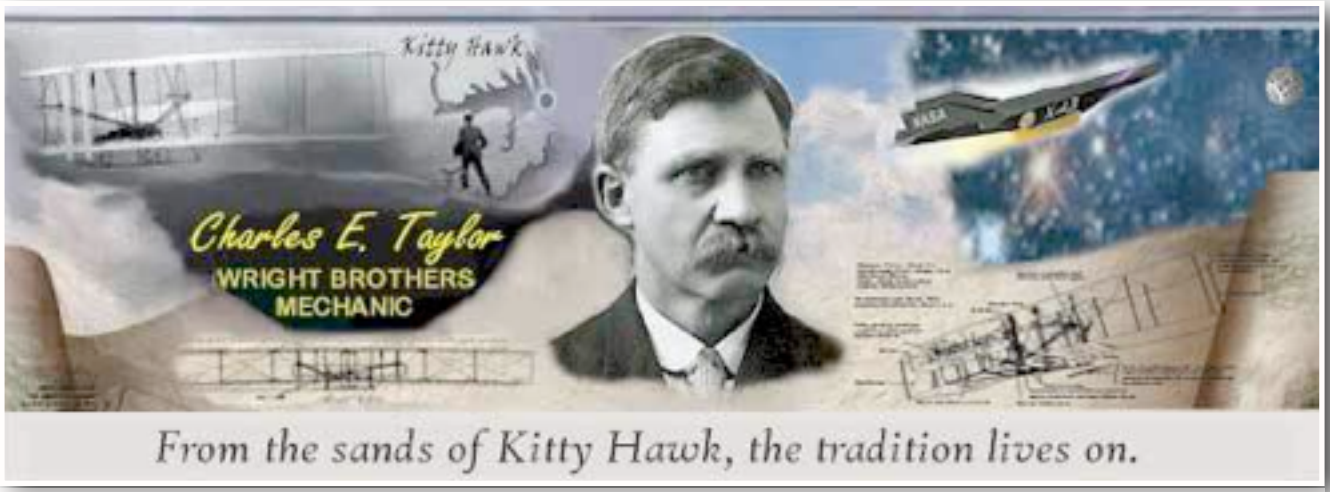
Aviation Human Factors Industry News

Volume XIV. Issue 19, October 14, 2018



Hello all,

To subscribe send an email to: rhughes@humanfactorsedu.com

In this weeks edition of *Aviation Human Factors Industry News* you will read the following stories:

FAA Aviation MX Human Factors Quarterly Newsletter

Dr. Bill Johnson, a frequent contributor to this newsletter, is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His comments are based on nearly 50 years of combined experience as a pilot, mechanic, airline engineering and MRO consultant, professor, and FAA scientific executive.

INSIDE THIS ISSUE:

Table of Contents

https://www.faa.gov/about/initiatives/maintenance_hf/fatigue/publications/

Scott Shappell Improves Safety by Factoring in the Human Element

Dr. Scott Shappell serves as chair of Embry-Riddle's Department of Human Factors and Behavioral Neurobiology.

"I walked on the same seawall I would run on every day when I was younger," says Shappell, now an internationally renowned expert and scholar in the field of human factors. "I remembered running along that seawall wondering, should I join the military, should I do a postdoc or should I do something different?"

Now chair of Embry-Riddle's Department of Human Factors and Behavioral Neurobiology, Shappell says serendipity has played a big role in his life, but he has ended up exactly where he wants to be in his career.

"My career has been everything and more than I ever thought it would be," he says. "I never thought I'd be where I am now."

His experiences led to his most well-known accomplishment – inventing the Human Factors Analysis and Classification System (HFACS), which is widely used and respected across aviation, the military, healthcare and other industries as an essential way to improve safety. The original HFACS pinpoints the role and types of human performance failures that contributed to aircraft accidents. Another version of the framework has been developed to classify workflow disruptions in healthcare settings.

