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ASSEMBLY — 37TH SESSION

TECHNICAL COMMISSION

Agenda Item 46: Other issues to be considered by the Technical Commission

EYJAFJALLAJOKUL VOLCANIC ASH CRISIS

(Presented by Belgium, on behalf of the European Union and its Member States,[1] by the other States Members of the European Civil Aviation Conference[2] and by Eurocontrol)

EXECUTIVE SUMMARY

The recent eruption of the Eyjafjallajokul volcano in Iceland severely disrupted air traffic services and, while safety was ensured, it became clear that the civil aviation community must improve its understanding of the effects of volcanic ash and how best they are mitigated. This raises multidisciplinary issues across several aviation domains, which may require action by different parties. This paper proposes some initial actions and identifies a leadership role for ICAO where efforts on the global level are required, the overall aim being to achieve a harmonised, global approach in case of future regional/global crises severely affecting aviation.

Action: The Assembly is invited to:

a) endorse the need to review the provisions in Annex 3 of the Chicago Convention in the light of identified improvement to Volcanic Ash Advisory Centre (VAAC) products;
b) direct the Organization to encourage the ICAO International Volcanic Ash Task Force (IVATF) to take account in its ongoing work of the manufacturers' agreed ash tolerance levels;
c) support the integration of relevant and accurate meteorological information into systems for flight planning and ATFM.
d) request the Council to direct the Air Navigation Bureau to consider further the benefits of a coordinated network management approach in the context of the ICAO Global Air Navigation Plan.
e) request the Organization to highlight the importance of the IVATF activity in identifying improvements in data collection and storage, for immediate tactical usage, as well as post-flight analysis.

Strategic Objectives:	This working paper relates to Strategic Objectives A, D and E
References:	Annex 3 — *Meteorological Service for International Air Navigation* Annex 11 — *Air Traffic* Annex 15 — *Aeronautical Information*

[1] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Iceland, Monaco, Montenegro, Norway, Republic of Moldova, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

1. INTRODUCTION

1.1 During the recent Eyjafjallajokull eruption, existing procedures in Europe maintained the highest level of aviation safety. However:

- air transport schedules were very badly disrupted with many cancellations over several days, damage to commercial air operators, and inconvenience to thousands of passengers;
- the aviation community's understanding of volcanic ash phenomena and their potential effects on aviation today was shown to be inadequate; and
- there was a general conviction that the response to any such future episode should be better coordinated on the basis of an agreed and harmonised approach.

1.2 The Eyjafjallajokull eruption also showed the provisions in Annex 3 — *Meteorological Service for International Air Navigation* to the Chicago Convention, in particular the strict avoidance guidance for operational encounters with ash, to be inappropriate in today's operational environment. Whilst they ensured the maintenance of the highest standards of safety of aviation, as any revised provisions must also do, they do not reflect or exploit advances in relevant technical capabilities which would allow for enhanced safety, greater economic efficiency and continuity in air services.

1.3 Addressing the challenge of volcanic ash requires comprehensive and coordinated actions across a number of aviation domains, notably with regard to meteorological services, but also in relation to aero-engine ash tolerance, ATM, and the robust application by air operators of risk management principles and processes in their decision-making process. Action in non-aviation domains such as satellite earth observation and volcanism are also needed.

2. ENHANCING THE VAAC PRODUCTS

2.1 During periods of volcanic ash activity the aviation community must receive accurate, timely and consistent information about the position, amount, composition, altitude, projected trajectory and drift of volcanic ash. The ability to forecast the evolution of ash clouds derived from an eruption, and then to achieve a good knowledge of their characteristics, is critical. Europe's learning from its experience with the Eyjafjallajokull eruption, notably the refining of outputs of the volcanic ash advisory centres (VAACs), has left it much better positioned to tackle the operational consequences of any future volcanic eruption.

2.2 There is an urgent need to review the relevant ICAO material in light of this recent learning. Potential improvements to Annex 3 can be grouped as follows:

2.2.1 **Frequency of volcanic ash advisories** – current guidelines indicate that advisories should be produced at least every six hours, with discretion to do so at a higher frequency. ICAO should consider recommending a minimum frequency of three hours, in order to facilitate improved operational planning. Discussions in the context of the Eyjafjallajokull eruption have shown this to be possible with current VAAC technologies.

2.2.2 **VAAC chart details** – the Eyjafjallajokull event has demonstrated a need for a greater specificity to be provided in Annex 3 and ICAO's associated *Handbook on the International Airways Volcanic Watch*, regarding the level of detail in VAAC charts. First, it would be necessary to show different levels of measured ash concentrations, commensurate with those deemed acceptable by manufacturers for engine tolerance levels[3]. Second, the associated flight level layers that are shown on the charts need to be more specific. This would allow national authorities to better determine any airspace restrictions and facilitate more tactical flight planning.

2.2.3 **Plotting VAAC charts on an overlay with FIR boundaries** – in order to avoid confusion that may arise from the use of VAAC charts in an operational and air traffic management context, the possibility of such charts incorporating the FIR boundaries needs to be considered.

2.3 The above improvements could be implemented in the short-term. However, VAAC products could be improved more substantially if other elements, relating to the observation, measurement, prediction and dispersion of volcanic ash clouds, were also addressed. A number of workshops and conferences have been organized in the aftermath of the Eyjafjallajokull event in which discussions with the experts from the science, technology and research communities have identified ideas worth addressing. The ICAO IVATF should consider the recommendations from these events as part of its ongoing work.

2.4 In the meantime, the Assembly should direct ICAO to promote in particular: improved scientific understanding of volcanic activities and ash clouds as they impact on civil aviation; the development of improved models to predict the behaviour of such clouds; and the investigation of all available means of observing ash to contribute to the validation/improvements of the ash models, either remotely (e.g. from space, ground or from higher altitudes) or from within the ash cloud (e.g. by unmanned aircraft systems).

