International Civil Aviation Organization

The Twentieth Meeting of the APANPIRG ATM/AIS/SAR Sub-Group (ATM/AIS/SAR/SG/20)

Singapore, 05 – 09 July 2010

Agenda Item 4: Review and progress the tasks assigned to the ATM/AIS/SAR/SG by APANPIRG

VOLCANIC ASH DEVELOPMENTS

(Presented by the Secretariat)

SUMMARY

This paper provides developments on the ICAO IVATF and EUR/NAT VATF as a result of the Icelandic Volcano Eruption in April and May 2010 that substantially disrupted travel and commerce in Europe and beyond.

This paper relates to

Strategic Objectives:
A: Safety – Enhance global civil aviation safety
D: Efficiency – Enhance the efficiency of aviation operations

Global Plan Initiatives:
GPI-18 Aeronautical information
GPI-19 Meteorological Systems

1. INTRODUCTION

1.1 The Eyjafefjallajökull Volcano eruption on 14 April 2010 significantly disrupted air travel and commerce in Europe and beyond. As a result of this event and to assist in the development of a global safety risk management framework to determine the safe levels of operation in airspace contaminated by volcanic ash, ICAO established the International Volcanic Ash Task Force (IVATF) on 29 April 2010. The composition of the task force is provided in section 5 of draft ICAO State letter AN 10/18.3-IND/10/5 in **Attachment 1**. As noted in the attachment to this State letter in the modus operandi,

> "The IVATF is a multi-disciplinary global group and a focal point and coordinating body of all work related to volcanic ash being carried out by ICAO and the global and regional levels. It will address issues related to air traffic management (ATM), airworthiness, aeronautical meteorology (MET) and atmospheric sciences and is tasked to identify work that needs to be undertaken, together with plans on how to progress them relying, to the extent possible, on existing bodies, such as the International Airways Volcano Watch Operations Group (IAVWOPSG) and the EUR/NAT Volcanic Ash Task Force. Any need for amendments to ICAO provisions, which are identified will be forwarded to the appropriate ICAO body for further action."

1.2 The terms of reference of the group are detailed in section 2.1 of the attached State letter. Associated tasks, together with expected deliverables, completion dates and coordination plans are provided in the table of the attachment.

2. DISCUSSION

2.1 As noted in the IVATF modus operandi, the IVATF relies in part on tasks conducted by existing bodies such as the EUR/NAT VATF which has met from 8 to 10 June 2010 in Paris to address volcanic ash issues raised by the recent Icelandic volcano event. In particular, the volcanic ash contingency plans were reviewed.

2.2 The EUR and NAT Regions have developed volcanic ash contingency plans that supplement global documentation on volcanic ash (Annexes 3, 11, 15, Doc 9691 and Doc 9766). The two plans were recently consolidated (EUR Doc 019 and NAT Doc 006, Part II) as agreed upon at the second meeting of the European and North Atlantic Volcanic Ash Task Force (EUR/NAT VATF/2) held in Paris from 8 to 10 June 2010 and provided in Appendix C to **Attachment 2**. The consolidated volcanic ash contingency plan has been endorsed by the North Atlantic Systems Planning Group (NAT SPG) on 23 June 2010 and is subject to endorsement by the European Air Navigation Planning Group (EANPG).

2.3 The consolidated volcanic ash contingency plan took into consideration the first meeting of EUR/NAT TF held in Paris on 12 May 2010 that determined a volcanic ash concentration threshold based on industry and scientific input for operators to utilize in their risk assessment used to determine whether or not to operate in the lower concentration of volcanic ash. Expanding on this theme, the EUR/NAT VATF/2 meeting agreed on thresholds of contamination levels and associated nomenclature.

2.4 Specifically, areas of low, medium and high contamination were defined with volcanic ash concentrations. That is, low contamination is defined as volcanic ash concentration of less than $2x10^{-3}$. Medium contamination is defined as volcanic ash concentration greater than $2x10^{-3}$ but less than $4x10^{-3}$ g/m^3 and high contamination is defined as volcanic ash concentration greater than $4x10^{-3}$ g/m^3. It is important to note that these volcanic ash concentration thresholds and associated contamination levels are not yet a global standard and that the formal procedures of developing this type of standard would be conducted through the established ICAO procedures.

2.5 Nomenclature consistent with other ICAO standards and recommended practices (SARPs) were also utilized in the combined contingency plan such as danger area, which is defined in Annex 2 as “an airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.” The EUR/NAT VATF/2 meeting agreed that danger areas are defined by the State with reference to the volcanic ash contamination levels. Therefore, there may be discontinuities at FIR boundaries if volcanic ash of various contamination levels impact several FIRs and the respective States use different contamination levels in determining the danger areas. This fact is expected to be addressed by the IVATF. Nevertheless, operators, through the State operator, are to decide on the safety of flight utilizing safety risk assessment.

2.6 The contingency phases are comprised of alerting, reactive and proactive phases. The alerting phase is characterized with limited information on the volcanic activity. A danger area is determined by an Area Control Centre (ACC) by way of a NOTAM with reference to established procedures or if not available by using a 120 nm radius around the volcano. If upper-level winds are known the center is located 60 nm downwind while still encompassing the volcano. ACC offers assistance to exit or remain clear of the danger area. Air Traffic Flow Management (ATFM) unit should initiate actions with regards to the exchange of information between Volcanic Ash Advisory

Centres (VAAC)s, Meteorological Watch Offices (MWO)s, Air Navigation Service Providers (ANSP)s and aircraft operators.

2.7 The reactive phase is characteristic of a volcanic eruption and consequently information such as eruption commenced SIGMET, NOTAM/ASHTAM, and first volcanic ash advisory is available. Danger areas are promulgated by NOTAM and ACC assists with rerouting aircraft around the danger areas. Air Traffic Flow Management (ATFM) unit should organize the exchange of latest information between VAACs, MWOs, ANSPs and aircraft operators.

2.8 The proactive phase is characterized with volcanic ash forecasts of contamination levels (where feasible) for 0, 6, 12 and 18 hours. The 0-hour and 6-hour forecasts are used: 1) to issue NOTAM indicating danger areas (separate NOTAM for medium levels of contamination if not indicated as a danger area), 2) to issue SIGMET on volcanic ash, and 3) to apply ATFM measures. The 12- and 18-hour forecasts are used to issue NOTAM for the primary purpose of flight planning. Operators utilize the volcanic ash contamination levels to perform their safety risk assessment noting that danger areas may be defined differently from State to State. ATFM may organize teleconferences to exchange the latest information between VAACs, MWOs, ANSPs and aircraft operators.

2.9 Reference is made to WP/14 to the ATM/AIS/SAR SG/20 meeting of APANPIRG, which contains a draft Decision that invites the CNS/MET SG/14 meeting to develop sub-regional volcanic ash contingency plans preferably utilizing a common template adapted for sub regional coordination amongst FIRs (i.e. western Pacific, Australia-Melanesia-Indonesia-Philippines, New Zealand-Tonga-Polynesia). Monitoring the IVATF developments is essential in that regional templates may be developed. The task forces equipped to adapt such a regional contingency plan template for the ASIA/PAC Region are under the jurisdiction of the CNS/MET SG, which meets in Jakarta, Indonesia from 19-22 July 2010. Identifying specific contingency and coordination needs that do not currently exist is necessary for the task force(s) to efficiently execute the tasks assigned and most importantly, develop the most useful material for States and operators.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information in this paper; and

b) consider identifying specific contingency and coordination needs for volcanic ash events in the Region.

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Tel.: +1 514-954-8194

Ref.: AN 10/18.3-IND/10/5 18 May 2010

Subject: Establishment of the International Volcanic Ash Task Force (IVATF)

Action required: Reply by 15 June 2010

Sir/Madam,

1. I have the honour to inform you that, in response to the disruptions to commercial air traffic in Europe caused by the eruption of Iceland's Eyjafjallajokull volcano, the International Civil Aviation Organization (ICAO) has established a task force with the attached *modus operandi* and terms of reference.

2. The task force, to be known as the International Volcanic Ash Task Force (IVATF), will assist the Secretariat to develop a global safety risk management framework that will make it possible to determine the safe levels of operation in airspace contaminated by volcanic ash.

3. It is expected that the work of the task force can be completed within a year although some complex issues will have to be pursued by appropriate ICAO bodies beyond 2011. The task will be progressed principally through correspondence. However, in view of the nature of the task, the task force will hold a meeting from 27 to 30 July 2010.

4. In light of the foregoing may I invite you to inform me, by 15 June 2010, whether your government or organization is willing to make available an expert for the IVATF and, if so, to let me know the name, address, telephone number and e-mail address of the nominee. When selecting the expert, you may wish to consider that the work of the IVATF will involve issues of a multi-disciplinary nature, encompassing air traffic management, airworthiness, aeronautical meteorology and atmospheric sciences.

5. For your information, invitations to make an expert available for participation in the work of the task force are being sent to:

Argentina, Australia, Brazil, Canada, Chile, France, Iceland, Japan, New Zealand, Russian Federation, Spain, United Kingdom, United States, Airports Council International (ACI), Civil Air Navigation Services

999 University Street
Montréal, Quebec
Canada H3C 5H7

Tel.: 514-954-8219
Fax: 514-954-6077

E-mail: icaohq@icao.int
www.icao.int

Organisation (CANSO), International Air Transport Association (IATA), International Coordinating Council of Aerospace Industries Associations (ICCAIA), International Federation of Air Line Pilots' Associations (IFALPA), International Federation of Air Traffic Controllers' Associations (IFATCA), International Federation of Airline Dispatchers' Associations (IFALDA), International Union of Geodesy and Geophysics (IUGG), World Meteorological Organization (WMO) and the World Organization of Volcano Observatories (WOVO).

Accept, Sir/Madam, the assurances of my highest consideration.

Raymond Benjamin
Secretary General

Enclosure:
Modus operandi and
terms of reference

ATTACHMENT to State letter AN 10/18.3-IND/10/5

MODUS OPERANDI AND TERMS OF REFERENCE OF THE INTERNATIONAL VOLCANIC ASH TASK FORCE (IVATF)

1. MODUS OPERANDI

1.1 The International Volcanic Ash Task Force (IVATF) is a multi-disciplinary global group and a focal point and coordinating body of all work related to volcanic ash being carried out by ICAO at the global and regional levels. It will address issues related to air traffic management (ATM), airworthiness, aeronautical meteorology (MET) and atmospheric sciences and is tasked to identify work that needs to be undertaken, together with plans on how to progress them relying, to the extent possible, on existing bodies, such as the International Airways Volcano Watch Operations Group (IAVWOPSG) and the EUR/NAT Volcanic Ash Task Force. Any need for amendments to ICAO provisions, which are identified will be forwarded to the appropriate ICAO body for further action.

1.2 The first meeting of the group will be held on 27 to 30 July 2010 and that the second meeting of the group will be convened in 2011. Between the meetings, the work will be progressed by the sub-groups with the following areas of expertise (the name of the group in brackets):

a) ATM (ATM sub-group);

b) airworthiness (AIR sub-group);

c) science (S sub-group); and

d) international airways volcano watch (IAVW coordination group).

1.3 Quarterly teleconferences will be held (in October 2010, January 2011 and April 2011) to monitor progress, i.e. at the teleconferences, the rapporteurs of each sub-group will provide progress reports and identify any issues which need to be brought to the attention of the IVATF as a whole.

1.4 The Secretary of the group is Dr. Olli M. Turpeinen, C/MET/AIM, ICAO Air Navigation Bureau (ANB) assisted by Mr. Raúl Romero, Secretary of the IAVWOPSG, ICAO Air Navigation Bureau (ANB).

2. TERMS OF REFERENCE

2.1 The IVATF is tasked to undertake, in close coordination with the IAVWOPSG and the EUR/NAT Volcanic Ash Task Force, the following tasks:

a) evaluation of the Icelandic eruption;

b) revision of guidance on volcanic ash contingency plans;

c) review of operational response to volcanic ash encounter;

d) development of ash concentration thresholds;

e) improvement of ash detection systems;

f) review of notification and warning for volcanic ash;

g) improvement and harmonization of dispersion models; and

h) improvement of visual volcanic ash advisory centre (VAAC) products.

2.2 The details of the tasks, together with the expected deliverables, completion dates and coordination plans, are in the table below.

