Volcanic Ash Perspectives
Airbus Status

September, 2010
Joelle Monso
Introduction

• *Interim Decisions*
  ‣ CAA UK
  ‣ EU/NAT VATF
  ‣ EASA
  ‣ Airbus Volcanic Ash Advice

• *Way forward: Airbus work plan*
  ‣ *Contribution to ICCAIA mid-term plan to set up appropriate procedures to ensure safe operations around VA events through IVATF (ICAO)*
  ‣ *Leading European Research Project to address atmospheric threat issues (including Onboard VA detection system)*
Interim Decisions

IVATF

Kickoff Meeting

4 WGs

7/27-30

EUR/NAT VATF

Face-To-Face Meeting

Comments to Interim Proposed Procedures

5/12 6/8-10 6/30

Interim ATM contingency plan delivered for endorsement by States

Second Face-To-Face Meeting

All Tasks Completed

7/15 8/19

EASA

Way Forward with ICCAIA

Quarterly Telecons

Workshop Measurement Techniques

Final ATM contingency plan integrating ICCAIA inputs

ICCAIA & AA midterm plan (2nd) : waiting for IVATF outcomes (8 tasks progress)

6/21

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ICAO- EU Contingency plan: Reason for Change

• Remove the notion of « 0 » ash concentration for clear area
• Introduce new terminology to provide flexibility for States own policy

Post-mod:
✓ Pre-mod: no agreed value on ash concentration which constitutes a hazard to jet aircraft engines. So, it was interpreted by States as potential hazard above « 0 » contamination level, with extensive airspace closure.
✓ Post-mod: Definition of danger area and introduction of the notion of restricted area in EUR region only (not NAT) to cope with all existing Systems.

• ICAO recognized that all modeled as concentrations are subject to uncertainty relative to errors in the estimation of the eruption strength.
  ‣ Danger area: defined around the volcanic source (120 Nm or 60 Nm buffer, forecast independant) declared by NOTAM.
  ‣ Contaminated area: from eruption: +0 & +6h will be declared only by SIGMET, then further every 6h declared by both SIGMET & NOTAM.

• Clearances should not normally be issued through danger area. Furthermore, States are not prevented from establishing Restricted or Prohibited Areas over the sovereign of the state, if considered necessary by the State concerned.
EU/NAT Contingency plan: Amendment

Key Element is
Introduction of concentration thresholds to depict areas of ash concentration as Low, Medium, High

Predicted (not clearly said)

Terminology

**Area of Low Contamination**: An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or less than $2 \times 10^{-3}$ g/m$^3$.

**Area of Medium Contamination**: An airspace of defined dimensions where volcanic ash may be encountered at concentrations greater than $2 \times 10^{-3}$ g/m$^3$, but less than $4 \times 10^{-3}$ g/m$^3$.

**Area of High Contamination**: An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or greater than $4 \times 10^{-3}$ g/m$^3$, or areas of contaminated airspace where no ash concentration guidance is available.
ICAO Volcanic Ash contingency Plans for EUR & NAT (Interim Contingency Plan)

Volcano Observatory

VAAC
Issue a Volcanic Ash Advisory

MET OFFICE
Issue SIGMET (contaminated areas)

SIGMETs allow route planning around plume without explicit airspace closure

STATES may establish Restriction *(danger area)

Area Control Centre (ANSP)
Issue NOTAM (danger area)

Operation through any area where VA is forecast is at the discretion of the operator
No airspace closure

Severity assessment against likelihood
OEM’s inputs needed
VAAC / MET Office - Ash concentration charts
17th May – Interim Decisions

Modelled Ash Concentration from FL000 to FL200 at 0000 UTC 19/05/2010

This is a guidance product, supplemental to the official VAAC, London Volcanic Ash Advisory and Volcanic Ash Graphic products.

Issue time: 201005181200

Met Office

Predicted area where volcanic ash may be encountered

Predicted area of ash concentrations that exceed acceptable engine manufacturers tolerance levels

NFZ (Black), TLZ (Grey), EPZ (Red) and Normal zone (White)

ICAO (EU/NAT): Danger area, Restricted area, Prohibited area:
New: low, medium and high (forecast of concentration) for restricted area

CAA – UK & UK MET Office ➔ NFZ (Black), TLZ (Grey), EPZ (Red) and Normal zone (White)

EASA ➔ NFZ (black), EPZ a (Grey), EPZ b (Red), Normal Zone (White)

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The notion of danger area as seen by EASA:

- **Black Zone**: Flight prohibited. Airspace closure.
- **Grey Zone (a)**: Flight Authorized upon presentation of Risk Assessment & Risk Management. Note: no concentration criteria adopted by OEM.

* (a*): Grey zone - option a or b.
Option b = re-classification in Red (EPZb) following clearance flights.

