident. The third is the time of day. The report said, "Scientific studies have revealed that there are two periods of maximal sleepiness during a usual 24-hour day. One occurs at night roughly between 3 a.m. and 5 a.m., and the other in midday roughly between 3 p.m. and 5 p.m."

The figure shows the sleep/wake histories for the mishap flightcrew for the 3 days before the mishap. The report said, "Overall, this information demonstrates that the entire crew displayed cumulative sleep loss and extended periods of continuous wakefulness. It should be noted that the cumulative sleep loss can be partially attributed to the reversal of the circadian pattern, with nighttime sleep periods at home followed by daytime sleep periods. Sleep obtained in opposition to the body's circadian rhythms is more disturbed than sleep that coincides with times when the body is programmed for sleep…. Also, the mishap occurred at about 4:56 p.m., in the 3 p.m. to 5 p.m. window of sleepiness."

Most critical is the information for the captain who was the pilot flying. The report said, "For the entire 65-hour period…the captain was awake for 50 hours with 15 hours of sleep. Including the 2-hour nap in the last 48 hours, the captain was awake for 41 hours with 7 hours of sleep. In the last 28.5 hours…the captain was awake for 23.5 hours with 5 hours of sleep."

These data can be translated into sleep debt based on the captain's stated usual sleep requirement of 8 hours. The data show that the captain acquired a personal sleep debt of about 8 hours over the 3-day period, the equivalent of one full night of sleep.

The captain later described his experiences at an NTSB public hearing.

"All I can say is that I was—I felt very lethargic or indifferent," said the captain. "I remember making the turn from base to final, but I don't remember trying to look for the airport or adding power or decreasing power.

"On the final…I heard Tom [the flight engineer] say something about he didn't like the looks of the approach…it was along the lines of, 'are we going to make this?'

"I remember looking over at him, and there again, I remember—being very lethargic about it or indifferent. I don't recall asking him or questioning anybody. I don't recall the engineer talking about the airspeeds at all. So it's very frustrating and disconcerting at night to try to lay there and think of how this—you know—how you could be so lethargic when so many things were going on, but that's just the way it was."

A U.S. National Aeronautics and Space Administration (NASA) scientist testified about the captain's behavior and associated fixation on the strobe light. He said, "I counted seven comments in the [CVR] transcript about the strobe. …I think what's really critical about that is that…in sleep-loss situations, you get people with tunnel vision. They get fixated on a piece of information to the exclusion of other things. …Right in the middle of [the approach, the captain] disregards a critical piece of information[:] the first officer or flight engineer—someone saying, 'I don't know if we're going to make this.'"

Even extremes of temperature, such as would be encountered when taking off from Scandinavia in January, for example, and landing in Jamaica, can cause stress, and that may contribute to fatigue.

smoking section of the hotel, where coughing is less likely to be heard.

If a pilot cannot avoid being on duty while fatigued, there are short-term measures that can be taken to reduce the effects of fatigue.

✗ Eating high-protein foods and drinking plenty of water can temporarily offset fatigue.

✗ Caffeinated beverages can temporarily enhance alertness.

✗ Talking with other crewmembers; getting out of the seat; and moving about the aircraft for a few minutes will tend to promote wakefulness.

Generally speaking, pilots who transition to a new time zone or work schedule for a short period should not try to readjust their circadian rhythms to the new environment. Circadian rhythms change slowly, sometimes by as little as 1 1/2 hours per day. As much as possible, temporarily transplanted pilots should maintain their usual circadian schedule—sleep and rest on their "at-home" clocks.

Fatigue is manageable. A better understanding of its causes and consequences ensures that pilots are fully alert while on duty ✈

Some Airlines Permit Pilots to Nap During Long Flights

Research has shown that short in-flight naps increase subsequent pilot wakefulness and performance on extended flights.

In a joint study conducted by NASA in 1994, the effectiveness of planned cockpit crew rest was tested. In the test, two groups of crewmembers made the same 9-hour trans-Pacific flight, but one group was allowed a 40-minute nap during a low-workload period of the flight.

Ninety-three percent of the crewmembers who were allowed to nap were able to fall asleep, and they slept for an average of 26 minutes. After waking, they showed better performance (based on reaction time and vigilance) and higher alertness (measured by brain waves and eye movements) than the group of pilots who had not napped.

Nevertheless, there are two potential negative effects of such naps. The first is sleep inertia, or the grogginess and disorientation that may occur on first awakening from a deep sleep. Sleep inertia can last for a few minutes or as long as a half an hour, but generally dissipates within 10 minutes to 15 minutes. The second potential negative is the effect of a nap on subsequent sleep periods. A recent nap may make it difficult for the crewmember to sleep during the normal ground resting time.

Some airlines, acknowledging the debilitating effects of in-flight fatigue on pilot performance, have established formal policies for providing pilots in both two- and three-person crews with the opportunity for controlled rest.

Lufthansa German Airlines, Swissair, and British Airways allow planned in-flight crew rest during low-workload periods near the end of the flight, but not within the 30 minutes before beginning the letdown to their destination. Generally, rest periods are from 30 minutes to 45 minutes, only one crewmember may rest at any one time, and rest is taken in the respective pilot's cockpit seat. Eyeshades and earplugs may be used, if desired, to help the resting pilot fall asleep. Depending on the airline, the preflight planning includes the crew-rest sequence, criteria for unplanned wakeup, and coordination with cabin staff.

Air Canada presently has no provisions for in-flight crew rest, but has submitted a request to Transport Canada to begin a test program of methods and procedures for allowing pilots on long flights to sleep for short periods before starting letdown to landing. The Air Canada test, if authorized, will be conducted in airplanes with three-pilot flightcrews.

KLM Royal Dutch Airlines also has controlled flight-deck crew rest under consideration.

For U.S. air carriers, regulations for crew scheduling and crew rest are promulgated in the U.S. Federal Aviation Regulations (FARs). The FARs specify the maximum number of accumulated flight hours permitted within certain calendar periods, how and when ground rest periods are scheduled, how duty time is defined, and conditions under which a flightcrew member may exceed the stated flight time limitations without being considered in violation of regulations. Nevertheless, the FARs make no reference to controlled crew rest.

