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MITIGATING THE IMPACT OF VOLCANIC ASH CLOUDS ON AVIATION – WHAT DO WE NEED TO KNOW?

Ms. Chairwoman and members of the Subcommittee, I am Captain Linda Orlady, Executive Air Safety Vice-Chair of the Air Line Pilots Association, International ("ALPA") which represents the safety interest of over 53,000 professional pilots at 38 airlines in the United States and Canada. On behalf of our members, I thank you for this opportunity to testify before you on the issue of volcanic ash and the risk it poses to aviation.

There are 1,500 known volcanoes around the world, and 600 (40%) of them are currently listed as active. Collectively, there are 55 to 60 volcanic eruptions annually, and the ash and gases propelled from these eruptions reach altitudes that are routinely traveled by the airlines. Flying in the presence of volcanic ash and gases poses a significant, but unfortunately little understood threat to the integrity of an aircraft, its engines, and to the health of all occupants onboard. Adding to these threats is the disturbing fact that volcanic ash clouds and gases are not displayed on either radar installed in the aircraft or on radar used by air traffic controllers. Furthermore, volcanic ash and gas conditions are extremely difficult to identify at night. When trying to avoid drifting ash clouds or gases, pilots must rely on forecasts from dispatchers, reports from air traffic controllers, or feedback from other pilots flying in the area to determine the location of these potential hazards. The coordination and standardization of this information is further complicated by the number of different entities who supply information to airlines and their crews.

The recent Icelandic eruption demonstrated quite clearly that there is a lack of standardization between the various forecasts available to flight crews and dispatchers. As operations resumed in Europe last week, we received several reports from crews at different airlines who were given conflicting information in their dispatch release documents. In some cases, crews had one depiction showing extensive ash coverage and yet another which showed nothing at all.

Although there have been no fatal commercial airline accidents attributed to volcanic ash, the occurrence of damage to aircraft and potential dangers to the passengers and crew have been well documented. The two most notable incidents involved a British Airways 747-200 flight over Indonesia in 1982 and a KLM 747-400 flying over Alaska in 1989. Both of these aircraft lost power to all four engines during an inadvertent volcanic ash encounter. In the case of the British Airways incident, all four engines lost power when the flight, operating in darkness, encountered a volcanic ash cloud invisible to them or the aircraft's weather radar. The crew declared an emergency as the airplane descended to about 12,000 ft where they were beneath the ash cloud but near mountainous terrain. They were able to restart three of the four engines but lost power to one of the three remaining engines when they again encountered ash while attempting to remain clear of the mountains! The crew was finally able to safely land the crippled airplane with only two of the four engines operating and with badly scratched windshields that impaired their visibility. Similarly, in the case of the KLM incident, the crew was able to restart the engines and safely land a crippled airplane, averting the loss of human life and a catastrophic aviation event.

In both cases, there was extensive damage to the airplane engines, windshields, and environmental control systems. Documented volcanic ash encounters such as these have revealed the known vulnerabilities in current aircraft systems; however, as aircraft are constructed and equipped with newer technologies such as sophisticated electronic systems, we will need to study and understand those susceptibilities to volcanic ash contamination.

The flight safety risk associated with operations in the vicinity of volcanic ash clouds is not limited to just the vulnerability of the aircraft, engines, and the onboard systems. There is also a potential health hazard from the volcanic gases such as Sulfur Dioxide (SO_2) or Hydrogen Sulfide (H_2S). For example, SO_2 can cause breathing difficulties if inhaled at significantly high concentration levels. H_2S may cause headaches and itchy eyes. Indications that volcanic gases are present include an acrid odor similar to electrical smoke, which may mislead the crew into thinking they have an electrical problem and cause further distractions or, worse yet, mask the presence of an actual serious electrical problem. Prolonged exposure to H_2S may dull the sense of smell causing the flight crew to believe erroneously that they are clear of the gaseous environment.

