Draft AFI VACP, Version XX

VOLCANIC ASH CONTINGENCY PLAN

—

AFRICA AND INDIAN OCEAN REGION

Proposed improvements to AFI VACP

Edition XX — September 2017

AFI VOLCANIC ASH CONTINGENCY PLAN

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FOREWORD

Within and adjacent to the Africa and Indian Ocean (AFI) Region) there are areas of volcanic activity which are likely to affect flight in the AFI Regions. The major volcanoes in the region are located in the following States:
Algeria, Cameroon, Cape Verde Islands, Chad, Comoros Island, Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, France (Reunion Island), Kenya, Madagascar, Mali, Niger, Nigeria, Rwanda, Sao Tome and Principe, Spain (Canary Islands, Madeira), Sudan, Tanzania and Uganda. The names of the concerned volcano are listed in appendix A**.**

This document is the AFI Air Traffic Management (ATM) Volcanic Ash Contingency Plan which sets out standardized guidelines and procedures for the provision of information to airlines and en-route aircraft before and during a volcanic eruption. Volcanic contamination, of which volcanic ash is the most serious, is a hazard for safe flight operations. Mitigating the hazards posed by volcanic ash in the atmosphere and/or at the aerodrome cannot be resolved in isolation but through collaborative decision-making (CDM) involving all stakeholders concerned. During an eruption volcanic contamination can reach and exceed the cruising altitudes of turbine-powered aircraft within minutes and spread over vast geographical areas within a few days.

This plan sets out standardized guidelines for the coordination of information and the alerting of aircraft before and during a volcanic eruption and procedures to be followed. Volcanic ash is a hazard to flight operations. It is important to note that other contaminants are also associated with volcanic activity. To mitigate the hazards of volcanic contamination aircraft operators, need to obtain information and support from many different sources including Air Traffic Management (ATM). The management of air traffic will be impacted proportionally to the extent and nature of the contamination. The issue cannot be resolved by individual stakeholders in isolation but needs collaborative decision making (CDM) involving all entities concerned.

Contingency planning for major service disruptions, such as that caused by volcanic ash, needs to encompass the whole ATM Community[2] as defined in ICAO's *Global Air Traffic Management Operational Concept* (Doc 9854). While general provisions exist for ATM Contingency Planning in Annex 11 [*Air Traffic Services*] and in the *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444), and some aspects are addressed in the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691 and in the *Handbook on the International Airways Volcano Watch* (IAVW Handbook, Doc 9766), ICAO's International Volcanic Ash Task Force (IVATF) developed comprehensive Guidance Material for ATM Volcanic Ash Contingency Planning in the form of a template.

This document is based on all of these sources and the needs and experience of the members of the ATM community in the AFI Regions of ICAO. While it focuses on the provision of ATM related services to airspace users within the frameworks of International Airways Volcano Watch (IAVW). It also establishes the connection to all relevant interfaces, such as the International Airways Volcano Watch, Meteorological Services, Flight Operations and Aerodromes. Wherever possible, duplication of text from other ICAO and industry documents is avoided by reference to the source.

The airspace users have (full and final) responsibility for the safety of flight operations in accordance with their Safety Risk Assessment (SRA) as accepted by their State's authority. This includes the decision about operation in airspace where volcanic ash is present or forecast (Annexes 6 [*Operation of Aircraft*], and 19 [*Safety Management*]; *Manual on Flight Safety and Volcanic Ash* (Doc 9974) refer).

The Air Navigation Service Providers (ANSP) act to achieve the objectives of the *Air Traffic Services* (Annex 11), which are (inter alia) to:

a) prevent collisions between aircraft;

b) expedite and maintain an orderly flow of air traffic;

c) provide advice and information useful for the safe and efficient conduct of flights.

This document is an ATM contingency plan including its interfaces with supporting services such as Aeronautical Information Service (AIS) and Meteorological (MET) services and that the plan therefore primarily addresses the provider States. Distribution of applicable AIS and MET messages related to volcanic ash are set out in relevant ICAO Annexes– namely *Annex 15– Aeronautical Information Services and Annex 3 – Meteorological Service for International Air Navigation.* Further principles of this contingency plan are that a cautious approach in case of limited information is adopted; and responses are scaled proportionally to the prevailing conditions. When limited information is available, the initial procedures are conservative. With increasing amount of and confidence in the information the constraints on flight operations can be relaxed based on appropriate risk management.

Small eruptions might only need a local response, while significant or major eruptions are likely to trigger national, sub-regional, Regional or even global activities. The contingency plan aims to ensure the highest level of service possible, to support safe and efficient flight operations in adverse conditions. This contingency plan is written to give sufficient background information and guidance to operational personnel, describing the end-to-end processes and information flows and referencing relevant Standard and Recommended Practices (SARPs) and Guidance Material.

While it is firmly rooted in the ICAO SARPs, this contingency plan is intended to provide the enabling support structure to implement best practices that serve the needs of the ATM Community. Desired developments (e.g. an action plan on arrangements that still need to be implemented) may be listed as an attachment to support the planning of amendments and improvements.

The guidelines provided in this document assume that the operators follow the ICAO requirements regarding Safety Management Systems (SMS). Detailed guidance on Safety Risk Assessments (SRAs) for flight operations with regard to volcanic ash contamination can be found in the *Manual on Flight Safety and Volcanic Ash* (ICAO Doc 9974) with examples given in appendix B.

Volcanic ash can also affect the operation of aircraft at aerodromes. Volcanic ash deposition at an aerodrome, even in small amounts, can result in the closure of the aerodrome until all the deposited ash has been removed. In extreme cases, the aerodrome may no longer be available for operation at all, resulting in repercussions on the ATM system, e.g. diversions, revised traffic flows, congestion at alternate aerodromes etc.

1. VOLCANIC ASH HAZARD

During an eruption volcanic ash can reach and exceed the cruising altitudes of turbine-powered aeroplanes within minutes and spread over vast geographical areas within a few days. Encounters with volcanic ash may result in one or more of the following and other problems:

a) malfunction, or failure, of one or more engines leading not only to reduction, or complete loss, of thrust but also to failures of electrical, pneumatic and hydraulic systems;

b) blockage of pitot and static sensors resulting in unreliable airspeed indications and erroneous warnings;

c) windscreens rendered partially or completely opaque;

d) smoke, dust and/or toxic chemical contamination of cabin air requiring crew use of oxygen masks, thus impacting communications; electronic systems may also be affected;

e) erosion of external and internal aircraft components;

f) reduced electronic cooling efficiency leading to a wide range of aircraft system failures;

g) aircraft need to be manoeuvred in a manner that conflicts with other aircraft;

h) deposits of volcanic ash on a runway degrading braking performance, most significantly if the ash is wet; in extreme cases, this can lead to runway closure.

It should be noted that some aircraft types or engine technologies are more vulnerable to volcanic contaminants; any specific measures to be applied by the regulatory authorities for flight operations, would therefore need to take into account these differences.

Considering that a turbine-engine aircraft travels about 150 km (80 NM) in 10 minutes and that volcanic ash can rise to flight levels commonly used by these aircraft in half that time, a timely response to volcanic eruptions and volcanic ash in the atmosphere is essential. It is therefore imperative that information on the volcanic activity is disseminated as soon as possible.

In order to ensure the smooth implementation and effectiveness of the contingency plan in case of an actual volcanic eruption, volcanic ash training and exercising should be conducted. ICAO DOC 9766 Appendix M [*VOLCEX Arrangements*] contains information on the regional and/or sub-regional volcanic ash exercise arrangements that can be used during this training.

ICAO has set up the International Airways Volcano Watch (IAVW) to provide near-real-time information on the largest possible number of volcanic events that affect aviation. State volcano observatories (VO) shall monitor active or potentially active volcanoes and shall provide information to Area Control Centres (ACC), Meteorological Watch Offices (MWO) and Volcanic Ash Advisory Centres (VAAC). It should be noted that currently not all active or potentially active volcanoes are actually monitored. VAACs detect the existence and extent of discernible volcanic ash in the atmosphere in their area of responsibility and issue advisory information regarding the extent and forecast movement of the volcanic ash cloud.

Special air-reports on volcanic activity (prescribed in PANS-ATM – Doc 4444) and the information collected by the IAVW (detailed in IAVW Handbook – Doc 9766) in accordance with SARPs of ICAO Annex 3 are elements of the input for the generation of volcanic ash advisories in alphanumeric (VAA) and graphic (VAG) forms. VAAs/VAGs are used by

a) MWOs to derive Significant Meteorological information (SIGMET)

b) airspace users for flight planning

c) Air Traffic Service (ATS) units for contingency planning

ATM operations in AFI require a well-coordinated and controlled actions to deal effectively and efficiently with volcanic ash in the airspace.

The Flight Information Centre (FIC)/ACC unit serves during a volcanic eruption as the critical communication link between affected aircraft in flight and the information providers. Commercial operators will coordinate actions with their flight crews en-route and affected air traffic services units. As this all results in increased workload for the ATS personnel involved, local procedures should address how this situation should be handled.

The provisions of Annexes 3 [*Meteorological Services for International Air Navigation*], 15 [*Aeronautical Information Services*] (AIS), and related documents are the basis of the detailed instructions contained in this contingency plan. Airspace users need as much advance notification as possible on the status of a volcano and/or volcanic ash airspace contamination and/or volcanic ash deposition at airports for strategic planning and the execution of flights to ensure the safety of the flying public.

This contingency plan provides Regional guidance on airspace management measures that might be taken by competent authorities (e.g. the establishment and withdrawal of Danger Areas); and the creation and

dissemination of Notices to Airmen (NOTAM)/ASHTAM and special air-reports on volcanic activity. Examples of NOTAM/ ASTAM are contained in appendix K (***Regional Information Flow Arrangements and Model Templates)***

The contingency plan, including its Appendices contains the organization of the information flow as per Annex 3 [*Meteorological Services for International Air Navigation*] and the information flow relating to supplementary information.

2. REGIONAL PREPARATION

The successful operation of air traffic in case of a volcanic ash event depends on coordinated arrangements.

2.1 INTERNATIONAL AIRWAYS VOLCANO WATCH (IAVW)

Annex 3 [*Meteorological Services for International Air Navigation*], Chapter 3 obliges States to arrange the monitoring of active and potentially active volcanoes by selected State volcano observatories.

The IAVW Handbook (Doc 9766) details the responsibilities of volcano observatories.

In areas where volcanoes are not adequately monitored by volcano observatories, remote sensing technologies, such as observation by satellites, and pilot reports serve as the main sources of information about eruptions and volcanic ash. Annex 3 [*Meteorological Services for International Air Navigation*], paragraphs 4.8, 5.5 and 5.9 refer.

Flight crews are required to report observations of volcanic activity by means of a special air-report. Arrangements should be put in place to ensure that such information is transferred without delay to the appropriate agencies. Instructions for air reporting of volcanic activity and the special air-report of volcanic activity form (Model VAR) can be found in Appendix 1 of PANS-ATM (Doc 4444).

Special air-reports on volcanic activity are necessary to improve the knowledge base of the VAACs. The communication and dissemination of pilot reports on volcanic activity is described in Appendix E [*Pilot Reports*].

Volcanic Ash Advisory Centres (VAAC) are established in the UK (London VAAC) and in France (Toulouse VAAC) serving the eastern part of the NAT, most of Europe and **AFI region**; and in Montreal and Washington for the western part of the NAT; the far eastern part of the EUR Region is served by VAAC Tokyo and VAAC Anchorage. Their area of responsibility and cooperation with other VAACs is described in Doc 9766 (Handbook on the IAVW). The VAACs follow a best practices approach agreed among them that aims to achieve global harmonization of their services.

2.1.7 VAACs provide approved and recognized information as defined in Annex 3 [*Meteorological Services for International Air Navigation*] that supports the SRA methodology applied by airspace users. Additionally, MET Offices collocated with VAACs London and Toulouse provide supplementary information[8]. Appendix D [*Description of* Selected VA Products] contains explanatory information about both Annex 3 [*Meteorological Services for International Air Navigation*], VA products, and supplementary information; this enables airspace users to understand the limitations of the products, and sources of information, when developing their SRAs and operational planning (Appendix F [*VAAC Checklist]* refers).

To keep information about affected airspace as accurate as possible, so that restrictions to flight operations can be limited as much as possible, the VAACs should have arrangements with those States having suitable infrastructure (LIDAR networks, aircraft to provide in-situ measurements, etc.) to allow the use of relevant data for the verification of actual volcanic ash (horizontal and vertical extent).

VAAC products should be amended as appropriate once information on observed volcanic ash has been verified. Appendix G contains the Regional monitoring capabilities and arrangements.

2.2 INFORMATION FLOW

Information on areas of observed and/or forecast volcanic ash shall be disseminated in accordance with Annex 3 [*Meteorological Services for International Air Navigation*] and Annex 15 [*Aeronautical Information Services*]. The details of all communication channels need to be established in advance and be available in local contingency arrangements. Telephone numbers, e-mail addresses, URLs of websites etc. should be kept up-to-date and saved on electronic systems for easy use (e.g. electronic phone book, internet browser bookmarks).

Templates for required messages and all relevant information for their completion shall be available locally.

Regional arrangements and example templates are available, as appropriate, in Appendix K [*Regional Information Flow Arrangements and Model Templates*] (e.g. teleconference procedures).

2.3 INFORMATION CONTROL

While the availability of required information is crucial for planning and execution of ATM operations and flight operations, recent events have shown that information overload can result from the inappropriate application of communication requirements.

Regional arrangements should be made to ensure availability of the necessary information in accordance with Annexes 3 [*Meteorological Services for International Air Navigation*] and 15 [*Aeronautical Information Services*].

States are encouraged to ensure the availability of guidance and procedures, on the range of information that may be used for the planning and execution of operations in their airspace (Appendix H [*State Checklist*]. and Appendix I [*ANSP Checklist*] refer). Appendix I contains sample of Regional arrangements and agreements for information service provisions while Appendix J contains action taken by MWO in the event of a volcanic eruption.

2.4 AIRSPACE MEASURES

The Chicago Convention reserves each contracting State the right, in the interest of public safety, temporarily to restrict or prohibit flying over the whole or any part of its territory

Annexes 11 [*Air Traffic Services*] and 15 [*Aeronautical Information Services*] define Restricted, Prohibited and Danger Areas and specify requirements for their identification and promulgation. Neither the Convention, nor any of the Annexes provide detailed guidance on the conditions that would necessitate the establishment of such areas, nor on specific procedures for their use. By inference of Article 12 of the Convention, over the High Seas only Danger Areas can be established. This is based on the United Nations Convention on the Law of the Sea (Montego Bay 1982).

In a volcanic ash scenario, the State should ensure that the authority which is responsible for determining the need for and extent of Danger Area should have the appropriate competencies, including on flight operations. The facility should be available permanently.