Meeting a Microburst

We saw, we stayed high, we survived.

BOB BROADSTON
Business Aviation Safety Journal, Vol 10, 1995
Courtesy *Approach* Magazine

The weather report for our pilot proficiency flight was about average for a fall day on the central California coast—rain, with thunderstorms likely in the Central Valley. The high desert and San Joaquin Valley were calling for slightly more than marginal VFR, and we elected to bounce at Palmdale and NAS Lemoore.

Preflight went normally, and after the usually hectic takeoff and departure from the San Francisco Bay area, we settled in for the flight to Palmdale. Using our search radar to dodge the heavier cells, we made our way toward Palmdale, finally breaking out of the heavier stuff about 50 miles north of the field. Edwards Approach reported isolated cells, but VFR conditions existed over most of the Antelope Valley area.

Approach vectored us for a straight-in ILS and passed a report of a shower at the field. Rolling out on final, we saw the cell, and things began to get interesting. The cell covered the entire field but did not totally obscure the runway. Around its periphery, we could see swirling dust where the downdrafts were hitting the ground. Neither approach nor tower had any reports of downdrafts.

Realizing that this might be a microburst, the captain elected to continue the approach, but at about 1,500 feet AGL. As we approached the field, we could see that the worst of the dust swirls were around the middle marker. As the off-duty pilot, I was able to snap a few quick photos during the approach.

As we entered the cell, we experienced moderate turbulence, about a 10-knot (kt) increase in airspeed, and a 2,000-fpm rate of descent. Passing out the other side, we lost about 15 to 20 kts and felt the same turbulence and rate of descent. We passed a PIREP to the tower about the size and strength of the downdraft. We held briefly until the cell passed and then completed the remainder of the flight without incident. Back home, I talked to the weather guessers who confirmed we had, in fact, tangled with a microburst.

We were lucky. The conditions that day let us see the microburst and successfully avoid it. In the process, all three pilots got valuable training and a new respect for thunderstorms and convective weather.

We could have been very unlucky. Had we been on the normal ILS profile, we'd have hit the microburst just at decision height, dirty and slow; the ride would have been much worse. It could have even been fatal.

There are some important questions to be asked. What if the field had been at minimums and nobody was aware of the microburst's presence? What if we had been returning from an all-night tactical event, tired, eager to land? What if…what if? ✈

WHAT IF?

What if? In past years, civilian aviators have placed a lot of emphasis on aircrew training for microbursts. Commercial airlines have developed standard operating procedures for both takeoff and approach. This emphasis is a result of the increased number of civilian mishaps attributed to microbursts.

These mishaps include:

- 24 June 1956: BOAC Argonaut at Kano, Nigeria; 32 killed, 11 injured.
- 30 January 1974: PAA Flight 759 at Pago Pago, American Samoa; 96 killed.
- 24 June 1975: Eastern Airlines B-727 at JFK, New York; 112 killed, 12 injured.
- 7 August 1975: Continental Flight 426 at Denver; 15 injured.
- 14 May 1976: Royal Jordanian Flight 600 at Doha, Qatar; 45 killed, 15 injured.
- 23 June 1976: Allegheny Flight 121 at Philadelphia; 86 injured.
- 3 June 1977: Continental DC-9 at Tucson. No injuries; power line severed.
- 2 August 1985: Delta L-1011 at DFW. Multiple casualties.

These mishaps brought on an aggressive attempt by the airlines to eliminate this type of mishap through pilot training and standard operating procedures.

MAJ ELIZABETH A. COATES
Chief, Weather Programs
AF Flight Standards Agency/XOFD

Ka-Boom!!! You're cruising along at altitude when suddenly a "big-bang" thunders in your ears. Regaining your composure as the ringing in your ears subsides, you ask yourself, "What in the heck was that?" Cross-checking your instrument panel, you're relieved to find that all of your avionics are operating normally. Thinking about what just happened, you remember flying through heavy rain showers and light turbulence and requesting clearance to climb to a higher altitude. You wince as you recall the static you heard over the radio as you called ATC. You realize your climb took you thorough the freezing level—and then the "*ka-boom*"!

By now you're beginning to recognize you've suffered a lightning strike. But did you know that lightning strikes and electrostatic discharges are the leading causes of weather-related aircraft incidents in the Air Force? Perhaps not. Did you know that recent mishap reports suggest you may not be aware of the difference between lightning strikes and electrostatic discharges? This article, hopefully, will shed some light on this subject (no pun intended) and help you avoid the hazards posed by lightning.

Actually, it's fairly easy to see how the two could be confused. There are, however, clear-cut differences between lightning strikes and electrostatic discharges. We commonly refer to an electrostatic discharge as "static electricity"—something we've all experienced. For example, remember the annoying shock you got when you walked across a carpeted floor and touched an object or another person? Likewise, as your aircraft moves through a cloud, precipitation or solid particles such as dust, haze, and ice, can induce a charge on the fuselage exterior. This charge interacts with an opposite charge in the surrounding atmosphere to trigger the electrostatic discharge.

Mr. Dennis Baseley, technical advisor on electromagnetic effects at the Aeronautical Systems Center at Wright-Patterson AFB, Ohio, provides a deeper insight into this phenomenon. In his description of electrostatic discharges, he states, "Precipitation static (p-static) occurs on the trailing or other sharp edges of the aircraft. To prevent p-static from being heard on the radios in the form of static, aircraft are equipped with p-static dischargers at these points.

"Furthermore, it's a misconception that discharges produce bright flashes or loud noises, because p-static dischargers reduce the charge to lower levels before they can be audibly detected. Additionally, p-static dischargers should not be confused with lightning protection devices, although they may serve as a convenient exit point for lightning and reduce damage to the aircraft structure. In short, many aircrews mistakenly report electrostatic discharges as lightning strikes."

