



High Marks Overall

BY WAYNE ROSENKRANS

The fine safety record of U.S. cold weather operations still warrants integrated risk reduction, auditors say.

Despite years of safe winter operations, including those in last season's remarkably harsh conditions, U.S. airlines and the federal government must avoid complacency and refine risk reduction, concludes a report by the U.S. Government Accountability Office (GAO). Working from August 2009 to July 2010 to determine how risks of airplane icing and other winter hazards could be mitigated further, GAO auditors weighed the accident and incident history of large commercial airplanes¹ related to icing and contaminated runways in the United States; results of Federal Aviation

Administration (FAA) inspection programs and enforcement of operator compliance with icing-related safety requirements (see "Airline Deicing Compliance," p. 15); results of FAA-industry initiatives on cold weather safety; and informed opinions about remaining challenges.

Inspection and enforcement policies were studied in conjunction with government databases, and subject specialists and aviation associations lent their expertise to a consensus view that icing remains a concern.

Non-government specialists told the auditors that meteorologists sometimes provide



overly cautious forecasts that cover too broad a geographical area, and that excessive false alarms can result in airline pilots discounting subsequent forecasts of icing. “[Air Line Pilots Association, International] representatives also said that pilots do not know when they are entering severe conditions, as they are only given generalized statements about icing conditions,” the report said. “Despite a variety of technologies ... to mitigate icing risks ... icing can be a significant hazard for aviation operations of all types, including commercial flights.”

One difference between current winter operational priorities and those of the late 1990s has been recent approval for implementing the Next Generation Air Transportation System (NextGen), which includes comprehensive enhancements to weather services. “Currently, NextGen weather researchers are focused on creating technology and procedures that enable forecasters to provide pilots with more precise and accurate predictions of icing conditions, which they believe will address the problem of pilots ignoring traditionally unreliable icing forecasts and better communicate the existence of dangerous weather conditions to pilots,” the report said.

The FAA’s 1997 *Inflight Aircraft Icing Plan* focused on in-flight icing, intentionally excluding ground-level icing issues. “Yet contaminated runways ... pose hazards to planes during takeoff and landing, and removing ice or preventing ice from forming on aircraft occurs not only during flight but also on the ground prior to takeoff,” the report said. “Since it issued the plan, FAA’s icing steering committee has identified many additional actions to reduce risks from icing, such as researching and developing approaches to mitigate the risk of [turbine engine] power loss from ice crystal ingestion. At [the GAO’s] request, FAA provided ... a lengthy compilation of the tasks it is undertaking with respect to icing; however, its *Inflight Aircraft Icing Plan* has not been publicly updated since the initial release in 1997.” Periodic informal reports to the industry have been made, however.

The auditors concluded that a formal update would be preferable to provide all stakeholders “consolidated and readily accessible” details. “Furthermore ... FAA is missing an opportunity to take a more holistic and coordinated approach to the broader range of issues related to winter weather, including ground icing and deicing, and contaminated runways,” the report said.

Since 1997, the FAA generally has accomplished plan objectives by creating or amending regulations and airworthiness directives, and by refining guidance to airlines, flight crews and other stakeholders, auditors found. Examples cited were the August 2007 final rule on revised airworthiness standards for transport category airplanes in icing conditions; proposed amendments in January 2009 to icing-related training requirements for air carrier flight crews and dispatchers; the August 2009 final rule requiring “a means to ensure timely activation of the ice-protection system on transport category airplanes”; and proposed amendments in June 2010 related to supercooled large droplet icing, ice crystal and mixed phase icing conditions that fall outside icing conditions covered by current standards for specified transport airplanes and engines.

The GAO recommended creation of a new holistic plan to reduce cold weather-related operational risks and suggested that this formal plan contain more detailed goals, time frames and measurable milestones than previous plans. “A comprehensive plan could help identify gaps or other areas for improvement and assist FAA in developing an integrated approach to winter operations,” the report said. “FAA should also periodically report to affected parties on its progress in implementing the plan, as well as any updates to the plan.”

