



INTERNATIONAL CIVIL AVIATION ORGANIZATION

SOUTH AMERICAN REGIONAL OFFICE

**ICAO SOUTH AMERICAN REGION VOLCANIC ASH CONTINGENCY PLAN
(VACP/SAM)**

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FOREWORD

The ICAO SAM Volcanic Ash Contingency Plan (VACP/SAM) is published by the ICAO South American Regional Office on behalf of the ICAO South American Region Implementation Group (SAMIG). This Plan takes into account the different aspects and actions that States should consider when volcanic activity affects one or more of their Flight Information Regions (FIRs). The purpose of this plan is to show a general scheme of action for these contingencies through recommendations, procedures, examples, etc., contained herein, in order to contribute to the safe and orderly air traffic flow in the SAM Region.

On behalf of the SAMIG, the Regional Office will publish the revised VACP/SAM versions that may be necessary to keep the document duly up to date.

Copies of the VACP/SAM may be requested to:

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This edition (*Version 1.1*) incorporates all those revisions and modifications made until June 2015. Subsequent amendments and/or corrigenda will be listed in the Amendment and Corrigenda Registry Table, in accordance with the procedure established in the next page.

REGISTRY OF AMENDMENTS AND CORRIGENDA

The publication of amendments and corrigenda is regularly announced by mail to the States and International Organisations, and on the website of the ICAO South American Regional Office, which should be consulted by those using this publication. Blank boxes facilitate recording.

AMENDMENTS			
No.	Effective date	Date recorded	Recorded by

CORRIGENDA			
No.	Effective date	Date recorded	Recorded by

ACRONYMS AND ABBREVIATIONS

CAA	Civil aviation authority
ACC	Area control centre
AD	Aerodrome
AIP	Aeronautical information publication
AIS	Aeronautical information service
AIREP	Air-report
ANSP	Air navigation service provider
ASHTAM	A special series NOTAM notifying by means of a specific format a change in activity of a volcano, a volcanic eruption and/or a volcanic ash cloud that is of significance to aircraft operations
ATC	Air traffic control
ATCO	Air traffic controller
ATFM	Air traffic flow management
ATM	Air traffic management
ATS	Air traffic services
CDM	Collaborative decision-making
FMU	Air traffic flow management unit
FIR	Flight information region
IAVW	International airways volcano watch
IVATF	International volcanic ash task force (of ICAO)
LOA	Letter of agreement
MET	Meteorology
MWO	Meteorological watch office
NOTAM	Notice to airmen
PANS ATM	Procedures for air navigation services
SAM	ICAO South American Region
SARPS	Standards and recommended practices
SIGMET	Information concerning en-route weather phenomena that may affect the safety of aircraft operations
SMS	Safety management system
SRA	Safety risk assessment
VAA	Volcanic ash advisory
VAAC	Volcanic ash advisory centre
VACP/SAM	SAM volcanic ash contingency plan
VAG	Volcanic ash advisory in graphical form
VAR	Volcanic activity report from aircraft (the real-time part of the VAR is issued in the same manner as an AIREP Special)
VOLCEX	Regular ICAO volcanic ash exercises to validate and improve regional volcanic ash contingency plans and procedures
VONA	Volcano observatory notice for aviation
WAFC	World area forecast centre

DEFINITIONS APPLICABLE TO THE VACP/SAM

Air report. Report from an aircraft in flight prepared in accordance with position and operational or meteorological information reporting requirements.

Volcanic ash. Comprised of minerals unique to the volcanic eruption. Minerals common to most volcanic ash are silica together with smaller amounts of the oxides of aluminium, iron, calcium and sodium. The glassy silicate material is very hard and extremely abrasive. Its melting point is below jet engine burner temperature, which introduces additional hazards. (Refer to Section 2.1 of ICAO's *Manual on volcanic ash, radioactive material and toxic chemical clouds* (Doc 9691)).

Volcanic ash advisory centre. A meteorological centre designated by regional air navigation agreement to provide advisory information to meteorological watch offices, area control centres, flight information centres, world area forecast centres, relevant regional area forecast centres, and international OPMET data banks regarding the lateral and vertical extent and forecast movement of volcanic ash in the atmosphere following volcanic eruptions.

Area control centre. A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

World area forecast centre (WAFC). A meteorological centre designated to prepare and supply significant weather forecasts and upper-air forecasts in digital and/or pictorial form on a global basis to regional area forecast centres, and direct to States by appropriate means as part of the aeronautical fixed service.

Air traffic service unit. A generic term meaning variously, an air traffic control unit, a flight information centre, or an air traffic services reporting office.

Aeronautical meteorological station. A station designated to make observations and meteorological reports for use in international air navigation.

State of Registry. The State on whose register the aircraft is entered.

State of the Operator. The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

Air traffic flow management. A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

Air traffic management. The dynamic and integrated management of air traffic and airspace (including air traffic services, airspace management, and air traffic flow management) in a safe, economic and efficient manner, through the collaborative provision of seamless facilities and incorporating ground-based and airborne functions.

AIRMET information. Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena that may affect the safety of low-level aircraft operations and which was not already included in the forecast issued for low-level flights in the flight information region concerned or sub-area thereof.

Meteorological information. Meteorological report, analysis, forecast, and any other statement relating to existing or expected meteorological conditions.

SIGMET information. Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena that may affect the safety of aircraft operations.

Meteorological report. A statement of observed meteorological conditions related to a specified time and location.

Standards and recommended practices. The Council adopts standards and recommended practices in accordance with Articles 54, 37, and 90 of the Convention on International Civil Aviation, and defined as follows:

Standard. A standard is any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognised as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; if unable to comply, the Council must be notified in accordance with Article 38 of the Convention.

Recommended practice. A recommended practice is any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognised as desirable in the interest of safety, regularity or efficiency of international air navigation and to which Contracting States will endeavour to conform in accordance with the Convention.