Whereas Danger Areas traditionally were absolutely avoided by aircraft, current safety management practices might allow the operation of (certain) aircraft in accordance with an appropriate Safety Risk Assessment (SRA). Although ATM normally expects aircraft to avoid Danger Areas established in connection to a volcanic ash event, the final decision regarding the route to be flown, whether it will be to avoid or proceed

through an area of volcanic ash or activity, is the flight crew's responsibility. Appendix L [*Guidance on the Establishment, Amendment and Withdrawal of Danger Areas*] describes the procedures for the use of Danger Areas.

2.5 AIR TRAFFIC FLOW MANAGEMENT – ATFM

Annex 11 [*Air Traffic Services*] paragraph 3.7.5 states that Air Traffic Flow Management shall be implemented for airspace where air traffic demand at times exceeds, or is expected to exceed, the declared capacity of the air traffic control services concerned.

Volcanic ash in airspace may result in a significant number of aircraft being re-routed into adjacent, non-affected areas. Regional arrangements should aim to provide sufficient capacity to safely and efficiently accommodate the revised traffic flow.

Regional ATFM units should be the ideal information pools and communication nodes for contingency situations and could be set up to support collaborative decision making (CDM) between ANSPs, Civil Aviation Authorities (CAA), VAACs, Meteorological Watch Offices (MWO) and airspace users.

Where permanent ATFM arrangements do not exist or cannot cope with the consequences of disruption caused by volcanic ash, contingency measures should be developed and agreed between the ANSPs and the airspace users. Appendix M [*Air Traffic Flow Management arrangements*] contains some existing Regional and sub-regional ATFM arrangements.

2.6 CRISIS MANAGEMENT ARRANGEMENTS

The nature of extraordinary contingency situations might require decision-making on a higher level than that of normal operations and beyond ATM. Arrangements should be in place to share information with national, Regional and sub-regional disaster management services that may have been implemented to address the crisis. These measures are to assure the delivery of essential goods through alternative means of transport in case of prolonged non-availability of airspace or airports, or the evacuation of humans from hazardous areas. Regional and/or sub-regional crisis management arrangements are detailed in Appendix N [*Crisis Management Arrangements*].

2.7 TRAINING AND EXERCISING

It is important to appropriately train personnel that may be involved in volcanic ash contingency operations, so that they have the necessary competency of their own area of responsibility, and have awareness of the information needs and the impact on stakeholders.

System-wide response to volcanic ash events shall be tested by the conduct of regular exercises. Doc 9766 contains *Guidance for conducting volcanic ash exercises in ICAO Regions*. The collection and documentation of relevant data on system performance is a key objective of exercising. Subsequent analysis of exercises and actual events should be used to develop improvements to the Regional and global volcanic ash contingency procedures.

2.8 REGULATIONS, MEANS OF COMPLIANCE AND GUIDANCE MATERIAL

States shall determine which Regulations and Directives they need to implement to ensure compliance with the global and Regional requirements. Prerequisite *Regional Regulations, Means of Compliance and Guidance Material* shall be developed from respective state guidance material.

2.9 OPERATORS FROM OUTSIDE THE REGION

Regional contingency planning (if developed) should be transparent to all users, and take account, as far as practical, of operators from outside the Region to ensure that they are familiar with the Regional operations.

3. RESPONSE TO A VOLCANIC ASH EVENT

3.0 PHASES OF AN EVENT

The response to a volcanic event that impacts air traffic has been divided into four distinct phases in this document — a Pre-Eruption Phase, a Start of Eruption Phase, an On-going Eruption Phase, and a Recovery Phase — as follows:

3.1 PRE-ERUPTION PHASE (when applicable):

General

The initial response, "raising the alert", commences when a volcanic eruption is expected. It should be noted that sometimes volcanoes erupt unexpectedly without any alert being raised; hence the pre-eruption phase may be omitted. Emphasis in this phase is placed on raising awareness of the potential hazard and to protect aircraft in flight. The actions shall be based on well-prepared, well-exercised contingency plans and standard operating procedures.

This phase is frequently characterized by a very limited availability of information on the potential extent and severity of the impending eruption. Notwithstanding the potentially limited extent of information available, the pre-eruption phase actions described below should be carried out for every expected eruption.

Volcano observatories shall provide the information on the state of the volcano showing pre-eruptive activity and notify their associated ACC, MWO and VAAC in form of the Volcano Observatory Notice for Aviation (VONA), as described in Appendix E of ICAO Doc 9766 (IAVW Handbook); Annex 3 [*Meteorological Services for International Air Navigation*], Appendix 2 para 4.1 refers.

If volcano observatories, VAACs or MWOs suspect volcanic activity in an area, they could request the appropriate ATS unit(s) to solicit Special air-reports on volcanic ash from suitable aircraft (route and altitude) at appropriate time intervals (e.g. every half hour).

Initial awareness of the event may be provided by means of a Special AIREP, VONA, satellite data, as well as other remote sensors. This information may lead to the production of the initial SIGMET, VAA/VAG, NOTAM as per the On-Going Eruption Phase. States should ensure that alerting information is distributed expeditiously by the most appropriate means to allow for the early warning of aircraft in flight.

VAACs should consider whether the information warrants the issuance of an initial Volcanic Ash Advisory (VAA).

Air operators and flight crews are expected to consider the potential effect of an eruption based on the operator's Safety Risk Assessment and standard operating procedures or to avoid the affected area.

Originating ACC/FIC Actions (eruption expected in its own FIR)

In the event of pre-eruption volcanic activity, which could pose a hazard to aviation, an ACC or FIC when appropriate, on receiving information of such an occurrence, should carry out the following:

a) ensure that appropriate AIS messages are originated in accordance with Annex 15 [*Aeronautical Information Services*]. These must provide as precise information as is available regarding the activity of the volcano. It is imperative that this information is issued by the international NOTAM office and disseminated as soon as possible in accordance with the provisions of Annex 15;

b) when so required by the State, define an initial, precautionary danger area in accordance with established local procedures. The size of the danger area should encompass a volume of airspace around the volcano in accordance with the information available, aiming to avoid undue disruption of flight operations;
i) if no such local procedures have been established, the danger area should be defined as a circle with a radius of 110 km (60 NM). The circle should be centered on the estimated or known location of the volcanic activity; in case of wind speeds exceeding 30 kts the danger area should be extended downwind by maximum half an hour of wind influence;

ii) ATC would not normally initiate a clearance through a danger area, it will inform aircraft about the potential hazard and continue to provide normal services. It is the responsibility of the pilot-in-command to determine the safest course of action.

c) advise the associated MWO and MET service provider(s) in accordance with national/Regional arrangements (unless the initial notification originated from such provider(s)), who will then inform the associated Volcanic Ash Advisory Center (VAAC);

d) alert flights already within the area concerned and offer assistance to enable aircraft to exit the area in the most expeditious and appropriate manner. Flight crews should be provided with all necessary information required to make safe and efficient decisions in dealing with the hazards in the defined area. Aircraft that are close to the area should be offered assistance to remain clear of the area;

e) immediately notify other affected ACCs/FICs of the event and the location and dimensions of the area concerned. The ACC should provide information on potential implications on traffic flow and its capability to handle the expected traffic. Adjacent ACCs may be asked to reroute flights not yet coordinated to keep them clear of the area. It should be noted that flight crews make the decision whether or not to completely avoid the area based on, for example, visual observations;

f) review the local contingency plan;

g) where applicable advice the appropriate ATFM unit(s) and coordinate and implement ATFM measures if necessary to maintain the required level of safety; and

h) relax airspace restrictions when possible to facilitate efficient traffic flow.

In order to assist staff in expediting the process of composing the AIS messages, a series of templates should be available for this stage of the volcanic activity

In addition to sending the relevant AIS messages to the normal distribution list, they will be sent to the relevant MWO(s), all VAACs, SADIS and the WIFS gateway.

Adjacent ACC/FIC actions

During the pre-eruption phase, ATS units will inform aircraft about the potential hazard and continue to provide normal services. Adjacent ACCs/FICs should take the following action to assist:

i) gain and maintain awareness of the affected area and inform pilots that will or might be affected;

j) when requested by pilots of aircraft advised that they will be affected by the area, re-clear flights to which control services are being provided after coordination with other affected ACCs; and

k) unless otherwise instructed, continue normal operations and;

l) if future traffic is affected by the area, consider the potential impact and the necessity for ATFM measures where applicable.

ATFM Unit actions where applicable

Where an ATFM unit is established, it should, upon receipt of preliminary information on volcanic activity from an ACC or the lead VAAC, initiate actions in accordance with its procedures to ensure exchange of

information in order to support CDM between air navigation service providers (ANSPs), meteorological watch offices (MWOs), VAACs and aircraft operators concerned.

3.2 START OF ERUPTION PHASE (when applicable):

The start of eruption phase commences when information about the outbreak of a volcanic eruption becomes available.

General

This phase commences when information about the outbreak of a volcanic eruption becomes available, with volcanic ash being ejected into the atmosphere. The focus of the processes in this phase is to protect aircraft in flight and at aerodromes from the hazards associated with the eruption through the collection and dissemination of information.

When an eruption does not impact the airspace above and around the volcano (e.g. lava flow) the processes described in the pre-eruption phase may be applicable.

Volcano observatories should assess the information on the state of the volcano showing eruptive activity and provide notification to their associated ACC, MWO and VAAC in form of the *Volcano Observatory Notice for Aviation* (VONA), as described in Appendix E of the IAVW Handbook (Doc 9766) (Annex 3 [*Meteorological Services for International Air Navigation*], Appendix 2 para 4.1 refers).

VAACs should collect all relevant information and act in accordance with paragraph 4.5 of the IAVW Handbook (Doc 9766).

Major activities of the start of eruption phase are: issuance of relevant AIS and MET messages in accordance with Annexes 15 [*Aeronautical Information Services*] and 3 [*Meteorological Services for International Air Navigation*], respectively (as detailed in the IAVW Handbook (Doc 9766), paragraphs 4.3 and 4.4); as well as provision of information and assistance to airborne traffic.

As appropriate, danger areas may be declared by the authority which is responsible for determining the need for and extent of Danger, Prohibited or Restricted Areas, and published via NOTAM (in accordance with the "*Airspace Measures*" section of this contingency plan).

Originating ACC/FIC actions (eruption in its own FIR)

The ACC/FIC providing services in the FIR within which the volcanic eruption takes place should act in accordance with the ATS contingency procedures contained in the PANS–ATM (Doc 4444), paragraph 15.8 and the guidance in paragraph 4.2 of the IAVW Handbook (Doc 9766) and inform flights about the existence, extent and forecast movement of volcanic ash and provide information useful for the safe and efficient conduct of flights.

If necessary, rerouting of traffic should commence immediately or may be in progress if the alerting time has been sufficient to activate the pre-eruption phase. The ACC should assist in rerouting aircraft around the affected and/or danger area as expeditiously as possible. Adjacent ACCs should also take the affected and/or danger area into account and give similar assistance to aircraft as early as possible.

During the start of eruption phase, although ATC will not normally initiate a clearance through a danger area, it will inform aircraft about the hazard and will continue to provide normal services. It is expected that aircraft will attempt to remain clear of the danger area; however, it is the responsibility of the pilot-in-command to determine the safest course of action.

During the start of eruption phase the ACC/FIC should:

a) ensure that a NOTAM is originated to define a Danger Area delineated cautiously so as to encompass a volume of airspace in accordance with the limited information available. Until reliable information on the extent of the eruption is available, the guidance for precautionary Danger Areas should be followed. In determining the area, information on upper winds should be taken into account. The purpose is to ensure safety of flight in the absence of any prediction from a competent authority on the extent of volcanic ash in the airspace;

b) maintain close liaison with MWOs and, where appropriate, VAACs, who should issue appropriate MET messages in accordance with Annex 3 [*Meteorological Services for International Air Navigation*];

c) solicit as far as practicable special air-reports on volcanic activity from aircraft in the area concerned to enlarge the knowledge about volcanic ash in the airspace; and

d) devise, implement and update ATFM measures where necessary to ensure safe and efficient flight operations, based on MET observations and forecasts in cooperation with aircraft operators and the adjacent ACCs using the CDM process;

e) ensure that reported differences between published information and observations (pilot reports, airborne measurements, etc.) are forwarded as soon as possible to the appropriate authorities to ensure revision of incorrect information and its dissemination to all concerned;

f) begin planning for the on-going eruption phase in conjunction with the aircraft operators, the appropriate ATFM unit and ACCs concerned; and

g) initiate appropriate AIS messages in accordance with Annex 15 [*Aeronautical Information Services*] and the IAVW Handbook (Doc 9766), should significant reductions in intensity of volcanic activity take place during this phase and evidence confirms that the airspace is no longer contaminated by volcanic ash. Otherwise, begin CDM planning for the on-going eruption phase in conjunction with aircraft operators, the appropriate ACCs and where applicable the ATFM unit serving the affected ACCs.

Adjacent ACC/FIC actions

During the start of eruption phase, adjacent ACCs/FICs should take the following actions:

a) gain and maintain awareness of the affected area and inform flights that will or might be affected; and

b) maintain a close liaison with the originating ACC/FIC ATFM unit, aircraft operators and appropriate ATFM where applicable so as to devise, implement and update flow of traffic and where applicable ATFM measures (including relaxation of airspace restrictions) which will enable safe and efficient flight operations; and

c) begin planning for the on-going eruption phase in conjunction with the aircraft operators, the appropriate ACCs/FICs unit and ATFM where applicable.

ATFM Unit actions (Where applicable)

During the start of eruption phase, depending on the impact and/or extent of the volcanic ash cloud, the appropriate ATFM unit should organize the exchange of latest information on the developments with the associated VAACs, ANSPs, MWOs and operators concerned in order to support CDM.

The ATFM unit will apply ATFM measures on request of the ANSPs concerned. The measures should be reviewed and updated in accordance with latest information. Airspace measures should be relaxed as soon as the situation allows.

3.3 ON-GOING ERUPTION PHASE:

The on-going eruption phase commences with the issuance of the first complete volcanic ash advisory (VAA) containing information on the extent and forecast movement of the volcanic ash cloud.

General

The on-going eruption phase commences with the issuance of the first complete (i.e. including forecasts) volcanic ash advisory (VAA) by the responsible VAAC that contains information on the extent and expected movement of the volcanic ash cloud in accordance with Annex 3 [*Meteorological Services for International Air Navigation*] provisions. It may take up to 3 hours after start of eruption to issue this first complete VAA.

Volcanic ash advisory information in graphical format (VAG) should also be issued by the VAAC, containing the same information as its text-based VAA equivalent. (Doc 9766, paragraph 4.5.1).

The VAA/VAG should be used to:

a) prepare appropriate AIS and MET messages in accordance with Annex 15 [*Aeronautical Information Services*] and Annex 3 [*Meteorological Services for International Air Navigation*] provisions, respectively; and

b) plan the provision of air traffic services, including the application of appropriate ATFM measures.