Table. Detailed tasks of the International Volcanic Ash Task Force (IVATF)

Title	*Task Description*	*Expected Deliverable*	*Expected completion Date*	*Coordination*	*Responsibility*
Evaluation of the Icelandic eruption	Determine (chronologically) what occurred after the eruption (the reaction to the event by the various stakeholders); identify what needs to be done next	Based on the evaluation and lessons learned, make recommendations	1 August 2010	EUR/NAT VATF, IAVWOPSG	IVATF as a whole
Revision of guidance on volcanic ash contingency plans	Assess existing (regional and global) guidance in light of the Icelandic eruption experience	Identify guidance which needs to be updated	1 August 2010	EUR/NAT VATF, IAVWOPSG	IVATF as a whole
Review of operational response to volcanic ash encounter	Assess contingency procedures and reporting criteria to detect and mitigate risk	Identify operational and ATC procedures which need to be updated, together with an assessment for the need of guidance for information sharing and decision making	1 August 2010 – 1 August 2011	ATM Section	ATM sub-group
Development of ash concentration thresholds	Develop the acceptable level(s) of ash concentration for safe aircraft operations in contaminated airspace; establish regulatory provisions required for the level(s) identified	Identify provisions required to be developed for various types of operations	1 November 2010 – 1 May 2013	OPS, ATM Sections	AIR sub-group
Improvement of ash detection systems	Determine the ways and means to improve ash detection/ avoidance systems	Identify technologies and recommend system requirements for ground, airborne and space-based systems	1 November 2010 - 1 May 2013	IAVWOPSG; AMOFSG; WMO	S sub-group

Title	*Task Description*	*Expected Deliverable*	*Expected completion Date*	*Coordination*	*Responsibility*
Review of notification and warning for volcanic ash	Review existing notification and warning procedures in light of the Icelandic eruption experience	Recommend procedures, as necessary, to enhance pre-flight and in-flight information dissemination technologies to ensure notification of all flights affected	1 March 2011	ATM Section; METWSG; IAVWOPSG	ATM sub-group
Improvement and harmonization of dispersion models	Identify any additional work related to the improvement and harmonization of dispersion models (including eruption source parameters), required to be undertaken by the IAVWOPSG	Centralized and harmonized VAAC forecasts available on-line	1 May 2011	IAVWOPSG	IAVW coordination group
Improvement of visual VAAC products	Identify the need to refine the existing VAG charts in the PNG format, with the view of mapping areas of ash contamination according to the level of ash concentration	Proposals for updated model charts to include displays of ash concentrations (products to be integrated in other MET charts)	1 May 2011	IAVWOPSG	IAVW coordination group

— END —

European and North Atlantic Office

SUMMARY OF DISCUSSIONS OF THE EUROPEAN AND NORTH ATLANTIC VOLCANIC ASH TASK FORCE (EUR/NAT VATF)

SECOND MEETING

(Paris, 8 to 10 June 2010)

1. Introduction

1.1 The second meeting of the European and North Atlantic Volcanic Ash Task Force (EUR/NAT VATF/2) was held on 8 to 10 June 2010 at the ICAO EUR/NAT Regional Office, Paris. The meeting was attended by 52 experts representing 19 States and 9 International Organizations. The lists of participants and contact details are at **Appendix A**.

1.2 The principle objectives of the meeting were to finalize proposals for amendment to the volcanic ash contingency plans of the EUR and NAT Regions, and draft recommendations for consideration at the International Volcanic Ash Task Force (IVATF).

1.3 Mr. Karsten Theil, ICAO Regional Director, Europe and North Atlantic, chaired the meeting with Secretariat assistance provided by Ms. Carole Stewart-Green, Mr. Sven Halle, Mr. Greg Brock and Mr. Willie Muir. Dr. Olli Turpeinen, Chief MET/AIM, ICAO Headquarters Montréal, assisted the meeting during Agenda Items 1, 2 and 4.

1.4 At its opening session, the Task Force adopted the following agenda:

Agenda Item 1: Report on activities since EUR/NAT VATF/1.

Agenda Item 2: Proposed Amendments to Volcanic Ash Contingency Plan – EUR Region (EUR Doc 019).

Agenda Item 3: Proposed Amendments to North Atlantic Volcanic Ash Contingency Plan (Nat Doc 006 Part II).

Agenda Item 4: Recommendations to the International Volcanic Ash Task Force.

Agenda Item 5: Any other business.

1.5 The list of papers considered by the Task Force is at **Appendix B**.

2. Summary of discussions

Report on activities since EUR/NAT VATF/1

2.1 The meeting recalled that it had formulated a Decision Record at EUR/NAT VATF/1 (12 May 2010), and that the decisions related to six specific areas:

i) Importance of standardised VAAC charts;

ii) Principles to the used for the derogation to the volcanic ash contingency plans;

iii) Revision to the contingency plans;

iv) Work programme to move to the "airline operator's responsibility option";

v) Single VAAC concept; and

vi) Scope of update of contingency plans.

2.2 During the intersession period, the EUR/NAT VATF had principally worked via correspondence and teleconference to progress the abovementioned decisions, including the promulgation of a NAT OPS Bulletin (2010-009) and initial revisions to the EUR and NAT volcanic ash contingency plans.

Proposed amendments to the volcanic ash contingency plans of the EUR and NAT Regions

2.3 When considering amendments to the contingency plans, the meeting recognised that much of the guidance contained therein was applicable to both the EUR and the NAT Regions and that considerable benefit (particularly from a Secretariat and an operational perspective) could be obtained by consolidating the two plans into a combined *Volcanic Ash Contingency Plan - EUR and NAT Regions*, provided that specific reference to any procedures of relevance to *only one* of the ICAO Regions was clearly defined in the Plan.

2.4 In addition, when discussing what changes were necessary to the volcanic ash contingency plans in light of recent events in the EUR and NAT Regions, the meeting emphasized the importance of:

i) adopting a harmonized and common methodology that could enable the Plan to be applicable to both the EUR and the NAT Regions, and perhaps used as a template for other ICAO Regions which do not yet have volcanic ash contingency plans;

ii) the use of nomenclature that provides consistency, clarity and simplicity, whilst also allowing States the flexibility to exercise their Sovereign Rights;

iii) the striking of a balance between the safety and efficiency; an

iv) redefining the Plan from an Air Traffic Services (ATS) contingency plan to an Air Traffic Management (ATM) contingency plan.

2.5 Consequently, a proposal for amendment to a *combined* volcanic ash contingency plan for the EUR and NAT Regions is presented at **Appendix C** to this report.

2.6 During the redrafting of the Plan, when considering the introduction of terminology such as *'Danger Zones', 'Restricted Zones', 'Danger Areas', 'Restricted Areas', 'Prohibited Areas'* etc, the meeting recognized the benefits of adopting the language used in ICAO SARPS which is globally applicable and understood. For example, Annex 2 – Rules of the Air – Chapter 1 refers as follows:

Danger area. *An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.*

Restricted area. *An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.*

Prohibited area. *An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.*

2.7 In view of the fact that Danger Areas may be established in any airspace, the meeting agreed that for the sake of simplicity and uniformity, to refer only to Danger Areas. However, it is noted in the document that States have the remit to establish Restricted or Prohibited Areas in their sovereign airspace.

2.8 The meeting acknowledged that air traffic control clearances are provided mainly to ensure safety of flight and maintain separation. Consequently, air traffic controllers do not normally issues clearances through Danger Areas; however, depending upon the State concerned it may be permissible to provide a clearance to penetrate a Danger Area when specifically requested by the pilot-in-command. The meeting also acknowledged that under no circumstance could access be denied to any part of High Seas airspace.

2.9 An airline operator, through the State of the Operator, would determine where it could or should not fly based upon, *inter alia,* a safety risk assessment. Accordingly, an example safety risk assessment process has been added to the Plan.

2.10 When considering the recent availability of ash concentration charts by the United Kingdom Met Office (co-located with Volcanic Ash Advisory Centre London), which had been developed under the direction of the United Kingdom Civil Aviation Authority, the meeting was aware that other similar products were in existence from other provider States in the EUR and NAT Regions, and that there was a need to adopt a common terminology to describe the different areas of contaminated airspace. The United Kingdom CAA had, for example, used the ash concentration guidance to facilitate the establishment of 'Enhanced Procedures Zones (EPZ)', Time Limited Zones (TLZ)', and 'No Fly Zones (NFZ)' in United Kingdom airspace, whilst the European Commission had defined the same airspaces using different terminology.

2.11 Consequently, and in view of the fact that no one definition would necessarily fit all, the meeting agreed that within the Plan, reference should only be made to *Areas of Low Contamination, Areas of Medium Contamination, and Areas of High Contamination*, based on agreed and stated thresholds of ash contamination. A State would then be in a position to exercise its oversight duties and impose certain requirements and restrictions for flights to operate in contaminated airspace. This would not prevent a State from exercising it oversight responsibilities; however if all States referred to the same terminology, it was hoped that this would facilitate interoperability and harmonisation of procedures.

2.12 With this approach, a State would be at liberty to determine whether it would treat, for example, only Areas of High Contamination as Danger Areas; or whether it would treat Areas of Medium and Areas of High Contamination as Danger Areas. This allows for the flexibility as described at paragraph 2.2 above. The meeting agreed however, that this could create a discontinuity at the interface between adjacent FIRs when one has a Danger Area based on Areas of High Contamination and the other established Danger Areas based on Areas of Medium and Areas of High Contamination. It was noted that this was an issue that would require further consideration within the EANPG and NAT SPG or the international arena (such as the IVATF) in view of fostering interoperability and harmonization.

2.13 When considering the over-flight of a contaminated airspace, irrespective of the expected ash concentration, the meeting recommended that States should require their operators to

adopt a procedure akin to that applied for operation over mountainous terrain, thus ensuring the necessary contingencies are in place in the event of an emergency. Such as recommendation has been included in the Plan.

2.14 The meeting recognised that the development and availability of ash concentration charts was beyond the current scope and framework of the International Airways Volcano Watch (IAVW) of ICAO – which operates the system of nine VAACs around the world providing volcanic ash advisory information in accordance with ICAO Annex 3 – *Meteorological Service for International Air Navigation*. The meeting was informed that the meteorological offices co-located with VAAC London and VAAC Toulouse (United Kingdom Met Office and Meteo-France respectively) were already in a position to promulgate such guidance charts; however, it was unclear whether other meteorological offices co-located with VAACs that have responsibility for the EUR and NAT Regions (i.e. VAAC Washington, VAAC Montréal, VAAC Anchorage and VAAC Tokyo) were also in a position to make such ash concentration guidance available. Accordingly, within the Plan, the provision of ash concentration charts by meteorological offices co-located with the VAACs should be fulfilled *where feasible*.

2.15 When considering the Alerting Phase, Reactive Phase, and Proactive Phase described in the Plan, the meeting noted that the Alerting Phase mainly detailed actions that would be conducted prior to the availability of information from the VAAC and other sources; the Reactive Phase mainly concerned the tactical rerouting of aircraft; and the Proactive Phase mainly concerned the ability to plan ahead taking into account the information from the VAAC and other sources. The meeting determined that these three phases should be maintained within the Plan, keeping the existing naming convention, but revised the procedures in the light of lessons learned and taking into consideration the possible availability of ash concentration guidance.

2.16 The Plan clearly indicates the limited differences between the procedures required in the EUR and NAT Regions, as follows:

i) NAT Organized Track System (OTS) [applicable only to the NAT Region]; and

ii) ASHTAM are not promulgated by NAT provider States, but may be provided by some EUR provider States.

2.17 In welcoming recent regional initiatives such as the European Aviation Crisis Coordination Cell (EACCC) at EUROCONTROL, the meeting recognized that there would be challenges in trying to accommodate such specific initiatives within a Plan that was intended to cover *all* States in the EUR and NAT Regions. Consequently, the meeting agreed that such initiatives could be referenced as necessary through the use of notes – for example, there is a note directing readers to the Central Flow Management Unit (CFMU).

2.18 In considering existing references to the CFMU of EUROCONTROL within the Plans, and noting that other air traffic flow management units provide service in the EUR and NAT Regions, the meeting determined that all such ‘CFMU’ references should revert to ‘appropriate ATFM unit’ in the revised Plan.

2.19 In order to facilitate the usability of the document the meeting agreed that sample SIGMET, NOTAM and ASHTAM should be included in an Appendix to the Plan. It was not possible to use the existing examples in the Plan, due to the need to:

i) Take account of the decision to reference ‘Danger Areas’ rather than ‘Danger Zones’;

ii) Refer to Areas of Low/Medium/High Contamination;

iii) Refer to ‘Clearance’ rather than ‘IFR clearances’; and

iv) Refer to ‘flights’ or ‘aircraft’ rather than ‘IFR flights’ and ‘IFR aircraft’.