Hardly Any Accidents

The National Transportation Safety Board (NTSB) database showed that in the category of large commercial airplanes over a recent 10-year period, one nonfatal accident occurred after the airplane encountered in-flight icing

conditions. GAO auditors found a total of five nonfatal accidents among large commercial airplanes involving snow or ice on runways. “Data on hundreds of incidents that occurred during this period reveal that icing, contaminated runways and other winter weather conditions pose substantial risk to aviation safety,” the report said. “FAA’s database of incidents includes 120 incidents related to icing, contaminated runways, taxiways or ramps, or other winter weather conditions involving large commercial airplanes that occurred from 1998 through 2007.

“These data covered a broad set of events, such as the collision of two airplanes at an ice-covered gate, and an airplane that hit the right main gear against the runway and scraped the left wing down the runway for about 63 ft [19 m] while attempting to land with ice accumulation on the airplane. During this same time period, the National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) received [more than] 600 icing and winter

weather-related incident reports involving large commercial airplanes. These incidents reveal a variety of safety issues such as runways contaminated by snow or ice, ground deicing problems and in-flight icing encounters [Figure 1]. These incidents thus also suggest that risks from icing and other winter weather operating conditions may be greater than indicated by NTSB’s accident database and by FAA’s incident database.”

FAA officials agreed that although ASRS reports can be subjective, the reports warrant ongoing review and also demonstrate the value of aggregating safety data from every known source. Operators of small commercial airplanes had more icing-related accidents and fatalities in the period than did operators of large commercial airplanes.

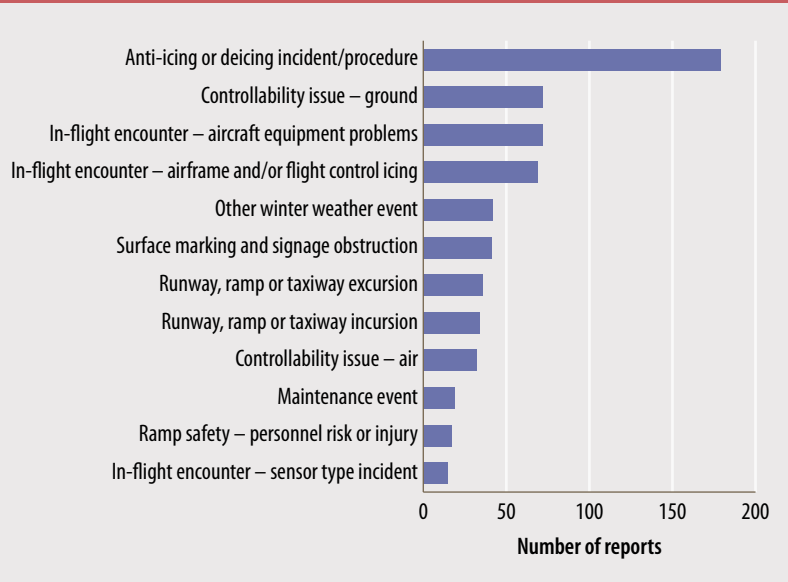
Basic/Applied Research

The FAA continues to conduct research on endurance times for deicing and anti-icing fluids, and provides separate annual guidance on best practices for other aspects of winter ground operations. “Regulations and guidance developed as a result of the ground icing program include a rule that no longer permits frost to be polished smooth on critical surfaces prior to takeoff and requires pilots to ensure that the wings of their aircraft are free of all frost prior to takeoff,” the report said.

FAA funding from 1999 to 2009 supported NASA research on severe icing conditions and National Center for Atmospheric Research (NCAR) research on weather and aircraft icing. GAO analysis also found FAA funding simultaneously enabled airports to construct deicing facilities and to acquire aircraft deicing equipment. Meanwhile, stricter environmental regulations affecting winter operations were proposed.

