VOLCANIC ASH
INTERNATIONAL TELECONFERENCES

17-23 April 2010

INFORMATION NOTE
REPORT OF PROCEEDINGS

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Context

After three weeks of activity, Iceland's Eyjafjallajokull volcano erupted on 14 April 2010 for the first time in almost 200 years. The ejected debris plume reached over 30,000 feet into the atmosphere and was carried by the prevailing wind over the UK and Northern Europe.

The aviation industry's standing instructions for dealing safely with volcanic ash, published by ICAO, are to avoid all encounters with ash. This advice has been incorporated into safety management systems operated by leading air traffic services and airspace management organisations. The "zero tolerance" of ash inherent in this advice led directly to a sequence of decisions that reduced air traffic flow through UK, Irish and Continental European airspace to a "zero rate" in those sectors identified as falling within the London Volcanic Ash Advisory Centre (VAAC) contaminated area.

The plume persisted over the British Isles and Northern Continental Europe for a number of days; the continued application of "zero rate" halted commercial aviation operations. By 18 April, commercial aviation movement through the airspace of 23 European countries had ceased and restrictions were in place in two other countries. Over 300 airports, representing 75% of the European network, closed. Precautions were taken to protect grounded aircraft from potential ashfall and to prepare aerodromes to deal properly with ashfall.

Urgent confirmation was needed as to whether a "zero tolerance" of volcanic ash was necessary to maintain flight safety. If not, then there was an urgent need to identify a density of ash which could be safely tolerated by commercial aircraft and engines; it was acknowledged that even if it could be established that operations in such ash densities were safe, there might be economic penalties in relation to an escalation in the engineering interventions necessary to sustain airworthiness standards.

Response

On 16 April, UKCAA hosted the first of a series of teleconference meetings aimed at gathering together the world's leading aircraft and engine manufacturers to focus on this issue. Supporting these discussions were leading scientific experts in meteorology, geology and volcanology, many of whom were directly monitoring the Eyjafjallajokull eruption and ash plume. Air Traffic Services experts, airspace managers and leading airlines also supported the work.

More than 60 organisations participated in a series of six teleconferences between 16 and 23 April. Instrumented flight test aircraft were made available to the group and the resulting data communicated after each flight sequence to the group.

On 20 April, the aircraft and engine manufacturers determined that their aircraft and engines would tolerate operations in an ash density of $2x10^{-3}g/m^3$. Flight operations in the UK recommenced shortly after this consolidated position had been determined. By 22 April, activities had resumed across Europe apart from airspace in southern Finland.

Eurocontrol has reportedly estimated that more than 100,000 flights were cancelled affecting the travel plans of around 10 million passengers. The airlines estimate their

losses in the order of €1.4 billion, the airports €250 million, ground handlers €200m and Air Navigation Service Providers €175 million with wider impacts beyond this grouping.

Agreed Position

The position agreed by the manufacturers on 20 April 2010 was presented in the following form:

Statement from the international conferences of airframe and aero engine manufacturers, aviation safety regulators, operators and specialist meteorological and research agencies

20 April 2010

In response to the exceptional operational circumstances currently being experienced in the UK due to volcanic ash, the airframe and engine manufacturers have held extensive discussions with regulators, operators, research centres, air traffic control service providers and meteorological agencies with a view to finding a way to resume operations in UK airspace.

1) The limited data available from previous volcanic ash encounters involving a variety of manufacturers' products has been analysed.

2) The understanding of previous volcanic ash eruptions is that flight operation restrictions have ensured that encounters with volcanic ash are minimised and appropriate precautionary inspections are carried out to identify whether encounters have occurred.

3) Based on the available data, a consensus has been reached among the parties to permit operations initially in areas of volcanic ash with densities predicted by the UK Met Office, of up to 2 $x10^{-3}g/m^3$ subject to appropriate precautionary maintenance practices being applied and the avoidance of visible ash.

4) The possible long-term effects of operation in volcanic ash are not known. In view of this, additional maintenance measures will be required to be developed by airframe manufacturers in conjunction with their engine suppliers to monitor for any possible long-term airworthiness effects resulting from operations in volcanic ash concentrations up to this level.

