Our 50th Year

flying SAFETY

A 30-Minute Lesson in CRM

CRM: It's Not Just for Fliers Anymore

Crew Coordination Pave Low Style

More Different Than Alike

JUNE 1994

The Expanding Roles of Crew Resource Management

THERE I WAS

■ As a young lieutenant, I was taxiing in trail with my flight commander for the flight to the home drome. The weather had improved to 1,500 feet overcast with 3 miles visibility. However, rain showers had left the ramp wet.

While taxiing cautiously, I discovered the perks of attempting to stop on newly paved asphalt. My flight lead stopped for quick check on a narrow taxiway with two cars on one side.

As I began braking, my aircraft started to fishtail, with every attempt yielding the same results. Unable to stop, I directed lead to move forward. The urgency in my voice resulted in his moving while the quick check on his jet was still in progress. Fortunately, my aircraft came to a stop before further action was required.

After taxiing my jet for a brake check, we were cleared for takeoff and subsequently taxied into departure position. Twenty seconds after lead released brakes, I began my takeoff roll and once safely airborne, established radar contact.

Following squadron standards and as briefed by lead, upon reaching 350 KCAS, I set the power at 850 degrees FTIT and complied with standard radar trail departure procedures. As the saying goes, I was "fat, dumb, and happy" following lead on the published SID (standard instrument departure).

If you haven't figured it out by now, it wasn't my day. Instead of maintaining my situational awareness by closely monitoring our position on the SID, I depended on my radar to follow lead. You guessed it — I lost my radar contact. I informed lead of this while attempting to reestablish radar contact. A glance at my flight instruments revealed my disorientation.

My aircraft was passing 3,000 feet MSL in excess of 20-degrees nose-up pitch with 190 KCAS and power set at 700 degrees FTIT. Immediately, I confirmed the unusual attitude and executed recovery procedures. Suffering from a severe case of the "leans," feeling as though I was in about 70 degrees of left bank, it was all I could do to keep my jet in a wings-level climb.

Upon reaching VFR conditions, and passing through 16,000 feet MSL, I was able to reorient myself and rejoin with lead. The remainder of the flight was uneventful.

In summary, this "nondemanding" mission was truly a learning experience. Hopefully, you already know trail departure procedures do not require the use of a radar. In fact, my dependence on a radar contact resulted in my spatial disorientation and unusual attitude, not to mention the "leans" which followed. The bottom line ... if my jet had been nose down instead of nose up, you wouldn't be reading this. ■

Our 50th Year

UNITED STATES AIR FORCE

Flying SAFETY

JUNE 1994

AIR FORCE SPECIAL PUBLICATION 91-1

VOLUME 50, NUMBER 6

page 2

page 4

page 16

SPECIAL FEATURES

REGULAR FEATURES

CONTRIBUTIONS

Contributions are welcome as are comments and criticism. No payments can be made for manuscripts submitted for publication. Address all correspondence to Editor, *Flying Safety* magazine, HQ AFSA/SEDP, 9700 Ave G, S.E., Ste 282, Kirtland Air Force Base, New Mexico 87117-5670. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

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. All names used in mishap stories are fictitious. 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, U.S. Government Printing Office (USGPO), Washington D.C. 20401; send changes in subscription mailings to the USGPO. Back issues of the magazine are not available. **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. Air Force units must contact their base PDO to establish or change requirements.

POSTAL INFORMATION — *Flying Safety* (ISSN 0279-9308) is published monthly by HQ AFSA/SEDP, 9700 Avenue G, S.E., Kirtland AFB NM 87117-5670. Second-Class postage paid at Albuquerque NM, and additional mailing offices. **POSTMASTER:** Send address changes to *Flying Safety*, 9700 Avenue G, S.E., Kirtland AFB NM 87117-5670.

A 30-Minute Lesson IN COCKPIT RESOURCE MANAGEMENT

CAPTAIN MICHAEL F. RYCKELEY
97 AMW/SE
Altus AFB, Oklahoma

■ "One hundred hours of sheer boredom filled with one hour of sheer terror" — this common expression in heavy aircraft came true on the first leg of a C-5 mission en route to Scott AFB, Illinois. The lessons I learned the hard way that day can be applied to all aircraft, especially those with two or more crewmembers.

I was a copilot on a highly experienced crew consisting almost entirely of instructors and evaluators. Our mission was to pick up the aircrew standardization and evaluation team (ASET) and deliver them to Dover AFB, Delaware, so they could conduct an evaluation of the base.

We were 1 hour into a 2-hour leg and had just leveled off at FL350. Weather was clear and a million and forecasted as such for our entire stateside route. It was my leg to fly, so the aircraft commander was working the radios.

Our VHF radios were giving us some reception trouble, but the aircraft commander finally reached Center after the third attempt (we must have been on the outer fringe). Things started to happen, and happen fast, shortly after "radar contact."

During an engine instrument scan, I noticed the no. 2 engine N1 (fan) indication had dropped and was now reading 8 percent lower than the other three engines. All other indications were normal and closely matched the other engines.

Just as I uttered, "Hey, engineer, what are you reading on no. 2 engine?" a loadmaster mentioned (on interphone) he smelled smoke and had a burning sensation in his eyes. I directed all crewmembers to don oxygen masks, called for the applicable checklist, and directed the scanner (another engineer) to look for the smoke source.

As the scanner was going downstairs for a look in the cargo compartment, the "low oil pressure" light on the no. 2 engine illuminated. I directed a precautionary engine shutdown while the aircraft commander simultaneously opened his checklist to the applicable section and asked the engineer for confirmation of the low oil pressure.

Before the engineer could respond, the scanner's suddenly tenor voice across the interphone alerted the crew, "Sparks, fuel, and flames are coming from the no. 2 engine!!"

Although there were no cockpit indications of a fire, I immediately executed the boldface (fire handle-pulled, agent-discharged) and called for the emergency engine

Photo by AIC Julie Cook, 97 Communications Squadron, Altus AFB OK

shutdown checklist. In less than a minute, the checklist was completed, and crew communication breakdown had begun.

The scanner, still in the cargo compartment, was talking to the crew on interphone but was not monitoring Center's frequency. Because of this, his (higher octave) statement "The #*&$# is still on fire! Get the aircraft down now!!" (and several others) blocked communication efforts with Center.

With the fire still ensuing, I selected and discharged the remaining fire bottle into the engine. For reasons I learned only after the flight, the second fire bottle would have the same negative result as the first one.

To add to the confusion of the moment, the aircraft commander had switched over to the VHF Guard (without notifying the crew) because he was unable to reach Center on the primary VHF (outer fringe, remember?). Unaware of this, I only heard Center's responses and questions — not what was being coordinated by the aircraft commander. (The command's regulation only required monitoring *UHF* Guard stateside.)

Additionally, without notifying the crew, the aircraft commander had turned down his interphone volume to better listen to Center — effectively isolating himself (temporarily) from the rest of the crew and their activities. After finally realizing the transmissions were being made on VHF Guard, I switched over as well, informing the crew of the change.

Suddenly, the airframe started to shake violently from one end to the other due to the failed engine seizing up. The scanner, blocking another Center transmission, shouted on interphone, "She's still on fire! There are pieces coming off the engine! It's coming apart! We need to land now!!"

This time the aircraft commander heard him and coordinated for an emergency descent and vectors to "the nearest runway 7,000 foot long" while I flew the airplane. Luckily, there was an Air National Guard base in the 10 o'clock position and 70 miles.

At the start of descent, the airframe stopped shaking and engine fire extinguished when the engine finally seized up. We spiraled down over the base, and within 20 minutes, we were rolling out on the runway with emergency response equipment in tow.

The aircraft was quickly brought to a stop, and we emergency egressed on the runway without incident. A visual inspection of the engine revealed five fist-sized perforations of the outer cowling caused by thrown fan blades and a 6-inch-by-6-foot swath cut into the inner cowling by the failed N1 fan section.

The entire sequence of events had lasted only 30 minutes but had aged me even more. It turns out the N1 bearings failed (8 percent lower N1 reading) causing the blades to rub against a flammable abradable seal and the inner cowling.

The smoke we had was the inner cowling being ground away by the N1 fan blades. (The N1 fan failure also eventually caused the loss of the engine oil.) The flames and sparks the scanner saw were from the abradable seal and inner cowling being ground away and igniting from the friction.

The lessons learned are still with me, and I pass them on to each of my students.

■ Beyond the boldface, clear communication is paramount in an emergency situation. *Tell the crew* if you're going off interphone. *Tell the crew* the new radio or frequency when it's changed. *Always monitor* the primary radio (if able) regardless of crew position!

The aircraft commander's interphone being turned down, the frequency change, and the scanner blocking transmissions all contributed unnecessary confusion during the initial stages of this emergency.

■ *Confirm* what you hear, or what you *think* you hear. Even though the engine is on fire, the specific location of the fire might make a difference in the actions, or the order you take them in.

In retrospect, all of the fire bottles in the world would not have extinguished this particular engine fire. After landing, I learned the fire was being spit out the *front* of the engine and was traveling back along the *outside* of the cowling. Looking back with 20/20 hindsight, I should have asked for more detail as to *where* the fire was on the engine before I used the remaining fire bottle. After it was discharged, there was no engine fire protection available for the no. 1 engine. I'm sure my actions would have been the same even with more information, but at least it would have been a more conscious decision rather than one based on incomplete information or some possible misconceptions.

■ Finally, always stay position-oriented — even if it's clear and a million. Ask yourself, "Where are my immediate emergency divert bases along my route?" Depending on the emergency, you may not have the time, or the luxury (especially overseas), of asking Center for assistance — and getting what you need in time. ■

SEMPER VIPER!

F-16 Flameout Approaches

Flameout approaches and simulated flameout approaches continue to be a weakness for Viper drivers. This article highlights important techniques considered essential to the successful completion of a flameout approach.

AUTHOR'S NOTE:
This article was written in memory of Joe Bill Dryden, experimental test pilot, who did a lot more for F-16 safety than most of us realize. When Joe Bill died last year, the Viper community suffered a tremendous loss.

MAJOR BILL WAGNER
HQ Air Force Safety Agency

MAJOR MARK GIGLIO
ACC/SEF Action Officer

MAJOR KEN McMILLAN
ACC/SEF Action Officer

MAJOR NEIL KRAUSE
HQ Air Force Safety Agency

■ Another day, another aircraft ... the FCF pilot was on takeoff leg when his machine coughed and transferred to SEC (secondary engine control). "No problem," he thought. "I'll just hook it up to high key and hang out there." The SOF agreed with this plan.

The MP went through all the appropriate checklists with the SOF. As he approached high key, he had 5,000 feet and 300 knots when his lone motor decided it didn't like working for its occupant.

With 1 mile to go to the runway, the MP thought he could squeeze in a couple of S-turns to get down to the runway. After the second S-turn, he found himself below Dash-One mins but stuck with the jet because he did not trust the seat at that low of an altitude with a sink rate.

All the members of the safety investigation board who tried the *flameout approach* (FO) from that position were able to complete it to an uneventful landing. Fortunately, the MP survived due to the courageous actions of a diligent firefighter, but this mishap points out how proper training and energy management on the part of the one guy who can make a difference could have turned a very bad situation into a good war story.

This is an article for Viper drivers. *Simulated flameout approaches* (SFOs), and especially FOs, continue to be a weakness for Viper drivers and can never have enough emphasis. We will attempt to provide some techniques learned over years of instruction and previous mishaps. This will give a framework in which to teach and practice SFOs with the intent of being able to do the FO when called upon to do so.

