Global strategy envisions training all air carrier pilots in airplane upset prevention and recovery.

Graduated Approach

BY WAYNE ROSENKRANS | FROM ORLANDO

In a hard-won consensus, about 80 international specialists from 45 organizations have identified "critical" knowledge, skills and attitudes that professional pilots must have to prevent airplane upsets — their primary goal — and to recover from an inadvertent upset. In laying out a rational plan for pilot training, their evidence-based work and expertise have been a stabilizing influence in the wake of high-profile loss of control–in flight (LOC-I) accidents, several representatives told the World Aviation Training Conference and Tradeshow (WATS 2012) in April in Orlando, Florida, U.S.

This work group — the International Committee for Aviation Training in Extended Envelopes (ICATEE) of the Royal Aeronautical Society — currently is completing the last of several near-term deliverables to the global aviation community, specific civil aviation authorities and the air transport industry, according to Bryan Burks, a captain for Alaska Airlines and ICATEE member. He also is the vice chairman of the National Training Council of Air Line Pilots Association, International (ALPA) and ALPA representative to the Royal Aeronautical Society's Flight Simulation Training Device International Working Group.

"For too long … we [as an industry] assumed that when we hire pilots with an ATP [airline transport pilot] certificate, they will come with the requisite knowledge and skills when it comes to aerodynamics," Burks said. "ICATEE [identified] a training gap; that that is not the case [*ASW,* 10/11, p. 36]. Hopefully, licensing requirements in the future will assure that an ATP license means something more. But in the meantime, the operator should probably [address] that deficit."

ICATEE has developed a strategy for *graduated* — that is, one step at a time in a building

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Current proposals call for upset prevention and recovery training in all-attitude, all-envelope airplanes (left) at the commercial pilot licensing level and in flight simulation training devices (above) at defined intervals throughout the careers of airline transport pilots.

block approach — implementation of enhanced upset prevention and recovery training (UPRT) that can be supported by the existing pilot training infrastructure.

"Enhanced, integrated UPRT contains three primary elements: academics, on-aircraft training at the [commercial pilot] licensing level [and] the appropriate use of flight simulation training devices [FSTDs]," he said. "[On-aircraft training] would be in an all-attitude, all-envelope, aerobatic-capable aircraft with a trained instructor early in a professional license scheme. … ICATEE also has identified opportunities to enhance FSTDs to provide UPRT." The on-aircraft element would be a UPRT endorsement to a commercial pilot certificate.

For FSTDs, the work group advocates and recommends enhanced aerodynamic (or *aero*) models beyond the normal envelope, new/improved tools for feedback to instructors and pilots in post-flight briefing, and significantly improved UPRT motion and buffet cues. "These will happen in the future … in a way that the industry can adopt in an organized fashion — and control the quality and, most importantly, the instructor qualifications," Burks said. "We've made some strong recommendations on how instructors should be qualified for the on-aircraft training aspect and for flight simulators. … [We also advocate] a gradual implementation of these requirements."

Exposure of pilots to the actual threat environment helps to develop habitual responses to incipient conditions and confidence in their ability to respond correctly to upset situations, said Sunjoo Advani, chairman of ICATEE. "There is no single tool for providing the optimum solution; we must integrate several tools," he said. "If pilots have the knowledge, if they have the capability, that is one thing. But being put into that threatening environment is very important."

Specifically, ICATEE concluded that the inadequate training environment has been based on several assumptions, which in turn became limitations to how the industry provided training to prevent upsets and respond to LOC-I. "[The industry] had assumed that the aircraft is in a normal operational envelope in a non-agitated flight condition," Advani said. "We also had assumed that situational awareness and information can be accurately correlated by the pilot with respect to the observed flight condition. … And we assumed that the handling skills that are taught during licensing are suitable and adequate to resolve the [potential upset] situation."

In the academic arena, ICATEE members have been updating, augmenting and adapting to current instructional media the *Airplane Upset Recovery Training Aid, Revision 2*. "We wanted to refresh the [training aid in October 2012] by looking at its limitations," Advani said. "Our new training manual, based on the [training aid], will include sections for pilots, instructors, training providers and regulators [that will be] very usable and user-friendly when implemented into training programs."