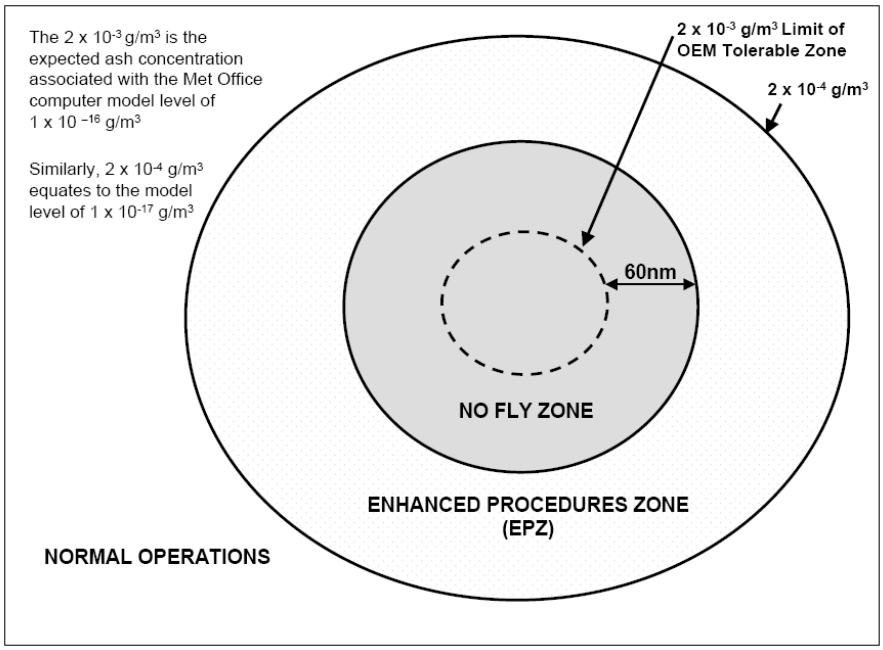
5) Industry and regulators are committed to continuing to work to acquire and analyse information arising from operational experience which would appear to offer an improved understanding of any longer term effects and to further modify maintenance programmes when appropriate.

Implementation

As well as defining a tolerable ash density level, the manufacturers group also considered how the tolerable level could be used to aid flight planning. The majority view supported the creation of a "No Fly" zone at ash concentrations above $2x10^{-3}$ g/m^3 with normal operations beyond this zone. There was a significant minority view in support of adding an intermediate "enhanced procedures" zone (below $2x10^{-3}$ but above $2x10^{-4}$).

The European National Supervisory Authorities (NSAs) and Air Navigation Service Providers (ANSPs) elected to adopt the 2 x 10^{-3} limit and to also apply a 60 nautical mile buffer around it in order to create an extended “No Fly” zone. An intermediate “Enhanced Procedures Zone” (EPZ) was also introduced as shown in the diagram.

To facilitate flight planning, the NSAs and/or ANSPs agreed to publish a NOTAM every 6 hours setting out the specific coordinates of the No Fly zone. The Enhanced Procedures Zone was defined on a revised chart published by the UK Met Office in its role as the London VAAC. Work to provide the necessary information in one published source continues.



For UK commercial operators, the UK CAA required operators, in planning flights through the EPZ, to carry out a risk assessment. CAA also encouraged operators to report any events they suspected could be linked to a volcanic ash encounter.

The CAA also reaffirmed its belief that the manufacturers are best placed to decide what the appropriate maintenance procedures should be in preparation for, or following, a flight in the EPZ. As no evidence existed of any additional safety concerns for operations within this zone, the CAA did not require enhancements to the instructions judged by the manufacturers necessary for their particular products.

By 23 April, all participating manufacturers, and a wider range of companies worldwide, had issued to operators of their aircraft and engines the engineering instructions necessary to ensure continued airworthiness of aircraft operating in ash density up to $2x10^{-3}$g/m^3.