The SFO

First off, realize THE SFO IS A

PROCEDURE. It is described in the Dash-One and is a defined maneuver. We will not belabor this description but talk techniques. Realize, first off, the KEY to the SFO is ENERGY MANAGEMENT.

Energy Management

The altitude and airspeed parameters are mandated to define that energy profile. With only one motor and no combat backup, you have to know what your overall **energy state** is at all times. Too much energy can be just as detrimental as too little energy, but you need to have a plan in either case. Make energy adjustments like you do on an ILS; make a lot of small corrections early instead of one or two large corrections at end game.

Bottom line, IF YOU CAN'T MEET and KEEP the MINIMUMS, GET OUT EARLY! "Stretching the pattern" with airspeed below optimum and altitude below recommended is a sure way to end up short (or even worse!).

Although techniques vary, according to a recent Edwards SFO study, an angle of bank of 50 to 55 degrees results in the best energy conservation. At bank angles greater than 60 degrees, altitude loss is significantly greater with a small ground track, and limiter is often encountered in the flare, compromising safety.

At bank angles less than 45 degrees, ground track is greater with a slight increase in altitude lost per turn. The wider ground track is tougher to judge, resulting in a shorter-than-normal final, which makes for alignment problems on final. If you're thinking AOA, 7 degrees is optimum but is difficult to fly due to the varying combination of trimmed AOA and load factor required.

Another important number to come out of the Edwards study was if you delay gear extension until low key, you can save 1,500 feet on your initial SFO altitude.

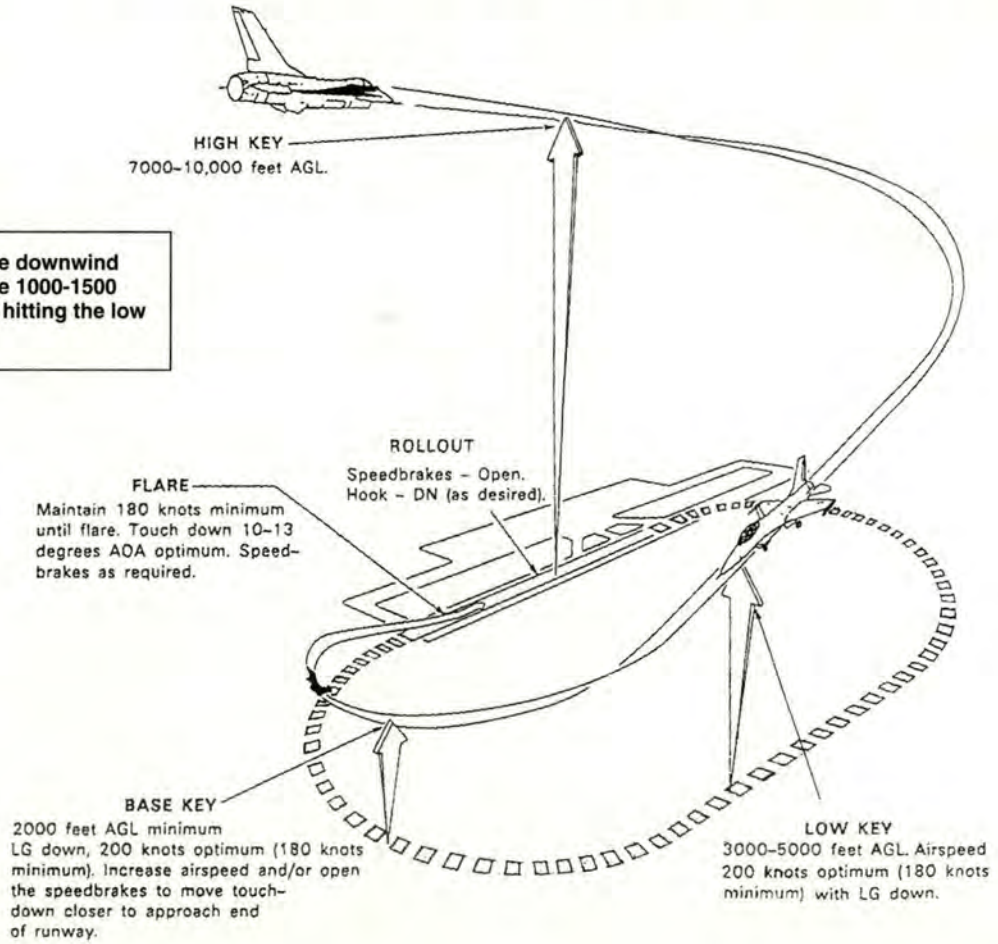
Airspeed, Airspeed, Airspeed

Shoot for optimum airspeed. Never allow airspeed to go below optimum until landing, and never allow it to go more than 10 to 15 knots hot without a reason, i.e., dumping excess energy (altitude). In the airspeed/altitude combination (i.e., kinetic/potential energy), airspeed is the most critical; it drives sink rate, ability to compensate for variations in altitude, or just about any other variable you can think of. Don't neglect the winds; all those good UPT techniques for adjusting the pattern still work in the SFO.

No matter what, by BASE KEY, you must have the parameters under control. Except for you LANTIRN drivers with nonjettisonable pods, if you carry 20 knots and 200 feet extra for "mom and the kids" and then try to shorten the aimpoint

continued

After rolling out on the downwind leg, you normally have 1000-1500 feet of altitude before hitting the low key altitude.



SEMPER VIPER! continued

as you should for a normal pattern, you're in for a very big surprise. Correct early for large variations; don't wait until the base-to-final turn to try to readjust the aimpoint and get rid of excess energy all at once.

At BASE KEY, either the landing is assured or it's time to leave. Strive always to see the same picture from base key to landing, no matter what you start with before that. The emphasis is on the picture.

In the Dash-One, the straight-in SFO talks about 11- to 17-degree glidepath. Guess what?! That also works for overheads. Shoot for about 15 degrees, and visualize that glidepath wire extending to the first third of the runway.

In a recent study of F-16 FO patterns over the last 10 years, AFSA found that, on average, 55 SFOs/FOs are made each year in response to an aircraft emergency. The bad news is that several more mishaps warranted SFOs but were not accomplished. For example, engine problems which occur when practicing an SFO should result in continuing that SFO rather than abandoning it for a straight-in approach. Clearly, the best option is to perform an SFO if continued engine operation is ever in doubt (weather permitting).

There have been three hard landings due to SFO training (back when we were allowed to land out of SFOs). This fact alone ought to tell you the landing phase of the FO is tough to judge.

There are two ways to handle this. First, where regs allow, practice the SFO down close to the runway and down to 11 units before going around. Second, start the roundout early to avoid "swapping ends" at the last moment. Again, avoid dumping the nose on final. Remember the roundout and flare at normal FO airspeeds can carry you 3,000 to 4,000 feet for an on-speed landing.

When you shift the aimpoint, airspeed will build. You must keep it under control (speedbrakes) — 10 to 15 knots extra is okay. More than that is a guarantee you will be LONG! When landing is assured, shift the aimpoint to the overrun. If airspeed exceeds 200 KIAS, shift it short of the overrun. As always, remember the hook if you need it, and if there's a cable available.

The first questions to answer are:

1. **How far is it to the runway?**
2. **How much smash do I have?**

You Thought You Had Options

Although they are limited, there are some options available to the intrepid fighter pilot as he maneuvers his crippled craft for landing. The first questions to answer are: **How far is it to the runway, and how much smash do I have?** This will determine whether you do the straight-in or the overhead FO.

The Dash-One recommends arriving over the runway at 7,000 to 10,000 feet AGL. If you are inside 20NM at one-to-one (no wind), at best range airspeed you will end up over the field at approximately 5,000 feet. This will put you below High Key altitude, so go for a 14- to 15-degree straight-in.

The advantage of the overhead over the straight-in FO pattern is the ability to make corrections. But if your ability to make it over the field is in question, you have nothing to gain by going to a position overhead the field. If you opt to continue the one-to-one until overhead the airfield, you will need to intercept the FO profile at low key or base key. If you're off runway heading, an

analysis of the overall energy state is in order to determine whether you need to head directly to base key or use up more energy by flying a longer wire. If you're over the field with excess energy, an extra turn might help.

For the straight-in, realize the airspeed difference between you and other aircraft that may be ahead of you. See and avoid.

In analyzing how far you are from the runway, there is an energy combination inside 4 NM and with more than the recommended altitude where a straight-in is not feasible and the overhead is going to be nonstandard. The option here may be to do a **teardrop** entry to the opposite runway or to another runway. If you are a ways from the field, keep in mind **hydrazine** is not unlimited, and having the JFS on can increase that time.

Training

Several issues need to be addressed here. First, you'll never find yourself directly over the field at 10,000 like you do for your check ride. Practice for the check when you're in the zone, but practice for the real threat at other times. Since energy management is the key, get clearance for the SFO from your **present position,** pull back the power, and then MANAGE. If nothing else, you'll learn a valuable lesson for future reference. Work with **odd altitudes and off-angle SFOs** because that's the threat. If airspace is a problem, make sure airfield management/wing training is working that hard with ATC.

In the Soup ...

For IMC FO approaches, the Dash-One is clear about the wx mins required to do a safe approach and landing. If you don't have the mins, you won't have the ability to get rid of the excess energy you'll be coming down the chute with. When clear of the wx, you need to adjust the overall energy level by S-turning on final or perhaps by going to a base key if you're coming in off runway heading. A "cheat sheet" for different fuel weights (stores should be gone if it really happens) when the pucker factor goes up can be a happy thing; a little extra effort on the ground can pay off big time in the air.

In flight test at Edwards, they found that the 300 to 330 KIAS airspeed range coming down the chute could not be achieved. It routinely fell short of that figure. They also found that initiating a level turn at the 275 knots that could be achieved would bleed down to 200 knots after only 100 degrees of turn with gear up rather than the 180 degrees from the Dash-One. Food for thought.

Night FO Approaches

At night, the flameout approach becomes much more difficult to accomplish. There are several factors to consider when you have to do the FO at night.

First, the FO is a whole lot easier to do out of a straight-in than the overhead. After all, when was the last time you did a standard overhead at night?! The procedure is more like doing an instrument approach. But there are some significant differences. The picture of the runway is different at night — it's almost at the bottom of the HUD versus slightly below the horizon line. This alone can present a disorienting impression of diving at the ground.

At night, the approach is more by the numbers in the energy management scheme. The Dash-One lists these in excruciating detail. The key is to realize the straight-in FO is the same as the overhead FO pattern in that energy management is the key. The ways this energy is managed are vastly different, however. You can't tighten or lengthen the pattern to adjust; all you can do is raise or lower the nose and fan the boards or S-turn to get rid of excess energy.

Also, the landing environment is not in sight until the flare because the landing light is pointing at the ground due to the nose-low position. Start the flare earlier due to the lack of visual cues. The VASIs and the ILS glide slope will not help either because they'll be white-over-white and pegged two dots high the entire way down the chute. The tendency here would be the same as during any night approach: Holding a few extra knots is the natural tendency, but a longer landing could bite you as the end of the runway is approaching.

The other problem with night FOs is you can't train for them due to regulatory guidance. Risk assessment shows the risk of having a mishap by accomplishing practice SFOs at night overrides the possible benefits gained. However, the sim can provide some good procedural practice, so take what you can get.

REMEMBER, WHEN IT'S ALL SAID AND DONE, YOU GET ONLY ONE CHANCE WITH THE FLAMEOUT PATTERN. WILL YOU EAT THE BEAR OR WILL THE BEAR EAT YOU? CHECK SIX! ■

Crew Resource Management

DR ALAN DIEHL*
Human Performance Technical Advisor
Air Force Safety Agency

Background

■ Sometimes the good stuff takes a while to get around to everybody. Crew resource management (CRM) training may be a case in point. This innovative training was first developed for the airlines after a series of spectacular "pilot error" mishaps.