Volcanic cloud. The sum of the material ejected from a volcano into the atmosphere and transported by upper winds. It comprises volcanic ash, gases and chemical substances¹ (refer to Section 2.1 of ICAO's Manual on volcanic ash, radioactive material and toxic chemical clouds (Doc 9691)).

Meteorological office. An office designated to provide meteorological service for international air navigation.

Aerodrome meteorological office. An office, located at an aerodrome, designated to provide meteorological service for international air navigation.

Procedures for air navigation services. Procedures approved by the Council, which include, in general, operational procedures that are considered to be insufficiently mature to be adopted as international standards and recommended practices, or more permanent texts that are not suitable or are too detailed to be included in an Annex.

Collaborate decision-making. A process whereby all ATM decisions, except tactical ATC decisions, are based on the exchange of all information relevant to air traffic operations between civilian and military stakeholders.

Flight information region. An airspace of defined dimensions within which flight information service and alerting service are provided.

Air traffic services. A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

Air traffic management service. A system that provides ATM by integrating human resources, information, technology, and facilities with the support of ground-based, airborne and/or airspace-based communications, navigation and surveillance.

Flexible use of airspace. An airspace management concept based on the principle that airspace must not be designated as exclusively military or civilian, but rather as a continuous airspace in which the requirements of all users are met as much as possible.

International airways volcano watch. Joint international arrangements for monitoring and providing warnings to aircraft of volcanic ash in the atmosphere.

Note.— The IAVW is based on the cooperation of aviation and non-aviation operational units using information derived from observing sources and networks that are provided by States. The watch is coordinated by ICAO with the cooperation of other concerned international organisations.

Affected area. A volume of airspace, an aerodrome or other area on the ground, identified by VAA/VAG and/or SIGMET as being affected by known or forecast volcanic cloud contamination.

Areas of contamination. Information on areas of observed and/or forecast volcanic ash in the atmosphere is provided by means of appropriate MET messages in accordance with Annex 3 – Meteorological Service for International Air Navigation.¹

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

NOTE.- In the context of volcanic ash cloud contamination, danger area is a volume of airspace identified by NOTAM as being affected by levels of known or forecast volcanic cloud contamination which States judge merit publication to operators.

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

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

¹ This will mainly include volcanic ash advisories (issued by the volcanic ash advisory centres) and SIGMET information on volcanic ash (issued by meteorological watch offices).

1. FOREWORD

1.1 The severity, persistence, and higher frequency of volcanic events with ash dispersion that have recently occurred in the South American (SAM) Region of ICAO (Hudson in 1991; Chaitén in 2008; Cordón Caulle in 2011; Villarica, 2015; Cabulco, 2015; and others), with their repercussions on the provision of air navigation services, call for a regional contingency plan to address events of this nature when volcanic activity affects one or more of its flight information regions (FIRs). The purpose of this plan is to show a general scheme of action for these contingencies, based on the recommendations, procedures, examples, etc. contained herein, in order to contribute to safe and orderly air traffic flow in the SAM Region. This plan establishes standard guidelines for warning aircraft of a volcanic eruption and the procedures to be followed. The plan also serves as a guide for the States of the Region for drafting their national volcanic ash contingency plans.

1.2 Volcanic contamination--the one caused by volcanic ash being the most severe—is a flight safety hazard. The mitigation of hazards posed by volcanic ash in the atmosphere and/or the aerodrome cannot be done in isolation, but through collaborative decision-making (CDM), with the participation of all stakeholders. 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. Volcanic ash encounters may generate a variety of hazards, including one or more of the following:

- a) malfunction or failure of one or more engines, causing not only the reduction or total loss of thrust, but also failure of electrical, pneumatic, and hydraulic systems;
- b) blockage of pitot or static sensors, resulting in unreliable airspeed readings and erroneous warnings;
- c) windscreens rendered partially or completely opaque;
- d) smoke, dust and/or toxic chemical contamination of cabin air, forcing the crew to don oxygen masks, which affects speech communications; electronic systems may also be affected;
- e) erosion of external and internal aircraft components;
- f) reduced electronic cooling efficiency, leading to a series of aircraft system failures;
- g) the aircraft may have to be manoeuvred in a manner that conflicts with other aircraft; and
- h) volcanic ash deposition on a runway may degrade aircraft braking performance, even more so if the volcanic ash is wet; and in extreme cases, it may lead to runway closure.

1.3 The regulatory authorities of the State of the Operator or State of Registry (see **Appendix G**), as applicable, should establish the appropriate operational procedures to be followed by the flight crew when operating within or near airspace with volcanic ash contamination. In accordance with ICAO Annex 6 – *Operation of Aircraft*, the Operators are required to conduct a risk assessment of operations in volcanic ash and to implement the appropriate mitigation measures in accordance with their safety management system (SMS) as approved by the State of the Operator or State of Registry, as applicable. The manual on *Flight Safety and Volcanic Ash – Risk management of flight operations with known or forecast volcanic ash contamination* (ICAO Doc 9974) contains more detailed guidance on the safety risk assessment (SRA) in flight operations related to volcanic ash contamination.

1.4 This document is an ATM contingency plan that includes interfaces with supporting services such as the Aeronautical Information Service (AIS) and the Meteorological Service (MET). Whenever mention is made in this Plan of actions by the volcanic Ash Advisory Centres (VAACs) (see **Appendix E**) and the Meteorological Watch Offices (MWOs) (see **Appendix D**), and when the Operators

are described, it will be only for clarification purposes. Consideration should also be given to ATS contingency plans, which cover other abnormal situations that could interact with a volcanic ash contingency. The distribution of the respective AIS and MET messages on volcanic ash is defined in the corresponding ICAO Annexes, namely Annex 15 – *Aeronautical Information Services*, and Annex 3 – *Meteorological Service for International Air Navigation*.