In 2017, Shappell received the Paul R. Chatelier Lifetime Achievement Award for outstanding accomplishments in the field of aerospace psychology, awarded by the Society of U.S. Naval Aerospace Experimental Psychologists.

“Scott Shappell is an internationally renowned author and scholar in human factors,” says Douglas Wiegmann, an associate professor of industrial and systems engineering at the University of Wisconsin-Madison, who developed the HFACS with Shappell. “In the 25 years that I’ve been in the field, I’ve never known anyone who has been more successful in translating human factors principles into practice. Dr Shappell’s impact on aviation human factors and system safety is truly remarkable.”

Shappell has produced more than 200 publications and presentations in areas of accident investigation, system safety, behavioral stressors, sustained operations and fatigue. He serves as an elected fellow or member of 10 different organizations and was a consulting editor for the *International Journal of Aviation Psychology* and a reviewer for six other journals.

“He is so well recognized in his field that I literally cannot walk into a meeting without people knowing him personally or the next generation of professionals introducing themselves by saying that they have read all of his works,” says Karen Gaines, dean of the College of Arts and Sciences at Embry-Riddle’s Daytona Beach campus.

An Unexpected Path

Growing up on a farm in Ohio, Shappell became interested in psychology at Wright State University.

After earning his doctorate in neuroscience from the University of Texas: Medical Branch, he joined the U.S. Navy “on a whim.” The choice led him to work in human factors for the military and develop HFACS. He also served as the Human Factors Branch Chief at the Naval Safety Center.

“I was put in charge of human factors of the North Atlantic fleet so it was really accident investigation,” he recalls. “I was the human error guy.”

Shappell was professor of industrial engineering at Clemson University in South Carolina from 2005 until 2012. He joined Embry-Riddle in fall 2012. With Gaines, he has helped build Embry-Riddle's human factors program into one of the top three in the country – and the only one to offer an undergraduate degree in aerospace physiology. Shappell helped drive the addition of a doctoral program, too.

Alumna Tara Cohen, now a human factors research scientist at Cedars-Sinai Medical Center, says Shappell has been fundamental in developing Embry-Riddle's human factors program into a department dedicated to research and innovation.

"His teaching and guidance pushed me to become an inquisitive scientist with the desire to continuously develop and learn more about the field of human factors," she says.

"I think what we have to offer changes lives," Shappell says. "I know there are people alive today because of what we do."

Pilots' post-traumatic stress disorder implicated in fatal aviation accidents

Post-traumatic stress disorder has been implicated in a very small percentage of fatal aviation accidents, according to new research published in the journal *Aviation Psychology and Applied Human Factors*."

There is a practical need to understand the implications of pilots returning to work after experiencing potentially traumatic events (PTE)s.

Currently there is very limited research available on aviation-related post-traumatic stress disorder (PTSD) among pilots and their long-term follow-up," explained study author Alpo Vuorio of the University of Helsinki.

For their study, Vuorio and his colleagues analyzed data on fatal aviation accidents from the National Transportation Safety Board (NTSB). They found that PTSD was mentioned in eight fatal accident investigations in the United States from January 1, 2000, to December 31, 2015.

The eight PTSD-related accidents accounted for 0.16% of the 4,862 fatal accidents during that time period.

For example, a 65-year-old male pilot entered a stall and crashed shortly after takeoff. The NTSB concluded the fatal accident was related to his decision to fly an unfamiliar aircraft (a Loehle 5151 Mustang) and his psychiatric condition.

"[A] review of the pilot's personal records indicated diagnoses of post-traumatic stress syndrome and bipolar disorder, both of which are associated with a variety of symptoms that tend to decrease and increase over time… it is likely that the pilot's psychiatric condition(s) directly contributed to his decision to take off from an unauthorized grassy area in an airplane in which he likely had little or no experience," the NTSB report said.

The pilot was also taking a number of medications, including clonazepam and quetiapine.