2.20 Therefore, appropriate examples need to be developed. The meeting did not believe it had the appropriate expertise for this task, and accordingly the EANPG COG and NAT SPG should be invited to determine how these messages should be developed.

Recommendations to the International Volcanic Ash Task Force

2.21 In accordance with its Terms of Reference, the meeting prepared a number of recommendations for consideration by the International Volcanic Ash Task Force (IVATF), based on lessons learned and experiences gained during the recent volcanic ash crisis in the EUR and NAT Regions.

2.22 **Appendix D** to this report provides, in tabulated format, the EUR/NAT VATF recommendations prepared by the meeting, and includes additional feedback received at the EUR/NAT Office from EUR/NAT VATF members via correspondence, for consideration at first meeting of the IVATF (IVATF/1), scheduled to take place in Montréal from 27 to 30 July 2010.

2.23 Each of the recommendations shown in **Appendix D** has been aligned with the appropriate sub-groups of the IVATF – for example, matters concerning improvements to the volcanic ash notification and warning mechanism should be considered by the ATM sub-group of the IVATF. However, it should be noted that a number of the recommendations cross disciplinary boundaries.

Any other business

2.24 No items were raised under any other business.

Close of the meeting

2.25 The ICAO Regional Director, Europe and North Atlantic, in noting that the task force had completed all of its deliverables on time and in accordance with its Terms of Reference, expressed his sincere gratitude to the members for their excellent contributions, and proceeded to dissolve the EUR/NAT VATF.

2.26 The EUR/NAT VATF meeting closed at 1730 hours on 10 June 2010.

APPENDIX A - LIST OF PARTICIPANTS

(paragraph 1.1 refers)

CANADA

Larry LACHANCE

CZECH REPUBLIC

Jan KRACMAR

Rudolf KRAUS

DENMARK

Bo FELDBERG

FRANCE

Jean-Pierre MESURE

Patrick JOSSE

GERMANY

Dirk ENGELBART

Erland LORENZEN

Bernd RANDECKER

Klaus STURM

ICELAND

Benedikt GRONDAL

Leifur HAKONARSON

IRELAND

Terry TREANOR

ITALY

Vincenzo CALCATERRA

Santo Giuseppe SGRO

Domenico VILLA

LITHUANIA

Margarita PAULAUSKIENE

Sergej SMIRNOV

NETHERLANDS

Rob VAN DER BOOM

NORWAY

Jan Gunnar PEDERSEN

Ira SMEDBY

PORTUGAL

Alvaro ANTUNES

ROMANIA

Octavian PLETER

Adrian STEFAN

Dorinel VISOIU

RUSSIAN FEDERATION

Elena GLUHOVSKAYA

SERBIA

Sasa VUCETA

SPAIN

Ricardo ALONSO GONZALEZ

SWITZERLAND

Dieter NUSSBAUMER

Sue BRASH

UNITED KINGDOM

Brendan KELLY

Nigel GAIT

Colin HORD

Doug JOHNSON

UNITED STATES

Kevin HAGGERTY

AEA

Araceli CAL

EASA

Henk PRUIS

EUROCONTROL

Zarko SIVCEV
Cay BOQUIST

EUROPEAN COMMISSION

Peter SORENSEN

ICCAIA

Richard KENNEDY

Joelle MONSO

IATA

Anthony VAN DER VELDT

IFALPA

Heinz FRÜHWIRTH

WMO

Herbert PUEMPEL

ICAO

Karsten THIEL (Chairman)

George FIRICAN

Olli TURPEINEN

Greg BROCK

Carole STEWART

Sven HALLE

Willie MIUR

LIST OF CONTACTS

CANADA	**Larry LACHANCE** Assistant Vice President of Operational Support NAV Canada 77 Metcalfe Street K1P 5L6 Ottawa, ON CANADA	+ 1 613 563 5426 Fax: 1 613 563 5602 E-mail: lachanl@navcanada.ca
CZECH REPUBLIC	**Jan KRACMAR** Air Navigation Services of Czech Republic RLP CR - DPLR/ORLNS Navigacni 787 CZ-25261 Jenec CZECH REPUBLIC	+ 420 220 37 2501 Fax: +420 220 37 2011 E-mail: kracmar@ans.cz
	Rudolf KRAUS CAA Letisté RUZYNE 16008 Prague CZECH REPUBLIC	+ 420 225 421 281 Fax: +420 220 561 692 E-mail: krausr@caa.cz
DENMARK	**Bo FELDBERG** Statens Luftfartvaesen Ellebdergved 50 2450 KBH DENMARK	+45 3618 6395 E-mail: bofe@slv.dk
FRANCE	**Jean-Pierre MESURE** DGAC France 50 Rue Henri Farman 75720 Paris Cedex 15 FRANCE	+33 1 58 09 43 80 E-mail: jean-pierre.mesure@aviation-civile.gouv.fr
	Patrick JOSSE Aviation Forecast Head Meteo France - Toulouse FRANCE	+ 33 1 56 10 78 237 Fax: + 33 1 56 10 78 209 E-mail: patrick.josse@meteo.fr
GERMANY	**Dirk ENGELBART** Federal Ministry of Transport BMVBS Division LR-21 Robert Schuman Platz 1 53175 Bonn GERMANY	+ 49 228 99 300 49 11 Fax: + 49 228 300 807 49 11 E-mail: dirk.engelbart@bmvbs.bund.de

	Erland LORENZEN Supervisory Office for ATC BAF Agency Bundesaufsichtsamt für Flugsicherung Federal Supervisory Authority for Air Navigation Services Robert-Bosch-Straße 28 63225 Langen GERMANY	+ 49 6103 804 33 50 E-mail: erland.lorenzen@baf.bund.de
	Bernd RANDECKER International Affairs DFS Deutsche Flugsicherung GmbH AM DFS Campus 10 63225 Langen GERMANY	4961037074144 Fax: 4961037074198 E-mail: bernd.randecker@dfs.de
	Klaus STURM Director (Aviation) Deutscher Wetterdienst (DWD) Frankfurterstrasse 135 D-63067 Offenbach am Main GERMANY	+ 49 69 8062 2899 Fax: + 49 69 8062 2014 E-mail: klaus.sturm@dwd.de
ICELAND	**Benedikt GRONDAL** Icelandic Civil Aviation Administration (ICAA) Inspector Air Navigation Services / NSA Skogarhlid 12 105 Reykjavik ICELAND	+354 569 4404 Fax: +354 562 3619 E-mail: benedikt@caa.is
	Leifur HAKONARSON ISAVIA P.O. Box 350 Reykjavik Airport IS-101 Reykjavik ICELAND	+354 4244206 Fax: +354 5624599 E-mail: leifur@isavia.is
IRELAND	**Terry TREANOR** Manager System Support & Performance Operations Directorate Irish Aviation Authority Aviation House Dublin IRELAND	+353 016031532 E-mail: terry.treanor@iaa.ie
ITALY	**Vincenzo CALCATERRA** ENAC - Direzione Regolazione Spazio Aereo Piazzale Luigi Sturzo, 15 00144 Roma ITALY	+ 39 069 801 8908 Fax: + 39 0645 40 5702 E-mail: v.calcaterra@enac.gov.it

	Santo Giuseppe SGRO ENAV/AOIS Via Appia Nuova 1491 Roma or ENAV Via Salaria 716 00138 Roma ITALY	+39 320 569 5079 E-mail: santo.sgro@enav.it
	Domenico VILLA ENAC - Direzione Regolazione Spazio Aereo Piazzale Luigi Sturzo, 15 00144 Roma ITALY	+390698018916 Fax: +390645405702 E-mail: d.villa@enac.gov.it
LITHUANIA	**Sergej SMIRNOV** Director ATM State Enterprise "Oro Navigacija" Rodunios kelias LT-02188 Vilnius LITHUANIA	+37052194503 Fax: +37052194522 E-mail: smirnov.s@ans.lt
	Margarita PAULAUSKIENE Head of Air Navigation Services Division CAA Rodunios kelias 2 LT-02188 Vilnius LITHUANIA	+37052739247 Fax: +37052739248 E-mail: margarita.paulauskiene@caa.lt
NETHERLANDS	**Rob VAN DER BOOM** Senior Policy Officer Ministry of Transport, Public Works and Water Management Directorate General for Civil Aviation and Maritime Affairs P.O. Box 20904 2500 EX The Hague NETHERLANDS	+ 31652596048 Fax: + 31703516213 E-mail: rob.vander.boom@minvenw.nl
NORWAY	**Jan Gunnar PEDERSEN** AVINOR - Norway P.O. Box 150 2061 Gardermoen NORWAY	+47 9719 4853 E-mail: jan-gunnar.pedersen@avinor.no
	Ira SMEDBY Inspector MET CAA P.O Box 243 8001 Bodö NORWAY	+47 98 26 18 05 E-mail: ira.smedby@caa.no

PORTUGAL	**Alvaro ANTUNES** NAV Portugal, EPE Apartado 47, 9580 909 Vila do Porto, ACORES PORTUGAL	+351296820519 Fax: +351 296 820 363 E-mail: alvaro.antunes@nav.pt
ROMANIA	**Octavian PLETER** INTR. DIFUZORULUI 1 010891 Bucharest ROMANIA	E-mail: otp@brainbond.ro
	Adrian STEFAN Bucharest FMP Supervisor Ion Ionescu de la Brad Blvd no: 10 Bucharest ROMANIA	+40 21 2083 194 Fax: +40 21 2083 274 E-mail: adrian.stefan@romatsa.ro
	Dorinel VISOIU Head of MET Division Romanian Air Traffic Services Administration (ROMATSA) 10, Ion Ionescu de la Brad Street P.O. box 18.90 71592 Bucharest ROMANIA	+ 40 21 208 32 06 Fax: + 40 21 208 35 79 E-mail: dorinel.visoiu@romatsa.ro
RUSSIAN FEDERATION	**Elena GLUHOVSKAYA** Federal Air Transport Agency Department of Airspace utilization management Department Adviser Leningradski pr 37 A-167 Moscow RUSSIAN FEDERATION	7 499231 6896 Fax: 7 499231 5535 E-mail: Gluhovskaya_EP@fana.ru
SERBIA	**Sasa VUCETA** Instructor Forecaster SMATSA SERBIA	+ 381 11 310 4868 E-mail: mwo.beograd@smatsa.rs
SPAIN	**Ricardo ALONSO GONZALEZ** Ministerio de Fomento - AESA Coordinador de Navegacion Aérea P° de la Castellana, 67 28071 Madrid SPAIN	34 91 597 78 32 Fax: +34 91 597 81 14 E-mail: ralonsog@fomento.es
SWITZERLAND	**Dieter NUSSBAUMER** ANS Policy and Rulemaking Mühlestrasse 2 CH-3063 Ittigen SWITZERLAND	+ 41 31 325 0810 E-mail: dieter.nussbaumer@bazl.admin.ch

	Sue BRASH Skyguide - Swiss Air Navigation Services Ltd P.O. Box 796 1215 Geneva SWITZERLAND	+ 41 22 417 43 05 E-mail: sue.brash@skyguide.ch
UNITED KINGDOM	**Brendan KELLY** Head of ATM Policy NATS CTC 4000 Parkway Whiteley, Farehm Hampshire PO15 7FL UNITED KINGDOM	+ 44 1489 615815 E-mail: brendan.kelly@nats.co.uk
	Nigel GAIT Meteorological Office Fitzroy Road Exeter Devon EX1 3PB UNITED KINGDOM	441 392 886 268 Fax: 441 392 88 5681 E-mail: nigel.gait@metoffice.gov.uk
	Colin HORD Civil Aviation Authority 45-59 Kingsway K6 G1 London WC2B 6TE UNITED KINGDOM	+44 20 7453 6527 Fax: +44 20 7453 6565 E-mail: colin.hord@caa.co.uk
	Doug JOHNSON Met Office FitzRoy Road Exeter Devon EX1 3PB UNITED KINGDOM	441 392 886 420 Fax: 441 392 886 5681 E-mail: doug.johnson@metoffice.gov.uk
UNITED STATES	**Kevin HAGGERTY** Air Traffic Organization, Strategy and Performance International Office, Europe, Africa and Middle East Group FAA c/o American Embassy Brussels BELGIUM	+32 (2) 508 2700 Fax: F +32 (2) 230 2597 E-mail: kevin.haggerty@faa.gov
AEA	**Araceli CAL** AEA Avenue Louise 350 B-1050 Brussels BELGIUM	+32 2 639 89 77 Fax: +32 2639 8999 E-mail: araceli.cal@aea.be