Technical Assessment

In deciding that $2x10^{-3}g/m^3$ was a tolerable ash density level, the manufacturers were able to take account of information and advice regarding:

- The rationale behind the ICAO "zero tolerance" approach and confirmation that it was not based on known safety concerns at low concentrations of ash (as briefed by FAA and US Weather Service staff who participated in that work)
- The use by the London VAAC of a predicted ash density of $2x10^{-4}g/m^3$ as the limit of the extant "no fly" zone and the value to restoring operations were it possible safely to reduce this limit to $2x10^{-3}g/m^3$ (as briefed by UK Met Office and NATS staff)
- The London VAAC ash density forecasting process including modelling, measurements and data blending and, with help from experts from the FAA and US Weather Service, comparisons of the London VAAC techniques with those used at the Washington and Anchorage VAACs
- An independent assessment of the London VAAC forecasts by the UK National Centre for Atmospheric Sciences confirming confidence in the Met Office products
- Instrumented flight test measurements from the UK Facility for Airborne Atmospheric Measurements (FAAM) and NERC, the UK Natural Environment Research Council, LIDAR laser measurements and meteorological balloon data all confirming that the forecast levels accorded well with the peak values being measured in the atmosphere
- The physical and chemical properties of particulates in the plume based on information from the Icelandic Met Office
- The calculated rate of accumulation of ash within the core of turbine engines and its expected subsequent behaviour and effects
- The robustness of airframe systems (e.g. Total Air Temperature probes, pitot probes and static ports) in relation to ash intake and flow erosion
- The operational experience in the presence of ash after the Mount Redoubt eruption in 1989 as reported extensively by Alaskan Airlines albeit that readily accessible data on the specific ash densities encountered was not available
- Detailed information on a range of specific encounters with ash including the KLM B747-400 incident in 1989 resulting in a four-engined flame out in a calculated ash density of $2g/m^3$
- Data from "pathfinder" flights flown by some European airlines between 15 and 19 April and for which manufacturers had had direct involvement in data acquisition pre and post flight; again there was typically a paucity of credible data on the specific ash densities encountered.

The manufacturers were clear that although they were content that $2x10^{-3}g/m^3$ represented a tolerable density level for their products, any further increase in this level would require more data on, and analysis of, the effects of ash contamination on airframes and engines.

Future Work – near term

By 26 April, the eruption from Eyjafjallajokull had subsided from a peak material ejection rate approaching 1,000 tonnes/second to a rate closer to 10 tonnes/second. However, fresh eruptions from this volcano can be expected for some time to come. Furthermore, the UK Geological Survey advises that 3 out of 4 eruptions of the current active volcano result in Katla, the larger volcano in that region of Iceland, also erupting. Hence, further work in relation to tolerability at higher ash concentrations is advisable in the near term.

It would seem sensible to consider assessing the tolerability of ash and other particulates at densities of the order of 10^{-2} g/m^3.

The Group also noted the potential value in examining the case for flights that transition through areas of contamination for a portion of the flight only. It might be possible to accommodate such flights were it possible to specify not only a tolerable rate of accumulation per hour of exposure but also a maximum total accumulation per flight. Were such an approach possible, it could provide aircraft operators with a mechanism to permit safe flight planning and to anticipate the necessity for post flight actions.

With this in mind, manufacturers are continuing to gather data from the current operations and from instrumented specialist atmospheric research aircraft in order to further validate current assumptions and to provide a basis for further work.

Additional airborne research assets are being identified internationally and arrangements made to coordinate their efforts with those of the UK assets. Early data acquisition is being aimed at exploring the outer edges of the no fly zone to confirm the forecast ash densities, to confirm the overall makeup of the ash plume and to provide information to the Health Protection Agency regarding health of aircraft occupants. The data is being committed to the repository run by EUFAR, the European Facility for Airborne Research which coordinates European atmospheric research assets.

In parallel, the UKCAA has alerted aircraft owners and operators, both private and commercial, of the need to report any actual or suspected encounters with ash. These occurrence reports are being gathered, examined and made available through a data repository being established by Eurocontrol. Manufacturers are also receiving such reports directly from the operators of their products.

In addition, manufacturers have worked with some airlines to establish a data gathering programme involving a selected group of aircraft which are being specifically monitored and their condition reported on an ongoing basis as they continue to operate within and outside of the Enhanced Procedures Zone.

Future Work – mid term

The group established a specialist group to compare the forecasts produced by different VAACs, to identify any variations in approach that might exist and to recommend best practice taking into account such inputs as the manufacturers and operators would make in relation to the usability of the solutions generated.