ACC/FIC Actions

Volcanic ash may affect any combination of airspace; therefore, it is not possible to prescribe measures to be taken for all situations. The following guidance therefore may prove useful during the on-going eruption phase, but should not be considered mandatory or exhaustive:

a) The ACC/FIC will continue to act in accordance with the ATS Contingency Procedures contained in PANS-ATM (Doc 4444) Chapter 15.8

b) ACCs/FICs affected by the movement of the volcanic ash shall ensure that appropriate AIS messages are originated in accordance with Annex 15 [*Aeronautical Information Services*]. ACCs/FICs concerned and the appropriate ATFM unit should continue to publish details on measures taken to ensure dissemination to all concerned;

c) the ACC/FIC should solicit special air-reports on volcanic activity if so requested by the appropriate VAAC;

d) ACCs/FICs and ATFM units should be aware that for the purposes of flight planning and execution, operators could treat the horizontal and vertical extent of the volcanic ash contaminated area to be over-flown as if it were mountainous terrain; and

e) any reported differences between published information and observations (pilot reports, airborne measurements, etc.) should be forwarded as soon as possible to the appropriate authorities to ensure revision of any incorrect information and its dissemination to all concerned.

ATFM Unit actions (Where applicable)

The ATFM units will continue to apply ATFM measures on request of the ANSPs concerned. The measures should be reviewed and updated (including relaxation of airspace measures) in accordance with latest information. Depending on the impact and/or extent of the volcanic ash, the appropriate ATFM unit may take the initiative to organize teleconferences to exchange the latest information on the developments, in order to support CDM, with the VAACs, ANSPs and MWOs and operators concerned. Attached, please find operators checklist guidance on action to be taken in appendix P

3.4 RECOVERY PHASE:

The recovery phase commences with the issuance of the first VAA containing the statement "NO VA EXP" (i.e. "no volcanic ash expected") which normally occurs when it is determined that no volcanic ash is expected in the atmosphere and the volcanic activity has reverted to its non-eruptive state.
The Handbook on the International Airways Volcano Watch (Doc 9766) does not differentiate consistently between these different phases, which are functionally quite different. The Regional VA Contingency Plan lists the appropriate actions in the respective sections.

The recovery phase commences with the issuance of the first VAA/VAG containing the statement "NO VA EXP" (i.e. "no volcanic ash expected") — which normally occurs when it is determined that the volcanic activity has reverted to its non-eruptive state and the airspace is no longer affected by volcanic ash. Consequently, appropriate MET and AIS messages should be issued in accordance with Annex 3 [*Meteorological Services for International Air Navigation*] and Annex 15 [*Aeronautical Information Services*], respectively.

ACCs/FICs and ATFM units should revert to normal operations as soon as practical.

Although the four distinct phases herein describe actions to be undertaken during an actual volcanic event, they are based on a theoretical scenario. Actual eruptions may not always be distinct with respect to ATM actions to be undertaken. Similarly, an eruption may occur without any pre-eruptive activity, or may cease and restart more than once. Hence, the first observation may be the presence of an ash cloud, which is already some distance away from the volcano. It is essential that the contingency planning prepares the ATM system for an appropriate response depending on the actual conditions.

4. APPENDICES:

Appendices to the document comprise material grouped separately for convenience but forming part of the main body of the document: information in VACP Appendices complement the main body text.

Appendix A — Major Volcanos in the AFI Region

Appendix B — Example of safety risk assessment process

Appendix C — Purposes of volcanic ash reporting and data collection

Appendix D — Description of selected va products

Appendix E — Pilot reports

Appendix F — VAAC Checklist

Appendix G — Regional monitoring capabilities and arrangements

Appendix H — State Checklist

Appendix I — ANSP Checklist

Appendix J — MWO Checklist

Appendix K — Regional Information Flow Arrangements and Model Templates

Appendix L — Guidance on the establishment, amendment and withdrawal of danger areas

Appendix M — Air traffic flow management arrangements

Appendix N — Crisis Management Arrangements

Appendix P — Airspace user (Operator) checklist

Appendix Q — Example of a hazard log (risk register)

APPENDIX A: MAJOR VOLCANOS IN THE AFI REGION

	Volcano Name	Volcano Type	Volcano Status Location	Location
1.	TAHALRA VOLCANIC FIELD	Pyroclastic cones	Holocene	Algeria
2.	ATAKOR VOLCANIC FIELD	Scoria cones	Holocene	Algeria
3.	MANZAZ VOLCANIC FIELD	Scoria cones	Holocene	Algeria
4.	IN EZZANE VOLCANIC FIELD	Volcanic field	Holocene	Algeria-Niger border
5.	CAMEROON	Stratovolcano	Historical	Cameroon
6.	TOMBEL GRABEN	Cinder cones	Holocene	Cameroon
7.	MANENGOUBA	Stratovolcano	Holocene	Cameroon
8.	OKU VOLCANIC FIELD	Stratovolcano	Holocene	Cameroon
9.	NGAOUNDERE PLATEAU	Volcanic field	Holocene	Cameroon
10.	LA PALMA	Stratovolcanoes	Historical	Canary Islands
11.	HIERRO	Shield volcano	Radiocarbon	Canary Islands
12.	TENERIFE	Stratovolcano	Historical	Canary Islands
13.	GRAN CANARIA	Fissure vents	Radiocarbon	Canary Islands
14.	FUERTEVENTURA	Fissure vents	Holocene	Canary Islands
15.	LANZAROTE	Fissure vents	Historical	Canary Islands
16.	FOGO	Stratovolcano	Historical	Cape Verde Islands
17.	BRAVA	Stratovolcano	Holocene	Cape Verde Islands
18.	SAO VICENTE	Stratovolcano	Holocene Cape	Verde Islands
19.	TARSO TOH	Volcanic field	Holocene	Chad
20.	TARSO TOUSSIDE	Stratovolcano	Stratovolcano	Holocene Chad
21.	TARSO VOON	Stratovolcano	Fumarolic	Chad
22.	EMI KOUSSI	Pyroclastic shield	Holocene	Chad
23.	LA GRILLE	Shield volcano	Holocene	Comore Island
24.	KARTHALA	Shield volcano	Historical	Comore Island
25.	KARISIMBI	Stratovolcano	Potassium-Argon	Democratic Republic Congo-Rwanda border
26.	VISOKE	Stratovolcano	Historical	Democratic Republic Congo-Rwanda border
27.	MAY-YA-MOTO	Fumarole field	Fumarolic	Democratic Republic of Congo
28.	NYAMURAGIRA	Shield volcano	Historical	Democratic Republic of Congo
29.	NYIRAGONGO	Stratovolcano	Historical	Democratic Republic of Congo
30.	TSHIBINDA	Cinder cones	Holocene	Democratic Republic of Congo
31.	ARDOUKOBA	Fissure vents	Historical	Djibouti
32.	GARBES	Fumarole field	Pleistocene	Djibouti
33.	BOINA	Fumarole field	Pleistocene	Djibouti-Ethiopia border
34.	JALUA	Stratovolcano	Holocene	Eritrea
35.	ALID	Stratovolcano	Holocene	Eritrea
36.	DUBBI	Stratovolcano	Historical	Eritrea
37.	NABRO	Stratovolcano	Holocene	Eritrea
38.	ASSAB VOLCANIC FIELD	VOLCANIC FIELD	Holocene	Eritrea

39.	GUFA	Volcanic field	Holocene	Eritrea-Djibouti border
40.	DALLOL	Explosion craters	Historical	Ethiopia
41.	GADA ALE	Stratovolcano	Holocene	Ethiopia
42.	ALU	Fissure vents	Holocene	Ethiopia
43.	DALAFFILLA	Stratovolcano	4 Historical	Ethiopia
44.	BORALE ALE	Stratovolcano	Holocene	Ethiopia
45.	ERTA ALE	Shield volcano	Historical	Ethiopia
46.	ALE BAGU	Stratovolcano	Holocene	Ethiopia
47.	HAYLI GUBBI	Shield volcano	Holocene	Ethiopia
48.	ASAVYO	Shield volcano	Holocene	Ethiopia
49.	MAT ALA	Shield volcano	Holocene	Ethiopia
50.	TAT ALI	Shield volcano	Holocene	Ethiopia
51.	BORAWLI	Stratovolcano	Holocene	Ethiopia
52.	AFDERA	Stratovolcano	Holocene?	Ethiopia
53.	MA ALALTA	Stratovolcano	Holocene	Ethiopia
54.	ALAYTA	Shield volcano	Historical	Ethiopia
55.	DABBAHU	Stratovolcano	Historical	Ethiopia

APPENDIX B: EXAMPLE OF SAFETY RISK ASSESSMENT PROCESS

Introduction
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 organization's safety performance criteria (acceptability), and finally taking action to reduce the safety risk to an acceptable level (mitigation).

Hazard Identification
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 I.**

The Safety Risk Assessment:
Risk is an assessment of the likelihood and the severity of adverse consequences resulting from a hazard.

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.

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 organization'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.

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 organization's own SMS, would be equally appropriate. Note that, for any flight, the safety outcome of a volcanic ash encounter may be significant.

Risk Likelihood

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 organization's own SMS would be equally appropriate.

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

a. The degree of exposure to the hazard.
b. 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.
c. The expert judgement of relevant stakeholders.

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 register is at APPENDIX Q.

Risk Tolerability

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).

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.

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

Mitigating Actions

Mitigating actions by themselves can introduce new hazards. Where an organization 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.

Records

The results of the safety risk assessment should be documented and promulgated throughout the organization 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.

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

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

APPENDIX C: PURPOSES OF VOLCANIC ASH REPORTING AND DATA COLLECTION

The main purposes for volcanic ash reporting and data collection are to:

a) locate the volcanic hazards:

b) notify immediately other aircraft (in-flight) about the hazard;

c) notify other interested parties: ANSPs (ATC, AIS, ATFM), VAACs, MWO, etc to ensure the consistent production of appropriate information and warning products in accordance with existing provisions;

d) analyze collected reports from the post-flight phase in order to:

i) identify areas of concern;

ii) validate and improve volcanic ash forecasts;

iii) improve existing procedures;

iv) assist in defining better airworthiness requirements; and

v) share lessons learned, etc.

PHASE OF OPERATIONS

The roles and responsibilities of the participants in the collection, exchange and dissemination of the volcanic information are distinctly different in two distinct phases:

a) in-flight; and

b) post-flight.

The following section analyses these separately.

PARTICIPANTS IN THE REPORTING PROCESS, THEIR ROLES AND RESPONSIBILITIES

Identification of the participants as well as their roles and responsibilities in general, but specifically during the two different phases of operations, is an important element in improving collection, exchange and dissemination of volcanic information. The number of participants and their roles and responsibilities depends on the phase of operations (in-flight, post-flight), their position in the information chain within one of these two phases and national/regional arrangements. One of the main issues regarding participants' roles and responsibilities is that each of them is, at one time or another, both a data/information provider and user of the information.

In-Flight Phase

4.2.1 Participants, Roles & Responsibilities

	Participants	Roles and Responsibilities
1	Pilots, civil and/or military, observing and/or encountering volcanic activity	To provide as much detailed information as possible about the type, position, colour, smell, dimensions of the volcanic contamination, level and time of the observation and forward VAR Part I immediately to the ATS unit with which the pilot is in radiotelephony (R/T) communication.

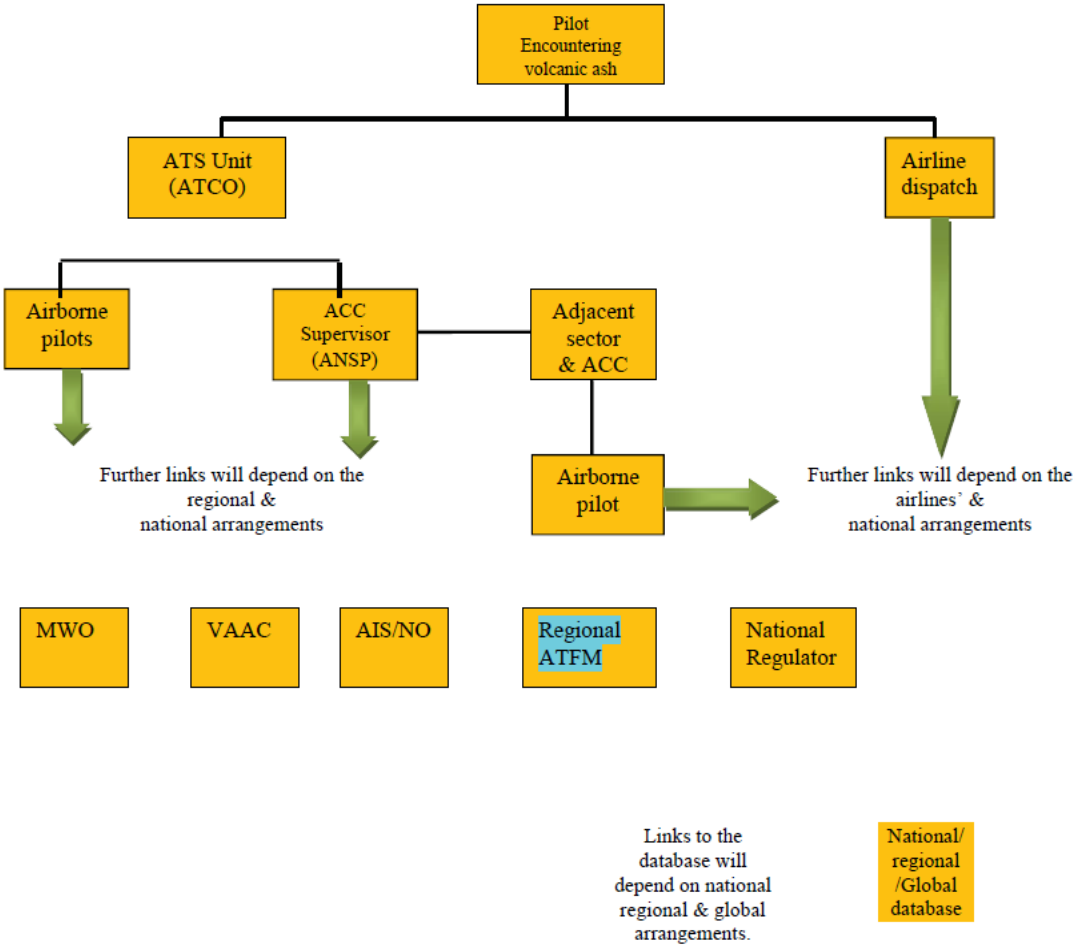
		Record the information required for VAR Part II on the appropriate form as soon as possible after the observation or encounter, and file the report via data link, if available.
2	ATS unit receiving the information from the pilot encountering volcanic event	To ensure that information received by an air traffic controller from the pilot has been copied, clarified (if necessary) and disseminated to other pilots as well as to the ACC Supervisor. In addition, air traffic controllers could ask other pilots flying within the same area if they have observed any volcanic activity
3	ATS unit/ACC Supervisor (if applicable) or other responsible person within the Air Navigation Service Provider	To use all means of communication and available forms to ensure that the information received from the air traffic controller has been: • passed on to the associated Meteorological organizations in accordance with national/regional arrangements; • fully and immediately disseminated across the organization, in particular to adjacent sectors and the associated NOTAM Office (NOF); • passed on to the neighbouring sectors and ACCs (if necessary); • passed on to the regional ATFM centre if existing (e.g. CFMU in AFI); • passed on to the national/regional authority responsible for the handling of contingency situations
4	Neighbouring ANSPs (ACCs etc.)	To ensure that information is provided to flight crews flying towards the area affected by the volcanic contamination; disseminated across the organization and the system prepared to cope with the possible changes of the traffic flows; and that the information is provided to the national authority responsible for the handling of contingency situations and passed on to the NOF and MWO as required
5	MET Watch Office	To use the information originated by flight crews and forwarded by the ATS unit which received the information in accordance with Annex 3
6	VAAC	To use the information originated by flight crews, MWOs and other competent sources in accordance with Annex 3
7	AIS / NOF	To publish appropriate AIS messages in accordance with Annex 15

8	ATFM unit or centre (if existing	To ensure that information received is stored and made available for information to all partners in its area of responsibility (ANSPs, airlines, VAAC, MET etc.). As part of the daily activity, coordinate ATFM measures with ACCs concerned.