Since the occurrence of the two near catastrophic events cited above, there has been an increased awareness in the airline community of the potential hazards of ash encounters. The improved availability of satellites coupled with technologies to transform satellite data into useful information along with improved coordination among international volcano monitoring facilities has helped to reduce the number of volcanic ash encounters worldwide. To date, ALPA along with the aviation industry has advocated for continued improvements in forecasting capabilities and dissemination of information to enable crews to safely avoid areas where there is a potential for a volcanic ash encounter. One outcome of this advocacy has been the creation of the Volcanic Ash Advisory Centers (VAAC), which is a network of nine facilities located worldwide. Each VAAC monitors the status of the active volcanoes within their assigned areas and disseminates information as needed to enable aircraft to safely avoid flying in hazardous volcanic ash conditions. ALPA continues to advocate for improved monitoring and forecasting capabilities but currently maintains the position, as is stated in the FAA Aeronautical Information Manual, to avoid any encounter with volcanic ash.

As vividly demonstrated during the recent eruption of the Eyjafjallajökull Volcano in Iceland, an ash cloud can drift for several days, travel thousands of miles, and envelop large areas of airspace. And while we have made progress in predicting where and when an eruption may occur, as previously stated, there is still work needed in forecasting and standardizing the information on where and how the resulting ash cloud will spread. The seismic activities and events leading up to the Eyjafjallajökull eruption were well monitored by the London-based VAAC, and as a consequence, flight crews had ample awareness of the imminent hazard and the possible need to re-route their flights accordingly. Unfortunately, the resulting ash cloud was so widespread that re-routing flights around European airspace to avoid potentially hazardous areas was not a viable option. European regulators, to their credit, recognized that in the absence of data demonstrating that safe flight was possible, the prudent course of action was to cease operations in the interest of safety. The disruption in air travel service cost billions of dollars to the industry and extreme inconvenience to the traveling public. The conservative approach taken by authorities - to put safety ahead of economic considerations - ensured that no lives were lost. However, the extent of the impact on worldwide operations demonstrated clearly that the strategy of circumventing an area of ash and gas is not necessarily a practical solution. Just as clearly, the situation demonstrated the benefit of having data to make it possible to reliably and objectively define a specific hazard area, potentially making it possible for flights to operate in some regions. The dilemma is that currently we do not have scientifically reliable and valid data which tells us how that might be accomplished. The areas of potential hazard cannot currently be defined in terms that are useable to flight crews both for dispatch and for use while airborne. Furthermore, the nature of potential damage to airframes and engines is not well understood. ALPA agrees that action is warranted to address future disruptions in service, however, as the economic impacts are assessed and mitigation strategies considered, the safety risk of flight operations in the vicinity of volcanic ash clouds cannot be compromised. ALPA is encouraged that the Senate version of the current FAA reauthorization bill contains language supporting the importance of research into volcanic ash hazards as well as other weather phenomena, and we urge the Congress to continue efforts to enact this legislation. Without such research to improve understanding of the hazards and ways to mitigate them, ALPA continues to advocate that the only safe course of action is for flight crews to avoid any encounter with volcanic ash.

If in the future, flight crews are allowed to fly in areas where there is a potential to encounter volcanic ash or gas concentrations, then any acceptable threshold established for safe operations within this environment must be based upon credible scientific data, analysis, and sound verification processes. New technologies will be needed to ensure all associated hazards within the allowable pre-established threshold are anticipated for and can be detected, measured, and safely mitigated by the flight crew prior to any encounter.

<u>Anticipate the hazard</u>: Better forecasting methods and information dissemination will be needed to enable crews to plan for and to implement, if necessary, safe exit strategies in the event of a volcanic ash encounter that exceeds the pre-determined limits of the airplane. As noted earlier, the current products available to flight crews vary widely in their interpretation of available data.