EASA	**Henk PRUIS** Powerplan & Fuel Systems Expert EASA Köln GERMANY	+ 49 221 89990 4035 Fax: + 49 221 89990 4535 E-mail: henk.pruis@easa.europa.eu
EUROCONTROL	**Zarko SIVCEV** Eurocontrol Rue de la Fusée, 96 B-1130 BRUSSELS BELGIUM	32 2729 9775 Fax: +32 2729 9028 E-mail: zarko.sivcev@eurocontrol.int
	Cay BOQUIST Eurocontrol Rue de la Fusée, 96 B-1130 BRUSSELS BELGIUM	+32 2 729 3260 Fax: +32 27299003 E-mail: cay.boquist@eurocontrol.int
EUROPEAN COMMISSION	**Peter SORENSEN** Aviation Directorate of the European Commission's Directorate General for Mobility and Transport Unit MOVVE E2 Single European Sky and Modernization of air traffic control BELGIUM	+32 2 299 3329 E-mail: Peter.SORENSEN@ec.europa.eu
IATA	**Anthony VAN DER VELDT** IATA Regional Office - Infrastructure (Europe) 350, Avenue Louise B-1050 Brussels BELGIUM	+ 3226261807 Fax: 3226485135 E-mail: vandervela@iata.org
ICCAIA	**Richard KENNEDY** The Boeing Company Canada Real de Las Merinas 1-3 Edificio 4 Planta 4 28042 Madrid SPAIN	+34 91 768 8400 E-mail: richard.j.kennedy@boeing.com
	Joelle MONSO AIRBUS 1 rond-point Maurice Bellonte 31707 Blagnac FRANCE	E-mail: joelle.monso@airbus.com

IFALPA	**Heinz FRÜHWIRTH** IFALPA member of ATS Committee Interpilot House Gogmore Lane Chertsey, KT16 9AP UNITED KINGDOM	+ 43 664 300 1643 E-mail: hf0512@aon.at
WMO	**Herbert PUEMPEL** W.M.O. - P.O. Box 2300 CH-1211 Geneva 2 SWITZERLAND	+ 41 22 730 8283 Fax: + 41 22 730 81 28 E-mail: hpuempel@wmo.int
ICAO	**Karten THEIL** ICAO 3 bis, Villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex FRANCE	+33 1 46 41 85 50 Fax: + 33 1 46 41 85 00 E-mail: ktheil@paris.icao.int
	Greg BROCK ICAO 3 bis, Villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex FRANCE	+33 1 46 41 85 16 Fax: + 33 1 46 41 85 00 E-mail: gbrock@paris.icao.int
	Sven HALLE ICAO 3 bis, Villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex FRANCE	+33 1 46 41 85 24 Fax: + 33 1 46 41 85 00 E-mail : shalle@paris.icao.int
	Carole STEWART-GREEN ICAO 3 bis, Villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex FRANCE	+33 1 46 41 85 22 Fax: + 33 1 46 41 85 00 E-mail : stewart@paris.icao.int
	Willie MIUR ICAO 3 bis, Villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex FRANCE	+33 1 46 41 85 85 Fax: + 33 1 46 41 85 00 E-mail : gbm1@hotmail.co.uk
	Olli TURPEINEN ICAO HQ Montreal 999 University Street Montreal Quebec H3C 5H7 CANADA	+ 1 514 954 82 19 Fax : + 1 514 954 60 77 E-mail: oturpeinen@icao.int

APPENDIX B - LIST OF DOCUMENTS
(paragraph 1.5 refers)

WP/IP	Agenda	Title	Presented by
WP01		Provisional Agenda	Secretariat
WP02	2	EUR Doc 019	Secretariat
WP02 Attach	2	EUR Doc 019 with draft amendments	Secretariat
WP03	3	NAT Doc 006	Secretariat
WP03 Attach	3	NAT Doc 006 with draft amendments	Secretariat
WP04	2/3	Proposed terminology to be used in the EUR and NAT Volcanic Ash ATM Contingency Plans	Secretariat
WP05	2	EUROCONTROL Proposal for Amendment to Doc 019	EUROCONTROL
WP05 Attach	2	EUR Doc 019 with proposed amendments	EUROCONTROL
IP01		Provisional schedule	Secretariat
IP02	1	Outcome of thee EUR/NAT VATF/1 Meeting	Secretariat
IP03	1/4	Terms of Reference of EUR/NAT VATF and International VATF	Secretariat
IP04	3	NAT OPS Bulletin 2010-009	Secretariat
IP05	4	AEA Proposal for Operations in Airspace at Risk of Volcanic Ash Contamination	AEA
Flimsy1		Updated proposed amendments to EUR Doc 019, up to Section 4	Secretariat
Flimsy2		WITHDRAWN	
Flimsy3		Updated proposed amendments to EUR Doc 019, Appendices B, C & D	Secretariat
Flimsy4		Updated revisions from discussion of Flimsy 1	Secretariat
Flimsy5		Updated proposed amendments to EUR Doc 019, Section 5 onwards (except Appendices B, C & D)	Secretariat
Flimsy6		PANS-ATM extracts concerning Volcanic Ash Reports	Secretariat
Flimsy7		Updated revisions from discussion of Flimsy 4	Secretariat
Flimsy8		Agreed text for Appendices B, C & D, from discussion of Flimsy 3	Secretariat
Flimsy9		Agreed text from discussion of Flimsy 5	Secretariat
Flimsy10		Updated proposed amendments to NAT Doc 006	Secretariat

APPENDIX C - PROPOSAL FOR AMENDMENT TO THE VOLCANIC ASH CONTINGENCY PLAN – EUR AND NAT REGIONS

EUR Doc 019
NAT Doc 006, Part II

INTERNATIONAL CIVIL AVIATION ORGANIZATION

PROPOSED AMENDMENT TO THE VOLCANIC ASH CONTINGENCY PLANS

EUR AND NAT REGIONS AS AGREED BY THE EUR/NAT VATF

Proposed amendments are indicated by showing new text in grey highlight and deleted text in ~~strikeout~~.

~~**Second Edition**~~

~~**September 2009**~~

June 2010

THIS DOCUMENT IS ISSUED BY THE ~~ICAO~~ EUR/NAT OFFICE~~, PARIS~~ OF ICAO

UNDER THE AUTHORITY OF THE EANPG AND THE NAT SPG

TABLE OF CONTENTS

FOREWORD

Within and adjacent to the ~~The~~ North Atlantic (NAT) and European (EUR) Regions ~~regions~~ there are ~~include~~ areas of volcanic activities~~; this contingency plan considers, in particular, volcanic activities in Iceland~~ which are likely to affect flight in the NAT and EUR ~~regions~~ Regions. ~~Also taken into consideration are possible eruptions in Italy, Canary Islands and Portugal (the Azores).~~ The plan sets out standardised guidelines for the alerting of aircraft when eruptions occur, and procedures to be followed ~~by the area control centres (ACCs) when planning routings around the ash cloud~~.

It should be noted that this document is an air traffic ~~services (ATS)~~ management (ATM) contingency plan including its interfaces with supporting services such as AIS and MET. Where distinct actions by the Meteorological Watch Offices (MWOs) are described, these are additional procedures to be considered by MWOs. Where actions by Volcanic Ash Advisory Centres(VAACs) and Aircraft Operators are described, ~~this is~~ these are for clarification only. ~~this document does not prescribe actions by any entity other than the ATS units concerned.~~

These suggested procedures are not intended to establish or confirm a safe level of ash concentration. Values have been agreed to depict an area of ash concentration as low, medium or high. Operation through any area where volcanic ash is forecast is at the discretion of the operator.

N**OTE** All modeled ash concentrations are subject to a level of uncertainty relative to errors in the estimation of the eruption strength.

Considering that a commercial aircraft will travel about 150 km (80 NM) in 10 minutes and that volcanic ash can rise to flight levels commonly used by turbine-engine aeroplanes in half that time, timely response to reports of volcanic ash is essential.

It is imperative that information on the volcanic activity is disseminated as soon as possible. In order to assist the staff in expediting the process in originating and issuing relevant messages (SIGMET, NOTAM, ASHTAM), a series of templates should be available for different stages of the volcanic activity. Examples of SIGMET, NOTAM and ASHTAM announcing volcanic activities in the different stages and operational measures are contained in Attachment I. ASHTAM will not be promulgated by service providers in the NAT Region.

A list of ICAO registered volcanoes should be available at the international NOTAM office with volcano name, number and nominal position.

In order to ensure the smooth implementation of the contingency plan in case of an actual volcanic eruption, annual VOLCEX exercises should be conducted.

Terminology

Area of Low Contamination: An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or less than $2x10^{-3}$ g/m^3.

Area of Medium Contamination: An airspace of defined dimensions where volcanic ash may be encountered at concentrations greater than $2x10^{-3}$ g/m^3, but less than $4x10^{-3}$ 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 $4x10^{-3}$ g/m^3, or areas of contaminated airspace where no ash concentration guidance is available.

It should be noted that "defined dimensions" refers to horizontal and vertical limits.

The response to a volcanic event has been divided into three distinct phases described briefly below.

ALERTING PHASE

The initial ~~emergency~~ response, "raising the alert". Alerting information will be provided by ~~with~~ SIGMET, NOTAM or ASHTAM as appropriate and disseminated to affected aircraft in flight by the most expeditious means. In addition to the normal distribution list, the NOTAM/ASHTAM will be addressed to meteorological/volcanological agencies.

If it is considered that the event could pose a hazard to aviation, a ~~A temporary danger zone~~ Danger Area[1] ~~of 120 nm radius~~ will be declared by NOTAM around the volcanic source. Normally, ~~No~~ clearances will not be issued through the ~~danger zone~~ Danger Area.

REACTIVE PHASE

The Reactive Phase commences at the outbreak of the volcanic eruption and entrance of volcanic ash into the atmosphere and mainly pertains to aircraft in flight. A "Start of eruption SIGMET" will be issued and a ~~temporary danger zone~~ Danger Area ~~of 120 NM radius centred on the volcanic source, or centred 60 NM downwind~~ will be declared by NOTAM. Normally, ~~No~~ clearances will not be issued through the ~~danger zone~~ Danger Area.

~~Once the Volcanic Ash Advisory (VAA) with +6, +12, +18 hrs forecasts of contaminated areas has been issued, SIGMETs and NOTAMs based on the VAA will be issued.~~

PROACTIVE PHASE

The Proactive phase commences with the issuance of the first VAA after completion of reactive responses. The +0 and +6 hrs forecasts of the contaminated area ~~is~~ are to be issued as SIGMET. The +12 and +18 hrs (and further into the future) forecasts of contaminated areas are to be issued as NOTAM/ASHTAM. Significant changes may result in a reversion ~~revert~~ to a temporary Reactive Phase situation and unscheduled issuance of VAA, SIGMET and NOTAM/ASHTAM. As appropriate, Danger Areas will be notified via NOTAM.

[1] Wherever this document discusses the possible establishment of Danger Areas, States are not prevented from establishing Restricted or Prohibited Areas over the sovereign territory of the State if considered necessary by the State concerned.

~~It should be noted that this document is an air traffic services (ATS) contingency plan. Where actions by the Meteorological Watch Offices (MWOs), (VAACs) are described, this is for clarification only; this document does not prescribe actions by any entity other than the ATS units concerned.~~

~~In order to ensure the smooth implementation of the contingency plan in case of an actual volcanic eruption, annual VOLCEX exercises should be conducted~~

1. ALERTING PHASE

1.1 This phase is characterised by a limited availability of information on the extent and severity of the volcanic event. The purpose of this phase is to ensure the safety of aircraft in flight and to promulgate information as a matter of urgency. ~~It is anticipated that this phase will last between 30 minutes and one hour~~. Regardless of the extent of information available the alerting phase actions should be carried out for every event.