"There is an association between PTSD and fatal aircraft accidents as a potentially contributing factor," Vuorio told PsyPost. "In incidents where potentially traumatic events occur, it is important to recognize them and to assess the need for treatment of the pilot."

However, it is unclear just how many pilots have PTSD. The researchers also found some cases where pilots had concealed their psychiatric conditions from aeromedical examiners — who are responsible for issuing medical certificates.

“This study would be more representative if there was access to data that reflected the true number of pilots who have been diagnosed or presumed to have PTSD, but these data were not available. In the future, hopefully, systematic data collection following aviation and work-related traumatic events and incidents among pilots will result in more comprehensive PTSD analyses,” Vuorio said.

“There are certain protective factors that can be assessed after a PTE. These protective factors include social/psychosocial support — in other words, and support from the friends, family, and peers,” he added.

“Psychiatric comorbidity is common with PTSD. If a pilot presents with fear of flying, evaluation of traumatic events might reveal useful information in assessing comorbidity.”

The study, “Pilot Post-traumatic Stress Disorder and Fatal Aviation Accidents“, was authored by Tanja Laukkala,Robert Bor, Bruce Budowle, Pooshan Navathe, Antti Sajantila, Markku Sainio, and Alpo Vuorio.

https://econtent.hogrefe.com/doi/abs/10.1027/2192-0923/a000144

House maintains pilot training changes enacted after Flight 3407 crash

In a victory for the families of the victims of the Flight 3407 airline disaster, the U.S. House of Representatives has approved a five-year budget reauthorization bill for the Federal Aviation Administration that preserves safety and training requirements enacted after that crash.

Congressman Brian Higgins (D-Buffalo/Niagara Falls) announced the House action.

“After several years of temporary extensions, this long-term reauthorization of the FAA provides considerable peace-of-mind in knowing the hard-fought achievements delivering one level of safety to the flying public, although never assured, are better protected for years to come,” Higgins said.The victim families had been calling for the adoption of a long-term FAA reauthorization bill that would maintain a number of flight safety improvements fought for following the 2009 crash of Continental Airlines Flight 3407 in Lancaster on its approach to the Buffalo-Niagara International Airport.

The safety improvements were first instituted in the Airline Safety and Federal Aviation Administration Extension Act authorized in 2010. The legislation now passed by the House will preserve the key measures gained by the flight 3407 families requiring greater transparency for travelers flying on sub-contractor airlines and additional rest time and training requirements for pilots.

Other highlights of the FAA reauthorization legislation which will improve safety and address consumers rights include a prohibition on the involuntary bumping of passengers from flights after their boarding passes have been collected or scanned;

a requirement that the FAA set minimum dimensions for passenger seats, including pitch and width; the establishment of a new "Aviation Consumer Advocate" position at the U.S. Department of Transportation to help resolve consumer complaints.

The legislation also requires that flight attendants receive a minimum of 10 hours of rest between duty periods and addresses issues faced by passengers with disabilities, by requiring the DOT to develop an "Airline Passengers with Disabilities> Bill of Rights" that creates a civil penalty for damage to passengers' wheelchairs and mobility aids.

All medium and large U.S. airports, including the Buffalo facility, will now have to provide private rooms for nursing mothers and baby changing tables in at least one restroom in each passenger terminal.

Funding for the National Transpiration Safety Board (NTSB) is also reauthorized for the next four years

FAA funding had been due to expire on Sunday. The House is expected to pass a one-week extension of that funding, through Oct. 7, to allow the U.S. Senate time to act on the full reauthorization legislation.

Wrong flap setting contributes to crash

This was the pilot's third skydiving flight of the day. He performed a back taxi on the runway at the airport in Warrenton, Virginia, for takeoff. He reported that as he rotated the Pacific Aerospace 750XL for takeoff, he heard a "steady" stall warning horn, the flight controls felt mushy, and the airplane would not climb.

Human Factors Industry News 9

He aborted the takeoff and applied maximum braking and reverse thrust, but the airplane overran the remaining runway. Subsequently, the landing gear collapsed and the plane hit a fence.The left and right wing sustained substantial damage.