3. VOLCANIC ASH OPERATIONAL THRESHOLDS

3.1 Today there is no international agreement on means to certify a level of volcanic ash tolerance. While the overall effects of volcanic ash on airframes and engines are relatively well known, it remains difficult to make accurate predictions about the effects on aircraft of combinations of ash concentration and exposure time. Moreover, ash from different volcanoes has been shown to have different characteristics, in terms of chemical composition, particle size, hardness, etc.

3.2 Against this background, the principal response has been avoidance of any intentional contact with volcanic ash. This precautionary approach was the basis of all relevant ICAO material, including Annex 3, and the ICAO EUR Volcanic Ash Contingency Plan[4], and thus the decision by European states to close their airspace or to withhold ATC clearances for flights into contaminated areas during the Eyjafjallajokul eruption. Operational experience has however now lead to assume that such an approach is not commensurate with the technical advances and operations of modern jet engines and with more precise ash predictions based on actual ash values measured in Spring of this year. During the Eyjafjallajokul crisis discussions in the manufacturers' community led to the determination of acceptable volcanic ash thresholds for engines ranging, under certain conditions, from 2000 µg/m3 to a maximum level of 4 000 µg /m^3, subsequently published by EASA[5] and incorporated in a revised version of the

[3] This has already been introduced into the amended ICAO EUR/NAT Volcanic Ash Contingency Plan 'Terminology' and as a part of the new Appendix D.
[4] Endorsed by the 51st meeting of the ICAO European Air Navigation Planning Group in December 2009.
[5] Safety Information Bulletin 2010-17R2 issued by the European Aviation Safety Agency on 21 May, 2010

ICAO EUR/NAT Volcanic Ash Contingency Plan. In this context ICAO should consider the opportunity of coordinating international measurement campaigns.

3.3 The gradual re-opening of European airspace was a direct consequence of applying these new thresholds. This experience needs to be considered carefully in the ongoing work of the ICAO IVATF. When addressing the threshold issue one must distinguish between 'hazardous' levels (i.e. safety critical) of ash concentrations, 'significant' levels that may entail an increased risk of engine damage resulting in additional maintenance costs, and levels that could leave traces of ash upon inspection, but not have any safety or cost implications. In this context it is increasingly becoming clear that whereas the focus is on volcanic ash, further consideration needs to be given to the airworthiness impact of other volcanic contaminants (e.g. SO^2) in the ICAO framework. Engine manufacturers have a very important role to play in developing and supplying this information.

4. AIR TRAFFIC MANAGEMENT AND OPERATIONS IN VOLCANIC ASH EVENTS

4.1 As has been highlighted in the European Working Paper on ATM[6], information management is vital for ATM, notably when considering the evolution of ATM in the direction of collaborative decision making (CDM).

4.2 The Eyjafjallajokull event has demonstrated the need for enhanced cooperation between the air traffic services, the aeronautical information services and notably with regard to meteorological services. The role of the Meteorological Watch Offices (MWO) in such events has been discussed in the ICAO EUR/NAT Volcanic Ash Task Force, leading to the inclusion of additional text in the revised ICAO EUR/NAT Volcanic Ash Contingency Plan and to this Plan being reclassified as an ATM (rather than ATS) document. These positive developments might be applied in other ICAO Regions and should be considered in the context of the revision of the 'Handbook on the International Airways Volcano Watch'. But it also substantiates the importance of the recommendation of the European working paper on ATM and, as such, the Assembly should give due consideration on how to accommodate this proposal.

4.3 The bigger message for the aviation community is however the crucial importance of airspace integration. As a direct consequence of the Eyjafjallajokull eruption, the EU Transport Ministers endorsed a proposal to accelerate full implementation of the Single European Sky initiative, including the appointment of a central European network manager, before the end of 2010, to enable a more harmonized and coordinated approach to be taken to risk and flow/capacity assessment, and to the rapid formulation of proposed handling solutions for any crisis seriously affecting the performance of the network, in coordination with other neighboring countries and regions. The benefits of coordinated network management needs to be considered in the wider context of the ICAO Global Air Navigation Plan[7].

5. VOLCANIC ASH REPORTING, REAL-TIME MEASUREMENT AND DATA COLLECTION.

5.1 The Eyjafjallajokull eruption confirmed the utmost importance of appropriate reporting, real-time measurements with all available technical means (including UAVs) and data collection with regard to better identification of risk and possible effects. Current ICAO provisions are highlighted in

[6] A37-WP/85-TE/33
[7] ICAO Doc 9750 – 'Global Air Navigation Plan'

Part 4, Section 4.1.2 of the 'Handbook on the International Airways Volcano Watch', and have been reflected in the ICAO EUR/NAT Volcanic Ash Contingency Plan.

5.2 The *tactical* value of this reporting is already recognized, and both this technology-based reporting and pilot/maintenance observations also have value for *post-flight* analysis. Consideration must therefore be given to this information's organized capture and centralized storage. European Aviation Safety Agency (EASA) Safety Information Bulletin (SIB) 17-R2 includes provisions for the reporting of ash encounters and findings through a dedicated email address, using a dedicated reporting form, ECCAIRS and ADREP 2000 compatible, which ICAO should consider using as a template for other regions in order to facilitate wider data collection and analytical synergies.

6. CONCLUSIONS

6.1 The Assembly is invited to consider as a matter of urgency directing ICAO to lead work at the global level to better address the disruptive effect of volcanic eruptions in the future, thereby ensuring a global harmonised approach and ensuring the necessary levels of safety, as well as to make full use of today's knowledge and technologies in order to limit disruption, maximize economic efficiency and protect the continuity of air services.

— END —