1.2 **ORIGINATING ACC ACTIONS** (eruption in its own flight information region)

1.2.1 In the event of significant pre-eruption volcanic activity, a volcanic eruption occurring, or a volcanic ash cloud being reported ~~in areas~~ which could ~~affect ATS routes used by civil~~ pose a hazard to aviation, an ACC, on receiving information of such an occurrence, should carry out the following:

a) Define an initial ~~danger zone~~ Danger Area in accordance with established procedures, or if no such procedures have been established the danger area should be defined as ~~of~~ a circle with a radius of 222 km (120 NM). If the eruption has not commenced or if no information on upper winds is available, the circle should be centred on the estimated location of the volcanic activity. If the eruption has started and predicted upper wind information is available, the circle should be centred 111 km (60 NM) downwind from while enclosing the volcano. ~~The size and location of the danger zone are intended to ensure that air traffic remains clear of any contaminated area by at least 111 km (60 NM).~~ The purpose of this initial ~~danger zone~~ Danger Area is to ensure safety of flight in the absence of any prediction from a competent authority of the extent of contamination.

b) Advise the associated Meteorological Watch Office (MWO) and the appropriate VAAC ~~by telephone~~ (unless the initial notification originated ~~was received~~ from either of these entities). The VAAC will then inform the appropriate Air Traffic ~~Central~~ Flow Management (ATFM) ~~Unit~~ units ~~(CFMU) in Brussels, which will issue an Air Traffic Flow and Capacity Management Information Message (AIM)~~.

c) Alert flights already within the ~~danger zone~~ Danger Area and offer assistance to enable an aircraft to exit ~~such an~~ the area in the most expeditious and appropriate manner ~~them vectors to expedite evacuation out of the area.~~ Also, aircraft that are close to the ~~danger zone~~ Danger Area should be ~~vectored~~ offered assistance to keep clear of the area. Tactically re-clear flights which would penetrate the ~~zone~~ Danger Area onto routes that will keep them clear. The ACC should immediately notify other affected ~~centres~~ ACC's of the event and the dimensions of the ~~danger zone~~ Danger Area. It should also negotiate any re-routings necessary for flights already coordinated but still within adjacent flight information regions (FIRs). It is also expected that adjacent ACCs will be asked to reroute flights not yet coordinated to keep them clear of the ~~danger zone~~ Danger Area.

d) ~~Issue~~ Ensure that a NOTAM/ASHTAM is originated. This must provide as precise information as is available regarding the activity of the volcano. The name (where applicable), reference number and position of the volcano should be included along with the date and time of the start of the eruption (if appropriate), levels and routes or portions of routes which could be affected and, as necessary, routes temporarily closed to air traffic. It is imperative that this information is issued by the international NOTAM office and is disseminated as soon as possible.

e) In order to assist the staff in expediting the process of composing the NOTAM/ASHTAM, a series of templates should be available for ~~different~~ this stage~~s~~ of the volcanic activity~~, such as alerting, eruption commenced, centre of temporary danger zone moved 60 NM downwind, contaminated area based on local MWO SIGMET, contaminated area based on VAA. A list of ICAO registered volcanoes should be available at the NOTAM office with volcano name, number and nominal position. An example alerting NOTAM announcing pre-eruption activity in volcano Katla is shown below:~~ Example NOTAM and ASHTAM are provided in Attachment I.

~~(A0777/04 NOTAMN~~

~~Q) BIRD/QWWXX/IV/NBO/W/000/999/6337.5N01901.5W120~~

~~A) BIRD~~

~~B) 0402260830 C) 0402261100~~

~~E) INCREASED VOLCANIC ACTIVITY, POSSIBLY INDICATING IMMINENT ERUPTION, REPORTED FOR VOLCANO KATLA 1702-03 6337.5N01901.5W ICELAND-S. VOLCANIC ASHCLOUD IS EXPECTED TO REACH 50.000 FEET FEW MINUTES FROM START OF ERUPTION. IFR AIRCRAFT ARE REQUIRED TO FLIGHT PLAN TO REMAIN AT LEAST 120NM CLEAR OF VOLCANO AND MAINTAIN WATCH FOR NOTAM/SIGMET FOR AREA. NO IFR CLEARANCE WILL BE ISSUED PENETRATING THE TEMPORARY DANGER ZONE.~~

~~F) GND G) UNL)~~

1.2.2 In addition to sending the NOTAM/ASHTAM (and any subsequent NOTAM/ASHTAM) to the normal distribution list, it will be sent to the relevant meteorological agencies after adding the appropriate WMO header ~~"NWIL31 BIRK ddhhmm" (where ddhhmm represents a date/time group)~~. Example NOTAM and ASHTAM are provided in Attachment I.

1.3 ADJACENT ACC ACTIONS

1.3.1 During the Alerting Phase aircraft should ~~will~~ be tactically rerouted to avoid the ~~danger zone~~ Danger Area. ~~As this phase will only last for a short period, any~~ Any ash cloud ~~would~~ should be contained within a limited area and disruption to traffic should not be excessive. Adjacent ACCs should take the following action to assist:

a) When advised, re-clear flights to which services are being provided and which will be affected by the ~~danger zone~~ Danger Area ~~but are still under your control~~.

b) Unless otherwise instructed, continue normal operations except:

i) if one or more routes are affected by the ~~danger zone~~ Danger Area, stop clearing aircraft on these routes and take steps to reroute onto routes clear of the ~~danger zone~~ Danger Area; and

ii) initiate a running plot of the affected area.

1.4 AIR TRAFFIC FLOW MANAGEMENT (ATFM) UNITS' ACTION

1.4.1 The ATFM unit and the VAACs will determine how their initial communications will take place on the basis of bilateral agreements. Upon reception of information on volcanic activity from the VAAC, the ATFM ~~flow management~~ unit should initiate actions in accordance with its procedures to ensure exchange of information between ANSPs, MWOs, VAACs and aircraft operators concerned. ~~in Brussels will issue an AIM. CFMU and the VAACs will determine how the initial communications will take place on the basis of bilateral agreements.~~

~~1.4.2 During the Reactive phase, depending on the impact of the volcanic ash, CFMU may take the initiative to organise teleconferences to exchange latest information on the developments with the VAACs, Air Navigation Service Providers (ANSPs) concerned and aircraft operators.~~

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2. REACTIVE PHASE

2.1 ~~This phase will last until such time as Proactive standing procedures can be adopted. The~~ This phase commences at the outbreak of volcanic eruption. Major activities of the phase are: Issuance of an "eruption commenced SIGMET", "eruption commenced NOTAM/ASHTAM", rerouting of airborne traffic, first VAA and issuance of SIGMET/NOTAM/ASHTAM based on the first VAA. As appropriate, Danger Areas will be notified via NOTAM. This phase will last until such time as the Proactive Phase can be activated.

2.2 ORIGINATING ACC ACTIONS (eruption in its own FIR)

2.2.1 ~~This phase begins at the outbreak of volcanic eruption.~~ Rerouting of traffic commences immediately or may be in progress if the alerting time has been sufficient to facilitate activation of the Alert Phase. ~~Air Traffic Controllers~~ The ACC should assist in ~~reroute~~ rerouting aircraft around the ~~danger zone~~ Danger Area as expeditiously as possible. ~~Air Traffic Controllers in adjacent~~ Adjacent ACCs ~~areas~~ should also take the ~~danger zone~~ Danger Area into account and ~~reroute~~ give similar assistance to aircraft as early as possible.

During this phase the ACC should:

a) Maintain close liaison with its associated MWO ~~and the appropriate VAAC~~. The MWO should issue a SIGMET message on the ash cloud and the forecast ~~movement~~ extent of the ash cloud at least every 6 hours, valid for 6 hours, based on the valid VAA as supplemented by additional appropriate sources of information.

b) Based on these forecasts and in cooperation with the adjacent ACCs, ~~air traffic flow management~~ ATFM measures should be devised and updated when necessary to ~~ensure that~~ enable aircraft to remain clear of Danger Areas ~~are cleared from the perimeter of the forecast furthest extent of the ash cloud~~.

c) Ensure ~~Issue~~ a NOTAM is originated to define a Danger Area. ~~Depending on the issuance time of VAA, NOTAM should be issued with 120NM radius temporary danger zone, or contaminated area based on SIGMET or VAA.~~

d) Ensure that reported differences between published information and observations (pilot reports, airborne measurements, etc.) are forwarded as soon as possible to the appropriate authorities.

~~**120 NM temporary danger area:**~~

~~(A0778/04 NOTAMR A0777/04~~

~~Q) BIRD/QWWXX/IV/NBO/W/000/999/6337.5N01901.5W120~~

~~A) BIRD~~

~~B) 0402260900 C) 0402261200~~

~~VOLCANIC ERUPTION REPORTED IN VOLCANO KATLA 1702-03 6337.5N01901.5W ICELAND-S. VOLCANIC ASHCLOUD REPORTED REACHING FL500. AIRCRAFT ON IFR CLEARANCE ARE REQUIRED TO REMAIN AT LEAST 120NM CLEAR OF VOLCANO AND MAINTAIN WATCH FOR NOTAM/SIGMET FOR BIRD AREA. NO IFR CLEARANCE WILL BE ISSUED PENETRATING THE TEMPORARY DANGER ZONE.~~

~~F) GND G) UNL)~~

~~Or~~

~~**Contaminated area based on SIGMET:**~~

~~A0778/04 NOTAMR A0777/04~~

~~Q) BIRD/QWWXX/IV/NBO/W/000/999/~~

~~A) BIRD~~

~~B) 0402261100 C) 0402261300~~

~~E) VOLCANIC ERUPTION IN VOLCANO KATLA 1702-03 6337.5N01901.5W ICELAND-S. THE FORECASTED ASHCLOUD IS ESTIMATED TO HAVE REACHED SFC/FL500 N6335W01930 - N6500W01940 - N6500W02100 - N6300W02100 - N6335W01930. NO IFR CLEARANCE WILL BE ISSUED PENETRATING THE CONTAMINATED AREA.~~

~~F) SFC G) UNL.~~

~~Or~~

~~**Contaminated area based on VAA:**~~

~~A0779/04 NOTAMR A0778/08~~

~~Q) BIRD/QWWXX/IV/NBO/W/000/999/~~

~~A) BIRD~~

~~B) 0402261200 C) 0402261800~~

~~E) VOLCANIC ERUPTION IN VOLCANO KATLA 1702-03 6337.5N 01901.5W.~~

~~CONTAMINATED AREA:~~

~~SFC/FL200~~

~~6416N01716W - 6100N01930W - 6100N02800W - 7200N02800W - 7800N01000W - 7800N0L- 7230N0L - 7300N00800W - 6416N01716W.~~

~~FL200/350~~

~~7500N02800W – 7900N01000W – 7230N0L – 7900N0L – 7000N0L – 7000N01600W – 7500N02800W.~~

~~FL350/550~~

~~6700N01700W – 7000N01900W – 7400N01000W – 7400N0L – 6900N0L – 6900N02000W – 6700N01700W .~~

~~NO IFR CLEARANCE WILL BE ISSUED PENETRATING THE CONTAMINATED AREA.~~

~~F) SFC G) UNL~~

~~d~~ e) Should ~~the volcano revert to its dormant state~~ significant reductions in intensity of volcanic activity take place during this phase and the airspace no longer is contaminated by volcanic ash, a NOTAMC cancelling the last active NOTAM shall be issued stating the cause for cancellation; new ASHTAM should be promulgated to update the situation. Otherwise, begin planning for the Proactive Phase in conjunction with ~~CFMU~~ the appropriate ATFM unit and the affected ACCs.

2.3 ADJACENT ACC ACTIONS

2.3.1 During the Reactive Phase the adjacent ACCs should take the following action:

a) Maintain close liaison with the appropriate ATFM unit and the originating ACC to design, implement and keep up to date ATFM measures which will ~~ensure~~ enable aircraft to remain clear of Danger Areas. ~~are cleared from the perimeter of the forecast furthest extent of the ash cloud~~

b) In the event that tactical measures additional to those issued by the appropriate ATFM unit are required, ~~the air traffic control (ATC) watch supervisors~~ the adjacent ACC should, in cooperation with the originating ACC, impose such measures. Details are included in the ATFM measures section of this document.

c) Maintain a running plot of the affected area.

d) Begin planning for the Proactive Phase in conjunction with the appropriate ATFM unit and ACCs concerned.

2.4 ATFM UNIT ACTIONS

2.4.1 During the Reactive Phase, depending on the impact of the volcanic ash, the appropriate ATFM unit ~~may~~ should ~~take initiative to~~ organise ~~teleconferences to~~ the exchange of latest information on the developments with the VAACs, ~~Air Navigation Service Providers (~~ANSPs~~)~~, and MWOs concerned and aircraft operators.