After the accident, the pilot reported that he observed the wing flaps in the fully retracted position. He reported that the flaps should have been set to 20° for takeoff.

The pilot reported that he forgot to set the flaps during the back taxi for takeoff because he was communicating with other airplanes near the airport.

The pilot did not use a physical checklist, but told investigators he did run through a checklist mentally.

Probable cause: The pilot's failure to set the wing flaps for takeoff, which resulted in an aerodynamic stall, an aborted takeoff, and a runway overrun.

NTSB Identification: GAA16CA477

This September 2016 accident report is provided by the National Transportation Safety Board. Published as an educational tool, it is intended to help pilots learn from the misfortunes of others.

NTSB: Fuel cap missing before fatal Swainsboro plane crash

A small plane that crashed in Georgia last month, killing four people, took off without a fuel cap, federal investigators said.

A preliminary report by the National Transportation Safety Board said the plane's pilot and a mechanic told a parachute rigger they planned to use "fuel cell tape" to cover an open fuel port.

Four people died when the plane operated by a skydiving service crashed Aug. 25 near Swainsboro in eastern Georgia. The dead included Army Staff Sgt. Aliaksandr Bahrytsevich, a member of the military parachute team the Golden Knights.

The NTSB's preliminary findings said the parachute rigger saw the plane take off with a group of skydivers after he reported the fuel cap missing, the Augusta Chronicle reported . It landed and took off with another group before crashing.The report states a parachute rigger noticed that the plane's right wing was missing a fuel cap while the pilot was fueling the craft. The pilot asked the parachute rigger to contact the maintenance facility at the airport to see if it had an extra fuel cap.

"The parachute rigger saw the mechanic and the pilot working on the airplane, and later told the parachute rigger that they decided to use 'fuel cell tape' over the fuel filler port," the report states.

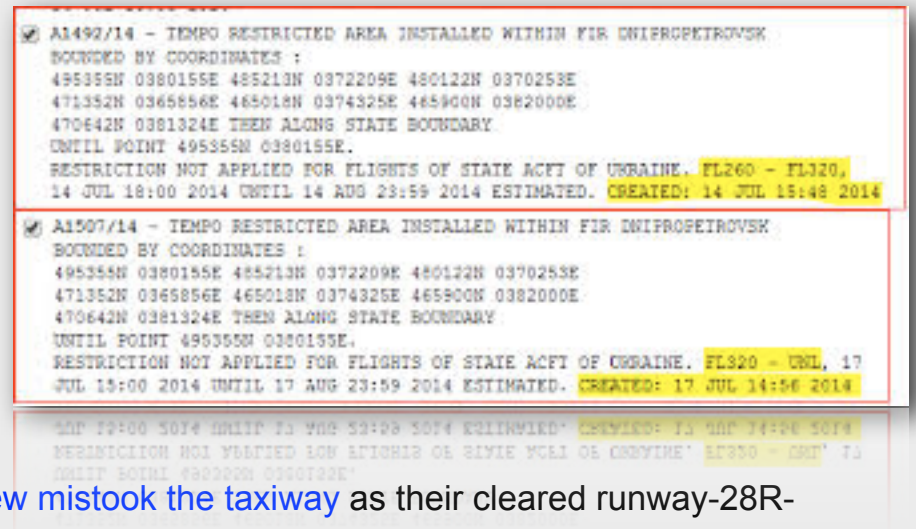
The plane took off for one flight with skydivers and then returned for the final group of skydivers. According to the report, the rigger saw the plane taxi for takeoff, but did not see the takeoff.

The plane, a Cessna 182A aircraft, was owned by The Jumping Place Skydiving Center in Statesboro.

Justin Duff, 42, of Statesboro; Bahrytsevich, 31, of Raeford, North Carolina; Andrew Swenson, 23, of South Daytona Beach, Florida; and Chris Eldridge, 42, of Rincon, Georgia, died in the crash, according to Emanuel County Coroner Randy Love.