In-flight reporting – Sample Flow Chart of the volcanic ash information

The chart below is a graphical representation of a possible path of the in-flight volcanic ash information and may differ between regions depending on regional arrangements. It also gives the position of the volcanic ash participants in the reporting chain. The flow chart is not exhaustive and the path of the information can be extended and new participants could be added depending of the national and regional requirements.

Post-Flight Operations Roles & Responsibilities and order of reporting



Post-Flight Operations Roles & Responsibilities and order of reporting

	Participants	Roles and Responsibilities
1	Civil and/or military pilots/airlines having	To file the volcanic ash report with as much detailed information as

	observed or encountered an eruption or volcanic contamination	possible about the volcanic activity and/or encounter (position, colour, smell, dimensions, FL, time of observation, impact on the flight, etc.). Ensure that the VAR is filed and transmitted to the relevant recipients as soon as possible after landing (if not filed via datalink already during the flight). Make an entry into the Aircraft Maintenance Log (AML) in case of an actual or suspected encounter with volcanic contamination
2	ANSP	To provide a summary report of effects of the volcanic activity that affected its operations at least once per day to the national authority with as much detailed information as possible about the number of encounters, impact on air traffic management, etc.)
3	AOC Maintenance - Post flight Inspection	To report about the observation of the aircraft surfaces, engine, etc, and to provide the information to the national (or regional or global, where applicable) central data repository
4	Investigation authority	All aeronautical service providers (including operators, ANSPs, airports, etc) shall investigate the effects of a volcanic activity, analyze the information and search for conclusions; and report the investigation results and relevant information to the national supervisory authority and any central data repository.
5	National Authority	To handle the national central data repository and report to the regional/global central data repository if any. To analyze reports from its aeronautical service providers and take action as appropriate
6	Regional Central Data Repository	To collect the national data and make them available to interested stakeholders under agreed conditions
7	MWO	To use the national and regional information coming from national and regional central data repositories
8	VAAC	To use the information originated by flight crews, and other competent sources to: a) validate its products accordingly and; b) improve the forecast
9	Global Data Repository (and research	To analyze the information stored in the regional central data repository and provide the research outcomes for lessons learnt

	institutes - where appropriate)	process.
10	Knowledge management (e.g. SKYbrary)	To use the post-flight lessons learnt and disseminate them to interested stakeholders.
11	ICAO	To review/revise ATM volcanic ash contingency plans.

Tools for presenting and sharing the volcanic ash information

To report, transmit and disseminate the volcanic ash encounter information, different types of tools can be used. The list below is provided to give ideas as to what tools can be used. It could also be split into regulatory and general information tools. At any case, it is not an exhaustive list and can be updated with new elements depending on regional experiences.

a) Radiotelephony and Data link Communications

b) VAR

c) NOTAM/ASHTAM

d) SIGMET

e) VAA/VAG

f) Central data repository e.g. CFMU Network Operations Portal (NOP)

g) Centralized web based sites with regularly updated information and maps – e.g. EVITA - http://www.eurocontrol.int/services/evita-european-crisis-visualisation-interactive-tool-atfcm

h) Teleconferences

i) Periodic Bulletins with the set of information defined by the data providers and data users; e.g. Smithsonian Institution Weekly Bulletin.

j) Centralized internet-based sites for the sharing of lessons learnt (Knowledge management – e.g. SKYbrary http://www.skybrary.aero/index.php/Main_Page)

APPENDIX D: DESCRIPTION OF SELECTED VA PRODUCTS

Use of Volcanic Ash VAA/VAG, SIGMET and NOTAM

There are a variety of methods by which volcanic ash information can be provided to users in a form that can be plotted on charts.

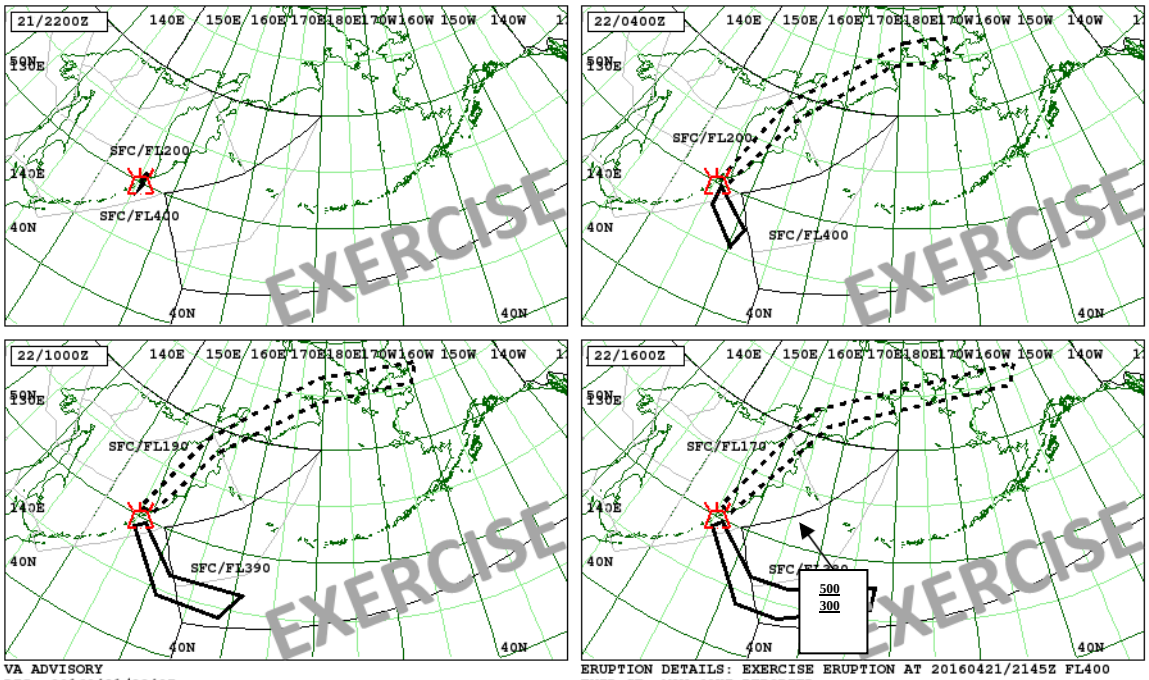
The VAA/VAG provided by the VAAC provides a regional view of the areas of ash contamination.

The VA SIGMET is issued by each MWO, who usually, unless they have additional information, take the VAA data and provide this for specific FIRs. SIGMETs are provided from the start of VA contamination of the corresponding FIR. They give information (based on a snapshot) for the beginning of the validity period and an outlook (also a snapshot) for the end of the validity period (which is a maximum of 6h later). The first SIGMET is generally shorter than 6h in order to have the following ones issued at synoptic hours (00, 06, 12 and 18z) and are mainly based on the VAAC's production (T+0 and T+6).

The VA NOTAM is issued by the NOTAM Office (NOF) and is usually supplied on the basis of information received from the MWO. In order to reduce information overload, the NOTAMs, where provided, give information on significant changes of the status of the volcano eruption and references existing information such as VAA/VAG and SIGMET.

ICAO Volcanic Ash Advisory (VAA) and VAG (Volcanic Ash Graphic)

In the event of an eruption, VAAC Tokyo or VAAC Anchorage will provide the ICAO Annex 3 [*Meteorological Services for International Air Navigation*] Volcanic Ash Advisory (VAA) and Volcanic Ash Graphic (VAG) as soon as practicable. Thereafter, VAA and VAG will be updated every 6 hours at 00, 06, 12 and 18 UTC for T+0, T+6, T+12, T+18 hours.



Both products are provided on the website detailed below, additionally the VAA is provided as an AFTN message.

- VAAC Tokyo Website http://ds.data.jma.go.jp/svd/vaac/data/index.html

- VAAC Anchorage Website http://vaac.arh.noaa.gov/

Although not currently a standard product, a T+24 VAG and/or VAA product is currently being trailed by VAAC Tokyo and VAAC Anchorage. This product is simply a standalone continuation of the standard VAG/VAA product showing the expected locations of plumes at the T+24 hour forecast stage.

Use of Volcanic Ash VAA/VAG, SIGMET, NOTAM and ASHTAM

There are a variety of methods by which volcanic ash information can be provided to users in a form that can be plotted on charts.

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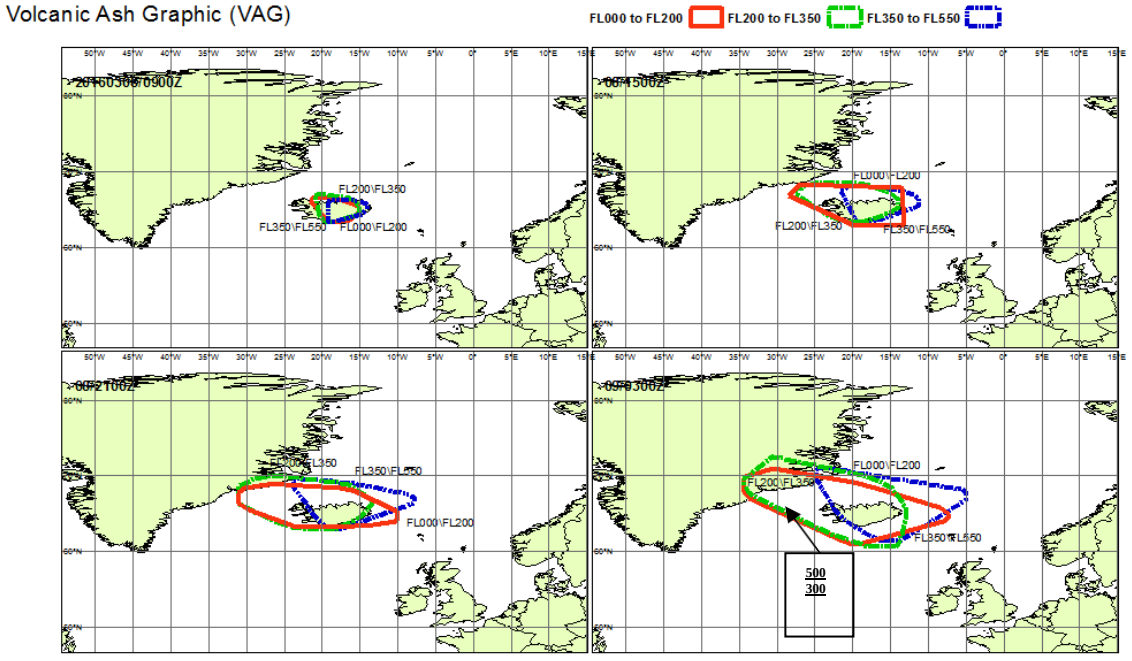
The VA SIGMET is issued by each MWO, who usually, unless they have additional information, take the VAA data and provide this for specific FIRs. Where a VAAC provides supplementary volcanic ash products [the information provided on the SIGMET is consistent with the low contamination area]. SIGMETs are provided from the start of VA contamination of the corresponding FIR/UIR. They give information (based on a snapshot) for the beginning of the validity period and an outlook (also a snapshot) for the end of the validity period (which is a maximum of 6h later). The first SIGMET is generally shorter than 6h in order to have the following ones issued at synoptic hours (00, 06, 12 and 18z) and are mainly based on the VAAC's production (T+0 and T+6).

The VA NOTAM is issued by the NOTAM Office (NOF) and is usually supplied on the basis of information received from the MWO. In order to reduce information overload, the NOTAMs, where provided, give information on significant changes of the status of the volcano eruption and references existing information such as VAA/VAG and SIGMET.

The ASHTAM is not widely used as a means of disseminating Volcanic Ash information and is not required where a State provides VA NOTAMs.

ICAO Volcanic Ash Advisory (VAA) and VAG (Volcanic Ash Graphic)

In the event of an eruption, VAAC London or VAAC Toulouse will provide the ICAO Annex 3 [*Meteorological Services for International Air Navigation*] Volcanic Ash Advisory (VAA) and Volcanic Ash Graphic (VAG) as soon as practicable. Thereafter, VAA and VAG will be updated every 6 hours at 00, 06, 12 and 18 UTC for T+0, T+6, T+12, T+18 hours.



Both products are provided on the website detailed below, additionally the VAA is provided as an AFTN message.

- VAAC London Website www.metoffice.gov.uk/aviation/**vaac**/
- VAAC Toulouse Website www.meteo.fr/**vaac**/

Although not currently a standard product, a T+24 VAG and/or VAA product is currently being trailed by VAAC Toulouse and VAAC London. This product is simply a standalone continuation of the standard VAG/VAA product showing the expected locations of plumes at the T+24 hour forecast stage.

In addition to the ICAO products detailed above a range of supplementary products are provided. These are detailed below.

Supplementary Volcanic Ash Charts provided by the London and Toulouse VAACs

The region is required to provide supplementary information on volcanic ash beyond a simple ash/no ash product to support the region's Safety Risk Assessment (SRA) based approach in case of a significant ash producing eruption. This means that multiple contamination levels will continue to underpin the AFI Volcanic Ash Contingency Plan (VACP). E.g Since the 2010 Eruption of Ejyafjallajökull, VAACs London and Toulouse have provided Volcanic Ash Concentration Charts in support of the VACP. These charts predict the location of a quantitative mass of ash per unit volume.

The Volcanic Ash Concentration Charts are provided for three contamination levels: -

Low contamination' Volcanic Ash Mass Concentration less than or equal to 2000 micrograms per cubic metre.