3. PROACTIVE PHASE

3.1 The meteorological office co-located with the VAAC will, where feasible, issue forecasts at six-hourly intervals with a nominal validity time of 00:00Z, 06:00Z, 12:00Z and 18:00Z which will define Areas of Low, Medium and High Contamination.

3.2 Following the Reactive Phase, the forecasts for the time of issuance +0 and +6 hours should be used to define airspace volumes encompassing the furthest extent of contamination predicted for that period. These volumes should be used to:

a) publish NOTAM indicating the extent of Danger Areas, indicating which areas of contamination are included therein;

b) issue SIGMET warning of potential hazard from areas of volcanic ash contamination;

c) publish NOTAM to separately indicate the extent of Areas of Medium Contamination if not included in a Danger Area; and

d) apply appropriate ATFM measures.

3.3 For the longer term, +12 and +18 hr forecasts should be used to generate NOTAM in order to ensure that adequate information is available to support flight planning. These messages should differentiate between levels of contamination.

3.4 Operators should use the information published regarding Areas of Low, Medium and High Contamination to plan their flights in accordance with their regulatory requirements and the service that will be provided in the airspace concerned. Operators should be aware that, depending on the State concerned, Danger Areas may be established to contain an Area of High Contamination, Areas of Medium/High Contamination, or Areas of Low/Medium/High Contamination.

~~Following the Reactive Phase, standing procedures should be adopted to route traffic clear of the affected area. VAA is issued every 6 hours at, for example, 00:01 06:00 12:00 18:00. VAA +6hr forecast should be issued as SIGMET, VAA +12hr and +18hr forecasts should be issued as NOTAM. ATC should use the SIGMET area to route traffic around the contaminated area and Aircraft Operators should use the NOTAMs to plan their flight paths to remain clear of the forecast contaminated area.~~

3.5 The volcanic ash ~~cloud~~ may affect any combination of airspace; therefore, it is impossible to prescribe measure to be taken for any particular situation. Nor is it possible to detail the actions to be taken by any particular ACC. ~~3.2~~ The following guidance may prove useful during the ~~proactive phase~~ Proactive Phase but should not be considered mandatory:

a) ACCs affected by the movement of the ash ~~cloud~~ should continue to ~~issue~~ originate NOTAM~~s~~/ASHTAM at appropriate intervals. ACCs concerned and ~~CFMU~~ the appropriate ATFM unit should continue to publish details on measures taken.

~~b) Should the ash cloud move wholly outside the originating ACC's airspace to affect adjacent or other FIRs only, the ACCs in charge of that airspace should take over responsibility for the promulgation of NOTAMs.~~

b~~c~~) Depending on the impact of the volcanic ash, ~~CFMU~~ the appropriate ATFM unit may take the initiative to organise teleconferences to exchange latest

information on the developments with the VAACs, ANSPs~~,~~ and MWO's concerned and aircraft operators.

c~~d~~) During this phase ~~it may be possible for~~ the VAAC should endeavour to assess the vertical extent of the ash cloud and provide appropriate VAA to define the contaminated airspace as accurately as possible. ~~While operators cannot be prevented from flight planning routes predicted to be above the ash cloud such routes should not be proposed by ATC.~~ For the purpose of flight planning operators should treat the horizontal and vertical limits of the Danger Area to be overflown as they would mountainous terrain. Operators are cautioned ~~against~~ regarding the risk of cabin depressurisation or engine failure resulting in the inability to maintain level flight above the Danger Area ~~such a cloud~~, especially where Extended Twin Operations (ETOPS) aircraft are involved.

d) Any reported differences between published information and observations (pilot reports, airborne measurements, etc.) should be forwarded as soon as possible to the appropriate authorities.

e) When the airspace is no longer contaminated by volcanic ash, a NOTAMC cancelling the active NOTAM shall be promulgated. New ASHTAM should be promulgated to update the situation.

4. ATFM PROCEDURES

4.1 ~~Upon reception of information on volcanic activity from the VAAC, CFMU will issue an AIM as appropriate.~~ Depending on the impact of the volcanic ash, the appropriate ATFM unit should organize the exchange of latest information on the developments with the VAACs, ANSPs and MWOs concerned and aircraft operators.

4.2 The ATFM unit will apply ATFM measures on request of the ANSPs ~~In close coordination with ACCs~~ concerned. ~~CFMU may apply ATFM measures to ensure that aircraft are cleared from the perimeter of the forecast furthest extent of the ash cloud~~. The measures should be reviewed and updated in accordance with updated information ~~agreement with respective ACCs on receipt of any forecast from the VAAC~~.

~~4.3 When ATFM measures are applied, CFMU should issue an AIM, explaining in plain language why the measures have been implemented.~~ Operators should also be advised to maintain watch for NOTAM/ASHTAM~~s~~ and SIGMET~~s~~ for the area.

~~4.4 Depending on the impact of the volcanic ash CFMU may take initiative to organise teleconferences to exchange latest information on the developments with the VAACs, ANSPs concerned and aircraft operators.~~

Note – procedures applicable to the EUROCONTROL Central Flow Management Unit (CFMU) area of responsibility are contained in the EUROCONTROL – Basic CFMU Handbook. This document is available at http://www.cfmu.eurocontrol.int/cfmu/public/standard_page/library_index.html

5. AIR TRAFFIC CONTROL PROCEDURES[2]

~~5.1 AIR TRAFFIC CONTROL PROCEDURES FOR ACCS~~

5.1~~.1~~ If ~~a~~ volcanic ash ~~cloud~~ is reported or forecast in the FIR for which the ACC is responsible, the following procedures ~~are~~ should be followed:

a) relay all available information immediately to pilots whose aircraft could be affected to ensure that they are aware of the horizontal and vertical extent of the ash ~~cloud's~~ contamination ~~position and the flight levels affected~~;

b) if requested, suggest appropriate rerouting to assist flights to avoid areas of known or forecast ash ~~clouds~~ contamination;

c) when appropriate, remind pilots that volcanic ash ~~clouds are~~ may not be detected by ~~airborne or~~ air traffic radar systems~~. The pilot should assume that radar will not give them advanced warning of the location of the ash cloud~~;

d) if modelled ash concentration guidance charts are available showing Areas of Low, Medium and High Contamination, Danger Areas may be established. Depending on the State concerned, the Danger Areas will be established to contain an Area of High Contamination, Areas of Medium/ High Contamination, or Areas of Low/Medium/High Contamination;

e) in the absence of ash concentration guidance, the entire area of forecast volcanic ash should be considered as an Area of High Contamination for the purposes of applying ATC procedures, until ash concentration guidance is available;

f) Normally, ATC should not provide a clearance for an aircraft to enter or operate within a Danger Area. Assistance to enable an aircraft to exit a Danger Area in the most expeditious and appropriate manner should be provided.

g) In the NAT Region, so far as practicable, Organized Tracks will not be established through a Danger Area. If Organized Tracks are established through contaminated areas, a note will be included on the NAT Track Message to identify such tracks.

~~d~~ h) if the ACC has been advised by an aircraft that it has entered ~~a volcanic~~ an area of ash contamination ~~cloud~~ and indicates that a distress situation exists:

i) consider the aircraft to be in an emergency situation;

ii) do not initiate any climb clearances to turbine-powered aircraft until the aircraft has exited the area of ash ~~cloud~~ contamination; and

iii) do not attempt to provide ~~escape~~ vectors without pilot concurrence.

5~~.1~~.2 Experience has shown that the recommended escape manoeuvre for an aircraft which has encountered ~~an~~ volcanic ash ~~cloud~~ is to reverse its course and begin a descent (if terrain permits). However, the final responsibility for this decision rests with the pilot.

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[2] This information is adapted from ~~ICAO Doc 9691~~ the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691). Refer to ~~the master~~ this document for full details.

6. GENERAL GUIDANCE FOR THE DEVELOPMENT OF ATS CONTINGENCY PLANS FOR VOLCANIC ASH ~~CLOUDS~~[3]

6.1 In ~~an emergency~~ a contingency plan relating to volcanic ash ~~clouds~~ certain steps need to be taken to provide a coordinated and controlled response for dealing with an event of this nature. Responsibilities should be clearly defined for the manager in charge, supervisors and air traffic controllers. The plan should also identify the officials who need to be contacted, the type of messages that are to be created, the proper distribution of the messages and how to conduct business.

6.2 Controllers need to be trained and be made aware of the potential effects if ~~that~~ aircraft ~~which~~ encounter ~~a~~ unsafe levels of volcanic ash ~~cloud can suffer a complete loss of power and that extreme caution needs to be taken to avoid entering an ash cloud. Since there is no means to detect the density of the ash cloud and size distribution of the particles, and their subsequent impact on engine performance and the integrity of the aircraft, controllers need to be aware of the serious consequences for an aircraft that may encounter an ash cloud.~~

6.3 Some particular points of guidance are as follows:

a) ~~Volcanic~~ volcanic ash clouds may extend for hundreds of miles horizontally and reach the stratosphere vertically~~, therefore pilots should not attempt to fly through or climb out of the cloud~~

b) ~~Volcanic~~ volcanic may block the pitot-static system of an aircraft, resulting in unreliable airspeed indications; and

c) ~~Braking~~ braking conditions at airports where volcanic ash has recently been deposited on the runway will affect the braking ability of the aircraft. This is more pronounced on runways contaminated with wet ash. Pilots and controllers should be aware of the consequences of volcanic ash being ingested into the engines during landing and taxiing. For departure it is recommenced that pilots avoid operating in visible airborne ash; instead they should allow sufficient time for the particles to settle before initiating a take-off roll, in order to avoid ingestion of ash particles into the engine. In addition, the movement area to be used should be carefully swept before any engine is started.

6.4 The ACC in conjunction with ~~CFMU~~ ATFM units serves as the critical communication link between the pilot, dispatcher and meteorologists during a volcanic eruption. During episodes of volcanic ash ~~clouds~~ contamination within the FIR, the ACC has two major communication roles. First and of greatest importance is its ability to communicate directly with aircraft en route which may encounter the ash ~~cloud~~. Based on the information provided in the volcanic ash SIGMET and volcanic ash advisory message and working with MWO meteorologists, the air traffic controllers should be able to provide the pilot with flight levels that are affected by the ash ~~cloud~~ and the projected trajectory and drift of the contamination ~~cloud~~. Through the use of radio communication, ACCs have the capability to coordinate with the pilot alternative routes which would keep the aircraft away from the volcanic ash ~~cloud~~.

6.5 Similarly, through the issuance of a NOTAM/ASHTAM for volcanic activity ~~(or an ASHTAM)~~ the ACC can disseminate information on the status and activity of a volcano even for pre-eruption increases in volcanic activity. NOTAM~~, (~~/ASHTAM~~)~~ and SIGMET~~s~~ together with special air reports (AIREPs) are critical to dispatchers for flight planning purposes.

[3] This information is adapted from ~~ICAO Doc 9691~~ the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691). Refer to ~~the master~~ this document for full details.

~~Airlines~~ Aircraft Operators need as much advance notification as possible on the status of a volcano for strategic planning of flights and the safety of the flying public. Dispatchers need to be in communication with pilots en route so that a coordinated decision can be made between the pilot, the dispatcher and air traffic control regarding alternative routes that are available. The ACC should advise the ATFM unit concerning the availability of alternative routes. It cannot be presumed, however, that an aircraft which is projected to encounter ~~an~~ ash ~~cloud~~ will be provided with the most desirable route to avoid the contamination ~~cloud~~. Other considerations have to be taken into account such as existing traffic levels on other routes and the amount of fuel reserve available for flights which may have to be diverted to other routes to allow for the affected aircraft to divert.