Notably, the training manual also will furnish examples of negative training to help airlines and other simulator training providers anticipate FSTD limitations as they implement UPRT scenarios. Every UPRT event recommended for initial and recurrent pilot training will have a dedicated instructor manual, the presenters said.

A substantial number of the pilot-track session attendees raised their hands when Advani asked if they were familiar with the current training aid and had used it in their training programs. ICATEE also has concentrated on breaking content into parts that are easier to absorb and is seeking to officially incorporate the manual into standards and recommended

Alaska Airlines Shares Voluntary UPRT Initiatives

Alaska Airlines has developed web-based and prototype Apple iPad-based courseware among other "very viable" ways to help line pilots to internalize academic content for airplane upset prevention and recovery training (UPRT), says Bryan Burks, a captain for the air carrier.

One of the airline's assumptions is that the timing, complexity, rate and amount of training have to be considered against the reality that line pilots sometimes can be "inundated" by academic study assignments. "The whole idea is to have retention of the requisite knowledge that we need to operate safely," Burks said.

Related work has focused on UPRT instructor pilot standardization and qualification. "[We] have the benefit of at least 12 of our check airmen and flight managers [including the director of training] having been through Calspan Corp. [advanced maneuvering and upset recovery program] in their Learjet in-flight simulator or APS Emergency Maneuver Training all-attitude, all-envelope UPRT training in an Extra 300," Burks said.

The flexibility of the airline's advanced qualification program (AQP) for pilots, with oversight by the U.S. Federal Aviation Administration, has enabled the introduction of a 12-month UPRT cycle that includes a one-day "classroom interaction" about aerodynamics and airplane upset. "We're going to tie in the academics, and, more importantly, we are going to have specific targeted training elements for the [flight simulation training device (FSTD)] pre-briefing and post-briefing, in which the instructor will assess the knowledge of the students," he said.

The flight operations training manual developed also details how UPRT is to be conducted in FSTDs. For the 2012 cycle, the manual specifies a nose-high upset event at high altitude.

The airline has focused intently on standardization of UPRT training in FSTDs partly because of the challenge of avoiding negative training. Burks gave an example of abandoning a proposed, internally developed UPRT scenario expected to be compatible with built-in, preselectable functions of its Boeing 737-800 FSTD instructor operating stations. The plan was to show simulated traffic on the traffic-alert and collision avoidance system and enable the flight crew to "envision flying into the wake behind a heavy large aircraft, and getting into a wake vortex," he said. In the scenario, the instructor suddenly slews the airplane to a pitch-up attitude followed by a rolloff.

"Unfortunately, because we did not understand the limitations of the device, we ended up with negative training," Burks said. The FSTD's instant pitch-up to about 25 degrees in reality would cause structural damage to the tail. Moreover, after a roll to about 110 degrees, when the pilot attempted to intervene with aileron and recover from the upset, nothing happened. "The simulator [had a] 'washout' — like an aerodynamic reset or reslew — so for about four seconds, no flight control inputs by the pilots were honored or recognized," he recalled.

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practices endorsed and/or required by the International Civil Aviation Organization (ICAO).

On-Airplane Rationale

The idea of conducting UPRT training for the current population of airline pilots in small all-attitude, all-envelope airplanes has been controversial. In the 2012 update on its work, ICATEE has been more specific and realistic about targeting this element to generations of pilots coming into the profession.

"The airplane is really the place where we can provide the psychological component, the physiological component, g-awareness [actual gravitational acceleration] and an accurate recovery environment," Advani said. "If pilots haven't been exposed to it, and they encounter an upset — even though it may be rare — they may end up applying the wrong control strategies and make the situation worse. … We realize we cannot take a transport category aircraft and start doing training on upsets. On a voluntary basis, [airlines also could provide UPRT flight training in an all-attitude, all-envelope airplane], and I think that improves pilot skills. However, we have to concentrate on the future. … So we need integration of the use of aerobatic-capable aircraft, qualified [UPRT] instruction [and] appropriate [and] better use of today's FSTDs."