1.5 Volcanic ash may also affect aircraft operation at aerodromes. Volcanic ash deposition at an aerodrome, even in very small quantities, may result in the closure of the aerodrome until all the deposited ash has been removed. In extreme cases, the aerodromes could be left completely inoperative, causing repercussions in air traffic management (ATM), *e.g.*, diversions to alternate aerodromes, rerouting of traffic flows, etc.

1.6 It is imperative that information on volcanic activity is disseminated as soon as possible. In order to assist staff in expediting the process of originating and issuing relevant SIGMET, NOTAM, and ASHTAM messages, templates thereof should be available for each stage of the volcanic activity. **Appendix J** shows examples of SIGMET, NOTAM, and ASHTAM messages containing operational measures and the different stages of volcanic activity. A list of ICAO-registered volcanoes, stating the name, number and nominal position of the volcano (see Doc 9691 Manual on volcanic ash, radioactive material and toxic chemical clouds, Appendix F) should be available at the State's International NOTAM Office. In order to ensure the smooth execution and effectiveness of the contingency plan in the event of a real volcanic eruption, annual exercises, called VOLCEX, should be conducted at intervals determined by GREPECAS.

1.7 This document has been prepared in accordance with a proposal of amendment to the *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444), paragraph 15.8, *Procedures for an ATC unit when a volcanic ash cloud is reported or forecast*, which is already available.

1.8 **Appendices A** and **B** contain, respectively, general considerations on the development of an ATM contingency plan for volcanic ash, and the problems that flight crews are expected to face when encountering volcanic ash.

2. INTRODUCTION

2.1 Declaration of a danger area

2.1.1 If it is considered that the volcanic event could pose a hazard to aviation, a danger area² may be declared by NOTAM. However, this option should only be applied over and in the proximity of the volcanic source. Normally, clearances will not be issued through the danger area unless explicitly requested by the flight crew. In this context, it should be noted that the final responsibility for aircraft safety rests with the flight crew. Therefore, the final decision regarding routing, whether to avoid or proceed through an area of volcanic activity, is the flight crew's responsibility. Mention in this document of the possible establishment of danger areas does not imply that States are prevented from establishing restricted or prohibited areas over their sovereign territory if considered necessary by the State concerned.

2.1.2 Although it is the prerogative of the provider State to promulgate a danger area in airspace over the high seas, it should be recognised that restrictions cannot be imposed to the freedom of flight over the high seas, in accordance with the United Nations Convention on the Law of the Sea (Montego Bay, 1982).

2.2 Phases of an event

2.2.1 The response to a volcanic event that affects 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:

- a) **PRE-ERUPTION PHASE** (when applicable): The initial response, “raising the alert”, commences when a volcanic eruption is expected.
Appropriate AIS and MET messages may be issued in accordance with Annex 15 and Annex 3, respectively, and disseminated to affected aircraft in flight by the most expeditious means. It should be noted that, sometimes volcanoes erupt unexpectedly without any alert being raised, hence the pre-eruption phase may be omitted.
- b) **START OF ERUPTION PHASE** (when applicable): The start of eruption phase commences at the outbreak of the volcanic eruption and entrance of volcanic ash into the atmosphere, and mainly involves aircraft in flight. Appropriate AIS and MET messages may be issued in accordance with Annex 15 and Annex 3, respectively, and a danger area may be declared by NOTAM. Normally, clearances will not be issued through the danger area unless explicitly requested by the flight crew.
- c) **ON-GOING ERUPTION PHASE**: The on-going eruption phase commences with the issuance of the first volcanic ash advisory (VAA) containing information on the extent and movement of the volcanic ash cloud following completion of the previous reactive responses. Appropriate AIS and MET messages may be issued in accordance with Annex 15 and Annex 3 respectively.
- d) **RECOVERY PHASE**: The recovery phase commences with the issuance of the first VAA/VAG indicating that the FIR is no longer contaminated with volcanic ash or the first VAA/VAG containing the statement “NO FURTHER ADVISORY”, which normally occurs when it is determined that no volcanic ash is expected in the atmosphere and the volcanic activity has reverted to its pre-eruption state.

² Depending on the State's regulations, the area may be established as a “danger area”, “restricted area” or “prohibited area”. Over the high seas, only a “danger area” may be established.

Appropriate AIS and MET messages shall be issued, in accordance with Annex 15 and Annex 3, respectively.

Note: These descriptions are amplified in Chapter 3 of this document.

2.2.2 Although the four phases describe actions to be undertaken during the actual volcanic event, they are based on a theoretical scenario. Actual eruptions may not always be so 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 that is already some distance away from the volcano. It is essential that the contingency plan prepare the ATM system for an appropriate response depending on the actual conditions. Therefore, the “Pre-Eruption Phase” and “Start of Eruption Phase” described in this document are annotated “when applicable” in order to provide for flexibility in the application of the contingency plan in those parts of the world with insufficient volcano monitoring and alerting.

2.2.3 Flight crews are required to report observations of volcanic activity by means of a special air-report (special AIREP). Arrangements should be put in place to ensure that such information is transferred without delay to the appropriate aeronautical agencies responsible for subsequent action. The communication and dissemination of pilot reports on volcanic activity are described in **Appendix C**.

3. PRE-ERUPTION PHASE

3.1 General

3.1.1 Where flight operations are planned in areas that are susceptible to volcanic eruptions, ATS units may expect to receive from flight crews the ICAO Volcanic Activity Report (VAR) form (published in the *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444), Appendix 1).

3.1.2 The focus of this phase is to gain early recognition of volcanic events. This phase is frequently characterised by a very limited availability of information on the potential extent and severity of the impending eruption. The priority is to ensure the continued safety of aircraft in flight, and there is therefore a requirement to promulgate information as a matter of urgency. Notwithstanding the potentially limited extent of information available, the pre-eruption phase actions described below should be carried out for every expected eruption.