Air Force fliers are often cited for similar problems by mishap boards. Furthermore, human errors cause many of our nonflight mishaps (be they ground, explosives, or nuke). Judgment errors alone were responsible for over 1,700 USAF ground mishaps in FY93. So we need to think about how such behavioral-based training might be extended to "earthospace" folks.

Who Needs It?

We all remember the classic "pilot error" disasters such as the airliner which crashed into the bridge on the Potomac after trying to take off with ice on its wings. (See photo.) But what about the USAF technician who dropped a socket wrench and destroyed an ICBM? Or the USN cruiser crew who misinterpreted radar data and accidentally shot down the Iranian airliner? These are vivid reminders of how such problems also occur to nonfliers.

While CRM programs were originally applied to airline cockpit crews, over the years the concepts were gradually extended to train an increasing variety of civilian and military occupations. CRM-type programs have been used for flight attendants, mechanics, weapons safety officers, air traffic controllers, and flight test engineers. In short, such training seems to be applicable whenever the job involves close coordination with others or requires highly accurate and time-critical decision making.

These so-called CRM programs show us how to effectively use all available *resources* — hardware, software, facilities, and people — to safely and efficiently accomplish the mission. The programs go by a wide variety of labels (e.g., Cockpit Resource Management, Crew Coordination Concepts, Coworkers Observing Behavior to Reduce Accidents, Judgment Training, Aeronautical Decision Making, Attention Awareness Training). However, the more comprehensive programs all basically teach five types of management skills. (See figure 1.)

What's Covered?

1. ***Attention Management*** *(Maintaining Situational Awareness)* This involves using techniques to control distractions which often lead to mishaps. Workload management skills are necessary to avoid the dual dangers of complacency and boredom (during less demanding tasks) while recognizing the higher probability of overlooking something important (during surge periods) — that is , learning how to mentally pace yourself, while always maintaining procedural and checklist discipline. Strategies such as the "DECIDE" Model are taught to improve headwork. (See Chart A.) People learn to recognize and break the "error chain" (most mishaps result from a series of small mistakes and/or mechanical discrepancies).

2. ***Crew Management*** *(Balancing Authority with Participation and Assertiveness with Respect)* This includes recognizing and overcoming various barriers to good communications as well as understanding the proper division of responsibilities. The benefits of teamwork are described as "All of us are smarter than any of us." Methods for achieving synergy by promoting inquiry, advocacy, and conflict resolution are discussed. Various "rules and tools" are pro-

NEW MANAGEMENT TRAINING CONCEPTS

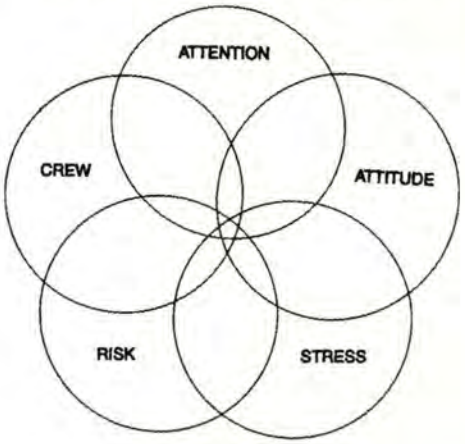


Figure 1.

*Dr. Diehl became an Air Force Reserve mechanic in 1965. He began teaching TQM concepts to improve employee effectiveness in 1975. At that time, CRM concepts were just being developed by a NASA psychologist, Dr. John Lauber. After investigating several airline accidents, Dr. Diehl thought CRM could do for safety what TQM had done for productivity. Thus, in 1979, he drafted the first government recommendation calling for CRM training (see *Flying Safety*, Dec 93, p. 20). In 1983, the FAA asked Dr. Diehl to examine potential methods of applying CRM training to air traffic controllers and mechanics.

It's Not Just for Fliers Anymore

vided. For instance, the "time-out" call requires the team to stop and clarify what is going on. Using such techniques can avert many mishaps because, in most situations, someone on the team thought something was wrong but he or she failed to speak up.

3. ***Stress Management*** *(Controlling Stress to Enhance Performance)* Discussion topics usually include lifestyle and working conditions which often accelerate fatigue or health problems which, in turn, can affect safety. The influences of life-stress events, such as divorce and financial problems, are explained, along with the symptoms exhibited by individuals at risk. Practical coping strategies are suggested. A prework stress "I'M SAFE" checklist is offered to insure one is free of problems. (See Chart B.)

4. ***Attitude Management*** *(Modifying Dangerous Behavioral Styles)* Certain behavioral styles which represent potential safety problems are described. Once recognized, these hazardous attitudes can be modified. For example, "anti-authority" feelings are characterized by the "Don't tell me" attitude. The antidote for this thought is to remember "The rules are usually right." (See Chart C.) Psychological inventories are often given to reveal one's own style, and results are interpreted.

5. ***Risk Management*** *(Evaluating Operational Hazard Information)* To maximize safety, one needs to rationally weigh qualitative and quantitative data related to potential dangers. Statistics on comparative risks for various operations are discussed (on-road versus off-road travel). The significance of certain environmental hazards are presented (night versus day operations). Potential problems associated with organizational issues are discussed (e.g., personnel

continued

Chart A

D-E-C-I-D-E Model
Mental Discipline Checklist

D–**Detect:**	Detect the fact a change has occurred which requires attention.
E–**Estimate:**	Estimate the significance of the change to the operation.
C–**Choose:**	Choose a safe outcome for the operation.
I–**Identify:**	Identify plausible actions and their risks to control the change.
D–**Do:**	Do the best option.
E–**Evaluate:**	Evaluate the effect of the action on the change and on progress of the operation.

Chart B

The "I'm Safe" Checklist

Illness?	Do I have any symptoms?
Medication?	Have I been taking prescription or over-the-counter drugs?
Stress?	Am I under psychological pressure from the job? Do I have money, health, or family problems?
Alcohol?	Have I had anything to drink recently? Do I have a hangover?
Fatigue?	Did I sleep well last night, and am I adequately rested?
Eating?	Have I eaten enough of the proper foods and drank fluids?

Chart C

Hazardous Attitudes

ATTITUDE	ATTITUDE	ATTITUDE
Anti-Authority	"Don't tell me!"	"Follow the rules. They are usually right."
Impulsivity	"Do something — quickly!"	"Not so fast. Think first."
Invulnerability	"It won't happen to me."	"It could happen to me."
Macho	"I can do it."	"Taking chances is foolish."
Resignation	"What's the use?"	"I'm not helpless. I can make a difference."
Missionitis	"I want to press on."	"I don't have to do this now."

Crew Resource Management continued

drawdowns, requirements for cross-training apprentices). Ideally, people learn how to maintain a healthy "margin of safety."

How Is It Taught?

Most CRM training programs usually start off with awareness sessions which are typically mass briefings. Training videos are often used to introduce the basic concepts. Interactive workshops follow to teach people how to apply various techniques associated with the five interrelated management skills. Case studies of mishaps are reviewed. Students participate in role-playing exercises to illustrate how such concepts work. These workshops normally take several hours to complete and are conducted by experienced facilitators.

The workshops are ideally followed by reinforcement sessions in simulators, if available (or in OJT settings, in some cases). Such sessions allow personnel to refine their newly acquired CRM skills. Facilitators critique such sessions. With practice, the concepts become integrated into the "organizational culture." Another tenet of CRM holds that the training needs to be updated periodically and given to people on a recurrent basis.

Sounds Like TQM?

Well, there are some similarities, but there are also important differences. First the similarities.

Both programs embrace methods of enhancing "empowerment" and communications, as well as operational effectiveness through continuous improvement. Both programs focus on improving group decision making, but CRM also deals with teaching individual as well as group skills to enhance situational awareness and judgment. (See figure 2.)

TQM deals with broader philosophic issues concerning organizational functions. CRM, in contrast, focuses on the specifics of task accomplishment with a particular piece of equipment or operational environment.

TQM emphasizes distributed decision making (transferring certain authority to lower organizational levels). While in CRM, the information flows up and down, but the decision making is normally done by the commander. Another major difference involves timing. TQM decision making is relatively long term (issues taking weeks or months), while CRM decision making often deals with critically short time periods (typically seconds or minutes). Because of this, CRM requires the use of a highly structured shorthand language. Finally, TQM is for everybody, but CRM is primarily practiced by personnel and supervisors who deal with dangerous, high-stress tasks.

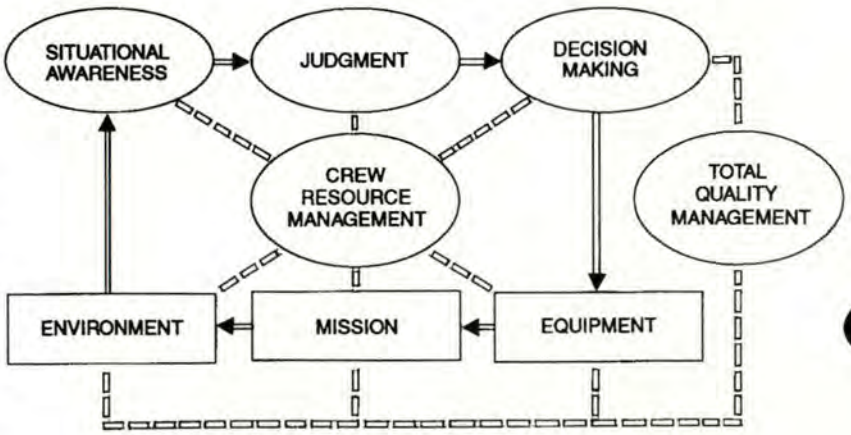
> While TQM is for everybody, CRM is primarily for those who deal with dangerous, high-stress tasks.

Does CRM Work?

An earlier article (*Flying Safety*, Dec 91, p. 7) described how this training reduced aircrew mishap rates for a variety of civil and military organizations. The rates dropped by as much as 81 percent after CRM was introduced. Great! So how did it work for the nonfliers? Thus far, several organizations have reported statistically significant improvements.

- Continental Airlines (Crew Coordination Concepts): Over 2,000 mechanics and supervisors have been training since the program began in 1991. This company found maintenance-caused ground damage mishaps have declined by about 30 percent.

Figure 2.



■ US Air Forces Europe (Attention Awareness Training): This demonstration was conducted with line maintenance personnel at an F-15C unit (Soesterberg AB) during 1993. Over the 6-month period, there was over a 60 percent drop in human factors-related logistics mishaps.

■ Oklahoma City Air Logistics Center (Coworkers Observing Behavior to Reduce Accidents): This project involving two engine overhaul shops was begun in 1991. Reported injury mishaps decreased by approximately 60 percent during the 6-month measurement period. These improvements were similar to those found by several major industrial companies.

Besides these formal studies (all of which happened to involve maintenance people), CRM-type training programs have also been favorably evaluated by several other groups. The "ammo troops" get a CRM block in AFSA's Advanced Weapons Safety Officer Course. AFMC has taught these concepts to its control room operators (along with test pilots and engineers) at the USAF Flight Test Center. The US Coast Guard has recently introduced such training to shipboard personnel, while the Republic of South Africa has been using CRM with its military air traffic controllers. The Australians have even applied similar concepts to high school driver education courses.

CRM training is appropriate wherever close coordination between people and time-critical decision making is involved.

Photo courtesy of NTSB

So What's the Bottom Line?