Medium contamination' Volcanic Ash Mass Concentration greater than 2000 micrograms per cubic metre and less than 4000 micrograms per cubic metre.

High contamination' Volcanic Ash Mass Concentration greater than or equal to 4000 micrograms per cubic metre

Volcanic Ash Mass Concentration charts are issued every 6 hours at 00, 06, 12 and 18 UTC for T+0, T+6, T+12, and T+18 hours ahead. It should be noted that the charts represent the actual or forecast location of ash over the 6-hour period up to the validity time.

The charts detail a number of polygons which will be divided into low, medium and high contamination areas.

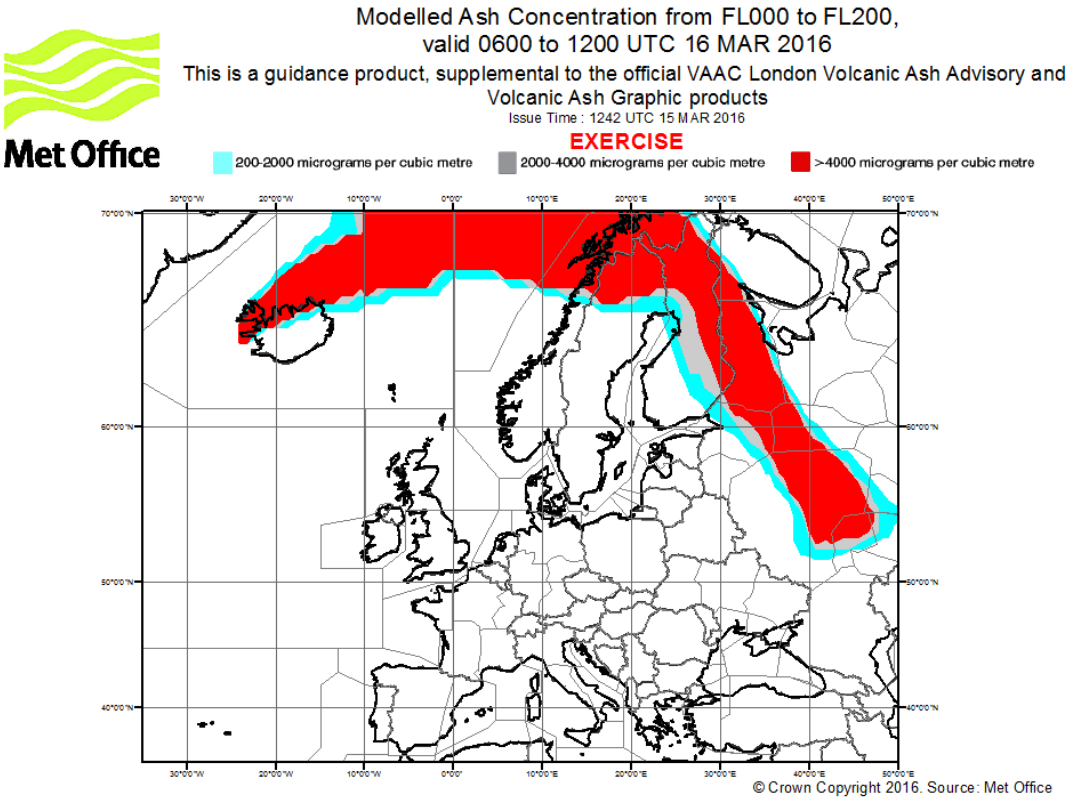
Low Contamination: <= 2000 micrograms per cubic metre

Medium Contamination: > 2000 < 4000 micrograms per cubic metre

High Contamination: >= 4000 micrograms per cubic metre

Separate charts covering different Flight Level bands (FL000-200, FL200-350, FL350- 550 are provided.

Example VA concentration chart

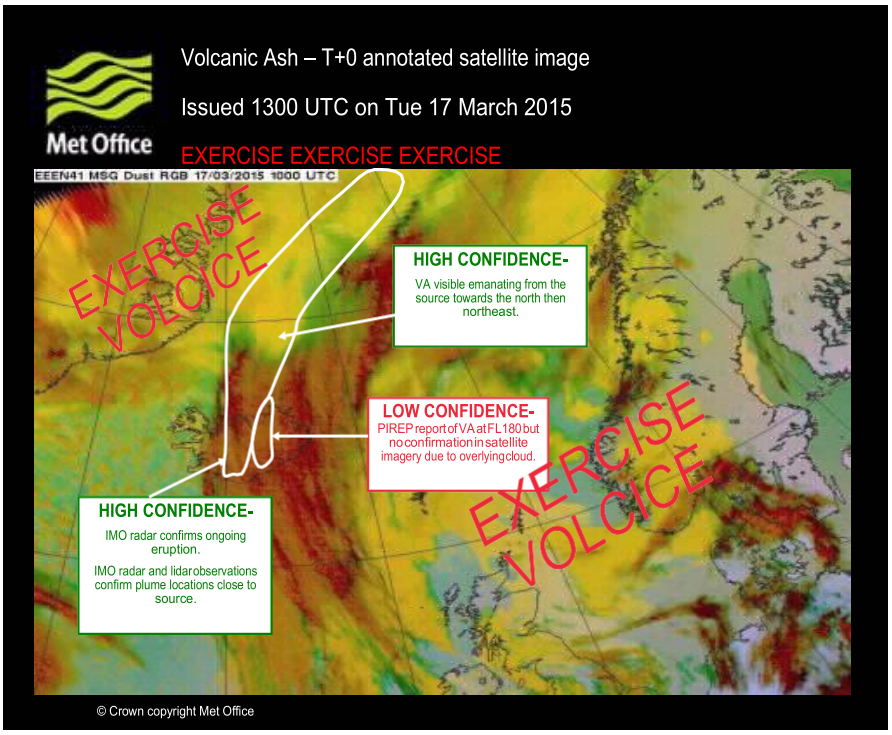


Annotated Satellite Image

At regular intervals of every 3 hours Toulouse and will produce a satellite image which is annotated with a variety of observational information related to volcanic ash including pilot reports, research aircraft reports, lidar information and other satellite information. This information assists users to understand how the VAAC forecasters are using this additional information that is being provided by indicating the confidence on which it is being evaluated.

These products will be issued every 3 hours at the following approximate times: 02, 05, 08, 11, 14, 17, 20, and 23 UTC.

2. Example Annotated Satellite Image:



Data Files

3. Data files in csv format will be provided for contour co-ordinates of the CML charts in a similar format to those currently provided. Note, however, that some of the information contained in the header (the first 11 lines of the csv file) will differ from those currently issued. Consideration will be given to publishing an XML schema for ingestion of this data. This will facilitate more streamlined ingestion of the contour data into visualisation packages.

CSV Format – Current (as at 15.03.16) format – as provided to EUROCONTROL – other variants also exist

VOLCANO: KATLA 372030
PSN: N6338 W01903
VOLCANIC ASH CONCENTRATION: LOW 200 MICROGRAMS PER CUBIC METRE CONTOUR LOW; 200 MICROGRAMS PER CUBIC METRE CONTOUR
ISSUE TYPE: TEST
MODEL RUN: 20160308/0900 ISSUE
TIME: 20160308/0858 VALIDITY
TIME: 20160308/2100 FLIGHT LEVEL:
FL200/FL350
REMARKS: CONFIDENCE AT T+0 IS HIGH DUE TO REPORTS FROM IMO. SEE ANNOTATED SATELLITE IMAGERY FOR FURTHER DETAILS.
ORIGINATOR: LONDON
VAAC POLY 1
N695414,W0245459
N693250,W0235049
N693215,W0220807
N684750,W0195437
N684648,W0191745
N682734,W0184723
N684737,W0174604
N684655,W0162922
N684025,W0161917
N680250,W0155101
N680022,W0151806
N665056,W0133348
N664025,W0132621

N662733,W0132612
N644629,W0144126
N635947,W0155135
N633641,W0165949
N625250,W0180538
N624940,W0181647
N624943,W0210705
N631210,W0221637
N631258,W0240012
N640316,W0262425
N645526,W0270302
N660404,W0270440
N663440,W0272739
N663440,W0274707
N654942,W0300425
N655254,W0301659
N662254,W0305802
N682727,W0310052
N684454,W0305010
N690819,W0294126
N693143,W0290455
N693250,W0282753
N695456,W0272057
N695414,W0245459

Use of Volcanic Ash VAA/VAG, SIGMET, NOTAM and ASHTAM

There are a variety of methods by which volcanic ash information can be provided to users in a form that can be plotted on charts.

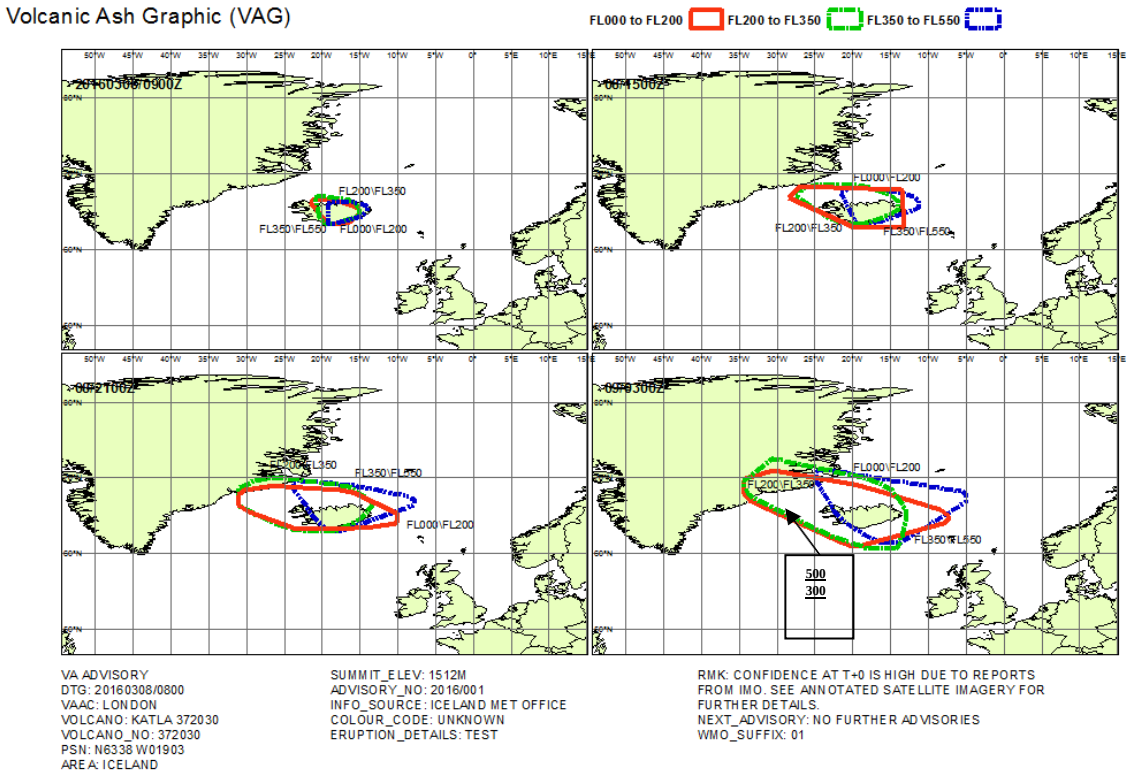
The VAA/VAG provided by the VAAC provides a regional view of the areas of ash contamination.

The VA SIGMET is issued by each MWO, who usually, unless they have additional information, take the VAA data and provide this for specific FIRs. Where a VAAC provides supplementary volcanic ash products [the information provided on the SIGMET is consistent with the low contamination area]. SIGMETs are provided from the start of VA contamination of the corresponding FIR/UIR. They give information (based on a snapshot) for the beginning of the validity period and an outlook (also a snapshot) for the end of the validity period (which is a maximum of 6h later). The first SIGMET is generally shorter than 6h in order to have the following ones issued at synoptic hours (06, 12 and 18z) and are mainly based on the VAAC's production (T+0 and T+6).

1. The VA NOTAM is issued by the NOTAM Office (NOF) and is usually supplied on the basis of information received from the MWO. In order to reduce information overload, the NOTAMs, where provided, give information on significant changes of the status of the volcano eruption and references existing information such as VAA/VAG and SIGMET.

The ASHTAM is not widely used as a means of disseminating Volcanic Ash information an *ICAO Volcanic Ash Advisory (VAA) and VAG (Volcanic Ash Graphic)*

In the event of an eruption, VAAC London or VAAC Toulouse will provide the ICAO Annex 3 [*Meteorological Services for International Air Navigation*] Volcanic Ash Advisory (VAA) and Volcanic Ash Graphic (VAG) as soon as practicable. Thereafter, VAA and VAG will be updated every 6 hours at 00, 06, 12 and 18 UTC for T+0, T+6, T+12, T+18 hours.



Both products are provided on the website detailed below, additionally the VAA is provided as an AFTN message: VAAC Toulouse Website www.meteo.fr/**vaac**/

Although not currently a standard product, a T+24 VAG and/or VAA product is currently being trialled by VAAC Toulouse. This product is simply a standalone continuation of the standard VAG/VAA product showing the expected locations of plumes at the T+24 hour forecast stage.

In addition to the ICAO products detailed above a range of supplementary products are provided. These are detailed below.

Annotated Satellite Image

At regular intervals of 3 hours VAAC Toulouse will produce a satellite image which is annotated with a variety of observational information related to volcanic ash including pilot reports, research aircraft reports, lidar information and other satellite information. This information assists users to understand how the VAAC forecasters are using is not required where a State provides VA NOTAMs. This additional information that is being provided by indicating the confidence on which it is being evaluated. These products will be issued every 3 hours at the following approximate times: 02, 05, 08, 11, 14, 17, 20, and 23 UTC.

Data Files

Data files in csv format will be provided for contour co-ordinates of the CML charts in a similar format to those currently provided. Note, however, that some of the information contained in the header (the first 11 lines of the csv file) will differ from those currently issued. Consideration will be given to publishing an XML schema for ingestion of this data. This will facilitate more streamlined ingestion of the contour data into visualization packages.