3.1.3 Generally, aircraft pilots are the source of information for an eruption, except in those cases in which there is an established volcano monitoring system. Consequently, pilots operating in areas with unsupervised volcanoes should always stay alert to those signs that could indicate an eruption and also understand the importance of their role as providers of information. Operators should provide pilots with the ICAO Volcanic Activity Report (VAR) form, preferably in a user-friendly electronic format.

3.1.4 The initial response, “raising the alert”, commences when a volcanic eruption is expected or when it occurs unexpectedly. The source of that information may be the pilot (AIREP/VAR) and/or the meteorological or volcanological agencies (VONAs). Arrangements in each State between volcanological and meteorological organisations and air traffic management agencies should ensure that alerting information is provided expeditiously to the affected aircraft in flight or through VONA, SIGMET, NOTAM, ASHTAM or retransmission of AIREPs, as appropriate, and disseminated in accordance with the established procedures.

3.1.5 This phase focuses on drawing the attention of aircraft to a potential hazard and protecting them from the hazards inherent to the eruption itself. Actions are based on well-prepared contingency plans and standard operating procedures. Aircraft are expected to exit or avoid the affected area in accordance with the standard operating procedures. This alert will trigger actions such as the collection of additional data and the conduction of specific safety risk assessments (SRAs).

3.2 Action by the originating ACC* (*eruption expected in its own flight information region*)

* Where the “ACC” term is used in this document, it is understood to also include all ATS facilities

3.2.1 In the event of significant pre-eruption volcanic activity, an eruption in process, or a reported volcanic ash cloud, which could pose a hazard to aviation, the area control centre (ACC) that receives the information should do as follows:

- a) advise the associated MET provider, in accordance with national/regional arrangements (unless said provider is the originator of the initial report), and the AIS, which, in turn, will inform the corresponding air traffic flow management (ATFM) units;
- b) ensure that appropriate MET (SIGMET) and AIS (NOTAM/ASHTAM) messages are originated in accordance with Annexes 3 and 15. These must provide precise information regarding the activity of the volcano as soon as it becomes available. It is imperative that this information is issued by the Meteorological Watch Office and the international NOTAM Office and disseminated as soon as possible, in accordance with the provisions of the aforementioned Annexes;

- c) when so required by the State, define an initial, precautionary danger area in accordance with established procedures. The size of this danger area should include a reasonable volume of airspace consistent with the limited information available, trying to avoid undue disruption of flight operations;
 - i. if no such procedures have been established, the danger area should be defined as a circle with a radius of 222 km (120 NM). If the eruption has not started and if there is no information available on upper wind, the circle should be centred on the estimated location of the volcanic activity or, if more information is available, the circle should have a radius of 111 km (60 NM);
 - ii. if a precautionary danger zone has been established, its size should include a reasonable volume of airspace consistent with the limited information available, trying to avoid the disruption of flight operations; and

Note.– An area with a radius of 5 to 10 minutes of flight time represents only 2 to 3 minutes of additional flight.

 - iii. although the ATC does not normally issue clearances through a danger area, it is the responsibility of the pilot-in-command to choose the safest course of action.
- d) alert the flights that are already in the danger area 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 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. Likewise, new tactical clearances should be issued to those flights whose original route is affected by this area;
- e) Immediately notify other ACCs of the event, indicating the location and dimensions of the danger area. It should also renegotiate and re-route, as necessary, those flights already coordinated but still within adjacent flight information regions. They will also require adjacent ACCs to reroute flights not yet coordinated to keep them clear of the area. It should be noted that flight crews may decide not to completely avoid the area based on, for example, visual observations;
- f) implement flow management measures if necessary to maintain the required level of safety;
- g) make sure that SIGMETs and NOTAM/ASHTAMs are issued. These should provide information on the activity of the volcano as precisely as possible, based on its availability. The message should include the name (as applicable), the reference number and the location of the volcano, together with the date and time of start of the eruption. It is imperative that the information is issued by the meteorological watch office and the international NOTAM office and disseminated as soon as possible;
- h) in order to assist staff in expediting the process of composing the NOTAM/ASHTAM messages, templates should be available for each stage of volcanic activity. Appendix J contains examples of NOTAM/ASHTAMs for these cases.

3.2.2 The initial NOTAM/ASHTAM and its subsequent messages shall be sent to all addressees in the distribution list and also to the meteorological agencies concerned, adding the corresponding heading of the World Meteorological Organization (WMO).

3.3 Action by adjacent ACCs

3.3.1 During the pre-eruption phase, the ATC should inform aircraft that they might be tactically re-routed to avoid danger areas. Adjacent ACCs should take the following action to provide proper assistance:

- a) following coordination with the originating ACC, re-clear flights to which services are being provided and whose routes will be affected by the establishment of the danger area; and
- b) unless otherwise instructed, continue normal operations, and
 - i. if one or more routes are affected by the danger area, suggest the rerouting of aircraft in flight, as applicable, to other routes away from the danger area; and
 - ii. remain aware of the affected area at all times.

3.4 Action by the ATFM unit

3.4.1 The ATFM unit and the associated volcanic ash advisory centre (VAAC) will determine when their initial communications will take place on the basis of bilateral agreements. Upon reception of information on volcanic activity from the VAACs, the ATFM unit should initiate actions in accordance with its procedures to ensure exchange of information in support of CDM among the air navigation service providers (ANSPs), MWOs, VAACs and aircraft operators concerned.

4. START OF ERUPTION PHASE

4.1 General

4.1.1 This phase commences at the outbreak of a volcanic eruption, 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 of the eruption, collect relevant information, and convert available information about the volcanic ash cloud (horizontal and vertical extent, etc.) into reliable and precise information.

4.1.2 The information for starting this phase can come from pilots (AIREP/VAR), ATS personnel, MET provider, or volcanological data (VONA/SIGMET). **Appendix L** contains the VONA format and an example.

4.1.3 In addition to relevant actions described under the pre-eruption phase, the main activities of the start of eruption phase are: issuance of a start-of-eruption SIGMET; issuance of a start-of-eruption NOTAM/ASHTAM; provision of information and assistance to traffic in flight. As appropriate, danger areas will be declared via NOTAM. This phase will last until such time as the on-going eruption phase is activated.

