UPSET RECOVERY in the *REAL WORLD*

BY RANDALL BROOKS

It is not safe to practice upset recoveries in airliners, transport category aircraft, business jets or even normal category piston airplanes, due to their aerodynamic and structural limitations. Instead, robust "upset training aircraft," capable of manoeuvring safely through a full range of attitudes and flight conditions, must be used. **APS Photo**

The complex manoeuvring and dynamic aerodynamics associated with airplane upset events cannot be modelled perfectly by even the most advanced flight simulator. Hence there is a need for in-aircraft training. **APS Image**

In November of 2014, the International Civil Aviation Organization (ICAO) called for a revolutionary change in how pilots should be trained in the future. In its recommendation that all commercial pilots should receive upset prevention and recovery training (UPRT) prior to licensing, ICAO intentionally specified that such training should take place in a real aircraft in addition to a flight simulator.

Why did ICAO, the United Nations agency for the promotion of standards and best practices in civil aviation, feel compelled to recommend that all commercial pilots should have UPRT training?

More interestingly, why did ICAO feel this training should be done in an aircraft, as opposed to being done exclusively in a highly sophisticated flight simulator?

THE NEED FOR UPRT

ICAO's call for UPRT was spawned by the increasing percentage of fatalities from what are termed "loss of control-in flight" (LOC-I) accidents. In recent years, this type of accident has become the number one cause of fatalities in all categories of civil aviation—airlines, business/corporate, and general aviation. While basic aircraft control is taught to all pilots, training in what to do when things "go wrong," such as when an aircraft is inadvertently upset in flight (an attitude or airspeed outside the range of normal operations), has been haphazard and often accomplished in an unregimented and unregulated manner. Airplane upset events are the precursor to a resulting LOC-I event.

There are a wide variety of causes contributing to the prevalence of the LOC-I threat. The increased use of automation and the accompanying lack of manual aircraft handling skills, as well as a departure from the basic fundamentals of airmanship in pilot training, are noted contributors, but the various factors can be grouped into pilot-induced, environment-induced and system anomaly-induced causes. Acting on data that clearly indicated the predominance of LOC-I accidents, with the most recent data showing it is currently responsible for over 41 per cent of airline fatalities, ICAO felt that dedicated UPRT was required. But why did the organization feel compelled to advocate training in an actual aircraft?

THE LIMITS OF TECHNOLOGY

The use of flight simulators in modern times represents one of the greatest contributions to aviation safety. The ability to train for complicated systems failures and challenging flight conditions in a simulator prepares pilots for a greater range of possible events than would be safe to initiate in an actual aircraft. Engine failures and low visibility landing conditions can be practiced with complete safety, without ever leaving the ground.

The required fidelity to fully replicate the dynamic motion involved in airplane upset events leading to loss of control is beyond the capability of current flight simulators. Today's simulators were never intended for use in teaching UPRT; a subject unaddressed until the last few years. Even with improvements in data processing and expanded flight envelopes, the complex manoeuvring and dynamic aerodynamics associated with airplane upset events cannot be modelled perfectly. Unfortunately, these simulator limitations can under-represent the difficulty of countering such events. In many cases, simulators manoeuvred beyond fidelity limits could demonstrate flight behaviour that is inconsistent with what pilots would actually experience, causing what is known as "negative training." Furthermore, even with future advances in simulation technology, there will still be limits to what flight simulation can achieve in this domain. These limits have to do with pilots, not with technology.

PHYSICAL AND PSYCHOLOGICAL LIMITS OF FLIGHT SIMULATION

Modern high fidelity flight simulators with motion bases are often referred to as "full flight simulators" because of their ability to realistically create sensations found in flight. They accomplish this through the use of very accurate visual scene creation and clever manipulation of their motion base to temporarily mimic accelerations, which create the illusion of flying for pilots in training. Their physical range of motion, however, limits their ability to create sustained accelerations—often called Gs—that pilots might experience in an upset event. A fact that is significant, but often missed, is their inability to create the sustained experience of *less* than 1 G (the gravity we experience

on the ground), the "light in the seat" experience—ideally 0.5 G—that pilots might encounter in flight. The ability to manage this reduction in G, or "unload" condition, can be critical in many loss of control events, but is impossible to practice in a ground-based flight simulator.

Perhaps more important than these *physiological* considerations, we are beginning to learn that the complex *psychology* involved in dealing with high threat upset events is essential to effective recovery. Interrelated with physiological considerations, such as a racing heartbeat and sweaty palms, the same psychological considerations that pilots must contend with in flight cannot be duplicated with sufficient fidelity in the safety of today's flight simulators. In a twist of irony, the inherent safety of a grounded flight simulator mutes the perception of risk that pilots must be prepared for, in order to safely manage the psychological effects of startle and surprise that are confronted in an actual upset event. This "reality factor" is something pilots must learn to face in an actual aircraft.

CHALLENGES IN THE AIR

It is not safe to practice upset recoveries in airliners, transport category aircraft, business jets and even normal category piston airplanes. Aerodynamic and structural limitations of such aircraft provide an insufficient margin of safety for pilots to learn the application of the full spectrum of ICAO-specified skills and techniques necessary to recover from airplane upsets.

Instead, robust "upset training aircraft" capable of manoeuvring safely through the full range of attitudes and flight conditions which could be encountered in airplane upsets must be used. The effective use of an all-attitude/all-envelope capable aircraft to provide UPRT is not itself without some challenges and risks. First, the training provided must be focused on the recovery considerations of the operational transport aircraft or airliner, not the airplane being used for training. Secondly, the techniques used must apply to the aerodynamic and structural considerations of the transport airplane. In other words, the skills taught must be transferable to the larger transport airplane in order to be useful. Airline accidents have occurred due to the misapplication of pilot techniques used for manoeuvring a fighter aircraft to control an airliner, which has much more limited structural margins and manoeuvring capability.

Regardless of the training airplane or simulator training platform used, the most important element is an instructor educated in how to correctly teach the important lessons of UPRT.

FULL CIRCLE

In the end, these training changes are not as new as one might imagine; in fact, they represent a return to the past. There was a time when all pilots, both civil and military, mastered the control of their airplanes in three dimensions through proficiency in aerobatic manoeuvring. Although on-aircraft UPRT differs significantly from classic aerobatic training, it still provides pilots with the complementary knowledge and manual handling skills needed to help reduce the number one cause of fatalities in aviation. Aircraft still operate in all three dimensions, and comprehensive upset training delivered by a qualified instructor "in actual flight" will help pilots to prevent and recover from a broader array of threats that they and their passengers may face in flight.

Randall 'Random' Brooks is the vice president of training and business development for Aviation Performance Solutions (APS). He is also a former corporate pilot, marketing demonstration and production test pilot, and formation aerobatic airshow pilot. Expanded versions of Skies *articles by APS are available at apstraining.com/skies. APS specializes in reducing the risk of loss of control in-flight globally through integrated upset prevention and recovery training (UPRT) solutions.*