The NTSB investigation continues.

NTSB Chairman Calls Notams 'Garbage'



NTSB chairman Robert Sumwalt called the Notam system in the U.S. "messed up" recently during a hearing on the July 7, 2017 incident at San Francisco International Airport (SFO) in which an Air Canada Airbus A320 nearly landed on a crowded taxiway. The crew mistook the taxiway as their cleared runway-28R- because Runway 28L was closed. The pilots failed to catch that note on page eight of the 27-page list the SFO Notams.

After acknowledging the "crew didn't comprehend the Notams," Sumwalt then read a verbose and complicated entry that limited a portion of a taxiway to aircraft with a wingspan of 214 feet or less. "Why is this even on there?" he asked. "That's what Notams are: they're a bunch of garbage that no one pays any attention to," adding that they're often written in a language that only computer programmers would understand.
Sumwalt also relayed a recent experience he had flying the jumpseat into North Carolina's Charlotte/Douglas International Airport, saying, "There were pages and pages and pages of Notams, including one for birds in the vicinity of the airport...when are there not birds in the vicinity of an airport?"

Not surprisingly, one of the NTSB's six safety recommendations stemming from this incident is a "more effective presentation of flight operations information to optimize pilot review and retention of relevant information."

Is the Captain's Authority Absolute?

Upgrading to captain is a special moment in any pilot's career. Putting on the fourth stripe gives the pilot added authority, and with that comes more responsibility and accountability. In the eyes of the regulator and your organization, the buck stops at the left seat with regards to safety and operational matters. Understanding the history, intent, and limits of this authority will ease this added burden for both the new and seasoned pilot-in-command.

The origins of captain's authority are deeply rooted in maritime law and tradition. At sea, operations in an unnatural environment required a single responsible authority. A ship's captain had absolute authority and was the unquestioned commander responsible for the ship, cargo, and crew. In fact, as an example, depending on the country's flag being flown, the captain could order someone restrained or locked up, remove any member of the staff, refuse to carry passengers or cargo, and legally perform a marriage.

In the early years of aviation, before 1930, there wasn't a strong need to mandate an aircraft commander until the advent of flying boats. These aircraft, such as the Pan Am Clippers, had multiple crewmembers that created the need to designate a commander. Early regulations, gave the pilot in command (PIC)—while in flight—the final responsibility and authority of the aircraft and crewmembers.

In the U.S., the current regulation outlining the responsibility and authority of the PIC is largely unchanged from the 1930s. Specifically, FAR 91.3 states, "The PIC of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft." The regulation further notes that in the event of "an in-flight emergency requiring immediate action, the PIC may deviate from any rule…to the extent required to meet the emergency." This rule goes on to state that if the PIC deviates from a rule, a written report to the administrator may be required.

Airline pilots must take into account the concept of “operational control” that is addressed in 14 CFR 121.533. This rule is what differentiates airline pilots from their seafaring counterparts. Elements of this reg outline the responsibilities of the certificate holder, aircraft dispatcher, and PIC. Operating under this rule, the PIC must understand that there is a shared joint responsibility with the dispatcher for preflight planning, delay, and dispatch of the flight. The intent is to continue to work with the dispatcher throughout the flight, especially when things don’t go as planned. During flight—defined as once the aircraft is operating under its own power for the purpose of flight—this rule specifies that the PIC is responsible for the safety of flight and grants full control and authority over other crewmembers.

Notwithstanding, during an actual in-flight emergency, all bets are off and the PIC can deviate from any rule, as necessary. This emergency authority allows the PIC to do whatever it takes to get the aircraft safely on the ground. Declaring an emergency with air traffic control is often very prudent and helps align the necessary resources to make the captain’s job easier.