4.2 ACTION BY THE ORIGINATING ACC (*eruption in its own flight information region*)

4.2.1 The ACC providing services in the FIR within which the volcanic eruption takes place should inform flights thereof and about the existence, extent and forecast movement of volcanic ash, and provide useful information for the safe conduct of flights.

4.2.2 Rerouting of traffic shall commence immediately or may be in progress if the alerting time has been sufficient. The ACC should assist in rerouting aircraft around the danger area as expeditiously as possible. Adjacent ACCs should also take the danger area into account and give similar

assistance to aircraft as early as possible. Although the ATC does not normally issue clearances through the danger area, it will inform aircraft about the hazard and will continue to provide normal services. Aircraft are expected to stay clear of the danger area, but it is the responsibility of the pilot-in-command to determine the safest course of action.

4.2.3 During this phase, the ACC should:

- a) maintain close liaison with the associated MWO. The MWO should issue a start-of-eruption SIGMET message through the most expeditious means. It may simply inform that an ash cloud has been reported, the date/time and its location. The start-of-eruption SIGMET can also be promulgated by means of a VAA. During this phase, information on the extent and severity of the event may be limited; however, whenever possible, the message should contain information on the extent and forecast movement of the ash according to the appropriate information sources;
- b) when necessary, ATFM measures should be reviewed and updated, based on forecasts and the cooperation of aircraft operators (CDM) and adjacent ACCs for the safe conduct of flight operations;
- c) make sure that a NOTAM is originated to define a danger area that includes a volume of airspace consistent with the limited information available. In determining the area, information on upper winds should be taken into account, if available. The purpose is to ensure safety of flight in the absence of any prediction of the extent of contamination from a competent authority;
- d) ensure that differences found between published information and observations (pilot reports, atmospheric measurements, etc.) are forwarded as soon as possible to the appropriate authorities to ensure their dissemination to all concerned; and
- e) begin planning the CDM for the on-going eruption phase in conjunction with the aircraft operators, the appropriate ATFM unit and ACCs concerned.

4.3 **Action by adjacent ACCs**

4.3.1 During the start-of-eruption phase, adjacent ACCs should take the following action:

- a) maintain a close liaison with the appropriate ATFM unit and the originating ACC in order to design, implement and keep ATFM measures duly updated for the safe conduct of flight operations;
- b) the adjacent ACC, in cooperation with the originating ACC and aircraft operators, should impose, as needed, tactical measures in addition to those issued by the corresponding ATFM unit;
- c) maintain awareness of the affected area; and
- d) begin planning for the on-going eruption phase in conjunction with the aircraft operators, the appropriate ATFM units, and ACCs concerned.

4.4 **Action by the ATFM unit**

4.4.1 During the start of eruption phase, depending on the impact and/or extent of the volcanic ash, the appropriate ATFM unit should organise the exchange of the latest information on the developments with the VAACs, ANSPs, MWOs, and operators concerned in order to support CDM, and communicate the available updated information to the appropriate regional or inter-regional ATFM units.

5. ON-GOING ERUPTION PHASE

5.1 General

5.1.1 The on-going eruption phase commences with the issuance of the first volcanic ash advisory/volcanic ash advisory in graphical form (VAA/VAG) by the Buenos Aires and Washington VAACs. The VAA/VAG will contain the current position of the volcanic ash and forecasts of the vertical and horizontal extent of the volcanic ash cloud and its forecast movement at six-hour intervals, from T+0 until T+18 hours. When the volcanic ash cloud is expected to move considerably for a period of 6 hours, SIGMET messages should be issued at shorter intervals. Both messages should be issued in accordance with Annex 3 provisions.

5.1.2 Volcanic ash cloud forecasts at T+6, T+12 and T+18 hours and more extensive forecasts (if available) are used for preparing the NOTAM/ASHTAM. Volcanic ash cloud forecasts and/or VAA/VAGs could include (if available) quality indicators (*e.g.*, certainty, variability, etc.) as well as risk levels that could be more easily used in SRAs.

5.1.3 Volcanic ash may affect any combination of airspace; therefore, it is not possible to prescribe measures for each particular situation. Furthermore, it is not possible to detail the actions to be taken by each ACC. The following guidance may prove useful during the on-going eruption phase but should not be considered mandatory:

- a) depending on the impact and/or extent of volcanic ash, the corresponding ATFM unit may take the initiative to organise teleconferences with the VAACs, ANSPs, MWOs, volcanological agencies and operators concerned to exchange the latest information on the developments in support of CDM,
- b) during this phase, VAACs should try to calculate the vertical extent of the area containing ash and provide the appropriate VAA/VAG in order to define the contaminated airspace as precisely as possible. For flight planning purposes, operators should try to have their aircraft overfly the horizontal and vertical boundaries of the danger area as if it were mountainous terrain. Operators shall be warned about the risk of cabin depressurization or engine failure that could take place if the flight level cannot be maintained, especially in the case of extended range operations by twin-engined aeroplanes (ETOPS), and
- c) any differences between published information and observations (pilot reports, atmospheric observations, etc.) must be forwarded as soon as possible to the appropriate authorities.

5.2 Action by the ACCs

5.2.1 The ACCs affected by the movement of ash should make sure that the NOTAM/ASHTAM continues to be originated at appropriate intervals. The ACCs involved and the ATFM units should continue publishing details of the measures taken, to ensure their distribution to all stakeholders.

