International Civil Aviation Organization

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)

REVISION REQUEST TO TERMS OF REFERENCE

(Presented by the International Coordinating Council of
Aerospace Industries Associations)

SUMMARY

Commercial jet aviation has been operating safely for many years since the hazards associated with operations in visible volcanic ash have been identified and, airspace and flight operational procedures have been put in place. These years of safe operation have been conducted without a defined ash concentration threshold for aircraft or jet engines. Until such time as the volcanic ash cloud modelling techniques advance to the point where they can accurately forecast volcanic ash clouds, it would be more beneficial to develop a better understanding of aircraft and engine tolerances to various types of ash clouds than to develop ash concentration thresholds for aircraft or jet engines.

1. INTRODUCTION

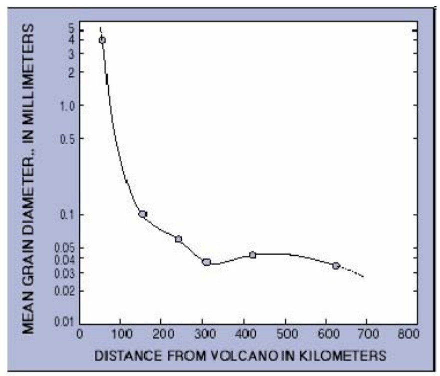
1.1 The Iceland's Eyjafjallajökull volcano eruption, and subsequent ash plume that drifted eastward reaching the United Kingdom and significant parts of western and central Europe was a unique situation in that the ash cloud extended over a region with a high volume of air traffic. The airspace contingency plans in place at the time were based on meteorological model forecasting of peak ash concentrations. The conservative decision to close airspace was a result of the heavy reliance on ash dispersion modelling of peak ash concentration and the manufacturers' guidance that aircraft should avoid visible ash. This approach of closing airspace based on an ash dispersion model forecast is predicated on the idea that aircraft and jet engines can operate safely at or below a defined ash concentration threshold. Flight operations can then be controlled simply by closing airspace with ash concentrations above this defined threshold. This airspace control approach is inconsistent with methods to safely control airspace in the presence of volcanic ash previously employed in other areas of the world.

2. DISCUSSION

2.1 As indicated by the charts below, each volcanic eruption has unique characteristics. The Phreatoplinian and Surseyan types of eruptions are of the most concern for aviation because of the ash plumes they create, which can be ejected to relatively high altitudes and drift for many miles downwind of the volcano. As the charts indicate below, these types of volcanic eruptions each have unique characteristics. Ash composition and ash particle size, which is correlated to distance from the eruption plume, are unique to each volcanic eruption. For example, the New Zealand Mt. Ruapehu eruption had no measurable silicon (one of the main elements in silica glass, which is one of the major concerns for jet engine operating in volcanic ash), whereas the Mt. St. Helens volcanic ash had significant amounts of silicon. Due to the unique aspects of each volcanic ash cloud, it may not be practical to define an aircraft or jet engine ash concentration threshold that would be of any operational benefit for controlling airspace in all future volcanic ash events. ICCAIA supports continuing efforts to better understand the susceptibility of aircraft and jet engines to volcanic ash clouds in order to enhance aviation safety. We do not believe, however, that closing airspace in the presence of volcanic ash based on ash dispersion model forecasts is a viable approach for the near term.

Table showing concentrations of leachable constituents in ashfall from historic eruptions (all concentrations in mg/kg).