Bearing in mind Mr. Baseley's comments, we can build upon our understanding of the differences between static discharges and lightning strikes by taking a closer look at lightning. Lightning is one of the many hazards associated with thunderstorm activity and may occur at any level within a thunderstorm or even outside of a thunderstorm. As air currents rise and fall within a thunderstorm, positive and negative charges separate within the cloud (see figure 1). Prior to a cloud-to-ground strike, these charge centers induce an opposite charge area over the ground. When the negative charge—formally called the "step leader"—meets the positive charge, a lightning discharge or flash results.

In like manner, as charge centers separate, discharges also occur inside and between clouds. In fact, most lightning never hits the ground, but occurs within these areas. One recent study indicated that the anvil of a thundercloud (the flat upper portion of the cloud so named because of its flat appearance) is particularly unsafe due to the presence of such electrical charges[1].

In addition, NASA research indicates an aircraft is more likely to be struck by lightning when it penetrates the upper reaches of a thunderstorm (35,000 to 40,000 feet) and ambient temperatures are near -40°C[2].

It's important to remember that lightning strikes not only occur within cells, but may also occur in the clear air around the top, sides, and bottom of a storm. Often a "bolt out of the blue" can occur several miles from

continued on next page

P-static dischargers should not be confused with lightning protection devices, although they may serve as a convenient exit point for lightning and reduce damage to the aircraft structure. In short, many aircrews mistakenly report electrostatic discharges as lightning strikes.

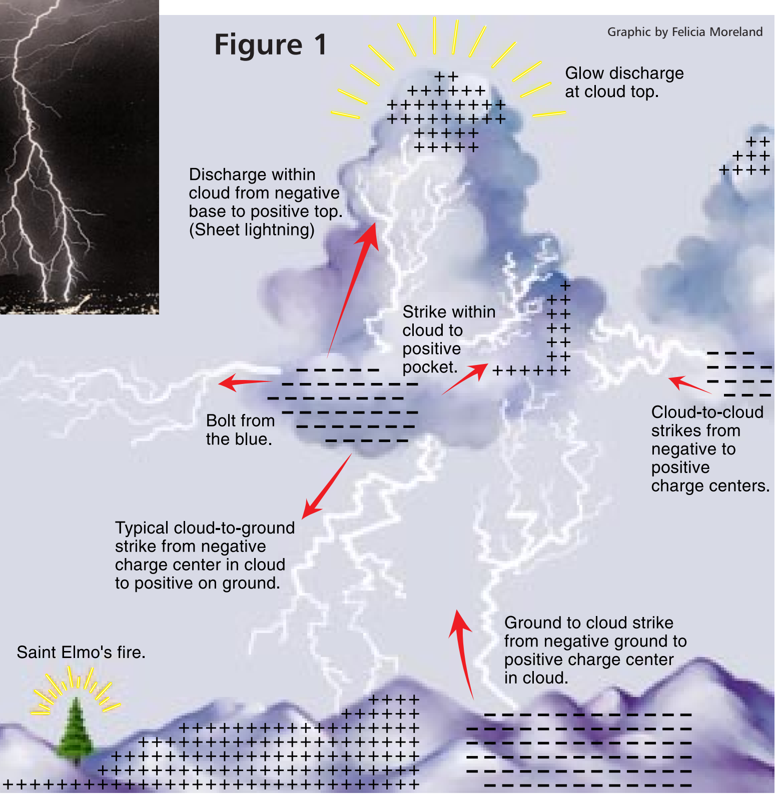


Figure 2

So where does the static you hear over your radios and your interphone come from? Aside from the p-static effects, what you re hearing is a noisy announcement that a lightning strike is about to happen.

a thunderstorm cell (see figure 2).

So where does the static you hear over your radios and your interphone come from? Aside from the p-static effects, what you're hearing is a noisy announcement that a lightning strike is about to happen. The static heard by the aircrew is an approaching step leader. It's Mother Nature's way of warning the crew to quickly move away from these conditions.

Still, there may be some gray areas where it's difficult to determine the difference between a lightning strike and an electrostatic discharge. Our data shows that the majority of Air Force lightning strikes occur at low altitudes in seemingly benign clouds and in areas outside of active thunderstorm cells.

Not surprisingly, several recent research programs, including the NASA Storm Hazards Program (1980-1986), USAF/FAA Lightning Characterization Program (1984-85, 87), and the French/Transall Program (1984, 1988), found that aircraft trigger 90 percent of the lightning strikes at low altitudes outside of thunderstorms[3]. They do this by providing the path of least resistance between two opposite-charged electrical centers. If the aircraft were not present, these strikes would not occur.

Electrically active zones have been observed in stratified clouds which have light to moderate precipitation, cloud depths greater than 1 km, and widths of up to several kilometers, light turbulence, and temperatures ranging from -6 to 11°C (near freezing). Under these conditions, precipitation such as mixed snow, sleet, and rain, in addition to increased vertical instability, increases the electrification within the cloud[4]. As a rule of thumb, pilots can reduce the chances of being hit by lightning by not flying in the following conditions:

Within 8°C of the freezing level.
Within 5,000 feet of the freezing level.
In light precipitation (including snow).
In clouds (including debris clouds).
In light or negligible turbulence[5].

But wait, what about the old saying, "Lightning never strikes twice." Well, this just is not true. A study of lightning strikes on the Empire State Building in New York City revealed an average of 23 strikes per year. During the same study, as many as 48 strikes were recorded in one year, and during one thunderstorm, eight strikes occurred within 24 minutes[6]. Like the Empire State Building, your aircraft is subject to multiple strikes. In a recent mishap, one aircraft reported being struck twice within a matter of minutes. So, if you ever encounter a lightning strike to your aircraft, exit the area quickly or you may get another jolt.

What happens if you and your aircraft are stuck by lightning? The physiological injuries can range in severity from "none" to "fatal" and include various degrees of burns, deafness, and flash blindness. Having your hair stand on end and/or feeling a slight tingling sensation in your skin indicates a building charge and a pending strike.

While most aircraft can survive a strike, lightning causes both direct and indirect effects (damage). Direct effects include fuselage punctures, damage or destruction of the radome, and burning, melting, or distortion of aircraft metallic and nonmetallic structures. In a worst case scenario, a lightning strike can cause a fire in the fuel system. Indirect effects include temporary or permanent damage to electronic circuits from the strong electric/magnetic fields caused by the lightning strike.