The industry can enhance feedback through use of better instructional tools and information in FSTDs. "In the future, we can look toward improving simulation fidelity through better aero models and … feedback tools, such as informing the pilots where they are with respect to the validated envelope," Advani said. "If they exceed the envelope, the instructor should have the ability to tell the pilot, 'We have gone beyond the bounds of what is known.'

"We also want to see if the pilots have exceeded the structural limitations

of the [real] aircraft [because] incorrect control inputs can be devastating." Methods tested as effective include displaying color-coded aerodynamic diagrams in the instructor operating station alongside replays of the pilot's control inputs with animation software. The instructional tools described have been designed to provide instructors more accurate situational awareness and a "powerful new way of providing UPRT feedback to pilots while avoiding negative training," he said.

Deliverables Arriving

The list of ICATEE deliverables comprises tasks accomplished, several with 2012 target dates. So far, ICATEE has presented its recommendations to the U.S. Federal Aviation Administration (FAA), the FAA-Industry Stall–Stick Pusher Working Group, the Adverse Weather Working Group and the Loss of Control Aviation Rulemaking Advisory Committee.

Proposed language was delivered in January in an executive level recommendation to ICAO for an amendment stating that UPRT "shall be conducted." "In [ICAO's] *Procedures for Air Navigation–Training* document, there will be references [submitted in October 2011] that refer to our training manual, which is scheduled for delivery to ICAO later this year, as well as the UPRT component for simulator documents such as [ICAO Doc 9625]," Advani said. Anticipated products include a report in mid-2012 from ICATEE's research and technology group to the Royal Aeronautical Society and a revision to the International Air Transport Association's FSTD data document.

Toward FSTD Stall Realism

ICATEE now considers the prospects of expanding the aero model used in simulators to be favorable for several reasons and will continue to pursue that objective, Burks said. He cited recent demonstration by Boeing Commercial Airplanes of a prototype enhanced aero model that would help commercial aviation to conduct aerodynamic stall training.

"[Today's model] is very good up to approach to stall, to the critical angle-of-attack," he said. "After that, there are [not enough] flight test data from the manufacturers that provide a good model to do training in the device. … An aerodynamic stall — for a swept-wing, transport category jet — is a place pilots don't want to be. Unfortunately, if a crew gets to the aerodynamic stall in most simulators today, it is a very benign representation. It does not look very much different than the approach to stall. So if they haven't actually stalled an airplane since they were in a Cessna 152 25 years ago, pilots have this false or benign sense of the aircraft performance. In an approach to stall, the aircraft still has airflow attached to the wings, and it is still somewhat controllable; it is in a decayed state, it has less margin, but it is controllable."

A simulator's stick shaker activates at about 5 nm (9 km) on final approach.

Advani noted, "What we have to teach is not the actual flight dynamics in that stall — how to fly in that region — but how to immediately recognize [the situation] and recover. The most important thing [is] how to avoid it and, if [they go] there, to get out as quickly as possible. … We're looking at how we can incorporate today's high-fidelity models that go up to the top of the [lift curve slope] with, perhaps, lower fidelity or representative models that simply teach the skills necessary for the recovery from upsets."

From experience supporting military FSTDs, aircraft manufacturers have a wealth of knowledge and can deliver very accurate engineering data, Burks said. "We are excited because they're going to bring that capability into the civil market now," he said. "The bottom line is we hope to have a good platform to introduce aerodynamic stall training to pilots and show them the marked difference between approach to stall and aerodynamic stall. This is going to enhance pilots' … upset prevention through avoidance, recognition and awareness."

Essential Refreshers

UPRT is not a one-time inoculation. "These are perishable skill sets," Burks said. "[At Alaska Airlines,] we believe that we need to revisit [UPRT] on an annual basis. After the skill sets are developed, we want to measure the effectiveness of the prevention strategies. So, eventually, after we gain exposure and develop the skill sets in the maneuver-based training, we want to validate that training by giving our pilots these events in a true surprise scenario." The objective is to apply prevention skills, not recovery skills, in those events.

To read an enhanced version of this story, go to <flightsafety.org/aerosafety-world-magazine/june-2012/upset-mitigation>.

Adapted by Susan Reed from a video presented by Capt. Paul Kolisch, Pinnacle Airlines