“When airlines and airports conduct deicing operations on aircraft and airfield pavement, the large amounts of chemicals used for deicing operations may drain off airport facilities to nearby rivers, lakes, streams and bays, and can have major impacts on water quality,” the report said. “In August 2009, the Environmental Protection Agency (EPA) issued a proposed rule on the use of deicing fluids at airports. According to EPA, the proposed rule would

Icing and Winter Weather-Related Event Reports for Large Commercial Airplanes by Category of Event, 1998 to 2007



Note: The GAO analyzed events due to winter weather conditions from reports in the U.S. National Aeronautics and Space Administration Aviation Safety Reporting System.

Source: U.S. Government Accountability Office (GAO)

Figure 1

Airline Deicing Compliance

Personnel from the Air Transportation Oversight System (ATOS) of the U.S. Federal Aviation Administration (FAA) check airline ground deicing programs for compliance with safety regulations. The oversight includes assessing the design of each program twice every five years and assessing its safety outcomes twice each year.

"Performance assessments confirm that an air carrier's operating systems produce intended results, including mitigation or control of hazards and associated risks," said a July 2010 report by the U.S. Government Accountability Office (GAO). "For inspections of ... ground [deicing] crews in fiscal years 2005 through 2009, FAA inspectors indicated that carriers were meeting the requirement in 16,867 out of 20,513 cases (82 percent), were not meeting the requirement in 3,569 cases (17 percent), and that the question was not applicable in 77 cases (0.4 percent). For inspections of

... flight crew [involvement in ground deicing] in fiscal years 2005 through 2009, FAA inspectors indicated that carriers were meeting the requirement in 13,734 out of 16,266 cases (84 percent), were not meeting the requirement in 2,122 cases (13 percent), and that the question was not applicable in 410 cases (3 percent). Of the 423 assessments ... from December 2007 through the end of fiscal year 2009, 290 (69 percent) did not require any corrective action by the carrier, while 133 (31 percent) required some form of corrective action."

Until April 2008, the FAA maintained oversight of some of these programs under different standards called National Work Program Guidelines (NPG). "In fiscal years 2005 through 2009, FAA initiated enforcement actions against large commercial carriers in 274 cases following one or more violations of icing-related regulations," the report said. "FAA had closed 254 of these actions by March

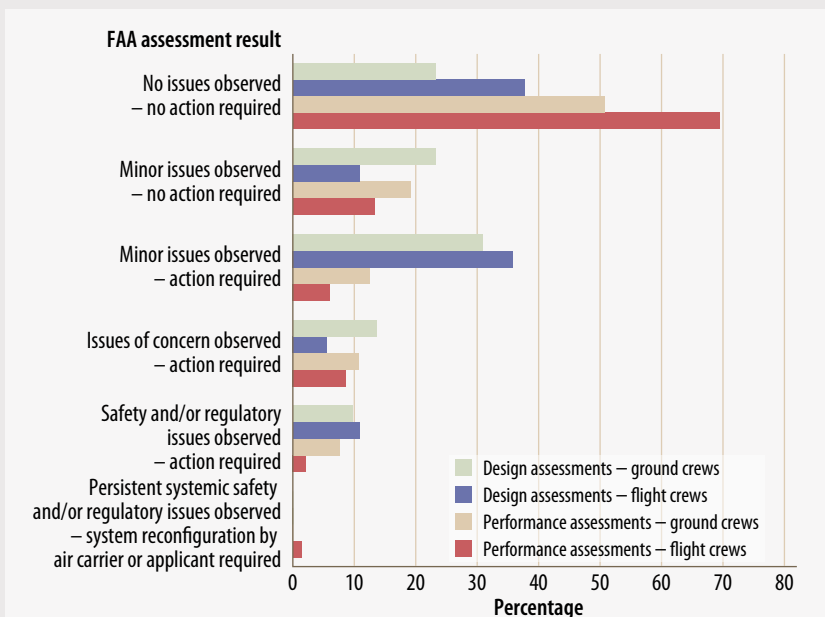
2010; of these, 226 were administrative actions, such as letters to carriers specifying required corrective actions; 22 were monetary fines ... ; three were closed with no action taken; two were [60-day and 90-day] suspensions of operating certificates ... ; and one was a revocation of an operating certificate.