	Fuego, Costa Rica		Pacaya, Guatemala		Santiaguito, Guatemala		Mt. St. Helens, USA		Ruapehu, New Zealand	
Element	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Median	Max
Al	5.2	26.8	12.8	21.2	5.2	19.6	-	-	42.8	1160
B	0.088	0.044	0.06	0.108	1.08	3.92	-	-	-	-
Ba	0.296	1	0.68	1.12	0.132	0.348	0.152	0.24	-	-
Br	-	-	-	-	-	-	-	-	1.6	13.6
Ca	400	1040	196	304	600	2240	440	800	1890	6760
Cd	0.008	0.04	0.056	0.128	0.056	0.256	0.0052	0.0252	-	-
Cl	124	232	204	840	440	1400	392	668	248	2020
Co	0.0036	0.0328	0.0072	0.024	0.132	0.6	0.0196	0.072	-	-
Cu	0.324	2.52	1.24	2.36	1.56	2.8	0.164	0.48	-	-
F	21.2	88	28.8	44	14.4	23.2	7.2	12	25.8	95.6
Fe	2.08	22.4	2.8	9.2	1.56	3.6	0.376	0.48	5.74	92.8
K	-	-	-	-	-	-	-	-	36.1	253
Li	0.044	0.116	0.0036	0.064	0.4	1.88	0.208	0.52	0.5	1.45
Mg	22	44	19.6	52	96	400	48	84	235	1200
Mn	1.48	3.12	1	2.88	19.6	92	7.6	13.2	-	-
Na	128	184	156	440	400	1760	264	440	292	1150
Pb	0.104	0.96	0.014	0.044	0.0096	0.048	0.0092	0.072	-	-
Si	7.2	12.4	9.2	15.2	7.6	11.2	40	56	-	-
Sr	2	5.2	1.64	2.6	1.48	4.4	1.76	2.88	-	-
U	0.00108	0.0028	0.00008	0.00048	0.0012	0.006	0	0	-	-
V	0.06	0.128	0.0248	0.068	0.0364	0.08	0.0012	0.0264	-	-
Zn	0.144	0.56	5.6	18.8	2.04	8.4	2.04	26.8	-	-
Nitrate									21.9	88.9
Sulphate							1000	1800	5190	24530



Figures and data above from http://volcanoes.usgs.gov/ash/properties.html

2.2 Alternatively, the ICAO European and North Atlantic Volcanic Ash Task Force (EUR/NAT VATF) has developed an airspace control proposal similar to the approach used by other airspace control authorities: after the initial eruption, the volcanic ash cloud is treated like a meteorological event and advisory and SIGMET information are provided to operators to allow them to determine how best to avoid operations in visible ash. (Note: visible ash is defined as ash that is visible via satellite imagery, trusted flight crew reports, (PIREPS), ground observers, etc.). In airspace controlled by the FAA, these visual observations are used in conjunction with meteorological forecasts to provide the best information regarding the location of the ash plume to operators to allow them to take the most appropriate action (re-route flights, divert flights to alternate airports or cancel flights). The decision to fly or where to fly remains with the operator.

2.3 Because volcanic ash clouds can extend beyond a single controlled airspace, consistency between volcanic ash advisory centres (VAACs) procedures is imperative. ICCAIA agrees with ICAO's International Volcanic Ash Task Force initiative to review global volcanic ash airspace contingency procedures and harmonize guidance based on successful experience.

2.4 Aircraft and jet engine manufacturers provide guidance for operations in ash events. The aircraft and jet engine manufacturers' advice is consistent: avoid operations in visible volcanic ash and if a flight inadvertently encounters volcanic ash, procedures for how best to get out of the ash are provided. The manufacturers also provide guidance for operations in low-level ash (non-visible) areas, i.e. in areas where there has been a known ash event, but there is no visible ash present. In these situations, aircraft and engine degradation can occur at different rates. As this degradation occurs and varies between operating environments, operators will typically need to adjust their maintenance practices to ensure aircraft degradation (e.g. plugged heat exchangers, filters, abrasions, etc) does not cause unscheduled aircraft downtime.

3. CONCLUSION

3.1 Commercial jet aviation has been operating safely for many years since the hazards associated with operations in visible volcanic ash have been identified and airspace and flight operational procedures have been put in place. These years of safe operation have been conducted without a defined ash concentration threshold for aircraft or jet engines. Due to the unique aspects of each volcanic ash cloud, it may not be practical to define an aircraft or jet engine ash concentration threshold, and even if one is defined for a particular volcanic ash event, it may not be of any practical operational benefit for controlling airspace in the next event. ICCAIA supports efforts to continue to understand the susceptibility of aircraft and jet engines to volcanic ash clouds. Such an undertaking is consistent with an industry desire to continuously enhance aviation safety. However, ICCAIA does not believe controlling airspace in the presence of volcanic ash based solely on ash dispersion model forecasts of ash concentration is a viable approach in the near term. ICCAIA believes operations in the presence of volcanic ash can be conducted safely by avoiding operations in visible ash. Operators should be provided advisory information based on visual observations used in conjunction with dispersion forecasts. This provides the best information regarding the location of an ash plume for operators to use in determining the most appropriate action (reroute flights, divert flights to alternate airports or cancel flights). This approach leaves the decision to fly, or where to fly, with the operators.

4. ACTION BY THE IVATF

4.1 The IVATF is invited to:

a) note the information in this paper; and

b) task the AIR sub-group to assess the need for aircraft and jet engine ash concentration thresholds and, the types of ash composition and particle size that are most detrimental to aircraft and jet engines.

— END —