After the emergency, the PIC should be prepared to document all of the details of the event and submit and required company reports, as well as a NASA or ASAP report, if that’s an option. It’s typical for the FAA to investigate an incident; it’s their job. Emergencies involving air carriers or air-taxi operations get more scrutiny. In fact, air traffic managers are specifically directed to notify FAA headquarters if an incident involves an air carrier or air-taxi operator.

As stated, regulations, at least in the U.S., are very specific and limit a captain’s authority only to flight. By design, this makes sense and as a captain, you can use this to your advantage. On the ground, at zero airspeed, there’s adequate time to consult with a dispatcher or others to help with decision making. Once airborne, though, decisions must be made “on the fly,” and this is where the captain has full authority.

NTSB Seeks Runway Alert Equipment on All Aircraft

The National Transportation Safety Board (NTSB) is calling on the FAA to require installation of alert systems on all aircraft that would warn pilots flying into primary airports that their aircraft are not lined up with a runway surface or the intended runway. The recommendation stemmed from the July 7, 2017 incident in which an Air Canada A320 lined up on a parallel taxiway while on approach into San Francisco. The crew initiated a go-around but had come within 100 feet of one aircraft lined up on the taxiway and 60 feet of another.

As a result, the NTSB found that "flight safety would be enhanced if airplanes landing at primary airports within Class B and C airspace were equipped with a cockpit system that provided flight crews with positional awareness information that is independent of, and dissimilar from, the current instrument landing system backup capability for navigating to a runway."

However, in his first official board meeting on an aircraft accident, newly confirmed vice chairman Bruce Landsberg highlighted a need for supporting data into applying general findings on additional equipment to general aviation.

The former long-time head of the AOPA Air Safety Institute, Landsberg suggested an amendment to limit the finding's threshold to 12,500 pounds. He said he believed the finding was a "bit broad" to include light general aviation in the recommendations. "Do we have data to support it? I have not seen any."

But that amendment was withdrawn after facing objections from other board members. New member and long-time Senate staff member Jennifer Homendy, who joined the board about the same time as Landsberg, pointed to FAA data that 85>

percent of wrong-surface landings involve general aviation and noted a need for data supporting the 12,500-pound threshold.

NTSB chairman Robert Sumwalt added, “I do not believe that this agency should be concerned with a burden to the industry….Our concern should be what are the factors in the event.”

https://ntsb.gov/news/events/Documents/DCA17IA148-Abstract.pdf

Plane safety 'no brainer': Qld inquest

A Queensland skydiving boss whose plane crashed killing five people had refused to install a key safety mechanism despite it being a "no brainer" to put it in the plane, an inquest was told.Paul Turner, former owner-operator of Adrenalin Skydivers, oversaw workplace safety when skydiving first-timer Joey King and his fiancee Rahula Hohua were killed just after take-off from Caboolture Airfield.

Pilot Andrew Aitken and instructors Glenn Norman and Juraj Glesk also died when the Cessna 206 crashed and burst into flames north of Brisbane in March 2014.

The inquest has heard pilot seat movement may have caused the crash.

Ian Robert Colville, director of the engineering company that maintained the plane, told the inquest Mr Turner refused to have the mechanism, known as an inertia reel, installed to prevent pilot seat movement.

"(He said) it was too heavy," Mr Colville said.

The 50-year aircraft maintenance veteran said he was surprised by that decision because not only was it free from Cessna, who was supplying the reel to all relevant plane owners, but it weighed only about one kilogram.

It was "nonsense" to worry about the weight and a "no brainer" to have it fitted, he said

Mr Colville said all the other Cessna owners his firm serviced agreed to have the device fitted, he said.

"It was at no cost to the owners, so why wouldn't they do it?"

The upgrade wasn't mandatory but Cessna manufacturer, Textron Aviation, had sent a directive recommending operators install the device.

Mr Turner has earlier denied he had been offered a seat stop and refused to accept it, instead claiming Cessna couldn't supply one.