The USAF has made a strong commitment to CRM. For more details, see the article by Major (Dr) Tony Kern in this issue. He has been "honcho-ing" the new Air Force instruction (AFI) on CRM. This instruction is the product of the CRM Working Group which includes operations, safety, and human factors folks who represent their respective MAJCOMs and the Air Staff. When approved, the AFI will require CRM in initial, upgrade, and recurrent training for all aircrew members, instructors, and their supervisors — no surprise. However, the AFI also will provide guidance on extending CRM training to some nonfliers. Exactly which occupations, how much training, and when the training will be given is to be established in the near future. ■

MAINTENANCE MATTERS

Bad Jack Job

■ This ground mishap occurred during an aircraft jacking operation and resulted in a maintainer getting injured. Unfortunately, it is a classic example of in spite of all we do in the safety business, we still have maintainers who take shortcuts leading to grief — and sometimes disaster.

Two fighters required jack jobs — one to cannibalize a main landing gear component and the other to install the "canned" part. Four people are required by tech data to do the task, but only three were used. The tech data also says to use three jacks, but only ONE was used. The tech data to accomplish the task was available but not followed.

Through pure luck, the cann action from the no. 1 aircraft (using the unauthorized procedures) was completed without a problem. However, for one technician, the jack job on the 2nd aircraft didn't fare as well. After a series of difficulties, a main gear tire unexpectedly rotated against the technician's right ankle and pinned him. The supervisor was also momentarily pinned but freed himself.

The supervisor took a shortcut because it was expedient. His role was all too typical of this kind of PREVENTABLE mishap: in a rush, noncompliance with tech data, taking shortcuts in maintenance actions, with no urgent or critical goal or mission to warrant the high risk-taking. He had only three people, instead of four, because no one else was available at the time. He used only one aircraft jack, instead of the required three, because this method was faster. Yet, the supervisor was not pressured to get the job done, and there was no priority in getting the aircraft repaired for immediate flight.

Bottom line: A supervisor set the stage for a ground mishap and put his crew's safety at risk. ■

$89,000 for a Cotter Pin?

■ For the want of a cotter pin worth only a few cents, an airlifter experienced a Class C in-flight mishap which cost the Air Force $89,000 and the aircrew a couple of very exciting moments. Why?

Attention to Detail ...
Attention to Detail ...

After a normal takeoff on a local training mission, the instructor flight engineer noticed the no. 3 engine pressure ratio was reading too high and informed the pilot. The throttle was retarded, BUT THE ENGINE DID NOT RESPOND.

The no. 3 engine instruments were exceeding max limitations, so the crew decided to shut down the engine by pulling the T-handle. An emergency was declared, and the aircrew got the aircraft safely back to base.

When maintenance opened up the engine cowling, they found the bolt, nut, and washer connecting the engine-mounted throttle linkage to the pylon-mounted throttle linkage were disassembled. This engine had been installed less than a month earlier.

Tech data says the nut should be secured with a cotter pin; however, it was not installed during the engine installation. The lack of a cotter pin allowed the nut to back off the linkage bolt, and the bolt fell out. Once the linkage was disconnected, the engine was able to accelerate freely — ON ITS OWN! The engine was rendered uncontrollable until the T-handle was pulled.

Both a maintainer and the seven-level inspector overlooked a missing piece of critical hardware during and after the engine installation. This small, inexpensive piece of hardware caused an $89,000 mishap, but it could have been a lot worse.

STOP AND THINK about it, fellow maintainers! People's lives hang in the balance of your ability to turn a quality wrench or thoroughly inspect the work of others!!

ATTENTION TO DETAIL ... ATTENTION TO DETAIL ... ATTENTION TO DETAIL. ■

Fumes in the Cockpit

CMSGT DON A. BENNETT
Technical Editor

■ A recent Class C physiological mishap is worth bringing to the attention of aircrews and maintenance technicians. Besides cutting the flight short, there was the potential for all crewmembers to be wrapped up in this incident. The outcome could have been far more serious. The lessons learned by this mishap aircrew will perhaps keep another unsuspecting aircrew from accepting an aircraft not quite ready for flight.

A Burnt-Rubber Odor

The aircraft had just undergone air refueling system repair work. All leak and operational checks had been done prior to crew show. The production supervisor briefed the crew on the work accomplished.

However, it was reported the sealant (MIL-S-8802) used on the air refueling system box back plate, located in the cockpit, was not completely dry — it was still tacky. Both the aircrew and maintainers noticed a burnt-rubber odor in the cockpit, but the flightcrew accepted the aircraft and the odor as flyable. After takeoff, the sealant vapor smell was more noticeable, but it was not considered significant.

Luckily, the aircrew was on a local mission. The instructor pilot (IP) was required by in-flight duties to be near the air refueling system box back plate. This caused him to be directly exposed to the fumes longer than other crewmembers. Almost an hour into the flight, the IP experienced symptoms of nausea and headache. He terminated the mission and returned to base.

Important Point to Consider

■ The "sealed" back plate acts as an additional barrier to prevent fuel from entering the cockpit. It has a rubber gasket which serves as a seal, but the local maintenance practice was to add sealant as an additional precaution. There is nothing wrong with this, *as long as the sealant is given adequate time to cure.* Tech data does not give guidance on using sealant on the back plate nor is there a cure check required for this type of sealant application.

Tech Order 1-1-3, *Aircraft Fuel Integral Tanks and Bladder Cells,* warns sealants are toxic to the respiratory tract, and prolonged contact should be avoided. The warning also states good general ventilation is necessary. Fuel systems technicians who work with this type of sealant for sustained periods report little or no ill effects from the fumes. Both the ground crew and the aircrew accepted the burnt-rubber smell as acceptable for flight.

Some Other Considerations

■ Maintainers, not the aircrew, are supposed to be knowledgeable of precautions while using sealants. Had the aircrew been thoroughly briefed on tech data warnings about prolonged breathing of sealant vapors, good ventilation, etc., they might not have okayed the burnt-rubber smell. The confines of a closed cockpit might not provide adequate ventilation.

In light of the highly explosive nature of their business, fuel systems technicians may report "little or no ill effects" from sealant vapors because tech data and safety standards demand more than adequate ventilation during fuel cell maintenance actions.

■ Since the application of the sealant was a "step beyond" requirements of tech data, the maintenance technicians should have gone a "step beyond" in its use.

The air refueling system box back plate is not considered a fuel tank/cell closure, so no leak or cure checks are required, at least not by tech data. However, technicians and the production supervisor should have taken the extra precaution of waiting for the sealant to cure properly before the release for flight. As mentioned earlier, at the very least, they should have briefed the sealant vapor warning to the aircrew.

Moral of the Story

Excellent mechanics, with good intentions, worked hard to make the launch, but they overlooked a few things. They exceeded tech data requirements in the spirit of making a safer aircraft but didn't consider the risk of their decision in a confined space. ■

An on tim
won't
if your j
comes

ne takeoff
matter
et never
home!

Land It at Thule!

RICHARD H. WOOD, COLONEL, USAF
(Retired)

■ It's been over 30 years. The statute of limitations has run out, so I guess I can tell the story. What can they do to me now?

It's the early 1960s. I'm a young Captain and the Aircraft Commander of a B-52H crew. I am also, coincidentally, a B-52 instructor pilot (IP) and the Wing Director of Safety. We were a little short-handed in those days.

If you recall those times, we had discovered missiles in Cuba, and President Kennedy had issued firm instructions to get them out of there, or else. We (Strategic Air Command) were the "or else." To demonstrate we weren't kidding, a whole flock of B-52s maintained a highly visible (to Russia) airborne alert operation for several months. I flew about 30 of those 24-hour missions, and believe me, we weren't kidding.

Let me digress for a minute and talk about the safety of that type of flying. Crew composition was left pretty much up to each wing. Some did it with the basic crew, and some chose to augment the crew with an extra pilot — usually a staff pilot who was available and could fill the seat. Carrying the extra pilot was not universally popular as he took up room. If you have ever been in the crew compartment of a B-52, you would understand the problem. There wasn't much room for the basic crew, and extra passengers just made it worse. After about 20 hours, you got to know more about the other crewmembers than you really wanted to know.

Nevertheless, I was the safety officer, and I held out for the extra pilot. The rumor SAC crews could stay awake and alert for 24 hours was started somewhere in the bowels of SAC headquarters by people who had never tried it. I had a few years' experience with long-range missions in both the B-47 and B-52, and I'm here to tell you, if you get tired enough, you sleep. I think it is interesting the FAA has only recently decided that permitting airline pilots to take short naps on long legs might be a good idea. Of course it is. It always has been. Why do you think they keep the door locked?

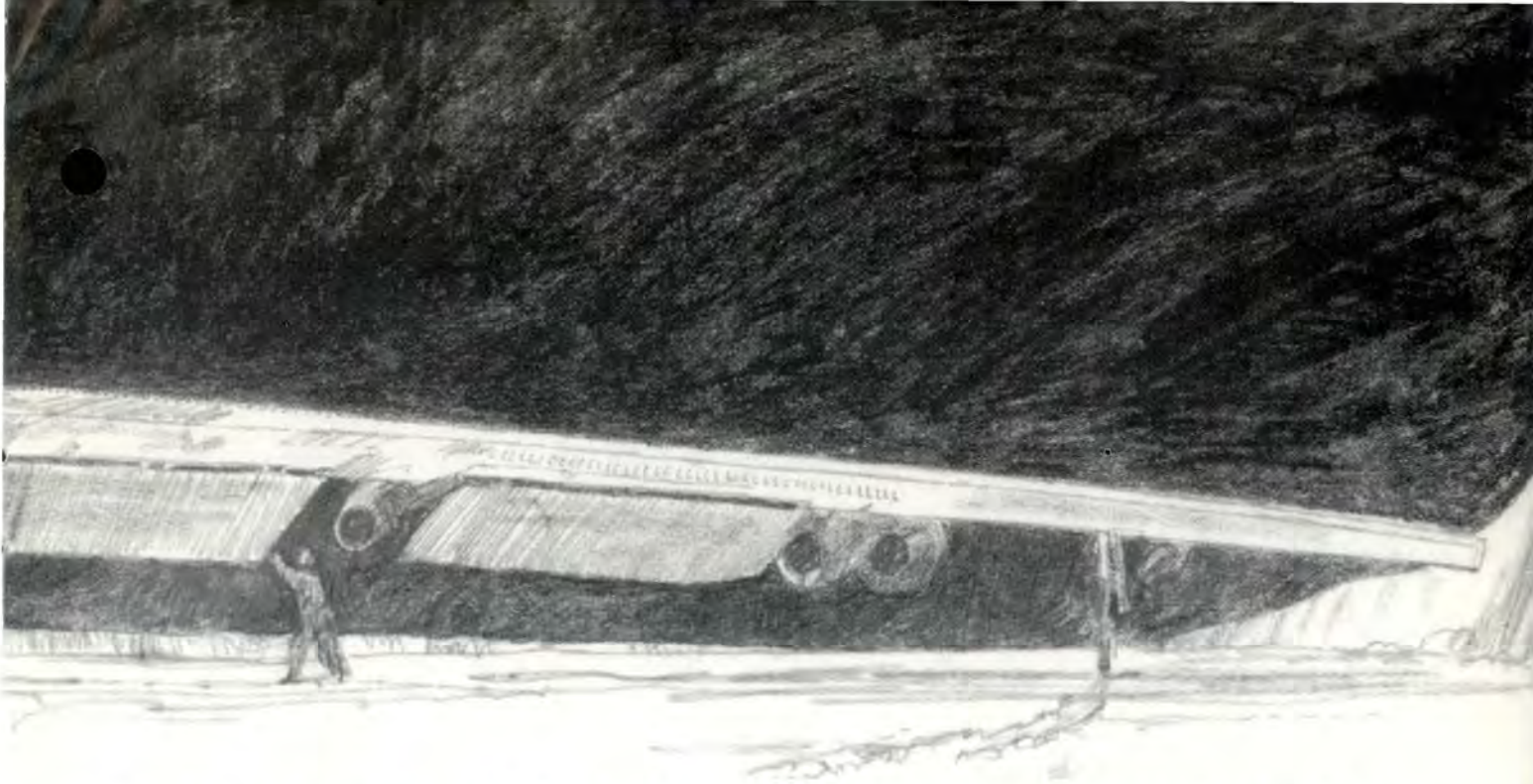
Anyway, I insisted we carry a third pilot, and I had a nifty schedule worked out where each of the three pilots spent 16 hours in the chair and 8 in the bunk — not all at once, of course. During critical phases of flight (takeoff, landing, and refueling), the primary pilots were in their correct seats. I was proud of this plan. The crews bought it, and I think it contributed some safety to the operation, because we always had two wide-awake pilots in the front seats.