5.2.2 If ash is reported or forecast in the FIR for which the ACC is responsible, it should apply the following procedures:

- a) immediately relay all available information to pilots whose aircraft could be affected to ensure that they are aware of the horizontal and vertical extent of the airspace contaminated with ash;

- b) if so required, suggest the appropriate rerouting to help flights avoid areas of known or forecast contamination;
- c) the ATC should not issue clearances for entry or operation of aircraft in a danger area. Aircraft should be provided the necessary assistance to exit a danger area as soon as possible;
- d) request a special air-report when the flight route leads the aircraft to or close to the forecast ash cloud, and send that special air-report to the corresponding agencies; and
- g) if an aircraft has informed the ACC that it has entered an area contaminated with volcanic ash:
 - i. consider that the aircraft is in an emergency situation;
 - ii. do not make modifications to the assigned route or level, unless it is requested by the flight crew or is required to meet airspace requirements or traffic conditions; and
 - iii. do not initiate vectoring without approval by the pilot.

5.2.3 Experience has shown that the escape manoeuvre recommended for an aircraft that has encountered a volcanic ash cloud is to reverse the course and start descending (if allowed by the terrain). However, the pilot has the final decision.

Note 1.— General procedures to be applied when a pilot reports an emergency situation are contained in Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444) Chapter 15, Procedures related to emergencies, communication failure and contingencies.

Note 2.— Guidance material concerning the effect of volcanic ash and its impact on aeronautical operational and support services is provided in Chapters 4 and 5 of the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691).

5.3 Action by the ATFM unit

5.3.1 Depending on the impact and/or extent of the volcanic ash and in order to support CDM, the appropriate ATFM unit should organise the exchange of the latest information available on the volcanic event with the VAACs, ANSPs, MWOs and operators concerned.

5.3.2 The ATFM unit will apply ATFM measures on request of the ANSPs concerned. The measures should be reviewed and updated in accordance with the latest information. Operators will be advised to periodically review the NOTAM/ASHTAMs and SIGMETs for the area.

Note 1.- The applicable ATFM measures appear in the Caribbean/South American (CAR/SAM) ATFM Manual <http://www.icao.int/SAM/eDocuments/2ATFM%20Manual%20Spa%20MAR10.pdf>

5.3.3 The ATFM unit should also consider civil-military coordination for the implementation of the Flexible Use of Airspace (FUA) concept, which permits temporary use of alternate routes that normally cross restricted airspaces, thus preventing aircraft from travelling long distances to avoid them.

Note 1.- Circular 330 AN/189 on civil-military cooperation in air traffic management provides guidance and examples on this topic.

Note 2.- Additional information on FUA may be obtained in the Guidelines for the Implementation of Flexible Use of Airspace (FUA) in the South American Region (SAM/FUA Guidelines) <http://www.icao.int/SAM/eDocuments/Manual%20Guía%20FUA.pdf>

6. RECOVERY PHASE

6.1 The recovery phase commences with the issuance of the VAA/VAG indicating that the FIR is no longer contaminated with volcanic ash, or of the first VAA/VAG containing the statement “NO FURTHER ADVISORY” — which normally occurs when it is determined that volcanic activity has returned to its pre-eruption status and the airspace is no longer contaminated with volcanic ash. Accordingly, the corresponding MET/AIS messages should be issued, in accordance with Annexes 3 and 15.

6.2 ACCs and ATFM units should return to their normal operations as soon as possible.

6.3 Once the event has concluded, the CAA should conduct an evaluation of the activities carried out by the different areas involved in order to improve the procedures applied.

Note 1.- Regarding the responsibilities assigned to the ATFM units mentioned in this document, these should be undertaken by the respective ACCs until the ATFM units are implemented.

Note 2.- All the actions described herein must, inasmuch as possible, be contained and honoured in letters of agreement between all units concerned.

7. RESPONSE TO VOLCANIC ASH EMERGENCIES AT AERODROMES

7.1 *LAR 153 – Aerodrome operations*, sets forth aerodrome operation requirements for States participating in the Regional Safety Oversight System (SRVSOP) that decide to adopt said regulation. Its objective is to promote among its member States the harmonisation and updating of safety regulations and procedures for civil aviation.

7.2 Item 153.540 – *Control of volcanic ash emissions*, of said regulation establishes that:

- a) The aerodrome operator must prepare a contingency plan for the control of volcanic emissions in accordance with **Appendix 2- Emergency response**, Part III – Volcanic ash emergencies of this Regulation, that is acceptable to the CAA, in order to ensure safety at the aerodrome;
- b) The contingency plan for the control of volcanic emissions must include procedures to be applied before, during, and after the natural phenomenon, in order to protect:
 - 1) Aircraft in flight;
 - 2) Aircraft on the ground;
 - 3) Fuel tanks;
 - 4) Ground vehicles;
 - 5) Aeronautical infrastructure, which includes:
 - i. Radio aids;
 - ii. Communications;
 - iii. Runways, taxiways, aprons, terminals;
 - iv. Ramp equipment; and
 - v. Electric power service, power plants, drinking water.

8. REFERENCE DOCUMENTS

- Annex 3: Meteorological service for international air navigation;
- Annex 6: Operation of aircraft;
- Annex 11: Air traffic services;

- Annex 15: Aeronautical information service;
- Annex 19: Safety management;
- LAR 153 – Aerodrome operations;
- Doc 4444 Procedures for air navigation services (PANS) – Air traffic management;
- Doc 9691 Manual on volcanic ash, radioactive material and toxic chemical clouds;
- Doc 9766 Handbook on the international airways volcano watch – Operational procedures and list of points of contact;
- Doc 9974 Flight safety and volcanic ash - Risk management of flight operations with known or forecast volcanic ash contamination;
- Air traffic management (ATM) volcanic ash contingency plan template prepared by the IVATF.

APPENDIX A

GENERAL GUIDANCE FOR THE DEVELOPMENT OF AN ATS VOLCANIC ASH CONTINGENCY PLAN

(This information has been adapted from the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691). Refer to that document for further details.)