These products must be standardized so that flight crews operating in an area, dispatchers on the ground, and air traffic controllers have a common understanding of where the threats areas may be and what mitigations may be possible. In addition, flight crew training programs must accommodate scenarios designed to help crews understand when volcanic effects are a potential hazard, how to recognize and cope with those effects, and how to develop effective exit strategies. This challenge is particularly true for carriers whose typical route structure involves flight in areas of known volcanic activity. Alaska Airlines, for example, has developed extensive classroom and scenario-based simulator training that provides crews with effective tools and techniques that can be used in the event of inadvertent airborne ash cloud exposure. In this training, pilots face a full range of hazards, both to the aircraft and to its occupants, and develop strategies for successfully recovering from such an emergency. More importantly, awareness of and simulated exposure to ash and gas clouds underscores the need for avoidance of these hazards. This type of comprehensive training, however, is not universal for airlines that may operate in the vicinity of volcanic activity. Detailed study of the effects of ash and gas on aircrews and airplanes must be undertaken and this information must be incorporated in training programs for crews operating in potential threat areas.

<u>Detect & Measure the hazard</u>: Currently, ATC and aircraft radars do not distinguish ash clouds from other weather related clouds. Crews may not realize they have entered a hazardous volcanic ash situation until they are already in it. By that time damage may have already occurred to the airplane engines and/or other flight systems. Forward looking systems are needed to detect an ash cloud and gases ahead of the airplane at sufficient distances to allow adequate time for the crew to safely divert around an unacceptable hazard. The forward looking system will also need to measure vital characteristics of the volcanic cloud, such as density and hazardous gas levels,

to enable the crews to evaluate the hazard relative to pre-determined threshold levels and decide if it safe to proceed through an area of concern or to divert. Aircraft certification requirements will need to be updated to provide for more ruggedized aircraft health monitoring systems and management processes. Both flight and maintenance crews will need to know and act accordingly if an aircraft engine or other vital component has been damaged or has deteriorated at an accelerated rate that would compromise the continued safety of flight. Finally, we need to understand if any encounter with ash might be considered acceptable. This understanding must be based on rigorous, structured testing and produce reliable and scientifically quantifiable results. It will never be acceptable to simply see how close to an ash cloud we can fly and hope for the best.

Mitigate the hazard: Regarding the establishment of an acceptable threshold for flight near or into known volcanic ash or gaseous conditions, there are important and applicable lessons learned from the regulatory and operational experiences that have enabled allowable flight into known icing conditions. Extensive wind tunnel research, studies, and flight testing has been done over many years to assess and certify the safety of flight into icing. Though flight into known icing conditions is allowed and can be safely conducted under certain conditions and with specific aircraft anti-icing and de-icing equipment and appropriately trained crews, icing-related accidents and incidents still remain an important flight safety issue in the airline community. As we have learned with icing, mitigating the risk of flight into acceptable volcanic cloud conditions will not be a quick process but evolutionary as we learn more about the nature of the hazards. As testing, research, and development mature enough to establish initial acceptable threshold levels and to identify the required equipment changes, new procedures will also be needed. Government and industry must work together to develop consistent regulatory and operational guidance and training plans to ensure the new technologies and information is properly transitioned to the primary users such as airline dispatchers, air traffic controllers, mechanics, and pilots.

In conclusion, we have made good progress over the past several years in monitoring worldwide volcanic activity and alerting the affected aviation community of an imminent eruption. However once an eruption has occurred, there is still work needed to better forecast and standardize information so that hazards associated with drifting volcanic ash clouds and gases can be safely avoided in flight. ALPA currently maintains that flights into volcanic ash environments are to be completely avoided. There is a significant amount of research and coordination needed to fully understand the hazards, vulnerabilities, and mitigation strategies to ensure safety is not compromised before we would support the dispatch and operation of aircraft into areas of known volcanic ash, even with a pre-determined threshold level considered to be safe.

Thank you again, for the opportunity to testify on this important subject.