Back to the story. We had been airborne about 10 hours, and I was snoozing in the bunk when my Electronic Warfare Officer (EWO) shook me awake.

"Boss, you better get up front. Something's gone wrong."

That didn't take long. The IP's jump seat was at the foot of the bunk. I slid into it and plugged myself into the interphone system.

The problem was fairly obvious and didn't require a lot of conversation. A generator was off the line, and its constant speed drive over-



If you're the type who would like to drive a bus through a parking garage designed for compact cars, you'd love to taxi a B-52 in the winter dark of Thule. But no matter who you are, you should enjoy this true reminiscence of one cold dark night when almost everything took a wrong turn.

heat light was on. The fire warning lights for engines no. 5 and no. 6 were on, and the pilots had (wisely) shut down both engines.

This was a problem with the early B-52H models. As delivered, the H-model had four monster AC generators and equally huge constant speed drives (CSDs). Both were firmly connected to the engine with no disconnect capability. The generator would physically fail and come to an abrupt halt. This would slow the CSD down while it was still being driven by the engine. This confused the CSD, and it sat there and got hot — really hot. In the meantime, the drag from the generator and CSD would slow the engine down.

Although the TF-33 fan jet engine was the latest and best we had, the fuel control unit was not too bright. It sensed the drop in RPM was due to a lack of fuel, so it opened the fuel faucet and added some.

More fuel was the last thing the engine needed. It really needed to be unhooked from the CSD. The engine took the excess fuel and did the only thing it could do with it. It converted the fuel to heat which ran the EGT way up, started a fire, and lit up the fire light. If not shut down very quickly, the fire burned through the cowling to the adjacent engine and lit that one up, too. That was the basic situation.

Things seemed to be pretty much under control. All the temperature gauges were headed down, and the CSD overheat light went out as I was looking at it. The pesky engine fire lights stayed on, though, and nothing we did seemed to make any difference. My suspicion was we had had a real fire which was now out. It had fused the fire warning circuits and given us a set of permanent fire lights, and there wasn't much we could do about it except pull the circuit breakers. Nobody liked that idea.

I climbed into the left seat and, through the magic of SAC's communication system, was rapidly in touch with the SAC command post at Offutt. I explained the situation and told them I thought we were in pretty good shape, and we could bring the plane home. But we still had two engine fire lights on.

After a few "Stand bys," they asked me to check the weather at Thule. That was no problem. We were in contact with Thule on another radio, and Thule was magnificently clear. We could see it sparkling on the otherwise dark and lifeless glacier of Greenland.

After another set of "Stand-bys," we got firm instructions. Land it at Thule. Immediately.

As I recall, I weighed something like 365,000 pounds which was somewhat above the design landing weight. We landed uphill into the glacier (which is the only way to land at Thule) and had no trouble. I rolled out to the end of the runway and swung the B-52 onto the large runup area.

Thule had a single parallel taxiway which led back to the parking ramp at the other end of the runway. It was February and darker than the inside of a football, and I couldn't see whether the taxiway was clear or not. I asked the tower, and they said, "No problem. Taxiway is fully plowed and in daily use." They

continued

Land It at Thule! continued

didn't mention "daily use" meant F-102s. They had never seen a BIG-52.

I started down the taxiway which was indeed plowed with about 8-foot snowbanks on either side. I was following the follow-me truck, and everything seemed okay until we noticed the snowbanks were getting closer. The taxiway was narrowing.

I stopped, as I didn't really believe we could go any further. The follow-me driver hopped out and tried egging me on with wands. No way. I had the NAV open the hatch, and I deployed the EWO and the Gunner with flashlights to see what was actually going on at the wingtips. This didn't take long.

"Boss, you might as well shut it down. Fifteen more feet and both wingtips are in the snowbanks."

I told the tower we couldn't go any further and we were shutting down. It was going to take a tow crew to back the plane out of there.

The news that a B-52 was completely blocking Thule's only taxiway generated a lot of action. Within minutes, we were surrounded by a bunch of maintenance vehicles, a bus, and one early model Coleman tractor with a universal tow bar.

A staff car arrived carrying a license plate with "Base Commander" and an eagle on it. I figured this is who ought to be in charge of this mess, so I walked over and saluted both the car and its occupant.

The Base Commander was Colonel MacDuff. He was only a few inches over 5 feet tall, and I couldn't see his face as his head was buried in his parka hood. All I could see was a pair of beady eyes and an unlit pipe.

Pressing on with all the wisdom of a captain, I explained how I happened to be there and why I was blocking his taxiway. I explained, in accordance with AFR 60-16 (I think), my plane was now his plane and he, as base commander, was responsible for it and its contents. While not wanting to tell him how to do his job, I pointed out the only solution was to push the B-52 back to the runup pad where I could turn it around and taxi it down the runway to the parking ramp.

Col MacDuff mulled this over for a minute or two and finally spoke in a grave, but firm, voice.

"Captain," he said, "you're right. I am now responsible for your damn airplane. My problem is I don't have anybody here at Thule who knows beans about a B-52. Fortunately, I have a highly qualified B-52 crew TDY to my station and, in accordance with AFR 32-4, they are now working for me!" I think he was making that up, but I couldn't prove it.

"Now," he continued, "I've got that ratty looking Coleman tractor over there and a universal tow bar which is supposed to fit anything and all the warm bodies and hired help you need. My instruction to you, Captain, is to get that damn plane pushed back to the runup pad and taxied down to the ramp where it belongs."

About that time, another staff car pulled up with a lieutenant from Base Operations.

"Colonel MacDuff, sir, SAC Head-

quarters is on the line and they want to talk to the B-52 pilot."

"Son, you tell SAC the B-52 pilot is still busy parking his plane, and he'll talk to 'em when he's done. Now go away."

It looked like I was going into the towing business.

Except for the fact I was tired and cold, I didn't see much of a problem. I had helped our crew chief hook up the tow bar and tow the plane before, and I knew what to do with the bypass keys and how to turn the tip gears with a turning bar. I also knew, without external power, there was no brake pressure. We had an emergency hydraulic hand pump in the forward wheel well which, if you pumped hard enough, would generate one measly brake application on one gear.

I put the other two pilots in the cockpit, although there wasn't much for them to do. I had the RN and nav at each tip gear supervising the gear-turners. I put someone in the forward wheel well at the hand pump, and I had eight people standing by to chock all eight wheels at the first sign of trouble. We hooked the tow bar to the forward gear and the tractor and got ready to push.

About that time, Col MacDuff wandered up.

"I see you're about ready to do it," he said.

"Right. We're all ready to go."

Col MacDuff shifted his pipe to the other corner of his mouth. "Where, may I ask, is your towing checklist?"

I was getting a little tired of this whole exercise. "Hell, Colonel, you don't need a damn checklist. You just hook up the tow bar and push. That's all there is to it."

Col MacDuff put his arm around my shoulders — no mean feat since he was short and we were both wearing parkas. "Son," he said, "I have bad news for you. I used to be Wing Commander at a SAC tanker base, and we had a towing accident. According to the mishap board, it was all my fault because we weren't using towing checklists, and that's how come I'm Base Commander here at Thule. If you don't have a towing checklist, I suggest you write one."

Well, I can tell when I'm on the losing side of an argument. I got a pad from my briefcase and spent about 20 minutes on the bus writing checklists for all team members. At least that warmed me up a little.

Anyway, we finally started to push, and things went all right for about 30 feet. Then, because we were pushing uphill on permafrost, the tractor would slide slightly out of line, and the tow bar would start to jackknife. We would fling chocks under the wheels, unhook the tow bar from the tractor, straighten it out, rehook the tractor, and go at it again. Because of the weight of the plane, the gradient, and the slippery surface, the tractor was having a tough time and was not sounding too healthy.

We were on about our tenth series of 30-foot pushes, and I figured if we could get one more good one, I could fire up six engines and turn it around.

On the eleventh go, we somehow got out of phase. The tow bar jackknifed, and the tow bar unhookers dropped the bar off the tractor before the chockers got the chocks under the wheels. The B-52 started to roll back downhill. It shoved the tow bar under the tractor, raising the front end of it completely off the ground. The driver put full power to the rear wheels, but the B-52 shoved it backwards anyway. The pilots in the cockpit were standing on the brakes, but there was no pressure. The person manning the pump in the forward wheel well jumped out and abandoned ship at the first sign of trouble. The chock meisters were valiantly throwing chocks under the wheels, but the B-52 was squirting them out like watermelon seeds. I ran for the forward wheel well and took a flying leap up onto the wheel well deck above the main gear (I

continued

Land It at Thule! continued

was in a lot better shape then) and started pumping. I didn't know what else to do.

About that time, the chockers just happened to simultaneously get chocks under all eight wheels at the same time, and the B-52 came to an abrupt halt. I didn't. I kept going and fell out of the wheel well flat on my back directly in front of the forward main gear.

I lay there thinking how nice and quiet it was and wondering if maybe I ought to move in case the B-52 changed its mind and started rolling again. About that time, Col MacDuff came up and grabbed my parka by the shoulders and stood me on my feet. For a midget, he was a man of surprising strength.

As he dusted the snow off me, he shifted his pipe to the other side of his mouth. "Son," he said, "it's a good thing that last set of chocks stopped it, because I was going to throw myself under there next."

I believed him.

About that time, the Base Ops lieutenant zoomed up.

"Sir," he said, "SAC Headquarters is back on the phone, and they really, really want to talk to the B-52 pilot right now!"

"Son, you tell SAC this ain't no SAC base. The pilot will talk with them when I'm done with him out here and not until."

I decided I'd had enough of this pushing and chocking drill. I opened a service valve so I could get full hydraulic pressure on both body systems without no. 5 and no. 6 engines running. The copilot and I fired up the remaining engines and showed the Thule folks what could be done with the cross-wind gear steering system. With the rear gear turned full to the right and the front gear full to the left (and a lot of power), we pretty much turned the plane around in its own length.

This maneuver is a little hard on the plane, but it is spectacular to watch. We taxied the B-52 back down the runway and parked it on the ramp, carefully leaving room for the big rescue plane we were expecting. Case closed, more or less.

Thinking about how close I had come to planting the B-52 (and all its contents) into dual snowbanks gave me the cold sweats. As far as SAC knew, it just took me an extra long time to park the plane. They never did find out what really happened.