Now that you know the risks posed by lightning and electrostatic discharges, what can you do to protect yourself? You can start by following MAJCOM guidance and the safety measures discussed in this article. For instance, the next time you encounter the atmospheric conditions listed above, avoid them if at all possible. Unless perhaps you'd prefer a not-too-subtle reminder from Mother Nature…

Find out more about AF Weather Programs at the Headquarters Air Force Flight Standards Agency Web site: http://www.andrews.af.mil/tenants/affsa/3frames.htm ✈

Like the Empire State Building, your aircraft is subject to multiple strikes. In a recent mishap, one aircraft reported being struck twice within a matter of minutes. So, if you ever encounter a lightning strike to your aircraft, exit the area quickly or you may get another jolt.

Sources:

1. Marshall, Thomas C. (NASA Langley Research Center) et al, _The Electrical Structure of Thunderstorm Anvils_, Volume 1, 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Vol 1991

2. Fisher, Bruce D. (NASA Langley Research Center, Hampton VA, USA), _Effects of Lightning on Aerospace Vehicles_, Conference Paper, Flight in Adverse Environmental Conditions, 1989

3. Mazur, Vladislav (National Severe Storms Lab, Norman OK, United States), _Lightning Threat to Aircraft: Do We Know All We Need to Know?_, Conference Paper, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Vol I, 1991

4. Rust and MacGorman, _Electrical Nature of Storms_, Oxford Press, NY, NY, 1996

5. AFJH 11-203, Vol.1 _Weather For Aircrews_, 1 March 1997

6. Uman, Martin, _Understanding Lightning_, Bek Technical Publications Inc., Carnegie PA, 1971

Did you know that there was a change to the METAR/TAF Code?? Effective 1 November 1998, the World Meteorological Organization (WMO) changed the code for ice pellets from "PE" to "PL." Example (excerpt from actual TAF):
"…BECMG 1314 0812G27KT 1600 -FZRAPE BR OVC004 690002 640505 540008 QNH3027INS" would now read "…BECMG 1314 0812G27KT 1600 -FZRAPL BR OVC004 690002 640505 540008 QNH3027INS"

There I Was

Official USAF Photo

Flying Safety, August 1993

Training students in the little Tweet was hardly something you bragged about. It was slow and it was noisy. It didn't go very far and it was noisy. In the summer it was hot and it was noisy. It took forever to climb high enough to do spins. But it sure was a good teaching tool. I learned a lesson almost every time I flew.

On one summer sortie at a southwestern base, I had climbed to the top of the high areas to accomplish some needed spin training. During the brief time we were at altitude, the typical afternoon buildups started. Eventually we were squeezed into one corner of the area in order to avoid spinning above the clouds. When Center announced the SOF's weather recall for potential thunderstorms over the base, I was ready to go home.

Looking from our area back toward the common recovery point out of the areas, I noticed two of the bigger towering cu's on either side of our usual route. Neither had reached much over 20,000 feet, and neither had anything resembling an anvil. I couldn't even see anything falling from the bases.

Since we were the only Tweet in the area, I was given an immediate descent to the recovery point. The two buildups appeared to be about 10 miles apart, so I planned to fly between the two towering columns and stay in the clear all the way home. It looked like the sky between them was blue and clear. At 200 KIAS, with the speedbrake extended, and using frequent valsalvas, we were "racing" downhill for home.

Suddenly we flew into a rain shower. The precipitation was so heavy we lost all forward visibility. The noise was so great we couldn't hear each other over the intercom. The shower lasted for about 7 or 8 seconds. As suddenly as it started, it was over, and we were back in the clear. I hardly had enough time to get my cross-cockpit instrument scan going.

Before I had a chance to say a word, the student muttered "Jeeez!" from the left seat.

"What is it?" I asked.

"Look at the wing," he answered.

I leaned over to see what was wrong with the left wing. I really couldn't see anything, and he finally said, "It's the intake."

Looking over my own canopy rail, I saw the fiberglass intake was thoroughly stripped of paint, and a lot of it had been delaminated. I declared a "precautionary" recovery with the SOF and returned straight home without a stop at the aux field.

The safety shop and the fire department met us as we cleared the runway. Before we could unstrap and climb out, all of the people on the ground were pointing at our jet and walking closer for a better view. After stepping over the side, I was as speechless as the people who met us. Every light (taxi light, "passing" light, wing tip, beacon, and strobe light) was gone. The entire speedbrake surface looked like a wild man with a ball peen hammer had pounded every square inch. The fiberglass intakes and the leading edge of the wing tips were stripped of paint and nearly peeled away as if hit with a giant sandblaster. The leading edge of the vertical and horizontal tails were seriously dented. Clearly, we had not flown through a rain shower. We had spent 7 or 8 seconds in some major hail.

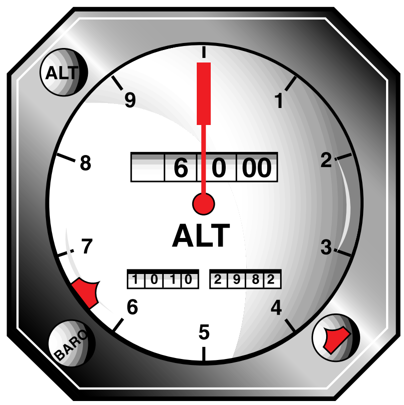
Despite the apparent lack of thunderstorm characteristics, the towering cu's were indeed growing thunderstorms. Even without an anvil, they were capable of producing major hail. My somewhat casual treatment of these clouds led me to believe it was "safe" to fly between them. Blue skies above and small building clouds were no insurance against the power of nature.