"In fiscal years 2005 through 2009, FAA completed 942 of 1,026 required inspections (92 percent) of small commercial carriers' ground deicing programs. ... FAA completed 2,029 out of 2,099 planned inspections (97 percent) of small commercial carriers' ground deicing programs under NPG, and it completed an additional 431 inspections that were not planned.

"In fiscal years 2005 through 2009, FAA initiated enforcement actions against small commercial carriers in 274 cases following one or more violations of icing-related regulations. FAA had closed 209 of these actions by March 2010; of these, 112 were administrative actions ... ; 29 were monetary fines ... ; 28 were closed with no action taken; 28 were suspensions of operating certificates ... ranging from seven to 270 days; and 12 were revocations of operating certificates."

A number of operators, airplane manufacturers, maintenance organizations and other entities also were directed to implement new technology, correct technical deficiencies and/or implement new winter operations procedures and manuals. "Since 1997, FAA has issued over 100 airworthiness directives to address icing safety issues involving more than 50 specific types of aircraft, including directives that require revising the FAA-approved airplane flight manual limitations to provide the flight crew with recognition cues and procedures for exiting severe icing conditions, or inserting a copy of the airworthiness directive in the manual," the report said.

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FAA = U.S. Federal Aviation Administration

Note: Results refer to inspections of ground deicing programs of large commercial air carriers from December 2007 through Sept. 30, 2009.

Source: U.S. Government Accountability Office analysis of FAA inspection data

‘Pilots are likely to encounter icing conditions beyond their aircraft’s capabilities at least once in their career.’

require 218 airports to collect spent deicing fluid and treat the associated wastewater, and six major airports would likely need to install centralized deicing pads to comply with the rule. Additionally, some airports would be required to reduce the amount of ammonia discharged from urea-based airfield pavement deicers or use more environmentally friendly airfield deicers that do not contain urea. EPA plans to issue a final rule in December 2010.”

Research performed by NASA scientists has advanced the aviation industry’s knowledge, awareness and strategies for managing encounters with severe atmospheric threats — notably enabling meteorologists to precisely locate and forecast supercooled large droplet icing conditions. “Furthermore, NASA has an icing program, focused generally on research related to the effects of in-flight icing on airframes and engines for many types of flight vehicles,” the report said. “NASA has developed icing simulation capabilities that allow researchers, manufacturers and certification authorities to better understand the growth and effects of ice on aircraft surfaces. NASA also produced a set of training materials for pilots operating in winter weather conditions.”

FAA-funded efforts to predict the location and severity of in-flight icing conditions also have engaged the National Oceanic and Atmospheric Administration and the National Weather Service. “The National Weather Service operates icing prediction systems, and NCAR conducts research to determine more efficient methods to complete this task,” the report said.

The atmospheric research center also introduced two in-flight icing weather products accessible to the aviation community at no cost via the Internet:² the NCAR Current Icing Product, which uses mathematical models combining satellite, radar, surface, pilot-observation and other sources of data to display detailed, three-dimensional, hourly graphics about icing that existed up to 12 hours before a flight; and the NCAR Forecast Icing Potential, which “calculates the likelihood of icing and supercooled

large droplet conditions,” the report said, and has been designed for operational interpretation by meteorologists and dispatchers only, according to the Web site.

Reviewers of the GAO auditors’ work noted that the Aircraft Icing Research Alliance, an international team of organizations, simultaneously has conducted icing-related research. U.S. private-sector initiatives — such as those responsible for wing deicers, anti-icing systems and heated wings developed by aircraft manufacturers — also have reduced winter operational risks in the study period, the report concluded.

“The National Science Foundation (NSF) ... said that a number of universities, under funding from NSF, conduct research into the physics of icing and also had provided in situ measurements (using a storm-penetration aircraft) of icing and other conditions associated with large convective storms,” the report said. This foundation also emphasized that upgrades to today’s icing forecast products will be needed as scientific knowledge evolves (ASW, 7/09, p. 13).