1. A volcanic ash contingency plan must establish sequential steps to provide a coordinated and controlled response to an event of this nature. Responsibilities should be perfectly well defined for Chiefs/Managers in charge of the ATS unit, supervisors and air traffic controllers (ATCO), officials or person responsible for keeping contacts periodically updated. The plan should also identify the units to be contacted, the type of messages to be created, the proper distribution of those messages, and how to carry out the task. The list of contacts at MWO/NOF/CAA/ANSP/volcanological institutes is contained in **Appendix K**.

2. The personnel must be trained and warned about the potential consequences of an encounter between an aircraft and a volcanic ash cloud.

3. Some points to be taken into account are as follows:

- a) volcanic ash contamination may extend hundreds of miles horizontally and reach the stratosphere vertically;
- b) volcanic ash may block the pitot-static system of an aircraft, resulting in unreliable airspeed indications;
- c) braking conditions at aerodromes where volcanic ash has recently been deposited on the runway will be affected. This is more pronounced on runways contaminated with wet ash. Both pilots and ATCOs should be made aware of the consequences of volcanic ash ingestion into the engines during landing and taxiing. For take-off, it is recommended that pilots void operating in visible airborne ash; instead, they should allow sufficient time for the particles to settle before initiating a take-off roll, in order to reduce the risk of particle ingestion into the engines. Likewise, a thorough clean-up should be carried out to remove ashes from the movement area to be used before igniting the engines;
- d) volcanic ash may result in loss of power in one or all engines of an aircraft; and
- e) aerodromes where volcanic ash has deposited could be declared as unsafe for flight operations. This could have consequences for the ATM system.

4. The ACC, together with the ATFM units, will serve as the critical communication link between the affected aircraft in flight and information providers. During volcanic ash contamination episodes within the FIR, the ACC has two major communication roles: first and foremost is their ability to communicate directly with aircraft that may encounter ash en route. ATCOs should be able to warn pilots of the flight levels affected by ash, the projected trajectory and drift of the cloud based on the information provide in the volcanic ash SIGMET, the VAAs, and working with the MWO. Through the use of radio communications, the ACCs can coordinate alternate routes with flight crews to keep them clear of the ash cloud. In this latter case, it is extremely important to establish close civil-military coordination to implement the Flexible Use of Airspace (FUA) concept, which allows for temporary use of alternate routes that normally cross restricted airspaces, thus preventing aircraft from travelling long distances to

avoid them. Circular 330 AN/189 on civil-military cooperation in air traffic management provides guidance and examples on this topic, the same as the SAM FUA Manual.

5. Similarly, the ACC, through the issuance of a NOTAM/ASHTAM for volcanic activity can disseminate information on the status and activity of a volcano and on increased pre-eruption volcanic activity. NOTAM, ASHTAM and SIGMETs together with AIREPs are critical to dispatchers for flight planning purposes. Operators need as much advance notification as possible on the status of a volcano for strategic planning of flights and the safety of passengers. Dispatchers need to be in communication with pilots en route so that coordinated decisions can be made between the pilot, the dispatcher and the ATC regarding available alternate routes. The ACC should advise the ATFM unit on the availability of alternate routes. It must not be assumed, however, that an aircraft that is projected to encounter an ash cloud will be provided a desirable air route to avoid the cloud. Other considerations have to be taken into account, such as existing traffic density on other air routes and the amount of fuel reserve available for flights that may have to be diverted to other routes.

6. The NOTAM/ASHTAM for volcanic activity provides information on the status of activity of a volcano when a change of operational significance occurs or is expected to occur in its activity. It is issued by the ACC through the respective international NOTAM office, based on the information received from any one of the information sources and/or information provided by the associated VAAs, meteorological stations, or the volcano observatory. The NOTAM/ASHTAM also provides information on the location, extent and movement of the ash cloud and the air routes and flight levels affected. NOTAMs may also be used to limit access to airspace affected by volcanic ash. Complete guidance on the issuance of the NOTAM and ASHTAM is provided in Annex 15 — *Aeronautical Information Services*. Annex 15 also includes a colour code chart that indicates the level of activity of the volcano. The colour code alert chart may be used to provide information on the status of the volcano, with “red” being the most severe, *i.e.*, volcanic eruption in progress with an ash column/cloud reported above flight level 250; and “green” at the other end indicating that volcanic activity has ceased and volcano activity is back to its pre-eruption state. It is very important that the volcanic ash NOTAM be cancelled and the ASHTAM be updated as soon as the volcano has reverted to its pre-eruption state, no further eruptions are expected by vulcanologists and no ash cloud is detectable or reported by the FIR concerned.

7. It is essential that the procedures to be followed by ACC personnel and supporting services such as MET, AIS and ATFM, continue during the volcanic eruption/presence of volcanic ash cloud, as described in the previous paragraphs; and that they be reflected in local staff manuals or instructions (adjusted as necessary to take account of local circumstances). It is also essential that such procedures/instructions form part of the basic training for ATS, AIS, ATFM, and MET personnel whose jobs would require them to take action in accordance with the procedures. Global information on the status of activity of volcanoes is provided in the monthly *Scientific Event Alert Network Bulletin* published by the United States Smithsonian Institution and sent free of charge to ACCs/FICs requesting it.

8. When considering the need to develop a local contingency plan, each State should generate an Action Plan that includes at least three (3) phases, namely:

- Phase I: Development of the National volcanic ash contingency plan, taking into account the regional volcanic ash contingency plan;
- Phase II: Harmonisation of the National contingency plan with those of adjacent countries; and
- Phase III: Delivery of the National contingency plan to the corresponding ICAO Regional Office.

9. When preparing the National Contingency Plan, attention should be paid to the guidelines contained in Attachment D to ICAO Annex 11 on contingency planning, and to national ATS contingency plans.