Since that day, if I even suspect there's a chance clouds might be potential thunderstorms, I've given them a wide berth. Even the slow Tweet can make double-digit distances around building weather with ease. Besides, even the Tweet deserves better treatment than I gave it around thunderstorms. ✈

Altimeter Settings *Revisited*

Courtesy ***Callback***, No. 233, Nov 98
NASA's Aviation Safety Reporting System (ASRS)

■ FL180 is the altitude at or above which all aircraft altimeters should be set at 29.92, and below which they should be set to the current barometric pressure of the nearest reporting station. A frequently reported cause for altimeter mis-setting incidents that occur during a climb or descent through this altitude is distraction by other cockpit tasks. In a report to ASRS from an air carrier captain, distractions inside and outside the cockpit, including a mechanical malfunction, led to an altitude deviation.



Felicia Moreland

While descending through approximately 23,000 feet and navigating an area of precipitation and thunderstorms, both air-conditioning packs failed…As we worked on the pressurization problem…we were assigned 11,000 feet. As we leveled, ATC asked our altitude because he saw us at approximately 10,500 feet. Then we noticed that two of our altimeters were still set at 29.92 with the pressure at 29.42. Our workload was obviously heavy, but we should not have missed this basic procedure. Someone always must pay attention to flying.

A 1997 ASRS study on flightcrew monitoring incidents found that a majority of such incidents occurred when the aircraft was in a "vertical" flight mode—climbing or descending. Flightcrews also were more likely to experience monitoring errors while performing two or more flight-related tasks—like the crew in this report which was avoiding weather, dealing with a pressurization problem, and talking to ATC, all while descending through FL180.

As our reporter noted, appropriate division of cockpit tasks (one pilot to fly the aircraft, the other to handle the malfunction), and adherence to procedures (the checklist) probably would have allowed the flightcrew to catch this mistake before ATC did.

12 O'Clock High

An air carrier crew's altitude problem started during preflight, when they failed to notice that their altimeter needles were aligned at the "12 o'clock" position—at an airport with a field elevation of 1,000 feet MSL. The First Officer reports:

After we leveled at 11,000 feet, Center said to descend and maintain 11,000 feet. We replied that we were level at 11,000 feet. About a minute later, Center again said to descend and maintain 11,000 feet. They said they showed us level at 12,000 feet and pointed out traffic at 13,000 feet. About that time, we discovered that the altimeters were set to 28.88 instead of the proper setting of 29.88. We quickly descended to 11,000 feet.

The night before, maintenance personnel had dialed both altimeters back to sea level…[the actual] field elevation is approximately 1,000 feet MSL. We accomplished all checklists on preflight, but failed to notice that the second digit [of the barometric setting indicator] had been set to an 8 instead of a 9. This is something that is easy to miss.

High to Low, Look Out Below

The rapidly changing weather associated with cold fronts and steep frontal slopes can create significant and sudden drops in barometric pressure, causing some pilots to mis-set their altimeters. An air carrier captain provides an example:

During descent below FL180, I put 29.82 into my altimeter. When the First Officer (FO) came back from talking to company on the No. 2 radio, he also put 29.82 into his altimeter. We were descending through 6,000 feet for 5,400 feet when the Approach Controller announced a ground proximity alert and told us to climb immediately to 6,000 feet and to recheck our altimeters at 28.82. We started to climb, checked our altimeters, and discovered our mistake…

It was an unusually low altimeter setting that day. Both the FO and I wrote the correct altimeter setting on our note pads, and both of us mis-set our altimeters.

Unusually low barometric pressures may take pilots by surprise, especially if the weather appears to be improving, leading the crew to believe that a higher altimeter setting looks plausible. The old adage, "High to low, look out below" is still sound advice.

Flying into cold air has the same effect as flying into a low-pressure area; that is, the aircraft is *lower* than the altimeter indicates. Altimeters cannot be corrected for temperature-related errors. However, pilots can adjust their minimum procedure altitudes to compensate for extremely low temperatures. Canadian pilots consult a government-provided chart to determine how much altitude to add to the procedure altitudes listed on approach charts, thus ensuring obstacle clearance during very low temperature operations. The U.S. Defense Mapping Agency publishes a similar altitude correction table for military pilots. Readers who would like more information about low temperature correction charts should refer to ASRS *Directline*, Issue No. 9, available on the ASRS Web site at **http://olias.arc.nasa.gov/asrs**

Editor's note: See also the related story, "It's Cold Out Here!" in the October 1998 issue of Flying Safety magazine. ✈

Maintenanc

Checking Those Pins Might Save Your Life

AME1(AW) ANDREW SMITH
Courtesy ***Mech***, Jul-Sep 98

...33 deaths, most of them caused by human error, as opposed to equipment failure.

Recently, I swapped sea stories with a civilian ejection-seat rep. Our conversation turned to seat safety. I asked him how many AMEs (aviation structural mechanic safety equipmentmen) had been hurt or killed during arming and de-arming-related accidents. To my surprise, he said he knew of 33 deaths, and, believe it or not, most of them were caused by human error, as opposed to equipment failure. The most important error was not using a checklist.

I've been in the Navy 18 years, so nothing I hear surprises me, except maybe a good sea story. When the conversation ended, I walked into the hangar and watched several people from different squadrons working in and around aircraft. I didn't see any of them check if the safety pins were in place before they climbed into a cockpit. Not one! It made me see the carelessness of many people working around a seat designed to eject a person out of the aircraft. That's like crossing a street without looking for traffic.

An ejection seat doesn't care who you are—an aircrew member ejecting in an emergency or a technician correcting a problem. An ejection seat has but one purpose: to throw a body into the air. If a hangar-deck ceiling happens to get in the way, that isn't the seat's problem—it's done its job. The safety pins installed on ejection seats are not cosmetic. They are there to protect you while you do maintenance. Check those pins.

Where Are Those Safety Guys?

AT2 ROBERT GILMORE
Courtesy ***Mech***, Jul-Sep 97

When deployed, it's easy to spot the safety reps in their white jerseys with green crosses. Squadrons also have QARs (quality assurance representatives) who constantly remind us about hazards, and every work center has an assigned Safety Petty Officer (PO). You'd think there would never be a time when there wasn't a safety guy around.

Our squadron embarked after being on the beach for a few months. Our safety department was particularly wary because we had several folks getting their first flightdeck experience, and most of us old salts were a bit rusty. The potential for mistakes was high, as was the risk of injury.