The specialist group is also drawing together such knowledge, data and research as they can find in order to contribute proactively to the development of new ICAO standards, practices or guidelines. Again, the continued involvement of the manufacturers has been identified as a key aim.

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5 May 2010

ATTENDANCE ON THE CONFERENCE CALLS

This table summarises known participation in a series of conference calls from Saturday 17 to Friday 23 April 2010. There was no call on 21 April.

- Total number of organisations involved: 63.
- Total number of organisations actively participating in calls: grew from 20 to 43.

It is likely that there were many more participants than recorded here due to difficulties for organisations in responding to the on-call registration process and because many organisations fielded teams of experts on each call: 12 from Boeing on Call 1, for example. "Linked" organisations were in contact with proceedings.

	Call 1	Call 2	Call 3	Call 4	Call 5	Call 6	Linked
Airframe Manufacturers							
Airbus	✓	✓	✓	✓	✓	✓	
ATR							✓
BAE Systems – Regional Aircraft					✓	✓	
Boeing	✓	✓	✓	✓	✓	✓	
Bombardier Aerospace				✓	✓	✓	
Bombardier Shorts Brothers				✓	✓	✓	
Cessna Textron							✓
Dassault					✓	✓	
Embraer				✓	✓	✓	
Gulfstream							✓
Engine Manufacturers							
General Electric	✓	✓	✓	✓	✓	✓	
Honeywell International				✓	✓	✓	
International Aero Engines						✓	
Pratt & Whitney	✓	✓	✓	✓	✓	✓	
Pratt & Whitney Canada			✓	✓	✓	✓	
Rolls Royce	✓	✓	✓	✓	✓	✓	
SNECMA		✓	✓	✓	✓	✓	
Williams International							✓
Air Navigation Service Providers							
Eurocontrol	✓						
FAA Air Traffic Control	✓	✓	✓	✓	✓	✓	
Meteo France (Toulouse VAAC)		✓		✓			
Met Office, Iceland							✓
Met Office, Netherlands		✓			✓		
Met Office, UK (London VAAC)	✓	✓	✓	✓	✓	✓	
National Oceanic and Atmospheric Administration (NOAA), US (Anchorage VAAC and Washington VAAC)	✓	✓	✓	✓	✓	✓	
NATS	✓	✓					
US Air Force Met Service						✓	

	Call 1	Call 2	Call 3	Call 4	Call 5	Call 6	Linked
Scientific Agencies							
CEV, National Flight Test Centre of France	✓						
Chief Scientific Adviser, UK				✓	✓	✓	
FAA Weather Group	✓	✓	✓	✓	✓	✓	
Facility for Airborne Atmospheric Measurements, UK (FAAM)	✓	✓	✓	✓		✓	
National Centre for Atmospheric Sciences, UK (NCAS)		✓	✓	✓	✓	✓	
Natural Environment Research Council, UK (NERC)	✓						
NLR, German Research Centre					✓		
US Geological Survey						✓	
Operators							
Air Canada						✓	
Air France						✓	
Astraeus							✓
British Airways	✓		✓		✓		
easyJet							✓
FlyBe				✓	✓	✓	
bmi					✓	✓	
Lufthansa				✓	✓	✓	
Monarch				✓	✓	✓	
Ryanair						✓	
Thomas Cook				✓	✓	✓	
Thomson Airways				✓			
United Airlines						✓	✓
Virgin Atlantic					✓	✓	
Representative Bodies							
Aerospace Industries Association						✓	
General Aviation Manufacturers Association						✓	
Oil & Gas UK							✓
Regulators							
AESA, Spain			✓	✓	✓	✓	
CAA, Netherlands	✓	✓	✓	✓			
CAA, Norway				✓			
CAA, UK	✓	✓	✓	✓	✓	✓	
DGAC France	✓	✓	✓	✓	✓	✓	
EASA	✓	✓	✓	✓	✓	✓	
FAA Airworthiness Certification	✓	✓	✓	✓	✓	✓	
Irish Aviation Authority			✓	✓	✓	✓	
MAA, UK Military Aviation Authority				✓	✓	✓	
Transport Canada				✓	✓		
UK DfT		✓	✓	✓		✓	

ENDS