I was a victim, I think, of having just enough knowledge to be dangerous. Yes, I knew how to hook up the tow bar and tow the plane, but I hadn't considered all the options. Actually, I could have put the bypass keys in the rear gear and pulled the plane from behind instead of pushing it from the front. Also, I could have hooked up an external power unit and had three or four people move it along with the plane. That would have provided brake pressure. Neither of those are common procedures, but they might have made a difference if I had thought of them.

I really should have gone with the Base Ops lieutenant to talk with SAC. At worst, they could have gotten someone on the phone who could discuss towing procedures with me. At best, they would have told me to leave it where it was and don't mess with it. They would fly a ground crew up to recover it.

I suppose you could say I was influenced somewhat by Col MacDuff. I don't think so. I can't lay it off on him. If I didn't really believe I could do it, I would have told him so in the first place. In those days, I was a bundle of supreme self-confidence.

I spent a little time thinking about how I would explain it to the mishap board if we had dinged the airplane. Since I had investigated a couple of mishaps already, I could think of a lot of pointy questions that would be hard to answer. Col MacDuff may have had the right idea. Turn it into a suicide. That would take it out of the safety category and make it nonreportable.

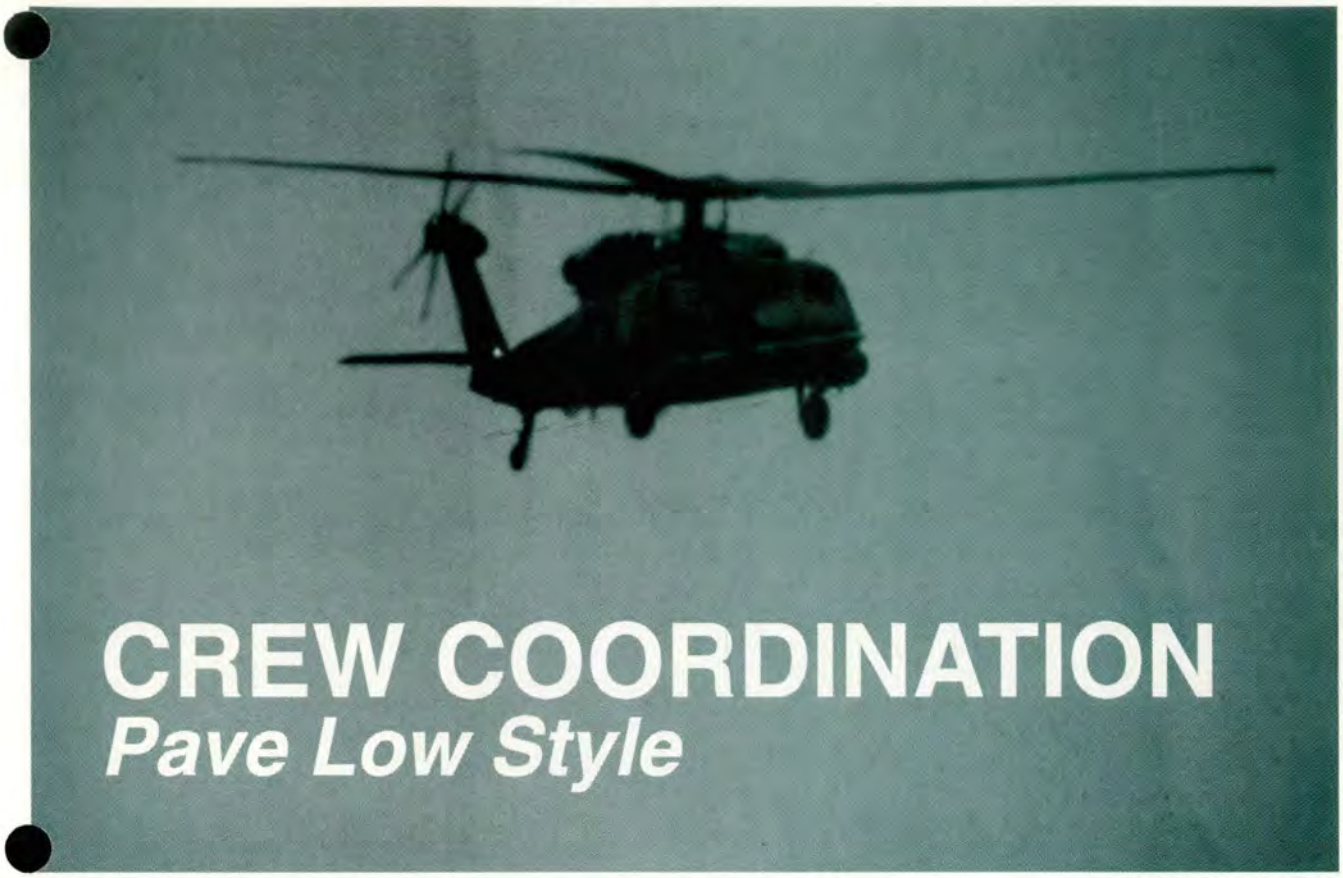
After the dust finally settled, Col MacDuff and I became good friends. We both realized how narrowly we had escaped disaster. He took us all to the officers club, opened it up, and started setting up beers on the bar.

He raised one and said, "Son, let's not tow any more B-52s this week."

I raised mine. "Hell, Colonel, let's not tow any for the rest of the month!"

We drank to that. ■

AUTHOR: Colonel Wood spent 26 years in the Force and accumulated over 6,000 hours as a pilot. He the author of several books, papers, and articles on aviation safety subjects and is currently the Director of Aviation Safety Programs for Southern California Safety Institute, the contractor for all USAF aviation safety education courses.



CREW COORDINATION
Pave Low Style

USAF photo by SrA Jerry Morrison

CAPTAIN CHRISTOPHER M. CICERE
HQ Air Force Special Operations Command
Hurlburt Field, Florida

■ Aviators hear a lot about crew coordination, but sometimes I wonder if we really know what it means. On a recent night tactical sortie on an MH-53J Pave Low, I saw first hand what crew coordination was all about. This crew had names, but the names are not important. It could have been anyone who flies the Pave.

From takeoff to landing, each crewmember, regardless of rank, is an integral part of the mission. Whether you are an instructor pilot or a new tail gunner fresh from RTU, everyone knows their inputs are critical to mission success.

During this particular night, our mission was to pick up survivors in hostile territory. As we approached the LZ, the pilot made contact with the survivor over the radio. In a darkened wooded area, the survivor gave his approximate location on his survival radio. In an instant, the right gunner spotted the injured survivor with his NVGs, calling out the clock position, giving the pilot directions to the downed aircrew member.

On the approach to the survivor, each Pave crewmember became involved in calling out obstacles and helping to direct the aircraft safely to the ground. As soon as the Pave touched down, the security team exited the aircraft. When the tail gunner called out the team was clear, the aircraft took off, waiting to be called back in.

Within 5 minutes, the survivor was located and ready for pickup. Once again the Pave made its approach with each crewmember working together to ensure the safe landing of the aircraft. The survivor was loaded on the aircraft, and in an instant, the Pave departed, mission accomplished.

What impresses me is crew coordination used in every aspect of the Pave mission, whether it is coming in to a hot LZ, looking for the tanker, or just landing at the home drome. If a gunner calls a go-around, the pilot executes the maneuver. During hoist operations, the right scanner directs the aircraft with the pilot executing each slight change in aircraft position. In either case, the pilot does not ask, "Are you sure?" He doesn't question another's judgment. If there is a question, that's what the debrief is for. The bottom line is, there is no room for lone rangers in the Pave Low.

In safety, we must have lessons learned. **What I learned is crew coordination does not just aid in mission accomplishment — in the Pave Low, it is a matter of survival.**

■ Crewmembers in the "Pave" are trained to speak up, to be aggressive in making their calls to be an integrated crew.

The Pave Low community has successfully created a culture where people feel free to speak their minds in an atmosphere of respect. The teamwork and effective use of crew coordination in the MH-53 Pave Low is what each and every crew aircraft in the USAF should shoot for. ■

More New USAF

MAJOR TONY KERN
Chief, Cockpit/Crew Resource Management
Air Education and Training Command

■ Military aviation is beginning to look at human factors training through the same lens as it does other forms of training, stressing realism and the combat environment.

Military Cockpit/Crew Resource Management (CRM) training began in 1985 when Military Airlift Command (MAC) started their CRM training programs by adapting existing airline programs to their needs. In 1989, Strategic Air Command (SAC) emulated MAC and started their own CRM training. Both of these programs were initially successful because the fundamental principles of CRM training provided a strong foundation for the programs to stand on.

However, these programs stagnated, and many crewmembers remain lukewarm to programs they see as "airline stuff." The unique flight environments of military aviators have not been adequately addressed — until now.

The USAF is currently developing guidelines to establish and **require** aircraft-specific and mission-specific training programs for all USAF crewmembers. During this process, it is essential operators provide inputs and feedback on the new training programs.

The development of these guidelines is taking the form of an Air Force Instruction supplemented by each MAJCOM. It is grounded in war-fighting theory as well as the traditional theoretical domains of CRM, i.e., aviation psychology, physiology, industrial engineering, and the like. Basic Air Force doctrine (AFM 1-1, Vol II) states:

"War is a violent contest between thinking, acting, and reacting antagonists ... Violent force, or even the threat of its use, injects levels of physical exertion, emotion, and ferocity that tend to undermine rationality on all sides. Ultimately, only man, not technology, can cope with the unpredictable (p. 17)."

This statement answers the question as to why military CRM programs must be different than airline programs. Simply stated, airline pilots wage their battles against nature and machine, whereas military pilots play against a smart adversary that constantly changes the rules — a human enemy armed with missiles and guns.

The friction of war is so important to the nature of Air Force training that any human factors training program which does not address mission-specific combat scenarios is simply inadequate. As far back as Clausewitz's *On War*, the inherent benefits of "artificial combat" have been realized, and programs such as RED FLAG, the various fighter weapons schools, and tactics schools are now standard parts of an aviator's maturation process. Military CRM training **must** also include combat and mission-specific dimensions.

A secondary reason why military CRM programs must differ from standard airline offerings is the experience factor. USAF front-line

Different Than Alike

CRM Programs to Stress Combat

fighter, bomber, and mobility aircraft are often crewed by individuals who don't even meet the minimum requirements to apply for an ATP rating (1,500 hours). To address this challenge, military CRM programs must build upon basic fundamentals and continually reinforce important human factors throughout the aviator's career.

The institutionalization of the mission-specific CRM program, using actual combat examples (both positive and negative), are steps in this direction. Researchers have collected over 800 "critical incidents" of effective and ineffective CRM across 10 major weapon systems which will be used to build these programs. No longer will Air Force CRM courses be limited to a few mishap reports to be rehashed as training examples.

Although much of existing CRM theory can, and will, be utilized in "Awareness" level programs taught during undergraduate flying training (UFT), the specific requirements of low-level, high-speed operations, or air-to-air intercepts under AWACS control, require a significant extension of current theory. Designing mission-oriented simulator training scenarios takes on new meaning when the student is a 24-year-old crewmember, traveling at 600 miles per hour and 400 feet AGL.

This environment may require a decision on whether to penetrate a potentially lethal threat ring of a surface-to-air missile or break over a ridge line which has a 50 percent chance of hiding a deadly AAA bank with a probability of kill of .85. Basic situational awareness still applies here, but decisions in these complex environments must be trained differently than airline-style decision making. The greater number of inputs and the immediacy of the requirement are unique to the military combat environment. Additionally, mission accomplishment priorities must be factored into these scenarios.

The new Air Force guidance to address these challenges will require five levels of training.

Awareness Traditional CRM training offered during UFT, stressing fundamental concepts, terms, motivation, and a roadmap for a career-spanning training system.