One day early in the deployment, I watched someone wearing a clean, new jersey (obviously a rookie on the flight deck) *walk through the static prop arc* of an E-2C Hawkeye. I thought how lucky he was that a safety guy hadn't seen him.

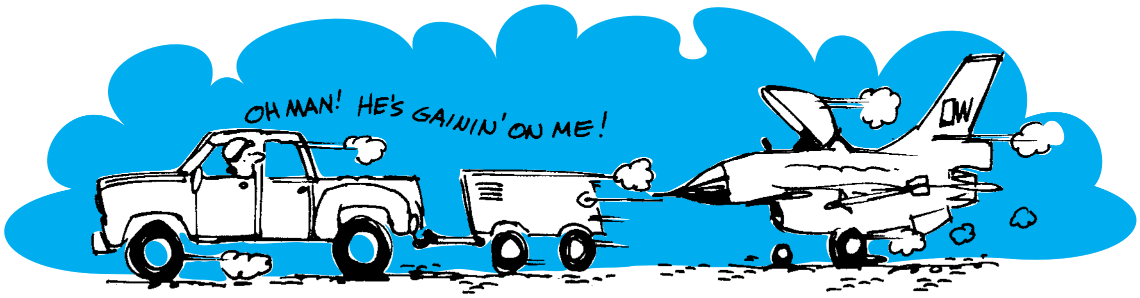
A little later, I noticed blueshirts chaining down aircraft *with the tiedown hooks facing down* in the padeyes. No safety guys around this time, either.

Then I watched someone give his buddy change for a soda *right out of his pocket in the middle of the flight deck*, and he didn't even have a FOD pouch! I expected a safety guy to stop this exchange any second and quickly escort this sailor off the flight deck, but no one showed up.

Then it finally occurred to me that *I was a part of the problem.* I could have stopped the new guy walking through the prop arc, corrected the blueshirts' tiedown procedures, and escorted the human change machine off the flight deck myself.

We can't expect only those wearing white jerseys or with titles like QAR or Safety PO to keep our safety programs intact. I taught myself a valuable lesson in leadership that day and answered my own question: *Those safety guys are everywhere; you only have to look in the mirror.*

ce Matters



Planes, *Trucks*, and Automobiles

Planes, Trucks, and Automobiles, Part One: The Falcon as prey. Visibility was clear and a million, and it was another normal day shift for the two security forces troops patrolling in their vehicle. Everything seemed quite routine. Maybe a little *too* routine. Along with their other responsibilities, they were required to patrol the F-16 flightline restricted areas periodically to ensure all was secure. That's what they were doing, and things were fine until the driver decided to take a shortcut between two aircraft parked side by side. *Note for non-Falcon types: There isn't much room between the wingtips of two parked F-16s; even less when a fire bottle is also present.* He tried to sidestep the fire bottle while maneuvering his vehicle between the wingtips, but the passenger side of the vehicle struck one of the F-16s. Cost: $16,000 damage to the electric jet and $1,300 damage to the patrol vehicle.

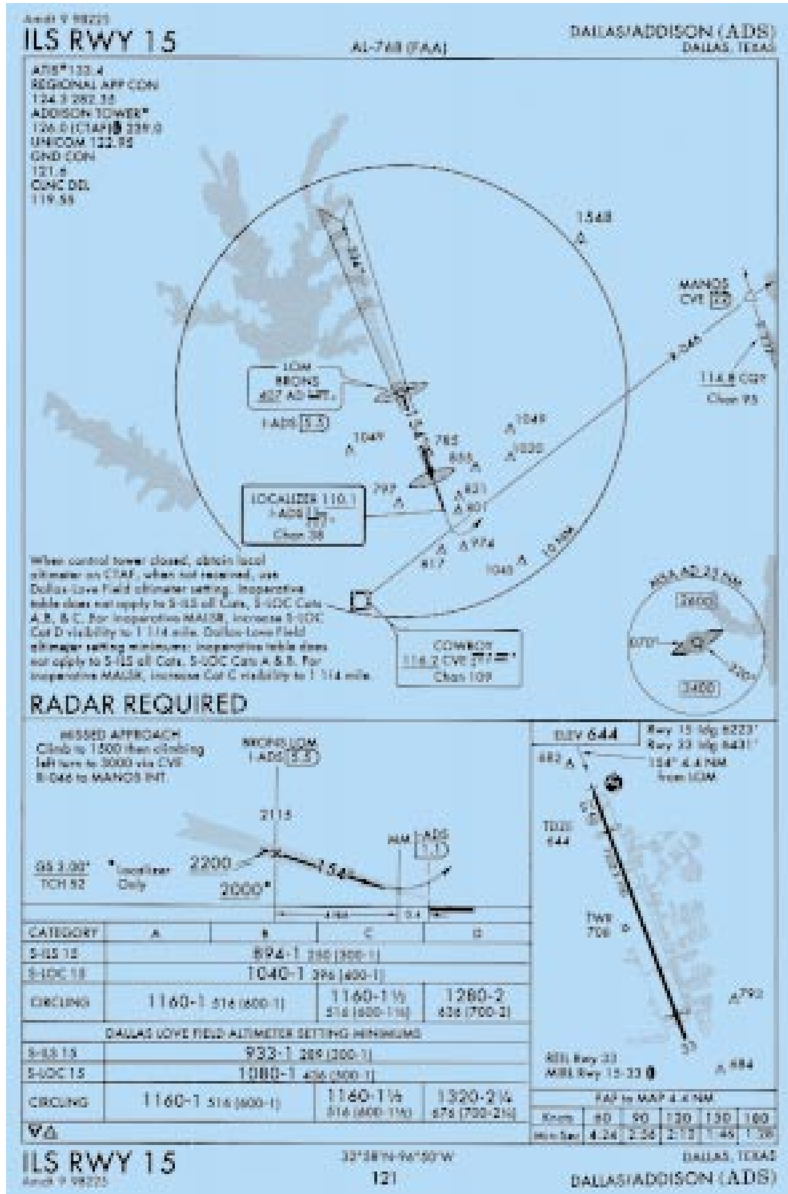
Planes, Trucks, and Automobiles, Part Two: Three strikes, you're out. A servicing truck was being positioned in order to service the aft latrine on a C-9. This particular vehicle was equipped with a cage on top for holding the suction hose. The driver and operator were accustomed to using servicing trucks that *weren't* equipped with this cage (strike one). And, since the suction hose on this particular vehicle had been shortened so that it would work more efficiently, it also meant the servicing crew would have to position their vehicle *closer than customary* to the aircraft (strike two). The stage for the mishap was set when the crew failed to properly fix chocks behind the rear wheels to prevent inadvertent contact between the vehicle and the aircraft. As the servicing truck backed into position to commence servicing, the cage on the vehicle hit the No. 1 engine cowling (strike three). All things considered, damage to the aircraft could have been much more serious—total mishap cost was only about $100. But based on all the unwanted attention these mechanics received, we're betting it seemed a lot more costly than that.

