Business & Commercial Aviation

Cockpit Discipline and the Low-Visibility Approach

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04/01/2004 01:58:10 PM

Late in 2003, a successful Southern California entrepreneur was flying his single-pilot light jet on a foggy, low-visibility, nighttime ILS approach into an airport located near the coast. Such coastal weather conditions, in spite of boasts to the contrary by the chamber of commerce, aren't all that uncommon early in SoCal winters, particularly during late evening hours when the air temperature and dew point are likely to converge.

ATIS was reporting the weather as partially obscured with 3/4-mile visibility. However, a thick fog bank was rolling in from the coast, promising a quick transition to near WOXOF conditions within the hour. Farther inland, the weather was considerably better. The ILS runway at the coastal region airport has a medium intensity approach lighting system with runway alignment indicator lights, but no touchdown zone or centerline lighting. So, as long as the 3/4-mile visibility held, there was a good probability of flying the approach to a successful landing.

Well before reaching ILS minimums, the pilot spotted the MALSR strobes. With the lead-in lights in sight, he elected to continue the approach down to 100 feet agl. Then, suddenly he encountered the fog bank and lost sight of the runway end. Shortly thereafter, he touched down 1,200 feet short of the displaced threshold and well left of centerline. Subsequently, the aircraft ripped through a taxiway junction sign on the left side of the runway and continued to plow through the dry grass off the runway for another 1,500 feet before coming to a stop.

The pilot emerged with no injuries other than a badly bruised ego. The airplane suffered considerably more damage, having not been built by John Deere. Factory service technicians patched it up sufficiently for a ferry flight to the manufacturer's plant, where it underwent extensive repairs.

How might this incident have been prevented? That's the focus of this report.

Getting Organized With a Mnemonic Tool: NOTAMS

An old chief pilot from Western Airlines explained to us decades ago that he taught his crews to prebrief low-visibility approaches using the mnemonic aid "NOTAMS." While a single-pilot IFR operator might think it's silly to brief himself before starting down on a low-visibility approach, the mnemonic has served many pilots well even though some may not have actually uttered the words. The time to get organized for any approach is well outside the initial approach fix or vector to final.

Each letter of NOTAMS cues the crew to review a particular aspect of the approach.

Navaids

Obstructions

Timing

Altitudes

Missed Approach

Speech!

Navaids: Up until the early 1990s, most business aircraft used short-range navaids, such as VORLOC and ADF receivers, almost exclusively for both en route and instrument approach navigation. Indeed, a VHF nav receiver was the only radio that most flight guidance systems could use in the lateral NAV mode, although in later years a few HSIs could use NDB signals to drive the course deviation needle.

As FMS and GPS boxes became commonplace, they added considerably greater instrument approach flying capabilities. But they also increased cockpit complexity, particularly with respect to setting up the avionics suite for the approach. In today's cockpits, you're usually flying with a superbly skilled navigator, but it's buried behind a CDU faceplate, doesn't listen to a word you say, and it surely doesn't lift a finger unless it's told exactly what to do at the appropriate time.

Aboard modern aircraft equipped with both short- and long-range navaids, selecting the wrong nav source for a specific instrument approach procedure has become a common error. The crew, for instance, dials in the correct localizer frequency in the VHF nav receiver, then identifies and verifies the signal. Later on, though, the pilots forget to switch the flight guidance system nav source to VORLOC from FMS or GPS, so the HSI and flight director provide erroneous guidance. Notably only some late model aircraft have an automatic FMS-to-ILS transition mode. Thus, switching from FMS to ILS is a manual operation in most business aircraft. Forget to make the switch and you're on track for plenty of confusion in the cockpit.

While navigation en route or in the terminal area using FMS or GPS, preselecting the inbound final approach course also can be a challenge in some EFIS-equipped aircraft. As long as GPS or FMS is the nav source for the flight guidance system and EFIS, the long-range nav system automatically slues the course selector to the appropriate track. But dialing in the final approach course usually is left up to the pilot. And in many aircraft, there's no ILS course preselect function. This has to be done after the flight guidance system's nav source is switched from FMS/GPS to VORLOC, such as when you're on vectors to final or inbound to the final approach fix.

Obstructions: Controlled flight into terrain (CFIT) causes the majority of accidents during instrument approaches, so it's an aspect of planning for the procedure that demands close attention. Jeppesen, more than a decade ago, made a large-scale improvement in crew situational awareness by including terrain contours on its instrument approach procedure charts. Man-made obstructions also are noted on the approach charts. However, it's also essential to check for temporary obstructions that may not be shown on charts, such as construction cranes and towers.