Better Training

The issue of what constitutes adequate pilot training and experience for safe airline winter operations resurfaced recently as part of government-industry discussion of minimum qualifications and aviation professionalism. “Aviation experts told us that pilots are likely to encounter icing conditions beyond their aircraft’s capabilities at least once in their career,” the report said. “For example, it is important that regional airline operators provide region-specific training to their pilots as regional airline consolidations may cause pilots to fly a geographically wider variety of routes with more variation in weather conditions.”

NASA specialists told GAO auditors that FAA written tests for pilot certification cover “very little operational information compared with what a pilot needs to know when faced with icing.” Educational materials that NASA specialists have designed to bridge this knowledge gap have not been endorsed by FAA,

however, and have not been added to commercial pilot training requirements, the report said.

Unmet Challenges

The assessment listed the principal winter-operations challenges for the United States beyond the 2010–2011 season as “improving the timeliness of FAA’s winter weather rulemaking efforts; ensuring the availability of adequate resources for icing-related research and development; ensuring that pilot training is thorough, relevant and realistic; ensuring the collection and distribution of timely and accurate weather information; addressing the environmental impacts of deicing fluids; and developing a more integrated [national] approach to effectively manage winter operations.”

The report described the U.S. rulemaking process as inherently time-consuming because of lengthy procedures and processes required by federal law, typically requiring years to propose, finalize and enforce as new or amended FAA safety regulations.

“External pressures — such as highly publicized accidents, recommendations by NTSB and congressional mandates — as well as internal pressures, such as changes in management’s emphasis — [noted since 2001 have] continued to add to and shift the [FAA’s] priorities,” the report said. “For some rules, difficult policy issues [in 2001] continued to remain unresolved late in the process.”

For example, the latest round of rulemaking efforts on the issue of airworthiness standards related to supercooled large droplets dates from 1997. The notice of proposed rulemaking was issued in July 2010 with a projected final rule date of January 2012, the report said.

“Much of the time on this rulemaking effort has been devoted to research and analysis aimed at quantifying the atmospheric conditions that lead to supercooled large droplet icing, as well as developing tools that would allow industry to comply with the ... rule,” the report said. Internal projects to accelerate all FAA rulemaking have been under way since 2009, however, FAA officials told the auditors.

NASA representatives advised the auditors that key areas for increased research and development

funding by FAA now include pilot training, experimental and computational simulation of supercooled large droplet effects, engine icing and ice effects on future aircraft wing designs.

“Because the outcomes of [NASA] research and development are often a required precursor to the development of rules and standards, as well as technological innovation, a decline in research and development resources can delay actions that would promote safe operation in icing conditions,” the report said. “For example, FAA’s chief scientist for icing told [GAO auditors that] the decline in NASA’s icing research budget has adversely affected NASA’s research to understand how icing affects various makes and models of aircraft in real time — research that would ultimately help pilots determine how to respond to specific icing encounters.” The NSF concurred that the issue has become a major concern.

FAA officials pointed out that developing an integrated approach to icing threats historically has been among their most difficult challenges. “FAA said that, in conjunction with the aviation industry, it needs to begin focusing on winter operations holistically because there are many vital elements to safe operations in winter weather conditions, including airport surface conditions, aircraft ground deicing, aircraft in-flight icing and icing certification, dissemination of airport condition information, air traffic handling of aircraft in icing conditions, and air traffic arrival and departure sequencing. ... FAA stressed that it is important [to] not view the components in isolation.” ➔

This article is based on GAO report no. GAO-10-678, “Aviation Safety: Improved Planning Could Help FAA Address Challenges Related to Winter Weather Operations,” released July 29, 2010, and available at <www.gao.gov/new.items/d10678.pdf>.

Notes

1. “Large commercial airplanes” in the GAO report referred to air carrier operations under U.S. Federal Aviation Regulations Part 121, and “small commercial airplanes” referred to commuter and on-demand operations under Part 135.
2. The website is <aviationweather.gov/adds/icing/>.