Planes, Trucks, and Automobiles, Part Three: The hazards of task saturation. Due to a manning shortage, the maintainer was involved in two separate tasks simultaneously. It was 0430 in the morning—a time of day when our internal clocks make us especially vulnerable to mental lapses—and he was tasked to work two F-16s parked side by side. Aircraft A required a power-on op check, and Aircraft B needed to be refueled. He called for the refuel, and after being advised there would be a short delay, drove his six-pack truck to the AGE sub-pool to pick up a dash-60 for the power-on op check on Aircraft A. He had no sooner returned with the dash-60, parked in front of Aircraft A, and connected the power unit cord to the aircraft, than the refuel truck arrived next door for Aircraft B. Realizing then that he didn't have the necessary job guide for the refuel, he walked over to the refuel truck driver and told him he was going to Support Section to get tech data and would be right back. He walked back over to his six-pack, hopped in, and pulled away. Unfortunately, the dash-60 was still connected to Aircraft A. The F-16 suffered damage that included a broken nose gear door, power receptacle, and landing light bracket, and the power unit's cord and other items needed repair. Total repair cost for the aircraft and dash-60? More than $15,000.

The one bright spot apparent in these three mishaps is that nobody was injured. Reminder: All of us make mistakes. If you witness an unsafe act—whether it's deliberate or inadvertent—intervene and prevent that unsafe action from continuing. You and your coworkers are all part of the same team, and when unsafe acts are prevented, the team wins. Work smart, look out for each other, and above all, be safe! ✈

The Final-Only Approach

CAPT J. C. FINDLEY
Advanced Instrument Flight School
Randolph AFB, Texas



Can an instrument pilot ever know too much about flying? I would say no; however, I would add the caveat that you'd better understand how to use the data you've ingested. Most instrument pilots can tell you a localizer is good out to 18 miles unless published otherwise. How does this information help us? It's nice to know, but it may do more harm than good if we erroneously use this information.

Look at the ILS RWY 15 Dallas/Addison (see the figure). If we get vectors to final (and we have to in this case), when can we descend to 2200'/2000' after being cleared on the ILS or localizer approach? Federal Aviation Regulation (FAR) 91.175(i) and AFM 11-217 state that we must maintain the last assigned altitude until we are on a published routing or a portion of the IAP (initial approach point). The localizer is good out to 18 miles, so we should be good to descend once we are inside 18 DME (distance measuring equipment), right? *Wrong!*

Regardless of the fact that the service volume of the localizer is 18 miles, the ILS/LOC protected airspace goes out only to 5.5 DME for the ILS 15 ADS. TERPs (Terminal Procedures) states that the length of the area considered for obstacle clearance is the area between the glideslope intercept point and a point 200 feet from the threshold. On a localizer, it's the area between the FAF (final approach fix) and the MAP (middle approach point). Beyond the glideslope intercept point or the FAF, the final portion of an IAP doesn't exist.

This type of approach has a radar intermediate segment that will not be shown on the published IAP. The intent of a final-only approach is to let ATC vector you to final at the MVA. You may then descend to your MDA/DH at the FAF/glideslope intercept point. This works fine as long as the MVA is the same as the FAF/glideslope intercept point *and* ATC vectors you at this altitude. What if ATC vectors you in at 3,000 feet or even 4,000 feet for the ILS 15 ADS? You may not descend from your assigned altitude until you get to 5.5 DME. If the descent gradient is unacceptable, it's your responsibility to get a lower altitude assigned or tell approach you cannot accept the approach clearance.

These final-only IAPs are designed to be easy to fly. They are, as long as both ATC and the pilot understand how to use them. Take care, and fly safely. ✈

☆ U.S. GOVERNMENT PRINTING OFFICE 1998-673-366/43052

THE Well Done AWARD

Presented for

outstanding airmanship

and professional

performance during

a hazardous situation

and for a

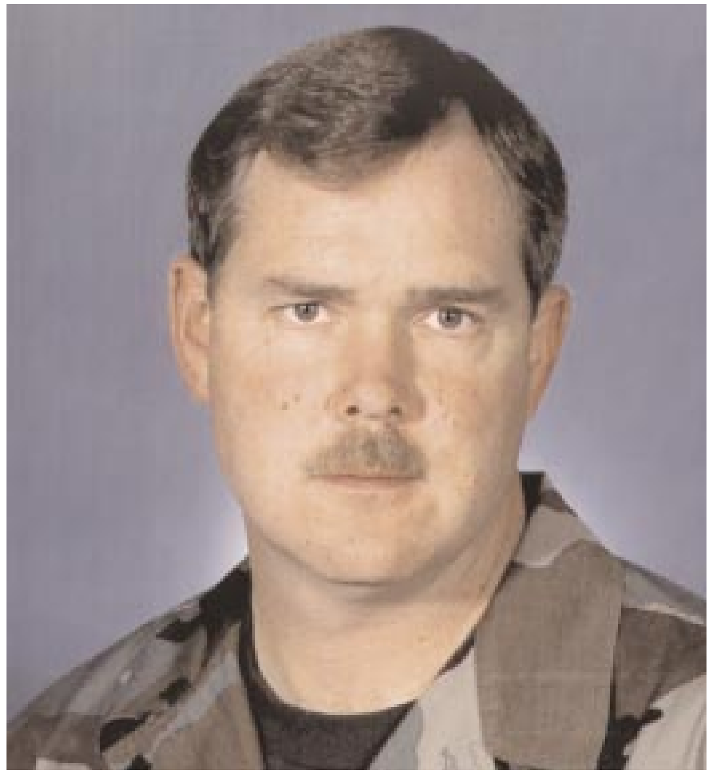
significant contribution

to the

United States Air Force

Mishap Prevention

Program.