If you're fully aware of obstructions and terrain hazards, you're much less likely to turn in the wrong direction on an approach or descend below a critical altitude. Beware of the VASI/PAPI trap: As Wally Roberts pointed out in "VGSI, a Surprisingly Short-Sighted Aid" (*B/CA,* March 2004, page 48), visual glideslope indicators (VGSIs) provide obstruction-free glidepath guidance for only the last 3.48 to 4 nm of the approach, depending upon the design of the VGSI. Beyond that range, obstructions can snag an aircraft if the crew puts blind faith in the VGSI system for glidepath guidance.

Timing: The clock plays a much less prominent role in today's cockpits because of the widespread availability of GPS, FMS and DME, but it's an important backup device should you lose your distance readout and thus be required to fly a timed approach.

Altitudes: Each published altitude on an approach has a specific purpose. Most are dictated by the obstruction clearance criteria specified in Order 8260.3B, the U.S. Standard for Terminal Instrument Procedures (TERPS) manual. In some terminal areas, different altitudes are specified for certain approaches to ensure there's adequate vertical traffic separation for aircraft operating at nearby airports.

Prior to commencing the approach, the crew should review and brief all altitudes associated with it. While this drill seems almost too fundamental for turbine aircraft operators, it's a rigorously observed litany in the SOP-conscious airline community. It starts with a look at minimum safe and emergency safe altitudes and includes a review of each altitude constraint associated with the procedure. Particular attention is paid to the glideslope/outer marker (GS/OM) intersection, a point that varies with specific approach procedures, but which is typically 4 miles and 1,400 feet above runway touchdown zone elevation (TDZE). This crosscheck not only verifies that the glideslope is providing accurate vertical guidance, it also serves as a crosscheck for the proper barometric setting on the pressure altimeters.

Business aircraft operators often fly nonprecision approaches, procedures shunned by most air carriers. On NPAs, it's critical to check for step-down fix crossing restrictions between the final approach fix and missed approach point. These fixes are inserted into the approach procedure because of close-in obstructions, such as power lines, towers, buildings, trees or terrain. But they're usually not contained in GPS or FMS databases, so it's up to the crew to not descend to the MDA until inside the crossing restriction fix. TSO C115B FMSes that have full vertical

navigation capabilities, including certified approach VNAV, eliminate this potential pitfall. They typically compute a glidepath to the runway touchdown point that clears any crossing restriction fix inside the final approach fix.

MDAs are especially tricky because they must be put into the context of Visual Descent Points (VDP) and Missed Approach Points (MAP), plus available runway for landing and type of aircraft being flown. If, for example, the runway is relatively short and the aircraft you're flying is relatively large, then the VDP becomes a critical go/no-go decision point for continuing the approach to landing or executing the missed approach. In contrast, if the runway is quite long and you're flying an aircraft that needs only a fraction of it for landing, then it may be safe to press beyond the VDP toward the MAP before making the critical land/go-around decision.

However, it's important to keep in mind the guidance of the Aeronautical Information Manual: "The missed approach point [MAP] on a nonprecision approach is not designed with any consideration to where the aircraft must begin descent to execute a safe landing."

Missed Approach: Military pilots are taught during their instrument training that gaining sight of the approach lights and runway environment at DH or MDA is a pleasant but unexpected surprise. At that rare point, they actually go visual and can land the aircraft. Every instrument approach is planned and briefed from the feeder fix all the way through to the missed approach holding fix as though breaking out into visual conditions at MDA or DH is uncertain at best.

While this method may seem extreme, it emphasizes the need to plan for the approach procedure from feeder fix to missed approach holding point. This often entails selecting the go-around mode on the flight director, reconfiguring the aircraft from landing to climb configuration, switching the flight guidance system nav source from ILS to FMS or GPS, and then activating the missed approach guidance function of the FMS or GPS all within a few seconds. The time to rehearse these functions is prior to commencing the approach procedure.

Speech!: This is your opportunity to make "campaign promises" that you intend to keep during the duration of the approach procedure. You make an ironclad commitment to abiding by all the rules and regulations required for the published approach and descent to landing. The basics might include your plans for speed and configuration changes, plus what visual cues must be in sight at the MDA or DH in order to descend on the approach to the landing point. It's essential to review the available runway for landing beyond the touchdown point, the runway required by your aircraft and the runway conditions. This is an ideal time to review visual landing aids such as approach and runway lights, runway end identifier lights, VGSI lights and runway markings. You might elect to review the verbal cues you want a second crewmember to provide to affect timely changes to your plan of action. It certainly should include all the steps you plan to take in the event a go-around and missed approach is required.