Aircraft and Crew Specific Taught at the formal training unit (FTU) during initial qualification in the aviator's primary weapon system, this short course will detail specific communication, decision making, as well as risk management aspects of the particular aircraft environment.

Mission-Specific (Continuation) The essence of the overall CRM program, this level will be taught at the aviator's mission base. It will stress actual experiences related to the *combat mission* of the wing or squadron.

Instructor/Evaluator Closes the training loop by training instructors and evaluators to provide in-flight instruction and evaluation. Makes CRM "need to know" vs "nice to know."

Supervisory The target audience ranges from squadron operations officers to MAJCOM commanders, stressing organizational value of CRM, diagnostic tools, and advocacy skills.

Are we teaching anything new in these programs? Probably not. The fact is, aviators have been passing along decision making, risk management, situational awareness, and judgment skills for decades. This has been an informal process, mostly done by word of mouth.

Are we teaching this information in a new way? *Definitely*. CRM training programs crystallize essential elements of human factors and deliver it systematically, in bite-sized portions, at critical junctures in an aviator's flying career. In short, the USAF feels this training is so important it is time to organize and manage the instruction.

Although it's hoped the word-of-mouth process continues, formalized, structured programs can ensure *everyone* gets the information at a point in time where they can integrate it with other aspects of their flying development. For example, aircraft-specific communications considerations will be offered at the FTUs and mission-related decision-making skills at the operational bases. CRM training will give the operator what is needed, when needed, to let him or her get on with the business of becoming one of the world's finest aviators.

The challenge for the military training community is to provide CRM training programs academically and technologically current in the form of a career-spanning, building-block training continuum. The components of these programs must be *combat oriented and based on actual military examples.* We can no longer afford to rely on modified airline programs to meet the needs of tomorrow's combat crewmember.

The challenge for crewmembers and supervisors is to give the new programs a chance, provide inputs when asked, and to critique the new programs thoroughly and honestly. CRM is here to stay. Let's make it work. ■

Major (Dr) Kern was formerly the Chief, CRM Plans and Programs for Air Education and Training Command (AETC) and has extensive background in cockpit/crew resource management program development and instruction. He is the author for the Air Force Instruction (AFI) which will change the way CRM is offered to Air Force team members. Major Kern is currently attending Army General Command and Staff College at Fort Leavenworth, Kansas.

LIKE A MOTH TO THE FLAME

CAPT FRANCISCO GONZALES
New Mexico Air National Guard

■ There you are, on your prized mountain low-level route. You're hitting all of your turn points just right and hey, your time is, well, just downright impressive!

Scanning the horizon, you see a little ribbon of smoke rising in the distance, just slightly to the right of your course. You immediately recognize here's a perfect opportunity to not only fly a flawless low-level, but you can save a whole forest in the process and still make your lunch date. You've chum'd your charts, checked the NOTAMs (military as well as civilian), and besides, it's September. You assure yourself Albuquerque Center will be delighted to relay the fire's lat/long to whomever.

So you press on, like a moth to the flame, er, smoke, that is. As you go over the sharp ridge line, you suddenly find yourself in the midst of a small formation of light aircraft, P-3s and C-130s, plus you notice a helicopter diving under your flightpath! Sprinkle in a couple of smoke jumpers (parachuting firefighters) jumping out of a C-23 *Sherpa* and your non-event day has rapidly turned into a major event.

Sound impossible? A quick scan of recent safety reports for just one U.S. Forest Service region alone unfortunately reveals otherwise.

■ An F-16 passed extremely close to a small fire retardant tanker and then pulled up and departed the Temporary Flight Restriction (TFR) (see FAR 91.137) area. A request to close both the Visual Flight Rules route (VR) and Instrument Flight Rules route (IR) sections in the area had been made a day prior with the controlling unit; however, the request had not been forwarded to the unit's Supervisor of Flying.

■ A T-38 banked sharply away to avoid colliding with a Forest Service aircraft operating over a fire. A TFR was in effect, plus a request to close a portion of a military training route (MTR) had been made with the local Air Force base; however, the base was not the controlling unit responsible for the MTR, and the route had never been closed down.

■ Two F-15s flew at 600 feet AGL through an aerial suppression effort, narrowly missing two fire retardant tanker aircraft. A TFR was in effect, and the MTRs in the area had already been closed.

■ Two military jets made multiple passes around the fire. They flew close enough to permit clear sight of their aircrafts' markings. A TFR was in effect.

■ An Army OV-1 *Mohawk* made numerous passes over a fire. A TFR had been in effect since the previous day. There were no training routes in the vicinity.

■ A C-130 flew 100 feet AGL over a fire. All the training routes in the area had been closed, and a TFR was in effect.

The U.S. Forest Service, along with the Bureau of Land Management and other federal, state, and Native American natural resources agencies, engage in fire suppression activities throughout the United States. Fire seasons obviously vary geographically. As a result, fire suppression operations occur not only during the summer but can occur in the spring or fall. Also, outside of these regional fire seasons, various natural resources agencies conduct controlled burn operations with the help of aviation assets.

So what does this mean to us military pilots? Plenty. Many MTRs,

VRs, and IRs are like Etch-a-Sketch® drawings across the national forests, state forests, Bureau of Land Management land, and Indian reservations. And this list also includes military operating areas (MOA).

While it may appear to be a desolate strip of land we're flying over, there are numerous dedicated professionals on the ground working year round to ensure they can rapidly save lives and protect the land from wildland fires. Part of this preparation entails the pre-positioning of lead planes (FACs), air tankers, and helicopters at various dedicated bases. This means these agencies can quickly marshal a vast array of resources and deploy them to any trouble hotspot.

And here is part of the crux of the problem. Say an aircrew dutifully schedules a route, checks all the NOTAMS, and monitors the proper frequency. But while they are entering point "A" of the route, a fire develops at point "C." The Forest Service, through the use of a unique software package, will input the fire's lat/long and retrieve a listing of all training routes falling within the proposed TFR. The dispatcher will then contact the route's controlling agencies and the FAA when the decision has been made to request a TFR.

Note: This process takes time, and there are numerous opportunities, as mentioned above, where the process fails. In the interim, that aircrew is steaming along to an inevitable beak-to-beak pass against a wide array of aircraft. More often than not, these aircrews are out of range or the terrain is masking their ability to be contacted. As far as our fictional aircrew knows, they are about to possibly gain some kudos (not the infamous survival school energy bars) from Center when they report smoke off in the fast-approaching distance.

Any hard-and-fast rules? Stay alert, scan for smoke, and stay away from these operations. That's what the FAR 91.137 Temporary Flight Restrictions is for — to provide a safe area of operation for these authorized aircraft and eliminate any unsafe congestion.

Even news helicopters have to receive special permission to enter a TFR. Usually a TFR will cover only 5 miles around the fire and anywhere from 2,000 to 3,000 feet AGL above the fire. But the actual size of the TFR will vary, so be prudent.

If you know a section of a route has been closed, grant it a wide berth in your flight, primarily because heavy air traffic will be transiting between the fire and its dedicated fire base. By simply pairing this knowledge with your low-level abort procedures reviewed in your preflight briefing, it could heighten your awareness to steer clear of smoke or wildland fires. Moreover, safety is an important factor in firefighting operations.

If an aircraft or helicopter zips or lolls, respectively, through an aerial suppression operation, it can shut down the operation until the powers that be are satisfied nobody else is going to be coming through. These are delays which not only compromise the aerial suppression operation but, even more importantly, undermine the safety and support of the hardworking firefighters on the ground. Let's do our part to not heighten the danger for an already hazardous occupation.

The U.S. Forest Service, along with other agencies, is constantly striving to improve communication with the various controlling agencies. And it is a process which *is* improving. As blue-suiters, we have to do our part — like read the inside cover of the FLIP AP/1B. (See "Forest Fire Season.") This pub has a little blurb to remind all of us about the forest-fire season so we won't be the next "moth in the flame."

Fly safe, have fun, but be prepared for the unexpected next time you're scooting across that ridge line. ■

It's important for aircrews on low-level routes to avoid smoke and wildland fires by at least 5 nautical miles.

FOREST FIRE SEASON

■ Many Military Training Routes (MTR) traverse areas of mountainous forest and range lands. Flightcrews must be alert for fire suppression activities using aircraft during the fire season. In many cases, a NOTAM designating a temporary flight restriction area will be in effect for such areas when a fire exists. All aircrews should be extremely alert for such areas whether designated or not and avoid such areas by at least 5 miles.

Typical fire seasons for various regions are as follows:

Northeast US — Mar, Apr, May

Southeast US — Mar, Apr, May, Sep, Oct, Nov

Arizona/New Mexico — Apr, May, Jun, Jul, Sep, Oct, Nov

California — May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

Colorado/Wyoming — May, Jun, Jul, Aug

North Dakota — May, Jun, Jul, Aug

Utah/Nevada/Idaho — Jun, Jul, Aug, Sep

Montana — Jun, Jul, Aug, Sep

Oregon/Washington — Jun, Jul, Aug, Sep, Oct ■

OPS TOPICS

Autopilot Failure Causes Gross Navigation Error

■ Recently an aircrew discovered they were off course after passing a checkpoint on a Pacific route in Tokyo's airspace. The error was discovered after the First Officer made a heading check and discovered a 13.5-degree error.

Further investigation revealed that the autopilot roll computer had failed in a 2- to 3-degree left bank, not enough for the crew to notice the failure. By the time the crew had discovered the error and had taken corrective action, high winds had blown the crew 45 miles off course. This resulted in the crew being 7 minutes late for their next checkpoint.

The Captain cited fatigue as a factor in his report to the Aviation Safety Reporting System. He stated, "This flight was the second all-nighter on the backside of the clock. All the crew were not time-zoned yet."

As a lesson learned, he states, "When the entire crew is very tired, it is essential that constant aircraft checks be made."

This incident highlights the need to maintain constant vigilance when using overwater navigation procedures. Periods of low aircrew demand, coupled with fatigue in an automated environment, invite trouble if there is a lapse in cockpit discipline. Human factors studies have proven humans are poor monitors of automated systems in these situations.

Having a "system" to enter waypoints in the Area/Inertial/GPS Navigation System, plotting your position on a chart 5 to 10 minutes after passing a waypoint, and cross-checking headings against what you should be turning to after passing a waypoint are all good techniques for "staying in the loop" with automated navigation systems. For more information on overwater navigation procedures, contact your local training flight or the Advanced Instrument Flight Course at DSN 347-4571. ■

High Flying Fitness

"The FAR requirements for oxygen are specific, but are they appropriate for smokers?"

DOUGLAS S. RITTER with LARRY PUTNAM, M.D.

Editor's note: Dr. Larry Putnam is an anesthesiologist and an aviation medical examiner practicing in Tucson, Arizona. He also is a senior Air Force flight surgeon and chief medical officer for the 162 TFW, Arizona Air National Guard. A Certified Flight Instructor — Instrument and Air Transport Pilot [rating], Putnam is an active GA pilot and flies an A36 Bonanza.

■ **Q. The FAR requirements for oxygen are specific about when a pilot and passengers are required to use or be provided with oxygen. I wonder, however, if these standards are appropriate for smokers, who, I assume, would be more susceptible to hypoxia? Are there any guidelines for smokers, or is it not the problem I suspect it is?**

A. FAR 91.211 [and Air Force Directives, as well — Ed.] states the legal requirements for supplemental oxygen use and availability. Although these minimum standards are designed to be applicable to all Part 91 pilots and their passengers, your assumption regarding smokers is correct. Though there are no specific regulatory standards for them, those who smoke should consider they start out with a significant handicap when it comes to flying unpressurized aircraft.