SMSGT DAVID P. SANDO

429th Electronic Combat Squadron
Cannon AFB, New Mexico

During a squadron sortie surge, SMSgt Sando was in the Quality Assurance office clearing an aircraft impoundment when he overheard the wing FOD NCO discussing an unidentified part found on the active runway earlier that morning. His curiosity pulled him into the conversation where he immediately identified the part as an EF-111A main landing gear strut retaining pin bolt.

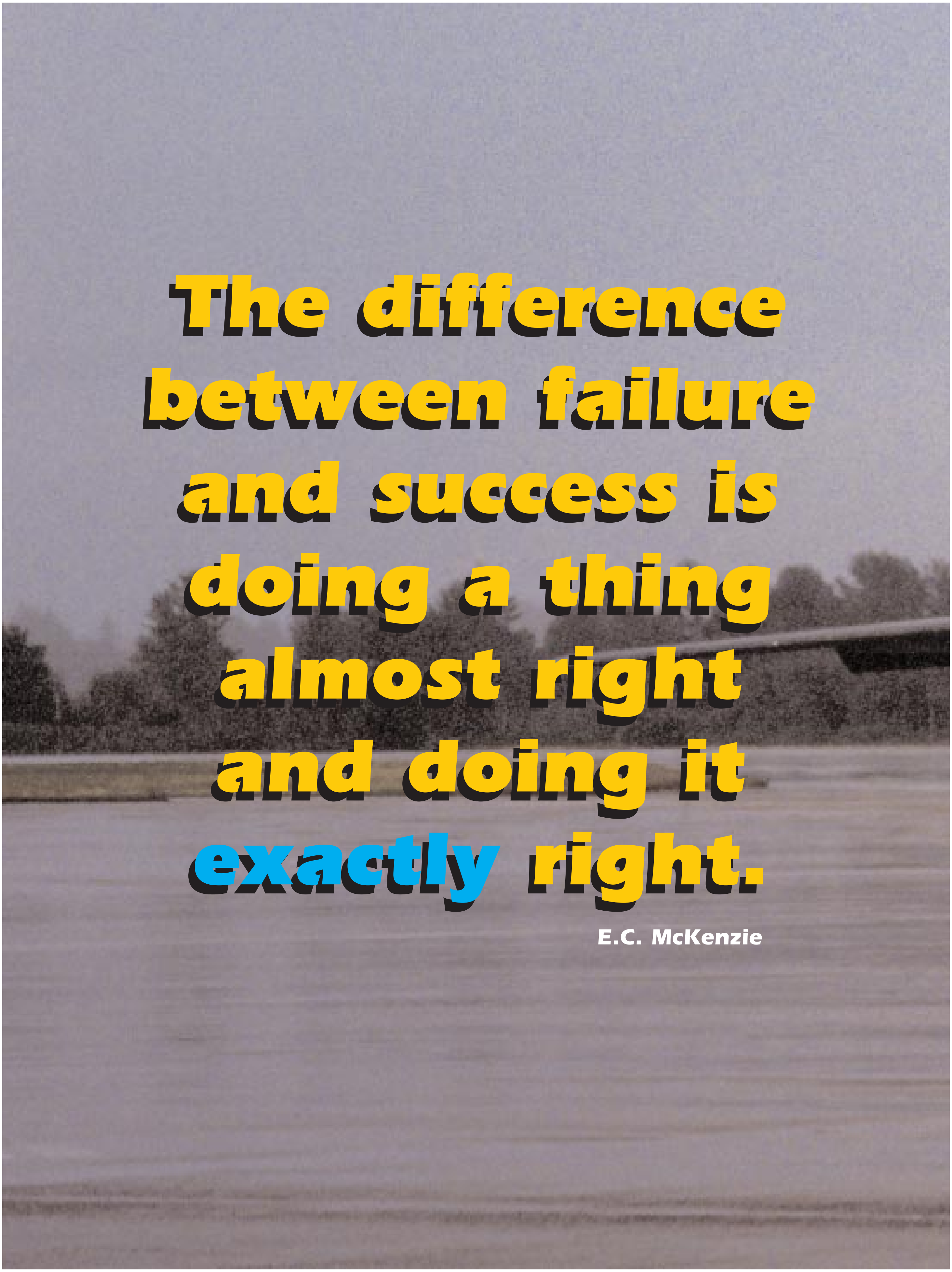
Aware of the possible repercussions from this part not being on the aircraft, SMSgt Sando immediately called the production superintendent and instructed him to stop the launch of the day's first sorties, which were preparing to taxi at the time. He then directed an immediate inspection of all aircraft on the flightline to identify which one the part came from.

The subsequent inspection revealed the bolt was missing from the left main landing gear strut retaining pin on aircraft 67-0037. This aircraft was scheduled to fly that day. The investigation found the strut retaining pin had broken in half, allowing the bolt to fall out. The aircraft had flown the night before and the assembly had failed upon landing.

Had SMSgt Sando not immediately identified the part and taken decisive action to ground the fleet for a one-time inspection, the landing gear on 67-0037 would have definitely malfunctioned. Had the aircraft taken off, the left side of the gear would have been dangling, the gear door would not have closed, and the aircraft would not have been able to land—forcing the crew into a controlled ejection situation.

WELL DONE!

(Since this event occurred, SMSgt Sando has been reassigned. He is currently the Maintenance Flight Flight Chief for the 49th Maintenance Squadron at Holloman AFB, New Mexico.) ✈


The difference between failure and success is doing a thing almost right and doing it exactly right.
E.C. McKenzie