6.6 The NOTAM/ASHTAM for volcanic activity ~~(and the ASHTAM)~~ provides information on the status of activity of a volcano when a change in its activity is, or is expected to be, of operational significance. They are ~~issued~~ originated by the ACC and issued through the respective international NOTAM office based on the information received from any one of the observing sources and/or advisory information provided by the associated VAAC. In addition to providing the status of activity of a volcano, the NOTAM ~~(or~~ /ASHTAM~~)~~ also provides information on the location, extent and movement of the ash contamination ~~cloud~~ and the air routes and flight levels affected. ~~The~~ NOTAM can also be used to ~~close~~ limit access to the airspace affected by the volcanic ash ~~cloud~~. Complete guidance on the issuance of ~~the~~ NOTAM ~~(~~and ASHTAM~~)~~ is provided in Annex 15 — *Aeronautical Information Services*. Included in Annex 15 is a volcano level of activity colour code chart. The colour code chart alert may be used to provide information on the status of the volcano, with "red" being the most severe, i.e. volcanic eruption in progress with an ash column/cloud reported above flight level 250, and "green" at the other extreme being volcanic activity considered to have ceased and volcano reverted to its normal pre-eruption state. It is very important that NOTAM for volcanic ash (and ASHTAM) be cancelled as soon as the volcano has reverted to its normal pre-eruption status, no further eruptions are expected by vulcanologists and no ash ~~cloud~~ is detectable or reported from the FIR concerned.

6.7 It is essential that the procedures which the ACC personnel, including supporting services such as MET, AIS and ATFM should follow during a volcanic eruption/ash cloud event described in the foregoing paragraphs are translated into the local staff instructions (adjusted as necessary to take account of local circumstances). It is also essential that these procedures/instructions form part of the basic training for all ~~air traffic services~~ ATS, AIS, ATFM and MET personnel whose jobs would require them to take action in accordance with the procedures. Background information to assist the ACC or Flight Information Centre (FIC) in maintaining an awareness of the status of activity of volcanoes in their FIR(s) is provided in the monthly Scientific Event Alert Network Bulletin published by the ~~U.S.~~ United States Smithsonian Institution and sent free of charge to ACCs/FICs requesting it.

APPENDIX A

ANTICIPATED PILOT ISSUES WHEN ENCOUNTERING VOLCANIC ASH ~~CLOUDS~~

1. Air Traffic Controllers should be aware that flight crews will be immediately dealing with some or all of the following issues when they encounter volcanic ash:

a) smoke or dust appearing in the cockpit which may prompt the flight crew to don oxygen masks (could interfere with the clarity of voice communications);

b) acrid odour similar to electrical smoke;

c) multiple engine malfunctions, such as stalls, increasing Exhaust Gas Temperature (EGT), torching, flameout, and thrust loss causing an immediate departure from assigned altitude;

d) on engine restart attempts, engines may accelerate to idle very slowly, especially at high altitudes (could result in inability to maintain altitude or Mach number);

e) at night, St. Elmo's fire/static discharges may be observed around the windshield, accompanied by a bright orange glow in the engine inlet(s);

f) possible loss of visibility due to cockpit windows becoming cracked or discoloured, due to the sandblast effect of the ash;

g) cockpit windows could be rendered completely opaque; and/or

h) sharp distinct shadows cast by landing lights as compared to the diffused shadows observed in clouds (this affects visual perception of objects outside the aircraft).

2. Simultaneously, ATC can expect pilots to be executing contingency procedures. This may include a possible course reversal and/or an emergency descent.

APPENDIX B

ACTION TAKEN BY METEOROLOGICAL WATCH OFFICES (MWO) IN THE EVENT OF A VOLCANIC ERUPTION[4]

1. On receipt of information ~~from an ACC~~ of a volcanic eruption and/or the existence of ~~a~~ volcanic ash ~~cloud~~, the MWO will:

a) ~~notify~~Notify, if necessary, the VAAC designated to provide volcanic ash advisories ~~advice on volcanic ash trajectories~~ for the FIR for which the ACC is responsible that a volcanic eruption and/or ash ~~cloud~~ has been reported~~, provide available relevant details and request advisory information on the extent and trajectory of volcanic ash;~~.

In the event that the MWO becomes aware of the occurrence of pre-eruption activity, a volcanic eruption or ash from any source other than the ACC, the information will be passed with all available relevant details on the extent and concentration of volcanic ash immediately to the ACC and to the designated VAAC.

Reported differences between ash encounters by aircraft and the information published in VAA, SIGMETs or NOTAMs received by ACC shall be made available as soon as possible to the respective MWO, preferably in the form of a special air-report. The MWO will relay the information to the respective originators of the published information.

b) Notify adjacent MWOs designated to provide VA warnings that a volcanic eruption and/or ash cloud has been reported, provide available relevant details on the extent and concentration of volcanic ash.

In the event that any other MWO becomes aware of the occurrence of volcanic ash cloud from any source other than the VAAC, the information should be passed immediately to the VAAC and any adjacent MWO downstream of the moving ash cloud.

~~b~~c) ~~as~~ As soon as practicable, advise the ACC and the VAAC whether or not the volcanic ash ~~cloud~~ is identifiable from ~~weather radar images or~~ satellite images/data, ground based or airborne measurements or other relevant sources; ~~and, if possible, provide regular information based on advice received from the VAAC on the horizontal and vertical extent of the cloud and the trajectory of the cloud; and~~.

~~c~~d) ~~issue~~ Issue a SIGMET message warning relating to the expected movement and vertical extent of volcanic ash for a validity period of 6 hours, to which is appended an 'outlook' providing information for up to a further 12 hours ~~beyond the initial 6 hour validity period concerning the trajectory of the ash cloud based on the advisory information provided by the VAAC concerned~~. Include in the SIGMET address all VAACs, the London World Area Forecast Centre (WAFC), the Vienna International Operational Meteorological (OPMET) data bank and regional OPMET data bank.

[4] This information is adapted ~~and condensed~~ from ~~ICAO Doc 9766 –~~ the *Handbook on the International Airways Volcano Watch (IAVW)* (Doc 9766). Refer to ~~the master~~ this document for full details.

e) provide information to assist with the origination of NOTAM by ACCs and maintain continuous coordination with ACCs, adjacent MWOs and the VAAC concerned to ensure consistency in the issuance and content of SIGMET and NOTAM/ASHTAM.

f) provide, if possible, regular volcanic briefings, based on the latest available ash observations and forecasts, to ACCs, ATFM units, Airport Operators and aircraft operators concerned, giving an outlook for more than +12hr.

~~2. In the event that the MWO becomes aware of the occurrence of pre-eruption activity, a volcanic eruption or ash cloud from any source other than the ACC, the information will be passed immediately to the ACC. The procedure above will then be followed.~~

~~3. In the event that any other meteorological office becomes aware of the occurrence of pre-eruption activity, a volcanic eruption or ash cloud from any source, the information will be passed immediately to the MWO for onward transmission to the ACC and appropriate VAAC.~~

APPENDIX C

ACTION TO BE TAKEN BY THE VAAC IN THE EVENT OF A VOLCANIC ERUPTION[5]

~~1.~~ On receipt of information from a MWO or any other source, of significant pre-eruptive/eruption activity and/or a volcanic ash cloud observed, the VAAC should:

a) initiate the volcanic ash computer trajectory/dispersal model in order to provide advisory information on volcanic ash trajectory to MWOs, ACCs, ~~CFMU~~ ATFM units and aircraft operators concerned;

b) review satellite images/data and any available pilot reports of the area for the time of the event to ascertain whether a volcanic ash cloud is identifiable and, if so, its extent;

c) inform the appropriate ATFM unit of the volcanic ash activity;

~~c~~d) prepare and issue advisory on the extent, and forecast trajectory, of the volcanic ash cloud in message format for transmission to the MWOs, ACCs, ~~CFMU~~ ATFM units and aircraft operators concerned in the VAAC area of responsibility, to the London WAFC, and to the Vienna International (OPMET) data bank and to other VAACs;

~~d~~e) monitor subsequent satellite information or other available observations to assist in tracking the movement of the volcanic ash ~~cloud~~;

~~e~~f) continue to issue advisory information to MWOs, ACCs, ~~CFMU~~ ATFM units and aircraft operators concerned at least at 6 hour intervals, and preferably more frequently, until such time as it is considered that the volcanic ash ~~cloud~~ is no longer identifiable from satellite data, no further reports of volcanic ash are received from the area and no further eruptions of the volcano are reported; and

~~f~~g) maintain regular contact with other VAACs and meteorological offices concerned, and, as necessary, ~~and~~ the Smithsonian Institute Global Volcanism Network, in order to keep up to date on the activity status of volcanoes in the VAAC area of responsibility.

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[5] This information is adapted ~~and condensed~~ from ~~ICAO Doc 9766~~ the *Handbook on the International Airways Volcano Watch (IAVW)* (Doc 9766). Refer to ~~the master~~ this document for full details.

APPENDIX D

PROCEDURES FOR THE PRODUCTION OF MODELLED ASH CONCENTRATION CHARTS

1. The following procedures are to be applied by the meteorological office of a contracting State, having accepted, by regional air navigation agreement, the responsibility for providing a VAAC within the framework of the international airways volcano watch (IAVW).

2. All Volcanic Ash Advisory (VAA) and Volcanic Ash Graphics (VAG) information issued by a Meteorological Office under designation as a VAAC within the framework of the International Airways Volcanic Watch shall be prepared in accordance with ICAO provisions.

3. Additionally, where feasible, the meteorological office may issue modelled ash concentration charts and corresponding coordinate data files at 6-hourly intervals showing the different ash concentrations for the validity periods T+0, T+6, T+12 and T+18 hours after data time. These charts will show forecast ash distribution in terms of Areas of Low, Medium and High Contamination and be published at the same time, and with the same validity periods, as the VAAs. Updated charts and data files should be distributed prior to the end of the validity time of those previously distributed.

4. These data may be used by States to prepare SIGMET and NOTAM and establish Danger Areas as appropriate.

APPENDIX E

ANTICIPATED ACTION BY STATES WITH REGARDS TO AIRCRAFT OPERATIONS IN THE EVENT OF A VOLCANIC ERUPTION

Safety Risk Assessments For Flights In Airspace Proximate To Volcanic Ash

1 Introduction

1.1 It is recommended that States which intend to allow Operators under their jurisdiction to operate in areas of volcanic ash contamination consider requiring Operators to carry out a safety risk assessment prior to carrying out such operations.

1.2 Safety risk assessments should be completed prior to planned operations in airspace or to/from aerodromes which may be contaminated by volcanic ash.

2 Applicability

2.1 All operators conducting flights in airspace or to/from aerodromes which could be affected by volcanic ash.

3 Recommendation

3.1 In accordance with ICAO Annex 6, Chapter 3, paragraph 3.3 Safety Management, it is recommended that States require all operators, planning to operate in areas where the presence of volcanic ash is forecast, to carry out a safety risk assessment prior to planned operations. The safety risk assessment should include a requirement for the operator to:

a) conduct their own risk assessment and develop operational procedures to address any remaining risks;

b) put in place appropriate maintenance ash damage inspections; and

c) ensure that any ash related incidents are reported by Special Air Reports and followed up by a Volcanic Activity Report (VAR).

3.2 Guidance in the preparation of such a safety risk assessment is provided in Appendix F of this document.

APPENDIX F

EXAMPLE SAFETY RISK ASSESSMENT PROCESS

1 Introduction

1.1 The safety risk assessment process is described in the *Safety Management Manual* (Doc 9859) .The process involves identifying the hazards associated with the activity (in this case airspace proximate to volcanic ash or flying to and from aerodromes affected by volcanic ash), considering the seriousness of the consequences of the hazard occurring (the severity), evaluating the likelihood or probability of it happening, deciding whether the consequent risk is acceptable and within the organisation's safety performance criteria (acceptability), and finally taking action to reduce the safety risk to an acceptable level (mitigation).

2 Hazard Identification

2.1 A hazard is any situation or condition that has the potential to cause adverse consequences. A suggested list of topics, that is not necessarily exhaustive, to be considered is attached at **Appendix G**

3 The Safety Risk Assessment

3.1 Risk is an assessment of the likelihood and the severity of adverse consequences resulting from a hazard.

3.2 To help an operator decide on the likelihood of a hazard causing harm, and to assist with possible mitigation of any perceived safety risk, all relevant stakeholders should be consulted.

3.3 The safety risk from each hazard should be assessed using a suitably calibrated safety risk assessment matrix. An example risk assessment matrix is given in *Safety Management Manual* (Doc 9859) but an alternative which aligns with an organisation's own Safety Management System (SMS) would be equally appropriate. The safety risk should be derived by considering the severity of the safety outcome arising from the hazard, together with the likelihood of the outcome.

3.4 The severity of any adverse consequences resulting from a particular hazard should be assessed using a suitably calibrated severity scale. Example scales are given in *Safety Management Manual* (Doc 9859) but an alternative, which aligns with an organisation's own SMS would be equally appropriate. Note that, for any flight, the safety outcome of a volcanic ash encounter may be significant.