Airbus contribution:

- ICCAIA Plan
- IVATF

**MET Office charts**
Interim Decision – Flying in EPZ (Red Area)

• Risk Assessment was based on:
  ‣ Engine Manufacturers and aircraft OEM experience, assessments and tests,
  ‣ Contributions from operators through tests in predicted EPZ,
• The following has been worked-out:
  ‣ There is no additional requirements from the OEMs, for flying in EPZ
  ‣ Sampling programmes were set up to check the absence of cumulative effects by repetitive inspection of selected A/C systems and Engines Components.
    – By the Engine Manufacturers with representative operators to
      ‣ Check HPC via borescope –airfoil erosion/accumulation of debris
      ‣ HPT/LPT via borescope-accumulation of debris on blade/nozzles/plugged cooling holes
      ‣ MCD and scavenge screens and
      ‣ Trend Monitoring review
    – By AIRBUS with AFR( A320 family), BAW (A320 family), DLH (A320 family), MON (A330 and A300-600), EIN (A320 family) to check Fuel, Cabin Air, Bleed and Airdata systems
      ‣ Exposure to ash has to be assessed by post processing DFDR data and UK met Office publised ash concentration charts to correlate routing with predicted ash contamination
      ‣ Interim Report has shown no findings, final report not completed yet (correlation not established for all sampled flights)
Mid & Long Term Schedule

IVATF

Kickoff Meeting
4 WG – A/W Group with 8 Tasks

7/27-30

Second Face-To-Face Meeting

Jan

6/8-10

Apr

All Tasks Completed

Summer

May

Quarterly Telecons

 EUR/NAT VATF

Face-To-Face Meeting
Comments to Interim Proposed Procedures

Interim ATM contingency plan delivered for endorsement by States

6/30

5/12

Final ATM contingency plan integrating ICCAIA inputs

6/8-10
tbd

6/21

EAS A

Workshop Measurement Techniques

ICCAIA midterm plan (1st)

ICCAIA & AA midterm plan (2nd) : waiting for IVATF outcomes (8 tasks progress)

8/19

Way Forward with ICCAIA

6/8-10
• 4 IVATF working groups: Airbus can participate to the AIR & ATM groups, and can support the Sciences & IAVW groups if needed:

  ‣ **Airworthiness Group**: « Airworthiness considerations / Risk Assessment & Guidance Material », Airbus participation through ICCAIA.
  ‣ **ATM Group**: available for participation,
  ‣ **Sciences Group**: available for activities interdependence with Airworthiness group.
  ‣ **IAVW Coordination group** (IAVWOPSG): we do not see need for Airbus participation.
IVATF Tasks – Key Items

• Airworthiness Group: « Airworthiness Considerations & Guidance Material for Risk Assessment »

- Assessment of Product Susceptibility (Engines /Airframe/ Equipment….)

- Establish Acceptable Operational Criteria

- Validate or Amend threshold values (EU/NAT Contingency Plan) - Actual versus Forecast concept. Note: Industry position promotes operation in avoidance of « Visible Ash » (« Visible Ash » criteria is to be defined)

- GM for Authorities and Operators establishing process to perform operational safety analysis and safety management.
Initial OEM Philosophy for Operations in Vicinity of Volcanic Ash in Europe

Waiting for IVATF outcome, current Airbus position is still valid:

• Engines are the leading indicator of ash ingestion; airframe also important but 2nd to engines

• Extensive operations in predicted ash concentrations have yielded nil or negligible findings

• The UK MET model appears to be conservative for Eyjafjallajökull based on flight test sampling and operator experience in the UK and European airspace.

• Flight in predicted densities higher than $2 \times 10^{-3} \text{ g/m}^3$ may be undertaken at operator discretion provided flight into visible* ash clouds is avoided. * Visible based on satellite or eyeball observations. Operators need to monitor position of the visible* ash cloud and forecast movement to allow night/IFR operations.

• Maximum use of in-flight pilot reports (PIREPs) encouraged to aid in the dissemination of information about suspected ash locations and vertical extent.
Airbus Perspectives for Volcanic Ash

Supporting ICAO IVATF

- Sciences
- IAVW (International Airways Volcano Watch)
- Airworthiness
- ATM

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September 2010
Airbus Perspectives for Volcanic Ash: CSA-SA

Leading European Research Project: FP 7th

ATMOSPHERIC THREAT

IAVW

Manufacturers
(Development of Measurement & Detection Instruments)

Airworthiness
(Authorities, States, ICAO)

Development of Safety standards

Rolls-Royce

BOEING

SAFRAN

SAFIRE

Scientific Support

THALES

Met Office

METEO FRANCE

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Where is it safe?
- Competence of MET Services and FIR Authorities
- detection and observation
- precise predictions
- improve communication broadcasting

What is Safe?
- Manufacturer’s Competence
  - Key Factors for Operation & Airworthiness considerations
  - Develop instruments and equipment

ATMOSPHERIC THREAT
- Ice Particles
- Dust, Sand, Hail….