1CSV Format – Current (as at 15.03.16) format – as provided to EUROCONTROL – other variants also exist
VOLCANO: KATLA 372030 PSN: N6338 W01903
VOLCANIC ASH CONCENTRATION: LOW 200 MICROGRAMS PER CUBIC METRE CONTOUR LOW; 200 MICROGRAMS PER CUBIC METRE CONTOUR
ISSUE TYPE: TEST
MODEL RUN: 20160308/0900 ISSUE TIME: 20160308/0858 VALIDITY TIME: 20160308/2100 FLIGHT LEVEL: FL200/FL350
REMARKS: CONFIDENCE AT T+0 IS HIGH DUE TO REPORTS FROM IMO. SEE ANNOTATED SATELLITE IMAGERY FOR FURTHER DETAILS.
ORIGINATOR: LONDON VAAC POLY 1 N695414, W0245459 N693250, W0235049

N693215,W0220807
N684750,W0195437
N684648,W0191745
N682734,W0184723
N684737,W0174604
N684655,W0162922
N684025,W0161917
N680250,W0155101
N680022,W0151806
N665056,W0133348
N664025,W0132621
N662733,W0132612
N644629,W0144126
N635947,W0155135
N633641,W0165949
N625250,W0180538
N624940,W0181647
N624943,W0210705
N631210,W0221637
N631258,W0240012
N640316,W0262425
N645526,W0270302
N660404,W0270440
N663440,W0272739
N663440,W0274707
N654942,W0300425
N655254,W0301659
N662254,W0305802
N682727,W0310052
N684454,W0305010
N690819,W0294126
N693143,W0290455
N693250,W0282753
N695456,W0272057
N695414,W0245459

APPENDIX E: PILOT REPORTS

Introduction

ICAO Annex 3 [*Meteorological Services for International Air Navigation*], paragraph 5.5, g) and h), prescribes that volcanic ash clouds, volcanic eruptions and pre-eruption volcanic activity, when observed, shall be reported by all aircraft. The ICAO *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444) contain detailed provisions on this special air report requirement in paragraphs 4.12.3 and 4.12.5, and the Volcanic Activity Report form in its Appendix 1.

In order to improve the rate of reporting and the sharing of information on volcanic ash encounters and observations in accordance with the above mentioned provisions (in-flight, via Special Air-Reports and post-flight via Volcanic Activity Report) the following procedures have been agreed for the AFI Region. A high level of global harmonization is essential to achieve the desired level of implementation and consistency of the information.

The purposes of volcanic ash reporting and data collection; and the responsibilities and roles of the participants in the reporting process are described in detail in Appendix C of the Volcanic Ash ATM Contingency Plan Template (VAACPT) attached.

With reference to the format of special air-report on volcanic ash, various formats provided in the provisions (Annex 3 [*Meteorological Services for International Air Navigation*] and PANS-ATM [Doc 4444] refer). ICAO is working at the global level to consider harmonizing the format of special air-report on volcanic ash in Annex 3 and PANS-ATM (Doc 4444). As this task may take some time (years) to be completed, the various formats are used in examples below based on the current provisions and to whom they apply. In this context it all operators under there are to report any encounter with volcanic ash or any other relevant maintenance and airworthiness related findings in the relevant ICAO VAR form.

Pilots should be aware that reporting *no volcanic ash* is important to verify information about airspace contamination from various sources that could lead to less airspace restrictions. Doc 9766, paragraph 4.7 requires that in the event of an eruption, operators should request their pilots to report, when appropriate, any observation related to a volcanic ash cloud including the absence of visible ash and all other relevant information such as observational conditions. The operator should then forward this information to the association VAAC in a timely manner. The best way to do so is to send this information by e-mail. The operational e-mail addresses of the VAACs are listed in Table 4-2 of Doc 9766.

“NO VISIBLE ASH OBSERVED” or “NO ASH VISIBLE” shall be reported in the “Other” plain text field of item 8 of the Special air-report of volcanic activity or VAR Form.

When a flight is observing volcanic activity or contamination over a prolonged period during flight, a series of special air-reports on volcanic ash shall be made, so that a four-dimensional representation of the situation is created.

Pilots should be trained for airborne observations of volcanic activity/contamination to avoid an erosion of the credibility of special air-reports on volcanic ash. Improved instructions on the use of the Volcanic Activity Report Form are required to achieve high quality of information for the VAR users.

VAAC requirements

VAAC Toulouse serve the AFI Region. Their requirements for receiving Special Air-Reports of Volcanic Activity are listed in Appendix-04 of DOC 9766.

Format and Routing instructions

For in-flight Special Air-Reports on Volcanic Activity and post-flight Volcanic Activity Reports, the form provided in PANS-ATM (Doc 4444) Appendix 1, section 2 shall be used.

Examples
Pilots*:*

Example referencing PANS-ATM (Doc 4444) Appendix 1, Part 1-Reporting instructions sections 1-4 and 9 is provided:

"AIREP SPECIAL UNITED AIRLINES TREE TOO TOO POSITION FIFE FIFE ZERO TREE NORTH WUN SEVEN ZERO TOO ZERO EAST FLIGHT LEVEL TREE ZERO ZERO CLIMBING TO FLIGHT LEVEL TREE FIFE ZERO VOLCANIC ASH CLOUD"

ATS unit:

1. ATS personnel 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) because of the abrasive effects of volcanic ash on windshields and landing lights, visibility for approach and landing may be markedly reduced. Forward visibility may be limited to that which is available through the side windows; 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, ATS personnel can expect flight crews to be executing contingency procedures such as the following:

a) if possible, the flight crew may immediately reduce thrust to idle;

b) exit volcanic ash cloud as quickly as possible. The shortest distance/time out of the ash may require an immediate, descending 180-degree turn (terrain permitting);

c) don flight crew oxygen masks at 100 per cent (if required);

d) monitor airspeed and pitch attitude. If unreliable airspeed is suspected, or a complete loss of airspeed indication occurs (volcanic ash may block the pitot system), the flight crew will establish the appropriate pitch attitude;

e) land at the nearest suitable airport; and

on landing, reverses may be used as lightly as feasible

The format used for forwarding of meteorological information received by voice communications to the associated meteorological watch office (MWO) is provided in subtitle 3 of Appendix 1 of PANS-ATM. An example is provided based on the information given by the pilot.

ARS UAL322 5503N17020E 0105 F300 ASC F350 VA CLD=

***MWO**:*

Example referencing Annex 3 [*Meteorological Services for International Air Navigation*], Appendix 6, Table A6-1 is provided based on information given by the ATS unit:

ARS UA322 VA CLD FL300/350 OBS AT 0105Z N5503E17020=
The MWO should send this message in accordance with regional dissemination schema to:
.
Appropriate Regional OPMET Data Bank.

Appropriate Volcanic Ash Advisory Centre

Example: **SIGMET, NOTAM, ASHTAM**

Guidance on WMO headers referred to in Alerting Phase, paragraph 1.2.2 refers can be found in WMO No.386 Volume I (*Manual of Global Telecommunications System)* Part II *(Operational Procedures for the Global Telecommunications System)*

NOTAM Offices are reminded that ASHTAM (or NOTAM for volcanic ash) should be distributed via AFTN to their associated MWO, the SADIS Gateway and all the VAAC, in accordance with guidelines contained in ICAO Doc 9766 Chapter 4 paragraph 4.3.

1. SIGMET

WVUK02 EGRR 180105
EGGX SIGMET 2 VALID 180105/180705 EGRREGGX
SHANWICK OCEANIC FIR VA ERUPTION MT KATLA PSN N6337 W01901 VA CLD
OBS AT 0100Z N6100 W02730 - N6100 W02230 - N5800 W01730 - N5630 W02000
FL200/350 MOV SE 35KT FCST 0705Z VA CLD APRX N5800 W02000 - N5730
W01200 - N5500 W00910 - N5430 W01530 - N5800 W02000=
Note: PSN replaces LOC as per Amendment 75 to Annex 3 (applicable 18 November 2010)

2. NOTAM alerting pre-eruptive activity

(A0777/10NOTAMN
Q) BIRD/QWWXX/IV/NBO/W/000/999/6337N01901WXXX
A) BIRD B) 1002260830 C) 1002261100 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.AIRCRAFT ARE
REQUIRED TO FLIGHT PLAN TO REMAIN AT LEAST XXXNM CLEAR OF VOLCANO AND
MAINTAIN WATCH FOR NOTAM/SIGMET FOR AREA.
F) GND G) UNL)
Note: XXX is a distance established by the Provider State in accordance with paragraph 1.2.1 a)

3. NOTAM establishing Danger Area after initial eruption

(A0778/10 NOTAMR A0777/10
Q) BIRD/QWWXX/IV/NBO/W/000/999/6337N01901WXXX
A) BIRD

B) 1002260900 C) 1002261200
E) VOLCANIC ERUPTION REPORTED IN VOLCANO KATLA 1702-03 6337.5N01901.5W ICELAND-S. VOLCANIC ASHCLOUD REPORTED REACHING FL500. AIRCRAFT ARE REQUIRED TO REMAIN AT LEAST XXXNM CLEAR OF VOLCANO AND MAINTAIN WATCH FOR NOTAM/SIGMET FOR BIRD AREA.
F) GND G) UNL)
Note: XXX is a distance established by the Provider State in accordance with paragraph 1.2.1 a)

4. NOTAM establishing Danger Area to include Area of High [or High/Medium or High/Medium/Low] Contamination

A0503/10 NOTAMN
Q) EGGN/QWWXX/IV/NBO/AE/000/350
A) EGPX B) 1005182300 C) 1005190500
E) TEMPORARY DANGER AREA HAS BEEN ESTABLISHED FOR VOLCANIC ASH AREA OF HIGH CONTAMINATION IN AREA 5812N00611W 5718N00216W 5552N00426W 5629N00652W
F) SFC
G) FL350)

5. NOTAM to define Area of Medium Contamination for which a Danger Area has not been established

A0207/10 NOTAMN
Q) EUEC/QWWXX/IV/AE/000/200
A) EIAA B) 1005190700 C) 1005191300
E) VOLCANIC ASH AREA OF MEDIUM CONTAMINATION FORECAST IN AREA 5243N00853W 5330N00618W 5150N00829W
F) SFC
G) FL200)

6. ASHTAM alerting pre-eruptive activity

VALI0021 LIRR 01091410
ASHTAM 005/10
A) ROMA FIR B) 01091350 C) ETNA 101-06 D) 3744N01500E
E) YELLOW ALERT
J) VULCANOLOGICAL AGENCY

7. ASHTAM alerting eruptive activity

VALI0024 LIRR 01151800
ASHTAM 015/10
A) ROMA FIR B) 01151650 C) ETNA 101-06 D) 3744N01500E
E) RED ALERT F) AREA AFFECTED 3700N01500E 3900N01600E 3800N001700W SFC/35000FT G) NE H) ROUTES AFFECTED WILL BE NOTIFIED BY ATC J) VULCANOLOGICAL AGENCY

8. ASHTAM alerting reduction in eruptive activity

VALI0035 LIRR 01300450
ASHTAM 025/10
A) ROMA FIR B) 01300350 C) ETNA 101-06 D) 3744N01500E
E) YELLOW ALERT FOLLOWING ORANGE J) VULCANOLOGICAL AGENCY
Tools and media for presenting and sharing the volcanic ash information

To report, transmit and disseminate information about visible or discernible ash, the following tools are used in the AFI Regions:

a) VAA/VAG ('Info Source' and 'Remark' sections)

b) Radiotelephony and Data Link Communications (Special Air Report)

c) VAR

d) NOTAM is issued for change in volcanic eruption status and is therefore possible that a special air-report could contribute to the evidence that would warrant a change in volcanic eruption status

e) SIGMET is issued by the MWO when volcanic ash is observed by aircraft, volcano observatory, ground-based radars, lidars or ceilometers or discernible on satellite.

f) Central data repository e.g. Network Manager (NM) Network Operations Portal (NOP) (To be developed)

g) Teleconferences

h) Summaries containing general information and lessons learned from previous experience.

APPENDIX F: VAAC CHECKLIST

VAACs and Volcano Observatories are elements of the Air Navigation Plan (ANP) Vol I

Detailed VAAC responsibilities and procedures are contained in Annex 3 [Meteorological Services for International Air Navigation] to the convention on International Civil Aviation.

Standards and Recommended Practices (Annex 3 chapter 3.5)

a) Technical specifications (Annex 3 Appendix 2.3)

b) Volcanic Ash Advisory Example (Annex 3 Appendix 2 Example A2-1)

c) Volcanic Ash Advisory Template (Annex 3 Appendix 2 Table A2-1)

Operational procedures and contact lists are documented in the Handbook on the International Airways Volcano Watch (IAVW Handbook, Doc 9766)

VAAC Toulouse : http://www.meteo.fr/vaac/

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 and 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 and movement;

c) Prepare and issue advisories on the extent, and forecast trajectory, of the volcanic ash contamination in message format for transmission to the MWOs, ACCs and operators concerned in the VAAC area of responsibility, and to the two Regional OPMET Data Banks (RODB) in Dakar and Pretoria. As well as inter-regional distribution, the RODBs will ensure dissemination of the advisory to all VAACs, the London World Area Forecast Centre (WAFC);

d) Monitor subsequent satellite information or other available observations to assist in tracking the movement of the volcanic ash;

e) Continue to issue advisory information (i.e. VAA/VAG), for validity periods T+0, T+6, T+12 and T+18 hours after data time, to MWOs, ACCs and operators concerned at least at 6 hour intervals, and preferably more frequently, until such time as it is considered that the volcanic ash 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) Maintain regular contact with other VAACs and meteorological offices concerned, and, as necessary, 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

APPENDIX G: REGIONAL MONITORING CAPABILITIES AND ARRANGEMENTS

Common to AFI Region

Volcano Observatories and Volcanoes monitored

Satellites : *MSG: http://www.eumetsat.org/IPPS/html/MSG/RGB/DUST/*

Aircraft sensors: AVOID: http://www.nilu.no/Nyhetsarkiv/tabid/74/language/en-GB/NewsId/261/AVOID-volcanic-ash-detection-technology-tested-on-Airbus-aircraft.aspx

ZEUS: http://www.metoffice.gov.uk/news/releases/archive/2014/zeus

APPENDIX H: STATE CHECKLIST

States need to ensure that they have robust arrangements in place that can be activated when there is volcanic contamination in their airspace. These arrangements should be in line with global and regional provisions. The aim should be to create cooperation of all entities involved, including those from non-aviation sectors, as appropriate. Contingency arrangements shall ensure safe and efficient flight operations for most circumstances. Crisis management should be available to assist in situations resulting in major loss of network capacity.

The following checklist provides a list of areas that might need to be covered, but is not necessarily exhaustive.

It is envisaged the following organizations in a State will be required to provide information to their stakeholders during a volcanic eruption, when volcanic contaminants are present or expected in the airspace or on airports. Their activities need to be coordinated by those operating the State Crisis Management Plan (if available).

a) Department/Ministry for Transport;

b) National Supervisory Authority (Regulator);

c) ANSPs (En-Route and Terminal);

d) Meteorological Office;

e) NOTAM Office;

f) Airlines and other airspace users;

g) Airports; and

h) Department/Ministry of Defence.

