International Civil Aviation Organization

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WORKING PAPER

INTERNATIONAL VOLCANIC ASH TASK FORCE (IVATF)

FIRST MEETING

Montréal, 27 to 30 July 2010

Agenda Item 5: Development of ash concentration thresholds (AIR sub-group)
5.2: Establishment of regulatory provisions

PERSPECTIVE ON AIRCRAFT AIRWORTHINESS WHEN OPERATING IN AIRSPACE CONTAINING VOLCANIC ASH

(Presented by the United States)

SUMMARY

The airworthiness of aircraft operating in airspace containing even low levels of volcanic ash is not well understood. Research is needed to determine the long term effects of volcanic ash exposure to aircraft systems and turbine engines. .

1. INTRODUCTION

1.1 As a result of the recent volcanic activity in Iceland which significantly impacted aviation in Europe, the ICAO volcanic ash task force has been asked to consider moving away from the international past practice of air traffic avoidance of volcanic ash to the establishment of flight into known low levels of volcanic ash. This paper provides airworthiness issues and concerns with this approach.

2. DISCUSSION

2.1 Certain aircraft systems can be vulnerable to exposure to volcanic ash. Gas turbine engines can incur total power loss after ingesting high concentrations of volcanic ash. Lower levels of ash and the associated aerosols can still damage engines through erosion of internal flowpath components, blockage of the secondary cooling flowpath, and corrosion of exposed surfaces. Long term exposure to low levels of volcanic ash is not well understood at this time, but likely result in accelerated hardware deterioration and performance loss.

2.2 Aircraft systems such as airspeed pitot tubes, fuel tank venting systems, cabin environmental control systems, avionics, and quality of cabin air to breathe can also be impacted by flying through a volcanic ash environment. The impact of extended exposure to low levels of ash and associated aerosols on these systems has not been studied and is of concern. Research is needed to determine occupant health and potential safety impact to the airplane from operation in low levels of contaminants.

2.3 There is no on-board aircraft-state measurement capability or current research to support determination of volcanic ash atmospheric densities to determine when an encounter is an operational threat. Without this on-board measurement, safe flight operations must rely on remote sensing and forecast models.

2.4 Volcanic ash forecast and diagnostic technologies are currently not spatially and temporally accurate enough to implement a robust, highly resolved, timely identification of all the ash properties and changing dynamics in a volcanic ash cloud. Also there is currently no accurate method of determining ash cloud vertical layering. And, there is no indication that this capability will be mature in the near-term future.

2.5 Before determining acceptable levels of volcanic ash for safe aircraft operation, the current volcanic ash forecast model accuracy must be improved and validated against real time measurements. This validation should occur for worldwide ash forecast models at all volcanic ash advisory centers so that a reliable common standard can be applied. Without this reliable standard forecast, it would be difficult to establish a meaningful ash concentration level for safe operation of aircraft engines.

2.6 Different aircraft and engine designs may be affected differently by volcanic ash. For example, modern turbofan engines ingest large volumes of air and their turbines run hotter than the melting point for volcanic ash constituents. They typically utilize exotic turbine component coatings that can be affected by volcanic aerosols such as sulfates and chlorides. They also use turbine nozzle cooling and blade cooling with passages that are vulnerable to ash blockage. They climb and descend relatively quickly and cruise at high altitudes. Older turboprop or turbofan engines typically do not have these same features and have different vulnerabilities. These design and operational differences can significantly affect the engine's susceptibility to environmental ash threats. Therefore aircraft operations and engine design should be considered when developing potential airworthiness standards for operations in volcanic ash.

2.7 Currently there are no standardized test methods for turbine engines or aircraft systems to simulate volcanic ash ingestion encounters. Neither is there a standard that defines the constituents of volcanic ash. Likely the constituents of the ash vary from volcano to volcano around the world. Additionally, these constituents change as the cloud disperses. Any method developed to assess aircraft engines for safe operation in ash would need to be based on a standard that accounts for these variations.

2.8 New rulemaking would likely be required to assure standardized assessment of safe operation of aircraft and engines in a volcanic ash environment. This would require a significant increase in cost and complexity of aircraft certification and aircraft turbine engine certification for volcanic ash operations.

2.9 There is no evidence that allowing operations into known low levels of volcanic ash would improve aviation safety. On the contrary it would increase complexity of operations and could

have the inadvertent effect of releasing an aircraft into a volcanic ash environment that may be more severe than forecast or diagnosed. Therefore any new standards should consider ash forecast variability.

3. CONCLUSION

3.1 Based on the above observations, a decision to potentially move away from the historically successful ash avoidance practice requires careful consideration. Analysis of the safety basis of this move should be conducted before moving forward. Extensive data gathering and research will be needed to support this move. International agreement on each of these elements is necessary before developing and implementing airworthiness standards.

3.2 The issues raised in this paper should be discussed within the IVATF AIR sub- group and addressed before agreeing on operational levels of volcanic ash. The TF may wish to formulate the following action:

Action Agreed 1/… — Safe operational levels in volcanic ash

That, the IVATF AIR sub-group be invited to investigate what is needed in the development of safe operating levels in volcanic ash taking into consideration the points in the paper.

4. ACTION BY THE IVATF

4.1 The IVATF is invited to:

a) note the information in this paper; and

b) decide on the draft action.

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