Grant it’s safe
- Competence of AAs and GOVs, ICAO
- establish safety standards
- establish approved procedures and guidelines

Operate Safely!
- Guidelines for operational decision-making

European Partners

FP7th – R&T on Unusual Atmospheric Conditions
WBS – Airbus is Project Leader with Strategic Supervision of global project

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Airbus Perspectives for Volcanic Ash

Development of Measurement (1) & Detection (2) Instruments for Volcanic Ash

EC Funding

Manufacturers

Provisions for Instrumentation on Flight Test Aircraft

(1) In the event of new eruption, participation in probing or sampling flights \(\rightarrow\) inputs for Model and Operation to Crisis Management.

Research Institutes

Instrument Development & Maintenance

IAVW

Airworthiness (Authorities, States, ICAO)

Measurement results for Analysis by Research Institutes

GM for Top level Requirements (Instrument development & System architecture)

EC Funding

Research Institutes

Instrument Development & Maintenance

IAVW

Airworthiness (Authorities, States, ICAO)

Measurement results for Analysis by Research Institutes

GM for Top level Requirements (Instrument development & System architecture)
**Airbus - How will work be accomplished?**

Airbus focus: Work through ICAO International Task force & EU Research Projects (R&T)

<table>
<thead>
<tr>
<th>International Aviation Industry Group</th>
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<tr>
<td>ICCAIA</td>
<td>Claude Schmitt</td>
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<td>ICAO IVATF</td>
<td>Manfred Birnfeld, Stephane Flori, Joelle Monso</td>
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<td>EU&amp;EC / EASA</td>
<td>Yves Regis / Anne Jany / Joelle Monso</td>
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<tr>
<td>FP 7th – R&amp;T</td>
<td>Fabien Dezitter</td>
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Our understanding is that all main activities shall be coordinated with the aims of ICAO IVATF

Key message:
Concentration values 2 or 4 mg/m³ in a context of overestimation of concentration (peak values) should not lead us to consider that these values are still acceptable for operation in a continuum.
Back-Up Slides
• European Partners that constitute the **Core Team**

- **Airframers**
  - DASSAULT AVIATION
  - AIRBUS

- **Engines Manufacturers**
  - Rolls-Royce
  - SAFRAN Snecma

- **System Suppliers**
  - THALES

- **Meteo Office**
  - MEDEO FRANCE
  - Met Office

- **Research Institutes**
  - ONERA
  - DLR
  - EADS
  - SAFIRE

- **EASA** and **EUROCONTROL**
(1) Measurement: Particle Collecting Device

- Particle Collecting Device to measure exposure detection to trigger maintenance action
- It should filter the air captured outside of the aircraft, air quantity measured by a flow meter (capture and store particles > 1um)

Air composition

Gas Analysis Device should analyse

Particle collection device
- Airflow duct system through cabin
- Additional pressure valves to seal cabin
- Inflight changeable filter box (avoiding contamination)
- Large and small particles filter
- Analysis in ground laboratory

=> Determine exactly what aerosols the cloud consists of
(1) Measurement: Particle Counting Probe

- **AIRBUS provisioning Installation of Instruments**

**CAPS – Cloud Aerosol and Precipitation Spectrometer**

- CAS: aerosols 0.5-50μm
- CIP: larger particles 25-1550μm
- Airspeed, Altitude, Temperature, liquid water content, relative humidity
- Size: 1200^2400^300, 20kg
- Speed range: 10-300m/s

In board data analysis: 20s delay between measurement and display of ash concentration measurement

- **AIRBUS provisioning Installation of Instruments**

**PCASP – Passive Cavity Aerosol Spectrometer Probe**

- Aerosols 0.1-3μm
- Dynamic pressure, temperature, flow of sample and sheath air
- Size: 1020^180, 16.2kg
- Speed range: 0-250m/s
(2) Detection: Ash Cloud Detection System

Should allow detecting ash plume position and give directly concentration ahead of aircraft flight direction

(laser + telescope on lateral window)

- AIRBUS provisioning Installation of Instruments
- LIDAR (DLR) or similar

- Analyzing of laser backscatter signatures
- Classification and detection of aerosol concentration at 5 - 7km range
- Needs in situ measurement for calibration
- Installation in cabin observing through specially glassed window
- Forward projection with mirror in 3D window
Airbus Probing Flights

**COOPERATION REQUIRED**

- Airbus has competence in operation of test aircraft in challenging environment
  - Flight Test Instrumentation and Engineering Expertise
    - Engine Survey and Real Time Analysis during flight
    - System Survey, real time analysis, reconfiguration
    - Expert Decision Making during flight
  - Aircraft operate under Flight Test Airworthiness Control
    - Aircraft configuration monitored by Flight Test special instructions
    - Crew and maintenance staff can adapt to operational environment
    - Risk assessment made by Management and Flight Crew

- Atmospheric research activity is not necessarily within Airbus competences
  - Instrument ownership should be with research organisation, but held available in case of need
  - Maintenance of instruments to be assured by appropriate Lab’s
  - Scientific on-site support necessary for interpretation of measurements
    - Full time availability of experts (shared between institutes?)
    - Scientists on board during sampling?