Preparatory Activities (see also ICAO Doc 9766, section 4.1): States having active or potentially active volcanos in their territory should establish:

a) One or more Volcano Observatories; and

b) A routine process for monitoring messages produced by Volcano Observatories;

Each State should:

a) Consider the use of available infrastructure or the implementation of new assets for the observation of volcanic contaminants; and review routinely their status

b) Mobile radar, gas and seismological sensors, GPS stations, etc. for use at or near volcanos;

c) LIDAR networks and high-performance ceilometer networks; and

d) Aircraft that can provide in-situ measurements.

e) Implement and routinely review a State Volcanic Contamination policy and guidance (in particular also for VA Danger Areas);

f) Establish and routinely review VA contingency plans, procedures, communication channels and message templates for all Stakeholders;

g) Establish and routinely update Staff Training activities (State and all stakeholders);

h) Establish and routinely review Crisis management provisions (ideally taking into account non-aviation sectors);

i) Establish a regular review and acceptance of new SRAs for State based operators (according to ICAO Doc 9974; and

j) Participate in State and ICAO Regional VA exercises.

Crisis Management Activities

6. All States shall:

a) ensure that all those involved in crisis management are briefed in due time when exceedance of the capacity of contingency arrangements has to be expected;

b) activate State Crisis Management Plan (if appropriate);

c) activate State volcanic ash NOTAM / SIGMET process as an addition to the VACP process;

d) convene regular meetings of State Crisis Management Teams until situation returns to non-crisis circumstances;

e) take part in Regional / sub-Regional Crisis Management teleconferences;

f) take part in regular teleconferences with airspace users (in particular airlines) operating in State FIR;

g) check VAAC guidance ahead of the provision of SIGMETs by MWOs; and

h) share volcanic contamination information from in situ sensors (e.g. LIDAR, Optical Particle Counter (OPC) and Aircraft) with other States and the responsible VAACs.

APPENDIX I: ANSP CHECKLIST

Local instructions

Air Navigation Service Providers (ANSP) will ensure that suitable local instructions are in place at ATC facilities to enable staff at all levels of the organization to manage a volcanic contamination contingency event safely and efficiently. These instructions be in accordance with the appropriate Volcanic Contamination Contingency Plan and will detail procedures necessary to deal with the ATC aspect of the contingency and also the interfaces with external agencies. These will include at a minimum, State regulators, adjacent ANSPs, Met Offices and the central ATFM unit (if any). These instructions may also detail the interface with the VAAC if appropriate.

Air Traffic Control provides services in a normal manner, including issuing reroute, flight level change and speed change clearances, to aircraft operating or planning to operate inside areas contaminated with volcanic ash when required due to traffic. It is the responsibility of the pilot-in-command to determine if such clearances can be safely accepted or not.

Personnel Training and Exercises

ANSPs will establish a training and exercise plan to ensure staff at all levels within the organization involved in a volcanic contamination contingency can execute the procedures detailed in local instructions. Continuation training will be provided to ensure that staff maintain a level of proficiency which allows them to safely and efficiently manage a volcanic contamination contingency situation at any time.

In the AFI Region ANSPs will participate in regular volcanic ash exercises organized within the framework of the ICAO VOLCEX Steering Group which includes wide participation by ANSPs, AOs, VAACs, Met providers, state regulators and Network and Crisis Management units.

Communication links

ANSPs will have in place effective communication links with at least their state regulator, adjacent ANSPs, Met Offices and their central ATFM unit (if any). Communication links with the VAAC may also be established where appropriate.

ATFM and Crisis Management

Central ATFM units (if available) will facilitate information exchange among existing crisis

APPENDIX J: MWO CHECKLIST

The MWO role is crucial during a volcanic ash contingency. MWOs are responsible for producing VA SIGMET for their FIRs making use of information from VAACs and any other locally available information. These SIGMETs may subsequently be used in NOTAM production. The accuracy and timeliness of VA SIGMET production is very important for the effectiveness of mitigation actions and the safety and efficiency of air traffic**.**

Action to be taken by MWO in the event of a volcanic eruption:

a) Pay attention to VAA/VAG produced by the AFI VAAC Toulouse as well as supplementary products provided by the MET offices co-located within AFI VAAC;

b) Monitor information from volcano observatories in their area of responsibility;

c) Immediately after the reception of any of those advisories, check within their area of responsibility for VA contaminated areas and;

d) Issue SIGMET according to VAAC advisory information, special air-reports on volcanic ash and any other relevant information and/or measurements available;

e) Assure that VA SIGMET format is compliant with provisions and SIGMET template of ICAO Annex 3 [*Meteorological Services for International Air Navigation*]; templates available in local instructions might help to achieve this;

f) Advise ACC and VAAC whether or not the volcanic ash is identifiable from satellite images/data, ground based or airborne measurements or other relevant sources.

g) Report differences between aircraft observations (e.g. ash encounters) or any other qualified source and the information published in VAA/VAG, SIGMET or NOTAM/ASHTAM to appropriate VAACs and MWO. The information should be passed immediately to adjacent MWO(s) downstream of the moving ash cloud;

h) On reception, forward special air-reports on volcanic ash to AFI VAAC, appropriate Regional OPMET Centre by AFTN which would then route to SADIS (EGZZWPXX) and WIFS (KWBCYMYX); Referencing Annex 3, Appendix 6, the format of a special air-report on volcanic ash is illustrated by the following example:

ARS UA322 VA CLD FL300/350 OBS AT 0105Z N5503E17020=

i) Coordinate as far as practicable with ACCs, adjacent MWOs and the AFI VAAC to ensure as much as possible consistency in VA analysis and forecast.

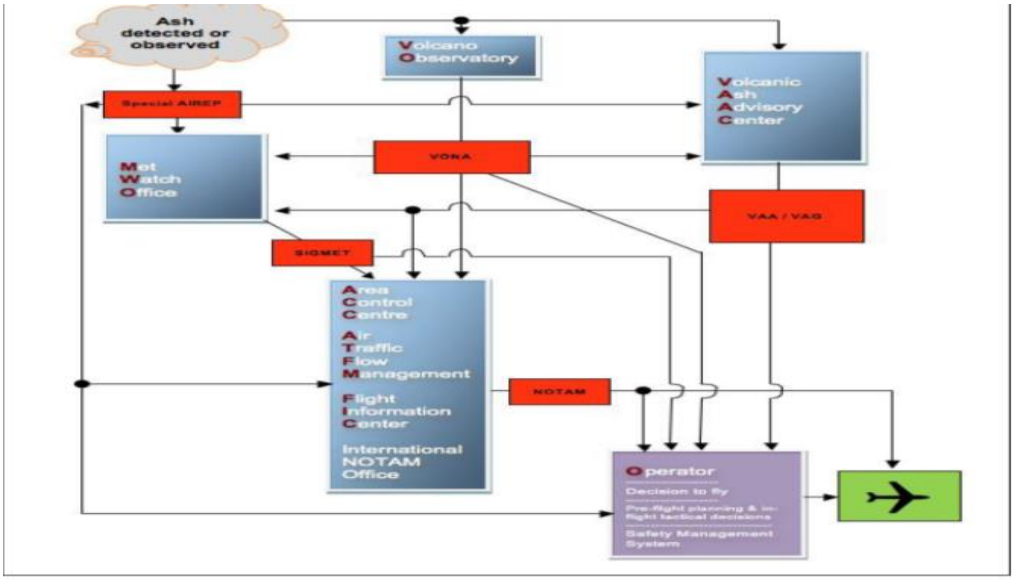
j) Provide as far as practicable regular volcanic briefings, based on the latest available ash observations and forecasts, to ACCs, ATFM units, airport operators and aircraft operators concerned;

k) Ensure that local instructions address VA contingency procedures;

l) Ensure that all relevant staff are trained regularly to apply the VA contingency procedures;

m) Participate in volcanic ash exercises.

APPENDIX K: REGIONAL INFORMATION FLOW ARRANGEMENTS AND MODEL TEMPLATES



VAAC: VAAC contact details: They can be found in ICAO Doc 9766 table 4-2 [VAAC Contact numbers]. For AFI reference is made with respect to Toulouse

VAAs (Volcanic Ash Advisory) and VAGs (Volcanic Ash Graphics): The VAA template is described in Annex 3 [Meteorological Services for International Air Navigation], in Appendix 2, Table A2-1 [template for advisory message for volcanic Ash].

VAA examples: *VA ADVISORY*

Example 1

DTG : 20100101/0605Z

VAAC : TOULOUSE

VOLCANO : ETNA 211060

PSN: N3744 E01500

AREA: ITALY

SUMMIT ELEV: 3330M

ADVISORY NR: 2015/12

INFO SOURCE: INGV, WEBCAM

AVIATION COLOUR CODE: RED

ERUPTION DETAILS: ERUPTION STARTED AT 0600Z

OBS VA DTG: 02/0600Z

OBS VA CLD: SFC/FL130 N3750 E01500 - N3800 E01550 - N3735 E01550 –

N3750 E01500 MOV E 45KT

FCST VA CLD +6HR: 02/1200Z SFC/FL130 N3750 E01505 - N3840 E01950 –

N3710 E01945 - N3750 E01505

FCST VA CLD +12HR: 02/1800Z NOT PROVIDED

FCST VA CLD +18HR: 03/0000Z NOT PROVIDED

RMK: PLEASE CHECK SIGMET FOR CURRENT WARNINGS.

NXT ADVISORY: NO LATER THAN 20150202/1200Z=

Example 2

DTG: 20100101/1500Z

VAAC: LONDON VOLCANO: ORAEFAJOKULL 374010

PSN: N6400 W01639 AREA: ICELAND

SUMMIT ELEV: 2119M

ADVISORY NR: 2010/002

INFO SOURCE: IMO

AVIATION COLOUR CODE: RED

ERUPTION DETAILS: OBS ASH PLUME, EST 12KM FROM RADAR.

OBS VA DTG : 10/1500Z

OBS VA CLD : NO VA EXP

FCST VA CLD +6HR : 10/2100Z SFC/FL200 N6329 W01651 - N6517 W01614 - N6849 E00351 - N6742 E01549 - N6329 W01651

FL200/350 N6327 W01656 - N6600 W01444 - N6750 W00307 - N6854 E01550 - N6718 E01833 - N6327 W01656

FL350/550 N6325 W01635 - N6450 W01625 - N6812 W00004 - N6841 E01441 - N6726 E01653 - N6325 W01635

FCST VA CLD +12HR : 11/0300Z SFC/FL200 N6334 W01640 - N6526 W01629 - N6945 E00502 - N6658 E03036 - N6327 E03908 - N6629 E00931 - N6334 W01640

FL200/350 N6329 W01701 - N6556 W01624 - N7009 E00806 - N6431 E04310 - N6026 E04358 - N6709 E00854 - N6329 W01701

FL350/550 N6334 W01650 - N6551 W01547 - N6931 E01235 - N6439 E03929 - N6128 E04027 - N6634 E01013 - N6334 W01650

FCST VA CLD +18HR : 11/0900Z SFC/FL200 N6327 W01717 - N6517 W01706 - N6905 E00017 - N6949 E02107 - N6024 E05301 - N5804 E05147 - N6630 E01612 - N6327 W01717 FL200/350 N6327 W01645 - N6556 W01613 - N7054 E01405 - N5925 E05658 - N5421 E04829 - N6717 E01018 - N6327 W01645 FL350/550 N6327 W01634 - N6634 W01510 - N7012 E01458 - N5953 E05349 - N5558 E04930 - N6630 E01405 - N6327 W01634

RMK: ASH PLUME NOW OBS, ESTIMATED HEIGHT 12KM FROM RADAR. INCREASING SEISMIC ACTIVITY. NXT ADVISORY: WILL BE ISSUED BY 20150210/1800Z =

VAA and VAG dissemination:

a) VAA are sent by the VAACs to the MWOs and ACC/FICs following ICAO Doc 9766 Part 2 on ICAO website

b) The VAAs are to be sent onto AFTN.

c) They can be retrieved as the VAGs in the VAACs Websites

VAAC London: VAAs & VAGs

VAAC Toulouse: VAAs & VAGs

VAAC Tokyo: VAAs & VAGs

VAAC Montréal: VAAs & VAGs

VAAC Washington: VAAs & VAGs

d) They can be retrieved as well in the secure SADIS FTP site

Volcano Observatories (VO)

VONA (Volcano Observatory Notice to Aviation)

VONA is a recommended practice (Annex 3). The VONA template can be found in ICAO Doc 9766 Appendix E.

VONA example:

(1) VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)	
(2) Issued:	*(20150202/0559Z)*
(3) Volcano:	*Etna 211060*
(4) Current Color Code:	*RED*
(5) Previous Color Code:	*ORANGE*
(6) Source:	*Etna Volcano Observatory*
(7) Notice Number:	*2015/0011/03E11*
(8) Volcano Location:	*3744N 01500E*
(9) Area:	*Italy*
(10) Summit Elevation:	*3300 m*
(11) Volcanic Activity Summary:	*EXPLOSIVE ACTIVITY AT NEW SE CRATER (NSEC) SUMMIT VENT - SIGNIFICANT ASH EMISSION OCCURS*
(12) Volcanic cloud height:	*UNKNOWN*
(13) Other volcanic cloud information:	*dark ash cloud at low elevation due to strong wind*
(14) Remarks:	*THE PHENOMENON IS DETECTED BY VIDEOSURVEILLANCE CAMERAS FROM 0558Z*
(15) Contacts:	*24/7 OE Control Room operator turnista@ct.ingv.it +39 095 7165800 Eugenio Privitera (OE Director) direttore.oe@ingv.it +39 095 7165800*
(16) Next Notice:	*A new VONA will be issued if conditions change significantly or the colour code is changes.*

MWO

6*. Volcanic Ash SIGMETs*

a) The VA SIGMET template is described in Annex 3 [Meteorological Services for International Air Navigation], Appendix 6 [Template for SIGMET and AIRMET messages].

b) VA SIGMET examples:

LFMM SIGMET 1 VALID 020800/021200 LFPW-

LFMM MARSEILLE FIR/UIR VA ERUPTION MT STROMBOLI

LOC N3848 E01511 VA CLD FCST E OF E00900 SFC/FL200 MOV NW 40KT

FCST 1200Z N4415 E00700 - N4400 E00700 - N4315 E00945 - N4115 E00945 –N4115 E00800 - N4045 E00800 - N4215 E00545 - N4345 E00545=

VA SIGMET dissemination

Appropriate Regional OPMET Centre – in this case, ROC Vienna at AFTN address LOWMMMXX, which would then route to SADIS (EGZZWPXX) and WIFS (KWBCYMYX) and be available to all stakeholders with a SADIS or WIFS account.

Appropriate VAAC – example: VAAC Tokyo at RJTDYMYX

Appropriate ACC and ATFM – example: ACC Petropavlovsk-Kamchatsky at UHPPZRZX and MATMC at UUUWZDZX NOTAM office

NOTAMs (ASHTAMs)

An example of NOTAM related to Volcanic Ash follows:

(W2867/15 NOTAMR W2866/15

Q) LIRR/QWWXX/IV/NBO/W/000/999/3759N01525E087

A) LIRR B)1512090826 C)1512101812EST

E) VOLCANO ETNA ID211060, PSN COORDINATES 374403N0150014E, ELEV 10922FT/3330M, EXPLOSIVE ACTIVITY IS INCREASED AT SE CRATER SUMMIT VENT.