The Window of Risk

Thom Granier, a senior Falcon 10 and Gulfstream G200 instructor at FlightSafety's Dallas Learning Center, emphasizes the "Window of Risk" associated with flying instrument approaches. He defines the Window of Risk as starting at the point you intercept the glideslope or final approach fix and begin descending to the airport. It ends at the point at which you've climbed out to your initial missed approach level-off altitude, stabilized at low-altitude cruise speed in the clean configuration toward the missed approach holding fix.

"You spend less than 5 percent of your flying time in the Window of Risk and more than 85 percent of all aircraft accidents occur there," Granier told *B/CA*. "This is when you're in the greatest danger, and one miscue can result in a very sad story," he added. Yet taking off and landing requires that every aircraft operate in the Window of Risk on every flight.

The key to operating safely in the Window of Risk is planning. This should be done in the nonthreatening phase of flight prior to commencing the approach.

"I don't want to play catch-up. I want to just keep up with what's going on," Granier explained. This is critical for single-pilot operations because the pilot-in-command "doesn't have the luxury of a second crewmember," Granier said.

"When I'm flying in the Window, I want all my attention focused on the approach, especially during single-pilot operations," he noted. The most critical part of the approach is at MDA or DH when the crew makes the decision to continue or go-around.

FAR Part 91.175 is very specific on the requirements for continuing the approach to landing, as noted in the accompanying sidebar, with emphasis added. The requirement for minimum "flight visibility" contained in Section (c)(2) is one of the most important, yet ambiguous, requirements for descending below MDA or DH. It puts the onus on the pilot to determine whether the actual visibility is equal to or better than the published minimums for the approach procedure. Section (c)(3), often cited by flight instructors, contains the 10 visual cues that may be used to identify the runway environment.

At night Section (c)(2) is critical. In low-visibility conditions, it's almost impossible to determine if the "flight visibility" will be better than published minimums during the entire approach and landing rollout. This requirement is re-emphasized in Section (d), which specifically addresses the flight visibility requirements for landing.

Initially you may gain sight of the high intensity approach lights or lead-in strobes at or above minimums, enabling you legally to continue the approach down to 100 feet agl. This may lead one to conclude that the "flight visibility" is equal to or better than published minimums. However, once you've flown beyond the high intensity approach lights, you may lose sight of the runway environment because the runway threshold and edge lights installed at most general aviation airports are much harder to see in low-visibility conditions than the ALS. In the absence of touchdown zone lights or high-intensity runway centerline lights, you may not have sufficient visual guidance cues to continue the approach to landing. Section (d) is unambiguous about this requirement.

That's the point at which you should execute an immediate go-around because you risk an off-pavement excursion if you can't see the runway centerline.

Note well: Those little cheating duck-under maneuvers are expressly forbidden. Turbine aircraft operators are not allowed to descend below the glideslope until inside the middle marker when approaching to land at a runway equipped with ILS in Class D airspace, and you're prohibited from ducking under the VGSI glidepath until a lower altitude is required for a safe landing, according to Part 91.129 (b) and (c).

"I surely remember the landings that scared me the worst," Granier said. He said he's forgotten practically all the landings that were routine. He recollected one misadventure decades ago in a U.S. Air Force KC-135 when he lost sight of the runway in heavy precipitation during the landing flare. He immediately initiated a go-around, but the main wheels still kissed the pavement. Once the four engines spooled up from idle and the aircraft began climbing, Granier and his crew knew they were on their way to exiting the Window of Risk.

"Any time you think you're about to lose visual contact with the runway, execute the missed approach. If in doubt, take it around," Granier advised.

Cockpit Discipline Pads Your Margins

Poor headwork, rather than inadequate hand skills, causes a disproportionate number of accidents, especially in the Window of Risk. Adopting standard operating procedures for flying instrument approaches, such as the NOTAMS mnemonic tool, can help reduce risk by improving your cockpit organization. Rigorously adhering to the requirements of Part 91.175, among other regulations, substantially boosts your safety margins. Knowing when to initiate a go-around and then diverting to an alternate with better weather conditions will prevent your continuing an approach to an airport at which you're just dying to land. **B/CA**

Reprinted from the April 2004 issue of *Business & Commercial Aviation* magazine