3.5 Risk Likelihood

3.5.1 The likelihood or probability of adverse consequences resulting from a particular hazard should then be assessed. The likelihood should be agreed using a suitably calibrated likelihood or probability scale. An example probability scale is given in *Safety Management Manual* (Doc 9859), but an alternative which aligns with an organisation's own SMS would be equally appropriate.

3.5.2 When assessing likelihood or probability the following factors should be taken into account:

- The degree of exposure to the hazard.

• Any historic incident or safety event data relating to the hazard. This can be derived from data from industry, regulators, other operators, Air Navigation Service Providers, internal reports etc.

• The expert judgement of relevant stakeholders.

3.5.3 The results of the assessment should be recorded in a hazard log, sometimes referred to as a risk register. An example of a hazard log is at **Appendix H**.

3.6 Risk Tolerability

3.6.1 At this stage of the process the safety risks should be classified in a range from acceptable to unacceptable. A suitable set of definitions for Risk Classification is given in *Safety Management Manual* (Doc 9859).

3.6.2 Appropriate mitigations for each identified hazard should then be considered, recorded on the hazard log and implemented. Mitigations must be adopted in order to reduce the safety risks to an acceptable level, but additional mitigation wherever reasonably practicable should also be considered where this might reduce an already acceptable safety risk even further. Thus, the mitigation process should reduce the safety risk to be as low as reasonably practicable.

3.6.3 Not all hazards can be suitably mitigated in which case the operation should not proceed.

3.7 Mitigating Actions

3.7.1 Mitigating actions by themselves can introduce new hazards. Where an organisation has an effective SMS then procedures will exist for continual monitoring of hazard, risk and involvement of qualified personnel in accepting the mitigating actions or otherwise. Operators without an effective SMS should repeat the safety risk assessment following any mitigation process and at regular intervals as the circumstances on which the original assessment was predicated may have changed. This ensures ongoing safety management or monitoring.

3.8 Records

3.8.1 The results of the safety risk assessment should be documented and promulgated throughout the organisation and submitted to the operator's national safety authority. Actions should be completed and mitigations verified and supported by evidence prior to the start of operations.

3.8.2 Any assumptions should be clearly stated and the safety risk assessment reviewed at regular intervals to ensure the assumptions and decisions remain valid.

3.8.3 Any safety performance monitoring requirements should also be identified and undertaken through the organisation's safety management processes.

APPENDIX G

EXAMPLE TABLE OF CONSIDERATIONS FOR PLANNED OPERATIONS IN AIRSPACE OR TO/FROM AERODROMES WHICH MAY BE CONTAMINATED BY VOLCANIC ASH.

Considerations	Guidance
Operator Procedures	
Type Certificate Holder Guidance	Operators must obtain advice from the Type Certificate Holder and engine manufacturer concerning both operations in potentially contaminated airspace and/or to/from aerodromes contaminated by volcanic ash, including subsequent maintenance action.
Guidance for Company Personnel	Publish procedures for flight planning, operations and maintenance. Review of flight crew procedures for detection of volcanic ash and associated escape manoeuvres. Type Certificate Holder advice on operations to/from aerodromes contaminated by volcanic ash including performance.
Flight Planning	These considerations will be applicable to all flights that plan to operate in airspace or to/from aerodromes which may be contaminated by volcanic ash.
NOTAM and ASHTAM	The operator must closely monitor NOTAM and ASHTAM to ensure that the latest information concerning volcanic ash is available to crews.
SIGMETs	The operator must closely monitor SIGMETs to ensure that the latest information concerning volcanic ash is available to crews.
Departure, Destination and any Alternates	Degree of contamination, additional performance, procedures and maintenance consideration.
Routing Policy	Shortest period in and over contaminated area.
Diversion Policy	Maximum allowed distance from a suitable alternate. Availability of alternates outside contaminated area. Diversion policy after an ash encounter.

Minimum Equipment List / Dispatch Deviation Guide	Consider additional restrictions for dispatching aircraft: • air conditioning packs; • engine bleeds; • air data computers; • standby instruments; • navigation systems; • Auxiliary Power Unit (APU); • Airborne Collision Avoidance System (ACAS); • Terrain Awareness Warning System (TAWS); • provision of crew oxygen; and • supplemental oxygen for passengers. (This list is not necessarily exhaustive.)

Considerations	Guidance
Operator Procedures	
Provision of Enhanced Flight Watch	Timely information to and from crew of latest information.
Fuel Policy	Consideration to the carriage of extra fuel.

Considerations	Guidance
Crew Procedures	These considerations will be applicable to all flights that plan to operate in airspace or to/from aerodromes which may be contaminated by volcanic ash.
Pilot Reports	Requirements for reporting in the event of an airborne encounter. Post-flight reporting.
Mandatory Occurrence Reports	Reminder regarding the necessity for filing MORs following an encounter.
Standard Operating Procedures	Review changes to normal and abnormal operating procedures: • pre-flight planning; • operations to/from aerodromes contaminated with volcanic ash; • supplemental oxygen; • engine-out procedures; and • escape routes. (This list is not necessarily exhaustive.)

Technical Log	Any actual or suspected volcanic ash encounter will require a tech log entry and appropriate maintenance action prior to subsequent flight. Penetration (detail and duration) of airspace or operations to/from aerodromes which may be contaminated by volcanic ash will require a tech log entry.

Considerations	Guidance
Maintenance Procedures	Operators, who are operating in areas of ash contamination, are recommended to enhance vigilance during inspections and regular maintenance and potentially adjust their maintenance practices, based upon the observations, to prevent unscheduled maintenance. Observations should include signs of unusual or accelerated abrasions, corrosion and / or ash accumulation. Operator co-operation is requested in reporting to manufacturers and the relevant authorities their observations and experiences from operations in areas of ash contamination. If significant observations are discovered beyond normal variations currently known, manufacturers will share these observations, and any improved recommendations for maintenance practices, with all operators and the relevant authorities.

Note: The above list is not necessarily exhaustive and operators must make their own assessments of the hazards on the specific routes they fly.

APPENDIX H

EXAMPLE OF A HAZARD LOG (RISK REGISTER)

HAZARD		Incident Sequence Description	Existing Controls	Outcome (Pre-Mitigation)			Additional Mitigation Required	Outcome (Post-Mitigation)			Actions and Owners	Monitoring and Review Requirements
No.	Description			Severity	Likelihood	Risk		Severity	Likelihood	Risk		

(additional rows as necessary)

APPENDIX I

EXAMPLE SIGMET, NOTAM, ASHTAM

NOTAM establishing Danger Area to include Area of High Contamination

NOTAM establishing Danger Area to include Area of Medium/High Contamination

NOTAM establishing Danger Area to include Area of Low/Medium/High Contamination

NOTAM to define Area of Medium Contamination

ASHTAM pre-eruption

ASHTAM eruption

ASHTAM reduction in activity

SIGMET notifying eruption

SIGMET notifying ash contamination

NOTAM/ASHTAM including explanation of proper WMO header (see Alerting Phase, paragraph 1.2.2)

SECRETARIAT NOTE – THE CONTENT FOR THESE MESSAGES NEEDS TO BE DEVELOPED

APPENDIX D - EUR/NAT VATF RECOMMENDATIONS FOR THE INTERNATIONAL VOLCANIC ASH TASK FORCE

IVATF sub-groups[6]	Principle tasks of each IVATF sub-group[6]	EUR/NAT VATF recommendations for the IVATF sub-groups[7]
IVATF as a whole	• Determine (chronologically) what occurred after the eruption (the reaction to the event by various stakeholders); identify what needs to be done next; and • Assess existing (regional and global) guidance in light of the Icelandic eruption experiences.	1.1. Determine the number of ash concentration levels to be used taking into consideration the operational requirements, scientific observation and forecast capability, and the need for safety and efficiency; 1.2. Re-evaluate PANS-ATM Doc 4444 paragraph 15.8 (principally 15.8.3) in view of permitting operations in airspace where ash contamination exists within safe/tolerable levels; 1.3. Consider whether the *Volcanic Ash Contingency Plan – EUR and NAT Regions* could be used as a template/model for other ICAO Regions; 1.4. Determine need for new or improved SARPs and/or guidance when: *entire* FIRs are contaminated by volcanic ash; volcanic ash is just entering an FIR; and/or the re-suspension of volcanic ash occurs (i.e. windblown ash) affecting an aerodrome or FIR;

[6] Extracted from ICAO State Letter reference AN 10/18.3-IND/10/5 (*Establishment of the International Volcanic Ash Task Force (IVATF)*) issued 18 May 2010.
[7] Based on the outcome of EUR/NAT VATF/2 meeting and feedback received at the EUR/NAT Office from EUR/NAT VATF members via correspondence.

Air Traffic Management (ATM) sub-group	• Assess contingency procedures and reporting criteria to detect and mitigate; and • Review existing notification and warning procedures in light of the Icelandic eruption experience.	1.5. Determine common methodology for simplifying complex airspace descriptions for dissemination by SIGMET, NOTAM/ASHTAM, or when defining Danger or Restricted Areas; 1.6. Develop guidance to aid the decision making process when contamination may be considered 'unsafe', and when airspace and/or aerodromes should be closed and re-opened; 1.7. Develop guidance relating to the use of alternate aerodromes when large areas of airspace contamination exist or for aircraft in emergency situations; 1.8. Consider standardization and possible aggregation of SIGMET and NOTAM for warning of airspace contamination (including ash concentration), and re-evaluate the utility/application of ASHTAM; 1.9. Evaluate the acceptability of referring operators to public Internet sites where detailed information concerning volcanic ash activity is provided; 1.10. Consider whether the current provision of volcanic ash advisory information *at least once every 6 hours* (valid T+0 to 18 hours) is sufficient to meet current and future user needs – consider longer term planning products (T+0 to T+30 hours); increased temporal resolution (particularly between T+0 and T+6); increased frequency of issuance (at least every 3 hours), etc; 1.11. Determine whether a central repository and information sharing scheme could be established for air ("pilot") and maintenance reports related to volcanic ash encounters; 1.12. Consider how to improve the submission of Volcanic Activity Reports (VAR) by clarifying the distribution mechanism to ensure that all concerned stakeholders receive the information in a timely and efficient manner;
Airworthiness (AIR) sub-group	• Develop the acceptable level(s) of ash concentration for safe aircraft operations in contaminated airspace; establish regulatory provisions required for the level(s) identified.	1.13. Determine what types of airspace contamination might be hazardous (or not) to aviation taking into consideration particle size, ratio, chemical composition, etc; 1.14. Determine commonly agreed threshold values and terminology (e.g. low/medium/high or light/moderate/severe) for each level of airspace contamination;

Science (S) sub-group	• Determine ways and means to improve ash detection/ avoidance systems	1.15. Determine the need for near real-time calibration and verification systems based on quantifiable data from in-situ and well-established airborne, ground and space-based remote sensing systems; 1.16. Establish standards and specifications related to volcanic ash observations and measurements; 1.17. Determine a suitable mechanism whereby the feed of volcanic ash observations and measurements to the VAACs can be enhanced in order to improve the timely and efficient data assimilation in dispersion modelling; 1.18. Identify a commonly agreed definition for 'visible ash' and the methods used to determine it (e.g. satellite image wavelength, remote sensing technique, etc); 1.19. Consider whether Eulerian dispersion models or ensemble forecasting techniques could be used to predict the dispersion of volcanic ash. Such modelling could reduce the uncertainties in model initialization (source parameters) and better identify 'levels of confidence' in the model output;
IAVW coordination group	• Identify any additional work related to the improvement and harmonization of dispersion models (including eruption source parameters), required to be undertaken by the IAVWOPSG; • Identify the need to refine the existing VAG charts in the PNG format, with the view of mapping areas of ash contamination according to the level of ash concentration.	1.20. Determine whether all VAACs are in a position to produce and disseminate ash concentration guidance charts and coordinate data (akin to that provided by the meteorological office co-located with VAAC London) and develop a draft amendment to ICAO SARPs accordingly; 1.21. Determine common user requirements with regards to the vertical segmentation (i.e. vertical layers) of ash advisory and concentration information that would allow more effective use of non-contaminated airspace above and below the expected contamination areas – to better support airport, terminal manoeuvring area and en-route flight operations; 1.22. Determine feasibility of observing and forecasting different types of airspace contamination (e.g. gas versus hard particles), and identify how less hazardous phenomenon to aviation, such as steam, could be relayed to airspace managers and users.

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