-SIGNIFICANT ASH EMISSION OCCURS.

GREY CLOUD OF ASH AND VAPOR GROWING ABOVE VOLCANO SUMMIT.

THE PHENOMENON IS OBSERVED BY VIDEOSURVEILLANCE CAMERAS.

ICAO LEVEL OF ALERT COLOUR: RED.

RMK: PILOTS SHALL WATCH OUT FOR RELEVANT SIGMET AND VOLCANIC

ADVISORY PRODUCTS PROVIDED BY TOULOUSE VOLCANIC ASH ADVISOR

CENTER (VAAC) IF AVBL THROUGH WEB SITE.

HTTP://WWW.METEO.FR/VAAC/EVAA.HTML (LOWER CASE).

REF AIP ENR 5.3.3-1

F) GND

G) UNL) =

Messages dissemination: *SADIS/WIFS Gateway at EGZZVANW*

VAAs (Volcanic Ash Advisory) and VAGs (Volcanic Ash Graphics)

The VAA template is described in Annex 3 [Meteorological Services for International Air Navigation], Appendix 2, Table A2-1 [template for advisory message for volcanic ash].

Example 3:

VA ADVISORY

DTG: 20100101/0605Z

VAAC: TOULOUSE

VOLCANO: ETNA 211060

PSN: N3744 E01500

AREA: ITALY

SUMMIT ELEV: 3330M

ADVISORY NR: 2015/12

INFO SOURCE: INGV, WEBCAM

AVIATION COLOUR CODE: RED

ERUPTION DETAILS: ERUPTION STARTED AT 0600Z

OBS VA DTG: 02/0600Z

OBS VA CLD: SFC/FL130 N3750 E01500 - N3800 E01550 - N3735 E01550 - N3750 E01500 MOV E 45KT

FCST VA CLD +6HR: 02/1200Z SFC/FL130 N3750 E01505 - N3840 E01950 - N3710 E01945 - N3750 E01505

FCST VA CLD +12HR: 02/1800Z NOT PROVIDED

FCST VA CLD +18HR: 03/0000Z NOT PROVIDED

RMK: PLEASE CHECK SIGMET FOR CURRENT WARNINGS.

NXT ADVISORY: NO LATER THAN 20150202/1200Z=

Example 4: VA ADVISORY

DTG: 20100101/1500Z

VAAC: LONDON

VOLCANO: ORAEFAJOKULL 374010

PSN: N6400 W01639

AREA: ICELAND

SUMMIT ELEV: 2119M

ADVISORY NR: 2010/002

INFO SOURCE : IMO

AVIATION COLOUR CODE : RED

ERUPTION DETAILS: OBS ASH PLUME, EST 12KM FROM RADAR.

OBS VA DTG : 10/1500Z

OBS VA CLD : NO VA EXP

FCST VA CLD +6HR : 10/2100Z SFC/FL200 N6329 W01651 - N6517 W01614 - N6849 E00351 - N6742 E01549 - N6329 W01651

FL200/350 N6327 W01656 - N6600 W01444 - N6750 W00307 - N6854 E01550 - N6718 E01833 - N6327 W01656

FL350/550 N6325 W01635 - N6450 W01625 - N6812 W00004 - N6841 E01441 - N6726 E01653 - N6325 W01635

FCST VA CLD +12HR : 11/0300Z SFC/FL200 N6334 W01640 - N6526 W01629 - N6945 E00502 - N6658 E03036 - N6327 E03908 - N6629 E00931 - N6334 W01640

FL200/350 N6329 W01701 - N6556 W01624 - N7009 E00806 - N6431 E04310 - N6026 E04358 - N6709 E00854 - N6329 W01701

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FCST VA CLD +18HR : 11/0900Z SFC/FL200 N6327 W01717 - N6517 W01706 - N6905 E00017 - N6949 E02107 - N6024 E05301 - N5804 E05147 - N6630 E01612 - N6327 W01717 FL200/350 N6327 W01645 - N6556 W01613 - N7054 E01405 - N5925 E05658 - N5421 E04829 - N6717 E01018 - N6327 W01645 FL350/550 N6327 W01634 - N6634 W01510 - N7012 E01458 - N5953 E05349 - N5558 E04930 - N6630 E01405 - N6327 W01634

RMK: ASH PLUME NOW OBS, ESTIMATED HEIGHT 12KM FROM RADAR. INCREASING SEISMIC ACTIVITY. NXT ADVISORY: WILL BE ISSUED BY 20150210/1800Z =

APPENDIX L: GUIDANCE ON THE ESTABLISHMENT, AMENDMENT AND WITHDRAWAL OF DANGER AREAS

This is a guidance to be used by Regional agencies as reference in the use of Danger Areas in regards to Volcanic Ash.

Use of Danger Areas

The use of precautionary Danger Areas over and in the proximity of a volcanic eruption has been considered appropriate. It should be noted that an initial Danger Area will always be a stationary circle around the volcano, it will not follow the ash cloud.

The competent authority for determining the need for and extent of Danger Areas is the one regulating flight operations. States should implement arrangements to ensure the timely declaration of Danger Area by an appropriate authority according to pre-defined conditions.

In the Pre-Eruption and Start of Eruption phases there is lack of available information and the focus should be on aircraft in flight in the vicinity and or heading towards the volcano. The most effective tool at that time period is a Danger Area and it should be determined by prevailing local wind speeds.

As more information is received the restrictions should be lifted appropriately.

Appropriate AIS and MET messages shall be issued in accordance with Annex 15 [*Aeronautical Information Services*] and Annex 3 [*Meteorological Services for International Air Navigation*], respectively.

When respective VAAC or local Met Office issues the first area of forecasted ash, Danger Areas should normally be deactivated.

Size and dimensions of Danger Areas:

a) the area will be centered on the estimated or known position of the volcanic activity;
b) the size of the Danger Area should not exceed 60NM in the AFI Region;
c) in case of strong wind speeds, the danger area should be extended downwind, not exceeding half the size of the area but will not follow the wind further;
d) the Danger Area should be promulgated via NOTAM.

APPENDIX M: AIR TRAFFIC FLOW MANAGEMENT ARRANGEMENTS

Network Manager (Where applicable)

Network Manager (NM) area of operations the NM perform the ATFM function in collaborative approach with all operational stakeholders.

Comprehensive guidance on ATFM in the NM area of operations will be found in the Network Manager (NM) Network Operations Handbook (when developed)

*A regional organized Track System (OTS) and oceanic clearance arrangements will have to be developed complete with a c*omprehensive guidance track system and clearance procedures.

During a volcanic contamination contingency situation ANSPs will take cognisance of volcanic ash forecasts when planning the OTS. Organized Tracks will not necessarily avoid areas forecast by the VAAC to be contaminated by volcanic ash. If Organized Tracks are established through forecast contaminated areas, a note will be included on the Track Message to identify such tracks.

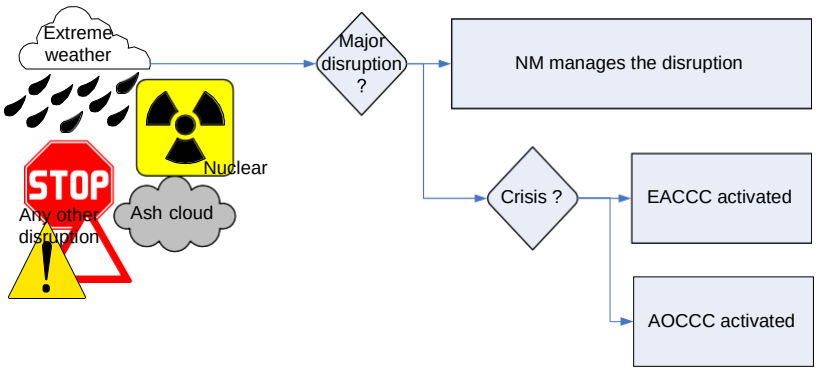
During volcanic ash contingency situations established track design and promulgation procedures will continue, as will the established clearance procedures. However, operators should be aware that the traffic situation is likely to be more random and complex than usual. Crews should be encouraged to contact ATC as early as possible to request clearance and clearances may take longer to formulate. The cleared flight profiles issued to flights are also more likely to contain changes to the requested lateral and vertical elements and crews should take particular care to check and confirm the clearance issued.

During the Recovery Phase, when aircraft may be dispersed on either side of the region, ANSPs may design a non-standard OTS which supports both westbound and eastbound organized tracks to suit customer demand.

APPENDIX N: Crisis Management Arrangements

Network Manager

Network Manager's area of operations the Network Manager (NM) provides the best assistance it can to help to mitigate the impact of major network disruptions or crisis situations. It also provides tools and services which enable users to anticipate or react to events more effectively, based on the best available knowledge of the ATM situation.



NM is liaising with other regions both on a daily basis and ad-hoc.

CCC:

Within the Network Manager's area of operations, the management of network crises is supported by a Aviation Crisis Coordination Cell (the ACCC) where The Network Manager, with the support of the ACCC, is responsible for coordinating the management of response to the network crisis, in accordance with the ACCC Rules of Procedure, involving close cooperation with corresponding structures in Member States.

NOP Portal (when designed)

The Network Operations Portal (NOP) is designed for ATM professionals. It provides real-time information on air traffic operations. The NOP enables partners to anticipate or react to events more effectively.

- Access to public NOP
- Access to protected NOP

Teleconferences

During crisis situations teleconferences are normally convened to facilitate collaboration and information sharing with operational stakeholders as well as coordination within the ACCC. In addition, ACCC Chair may decide to invite State Focal Points and, depending on the nature of the crisis, experts from relevant fields of expertise.

Crisis Visualization Interactive Tool for ATFCM (CVITA)

CVITA is a collaborative online tool which allows users to visualize the impact of a crisis on air traffic in Europe.

In the event of a volcanic ash event, CVITA:

a) displays ash concentration data received from VAAC Toulouse;
b) displays the coordinates of Danger Areas, as declared by States via NOTAM;
c) displays local areas defined by aircraft operators;
d) detects sectors, aerodromes and flights impacted by either ash concentration data or Danger Areas, or

areas locally defined by aircraft operators.

APPENDIX P: AIRSPACE USER (OPERATOR) CHECKLIST

SRA (according to ICAO Doc 9974) within SMS (Annex 19 [*Safety Management*]; Doc 9859).

Standard Operating Procedures (SOP) should be included in different Operations (OPS) Manual Parts (General & Definitions, Aircraft Specifics, Training) for both phases:

a) FLIGHT EXECUTION
b) FLIGHT PLANNING

Sources of information: To avoid information overload, the Operator should identify, prioritize & select the sources of information according to areas flown and as approved by its regulator, including Private Weather Service Provider, VAA, VAGs, European Concentration Charts, SIGMETS (OBS or FCST), Special AIREPs, NOTAMs & Surface weather METARs.

Procedures: The Operator should establish acceptable areas within which it may fly: above, below or with or without a margin of a predicted contaminated area.

Volcano Eruption Required information for dispatchers and flight crews

FLIGHT EXECUTION:

a) Alert Flight Crews (ACARS, VHF, HF or SatCom…), FOC & Engineers/Maintenance.

b) Provide Volcano name & location, ash direction, Entry & Exit points of expected contaminated areas.

c) If possible & when distance permits: create an exclusion zone, establish wind direction to circumnavigate area.

d) Review Destination, alternate, ETOPS & Depressurisation aerodromes availability.

e) Review & provide ETPs & escape routes.

f) Specific instructions for Flight Crews & Operational Control in case of volcanic contamination are described in Ops Manual Part related to Aircraft Specifics.

g) Monitor updated information.

h) When available, pilot participation via pre-formatted ACARS messages (Special AIREPS): Visible Ash Yes/No.

i) FOC/Dispatch to Relay Special AIREPs to the European Network Manager (Subregional procedure).

FLIGHT PLANNING:

a) Identify areas to be avoided.

b) Flight plan avoiding identified areas.

c) Establish Company Fuel policy (RCF, Contingency, etc.)

d) Avoid selecting ETOPS alternates & escape routes that are within predicted contaminated area.

e) Consider Depressurization (O_2) time limits.

f) Provide related text and graphic in weather/flight brief.

5. Dedicated team: It is recommended to nominate a temporary team dedicated to monitor, disseminate & centralize updated information & participate in teleconferences & crisis contingency plans.

6. Training for:

Crew: OPS Manual (General & Definitions, Aircraft Specifics, Training)

Dispatch: Ops Manual (General & Definitions, Training)

Engineers/Maintenance: Ops Manual (Aircraft Specifics, Training)

Contents:

a) volcanic contamination hazards
    - general
    - aircraft specific

b) Safety management principles

c) operator SMS and SRA

d) ATM contingency planning

e) Planning of operations

f) Executing of operations

g) Handling of differences to planned operating conditions in flight

h) Communications

Participation in volcanic contingency exercises (e.g. VOLCEX, VOLKAM)

APPENDIX Q: 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 No. Description Requirements
No.	Description			Severity	Likelihood	Risk		Severity	Likelihood	Risk		

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.

REFERENCE DOCUMENTS

SARPs

Annex 3 — *Meteorological Services for International Air Navigation* — Applicable 14 November 2013 page(s) 7, 11, 12, 13, 16, 19, 20, 21, 22, 26, 27, 31, 35, 38, 39, 40, 42, 44, 45, 47, 48, 49, 52, 53, 58, 61, 62

Annex 6 — *Operation of Aircraft* — Applicable 13 November 2014
page(s) 6

Annex 11 — *Air Traffic Services* — Applicable 14 November 2013 page(s) 6, 7, 14

Annex 15 — *Aeronautical Information Services* — Applicable 14 November 2013
page(s) 7, 11, 13, 14, 17, 19, 20, 21, 22, 61, 62

Annex 19 — *Safety Management* — Applicable 14 November 2013 page(s) 7, 33

Doc 4444 — *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM) — Applicable 13 November 2014 page(s) v, 6, 10, 12, 19, 21, 26, 27

Guidance

Doc 9691 — *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds*
page(s) 6, 24

Doc 9766 — *Handbook on the International Airways Volcano Watch* (IAVW Handbook)
page(s) 6, 15, 16, 19, 20, 26, 29, 31, 38, 39, 41, 43, 44, 47, 48, 67

Doc 9854 — *Global Air Traffic Management Operational Concept*
page(s) 6

Doc 9859 — *Safety Management Manual* (SMM)
page(s) 33

Doc 9974 — *Manual on Flight Safety and Volcanic Ash* – subtitled: *Risk Management of Flight Operations with Known or Forecast Volcanic Ash Contamination*
page(s) 7, 30, 33