The Civil Aviation Safety Authority national manager of operations and standards, Anthony Stanton, told the inquest that although skydiving operations carried fee-paying passengers on their planes, they didn't operate under commercial aviation regulations at that time.

Instead, the Australian Parachuting Federation was charged with overseeing an audit system carried out, at the time of the crash, by volunteers lacking specialized aircraft knowledge and with fewer risk controls than other aviation activities, such as scenic flights.

Faster power switches for aircraft safety: Going from milliseconds to microseconds

In a few milliseconds, electrical arcing in aircraft wiring can release thousands of joules of energy. This is enough to ignite wire insulation, pierce hydraulic lines, and compromise critical flight-control subsystems.

The aviation industry urgently needs reliable arc-fault detection and mitigation measures. Going on decades now, academic and commercial research on the subject continues because arc detection is such a difficult problem to solve.

Sometimes arc currents are indistinguishable from normal operating currents. Although arc fault circuit interrupters are commercially available for AC power systems, they are imperfect and prone to missed detections and nuisance tripping. Furthermore, AC arcing is a different phenomenon than DC arcing: DC detectors do not benefit from the repeated arc ignitions that arise from AC zero-current crossings.

Any detection solution will rely on fast circuit-breaking action to extinguish faults. For high-voltage, high-current, DC power systems, a new generation of solid-state power switches is now available to meet that need. Conventional approach to power switching

The principal power-distribution switching elements in an aircraft are, conventionally, some form of mechanical switch. Generally, these are circuit breakers or contactors with over-current trip functionality. These devices are engineered to be high-performance and highly reliable.

Nevertheless, even with design features to minimize turnoff time, a high current turnoff may last 30 to 50 milliseconds, an effective eternity in which an arc fault can precipitate a major failure.

This turnoff duration is dominated by the lifetime of another type of arcing – drawn arcing established between separating contacts. To minimize this event, high current electromechanical switches often include blowout coils, or blowout permanent magnets (exclusively for DC devices), which accelerate arc quenching. These features exploit the Lorentz force, acting on charged particles moving with velocity through a magnetic field. Arcs are pushed out to the edge of the contacts, then stretched until they extinguish.

While a stronger magnetic field will push the arc out faster, practical devices must contend with size and weight constraints. The larger the current, and the larger the loop inductance, the harder it will be to quench drawn arcs quickly.

Solid-state switching for faster arcing mitigation

Because of these challenges, certain applications benefit from arcless solid-state switching or arcless hybrid switching. Instead of opening a contact gap, a solid-state switch uses transistors to throttle current. This cutoff can happen very quickly – as brief as microseconds – minimizing damage from major arc-faults.
This speed comes with some important penalties:

• First, the cost. High-performance transistors are expensive, especially cutting-edge high-temperature, low on-resistance die made from silicon carbide. Further, some complex electronics are required for bias supplies and gate driving, at a minimum. These factors push the starting cost of a solid-state solution beyond that of a comparable electromechanical one.
• Second, the on- and off-resistances of solid-state devices are inferior to electromechanical ones. Paralleling more transistors will improve the on-resistance but will reduce the off-resistance (increasing leakage). On-state and switching losses can be significant; they also mandate external cooling to prevent transistors from reaching their maximum allowable junction temperatures (Tj,max). Transistors operating near or beyond Tj,max are likely to fail.

Generated heat must be evacuated efficiently, requiring expensive packaging materials, which further drive up costs.

By way of comparison, a 125 A DC solid-state power controller from TE Connectivity has a nominal on-resistance of 4 milliohms, producing 63 watts of dissipation. A comparable electromechanical contactor might have a contact resistance of 0.5 milliohms, yielding only 8 watts of contact loss, 14 watts if you include coil power. While 63 watts is impressively low for a solid-state switch at these breakdown voltage and current levels, it is still significantly larger than the loss of a conventional contactor. This is proving to be an acceptable tradeoff for customers who recognize that a 30-microsecond arc elimination will cause significantly less damage than a 30-millisecond one.