The basis for this conclusion is that smokers are particularly susceptible to what is known as *hypemic (anemic) hypoxia*. This type of hypoxia is brought about because the blood is unable to carry enough oxygen even though there is plenty of oxygen available to breathe. This may be caused by numerous factors, including disease, blood loss, and blood cell abnormalities. In this particular case, the mechanism which interferes with the blood's normal oxygen-bearing capacity is the effects of carbon monoxide in cigarette smoke.

Hemoglobin, a pigment in the red blood cells, is the primary means by which oxygen is transported through the body. It also helps transport waste carbon dioxide from the body. Hemoglobin is a large, complex molecule which, when combined with oxygen, gives oxygenated blood its characteristic bright red color. Each red blood cell in a healthy human contains an average of 350 molecules of hemoglobin. Molecules or oxygen are attracted to the hemoglobin and attach themselves to it. Each hemoglobin molecule can carry four oxygen molecules.

Unfortunately, carbon monoxide has a significantly greater affinity for hemoglobin than does oxygen. So, if there are significant amounts of carbon monoxide available, it is going to displace the oxygen that would normally attach itself to the hemoglobin. This is one reason carbon monoxide is so toxic to humans and animals.

Cigarette smoke contains copious amounts of carbon monoxide. Studies have shown up to 10 percent of the blood hemoglobin in a very heavy smoker can be saturated with carbon monoxide. The "average" smoker probably maintains a 5 percent saturation. Depending upon which references you rely on, this can mean a smoker pays a penalty of from 3,000 to 7,000 feet in altitude tolerance.

This is a serious handicap. A heavy smoker could be in serious danger of hypoxia while flying as low as 5,000 feet. Another penalty paid by smokers is, in comparison with nonsmokers, their night vision will be degraded by approximately 20 percent. Since night vision is already very susceptible to oxygen deprivation, you can see this can make a big difference.

The bottom line is that smokers should probably use oxygen at lower altitudes than legally required and that, even more than nonsmokers, they will benefit from breathing oxygen at night.

Vitamins and Stress

Q. I am a pilot for a regional airline and found "Avoiding a Stress Knockout" (Nov 1, 1992) very helpful. One area which you overlooked is the use of vitamins to combat stress. For a couple of

*Aviation Safety Magazine continued

High Flying Fitness continued

years, I've been taking a combination of vitamin pills which my wife buys for me. They are supposed to help fight the negative effects of too much stress. Is this so, or are we just wasting our money?

A. We didn't mention the use of vitamins to counteract stress because there is little or no scientific evidence they are effective for this purpose. Numerous claims have been made by those who sell these drugs (vitamins *are* drugs) that they help combat stress or stress-related illnesses. Responsible medical opinion is these claims are pure bunk.

In general, manufacturers try to twist what is known about vitamin requirements to suit their purposes — selling more vitamins, usually at inflated prices. Often, their claims are based on research which has shown a deficiency of a particular vitamin may contribute to some disorders which may be interpreted as stress-related. Or claims may be based on longstanding knowledge that links a particular vitamin deficiency with a health problem which might be construed to have some relationship with stress of some sort or another.

Or they may be hanging their hat on the body's need for additional vitamins, of one kind or another, when recovering from trauma such as surgery — admittedly, a stressful event.

In all of these cases, the promoters are either stretching the truth or turning the truth inside out in order to sell their products. As long as you are getting the required normal amounts of vitamins and minerals in your diet, additional amounts will rarely offer any additional health benefits and, in some cases, can actually harm you.

Having said all that, it is worth noting some supplemental vitamins

are beneficial. For years, nutritionists have told us all we need to do to get our vitamins is to eat a "balanced diet." For most people, this is correct. But, let's face it, how many of us really do eat a balanced diet, as defined by nutritionists? The government's new "food pyramid" encompassing the USDA's dietary guidelines, for example, recommends five to nine servings of fruit and veggies a day. Fact is, most of us don't meet these guidelines. Too many of us are overfed and undernourished.

Also, there are unique circumstances in which supplemental vitamins and minerals are needed or appropriate. Many pilots are following special diets to lose weight, reduce cholesterol, or what have you. Many times, these diets result in an inadequate intake of certain vitamins and minerals. Some vegetarians may not receive all of the minerals and vitamins they ought to be getting. Pregnancy can increase the need for specific supplements. Many women do not receive enough iron or calcium during some periods of their lives. Some diseases or disorders and some medications interfere with nutrient intake, digestion, absorption, metabolism, or excretion. And some specific medical problems do respond to supplemental dosages of vitamins or minerals.

Because our eating habits have become so poor, many nutritionists and doctors are now recommending those who do not eat a "balanced diet" should take a daily, commercially available multivitamin and mineral supplement. Generally, these supplements should contain between 50 percent and 150 percent of the recommended dietary allowance (RDA). Multivitamin and mineral supplements which offer more than 200 percent of the RDA should be avoided, except under a doctor's supervision.

Commercial multivitamin and mineral supplement preparations usually contain a good balance of nutrients. Taking many vitamins or minerals is costly and can lead to an imbalance which can cause serious health problems. Single vitamin or mineral supplements may be needed for specific problems but should be taken only under your doctor's supervision.

Individuals on any sort of special diet or with specific medical problems would do well to consult with their doctors or nutritionists for specific recommendations. Self-medication with megadoses of vitamins and minerals can be hazardous to your health and your medical certificate. Don't do it!

Ginger and Air Sickness

Q. I read with interest the information about Sea-Band wristbands in the Oct 1, 1992 Medical Matters. Some years ago, I read an article about using ginger to combat seasickness. Since then, I have used candied ginger from the spice rack in the market to prevent queasiness while flying. It seems to be very effective, tastes great, and has no apparent side effects. Is this an acceptable remedy?

A. If, by "acceptable," you mean "effective," the answer for many people is yes. If your question is

*U.S. GOVERNMENT PRINTING OFFICE 1994-573-261/84010

whether or not the FAA considers it acceptable, the answer is also yes, to a point.

Let's first consider the question of whether or not it works. Ginger has been considered a "folk remedy" for indigestion and seasickness for centuries. Early texts describe sailors sucking on ginger root to prevent seasickness. There have been numerous studies of the effectiveness of ginger in preventing motion sickness. Those performed in the early 1980s which purported to prove ginger was more effective than Dramamine have been faulted on the methodology used. Results of other studies have varied.

More recently, double-blind studies by Danish scientists have shown ginger may be about 38 percent effective at relieving all of the symptoms of motion sickness and up to 78 percent effective at stopping vomiting.

Ginger has the advantage of lacking many of the common adverse side effects of traditional drugs, such as drowsiness, which are particularly a problem for pilots. The actual mechanism by which it works is not fully understood. NASA reportedly has used it for those astronauts for whom it has proven to be effective. If it is good enough for them, we should probably feel comfortable using it, too.

For many people, however, ginger does nothing to counteract motion sickness. Like so many other things, the only way to know for sure is to try it. Given its low cost and general lack of adverse effects, it may be worth a try if air sickness is a problem for you or your passengers.

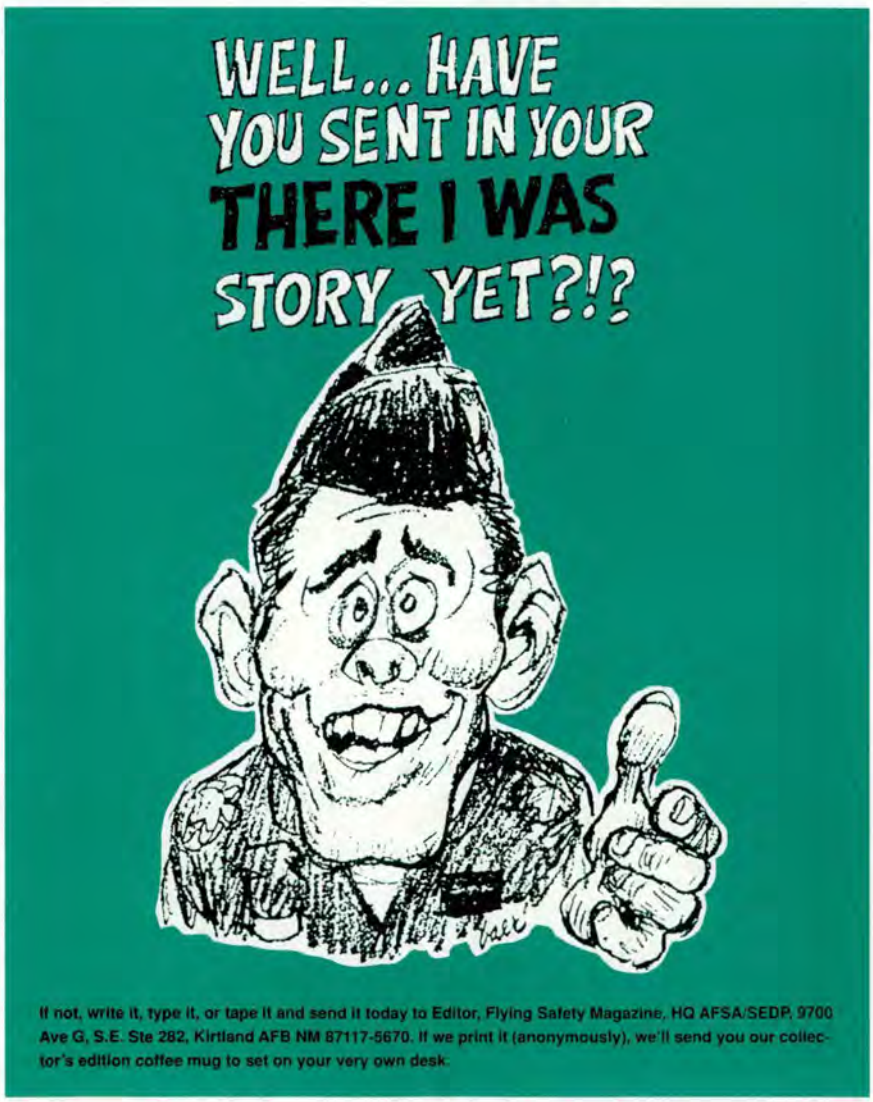
The normal dosage used in most studies is about 1,000 to 1,500 milligrams of the powdered form (about half a teaspoonful) taken at least a half hour before flying. If fresh ginger is used, then double this amount will be necessary. The preventive effects, where observed in the published studies, lasted for at least 4 hours.

As you mentioned, ginger is readily available in crystalline (candied) form in supermarkets or in "health food" stores. Though many people love the taste and suck on it like hard candy, some people find its strong flavor unpalatable. Most of the studies have used the dry, powdered form, also available as a pill or capsule, taken with water or mixed into some beverage. The pills or capsules are usually found only in health food and some drug stores, usually at a higher cost.

You should never swallow dry ginger plain as it can burn the esophagus. Another method of taking ginger many find more palatable is in a hot tea, perhaps in combination with other herbs or traditional tea. Also, 12 ounces of ginger ale or ginger beer, if made with real ginger as opposed to artificial flavorings, can contain enough ginger to do the job.

Finally, the FAA doesn't consider ginger a prohibited drug. Ginger is generally considered to be safe. However, it can have adverse side effects which could render some people unfit to fly. Among the reported adverse effects of ginger are diarrhea and nausea. ■

Aviation Safety, April 1, 1993
Reprinted with Permission
Aviation Safety Magazine
75 Holly Hill Lane
Greenwich CT 06836
1-800-424-7887



Don't let mission tempo compromise your integrity!