A best-of-both-worlds approach combines the two solutions. A hybrid contactor electrically straps solid-state transistors across the contacts of a standard contactor. The transistors are switched on during state transitions, effectively absorbing what would have been contact arcing energy. During a turn-on, this means no arcing during contact bounce, further extending contact life. When fully on, the on-resistance is simply the contact resistance. When fully off, the leakage is defined by the contacts and not by the transistors.

A well-designed hybrid contactor can switch faster than a conventional one, and without the cooling required by a solid-state-only solution. A hybrid part can also be smaller for the same rating, with no need for blowout hardware, and with smaller armature spring and drive coil. The primary disadvantage is that the cost for a hybrid contactor will be driven by its solid-state content.

With ever-increasing power requirements, aircraft need a new generation of faster, higher-performance power switches. As a result, solid-state devices are becoming key elements in the modernization of military and commercial aerospace power distribution systems.

Researchers See the Light To Reducing Bird Strikes

Researchers at Purdue University believe that adding externally mounted red and blue LED lights to aircraft might one day help reduce midairs with birds. They found that LED lights in these color spectrums lead some birds in the opposite direction, according to a study published yesterday.

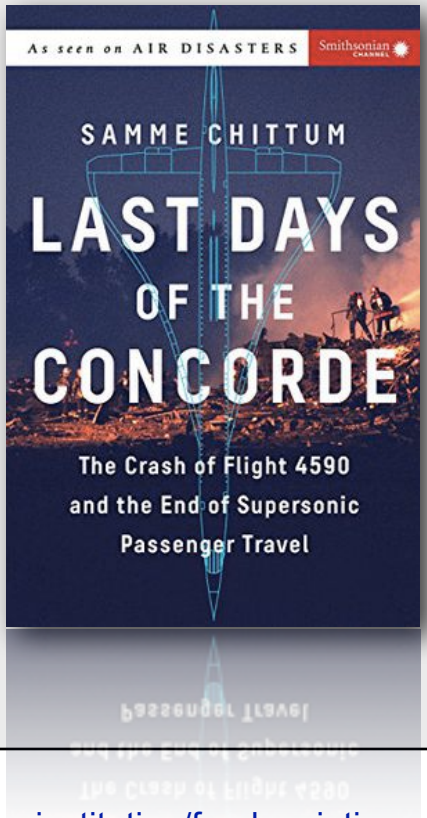
While lights have been used to try to create "avoidance behavior" in birds before, the Purdue researchers came up short in finding literature to support what kinds of light might work. In collaboration with the USDA Animal and Plant Health Inspection Service, the Purdue researchers thus conducted tests to see what kind of light could help to shoo birds away from airplanes.

Researchers used a single-choice test, in which the bird chooses between a light on and off rather than between two colors, said Esteban Fernandez-Juricic, a professor of biological sciences at Purdue who led the study. The test, which was repeated with five different wavelengths of light, found that birds consistently avoided LED lights with peaks at 470 and 630 nanometers, which appear blue and red to the human eye. Ultraviolet, green, and white light didn't generate any obvious pattern of avoidance or attraction, researchers said.

Fernandez-Juricic said they will now move to test other bird species' responses to different types of light, as well as modifying the test and doing more experiments.

Last Days of the Concorde: The Crash of Flight 4590 and the End of Supersonic Passenger Travel (Air Disasters)

On July 25, 2000, the chartered Concorde jet, en route to America, crashed and killed all 109 passengers and crew onboard and four people on the ground. Urgent questions immediately arose. What caused the fire? Could it have been prevented? And, most urgently, was the Concorde safe to fly? Samme Chittum offers a fascinating insider's look at the dramatic disaster, the hunt for clues, and the systemic overhauls that followed the crash.



Read more: https://www.smithsonianmag.com/smithsonian-institution/freak-aviation-disaster-brought-supersonic-idealism-down-flames-180970459/#gvHzHM1dH2xPCgKY.99