APPENDIX B**ASPECTS TO BE CONSIDERED BY THE PILOT WHEN ENCOUNTERING VOLCANIC ASH**

1. ATS personnel should be aware that flight crews may have to immediately face some or all of the following issues when they encounter volcanic ash. ATCOs must be alert to the following issues:

- a) smoke or dust appearing in the cockpit which may prompt the flight crew to don oxygen masks (which could interfere with the clarity of speech communications);
- b) acrid odour similar to electrical smoke;
- c) multiple engine failures, such as stalls, increasing exhaust gas temperature (EGT), flare, fire, and thrust loss resulting in an immediate deviation from the assigned altitude;
- d) on engine restart attempts, engines may go idle, especially at high altitudes (which could result in inability to maintain height or Mach number);
- e) at night, static discharges known as “St. Elmo's fire” 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, as a result of the sandblast effect of the volcanic ash;
- g) cabin windows may become completely opaque; and/or
- h) at night, sharp distinct shadows may be cast by landing lights against volcanic ash (as compared to the diffuse shadows observed in water clouds), affecting visual perception of objects outside the aircraft.

2. Simultaneously, ATS personnel will be waiting for flight crews to execute contingency procedures such as:

- 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 aerodrome; and
- f) upon landing, thrust reversers may be used as lightly as feasible.

APPENDIX C

COMMUNICATION AND DISSEMINATION OF PILOT REPORTS OF VOLCANIC ACTIVITY

1. INTRODUCTION

1.1 ICAO Annex 3 — *Meteorological Service 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 Appendix 1.

1.2 Experience has shown that reporting and sharing of information on volcanic ash encounters in accordance with the above mentioned provisions (in-flight and post-flight) varies across the world. The efficiency and quality of reporting currently depend heavily on regional characteristics and the level of regional integration. A high level of global harmonization is essential to achieve the desired level of implementation and consistency of the information.

2. PURPOSES OF VOLCANIC ASH REPORTING AND DATA COLLECTION

2.1 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) analyse collected reports from the post-flight phase in order to:
 - 1) identify areas of concern;
 - 2) validate and improve volcanic ash dispersion forecasts;
 - 3) improve existing procedures;
 - 4) assist in defining better airworthiness requirements; and
 - 5) share lessons learned, etc.

3. PHASE OF OPERATIONS

3.1 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.

3.2 The following section analyses these separately.

4. PARTICIPANTS IN THE REPORTING PROCESS, THEIR ROLES AND RESPONSIBILITIES

4.1 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.

4.2 *In-Flight Phase*

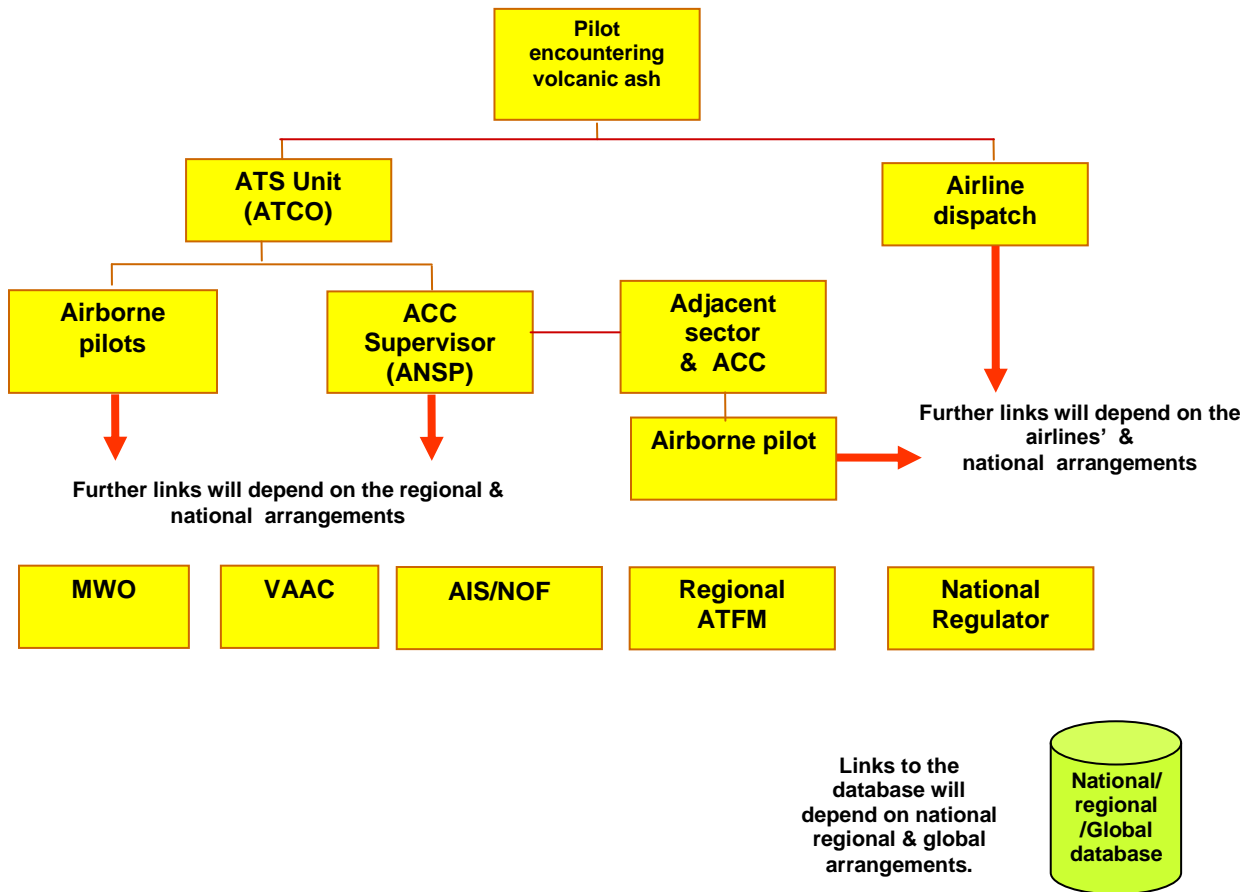
4.2.1 Participants, Roles & Responsibilities

	Participants	Roles & 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, or by any authorized available mean and disseminated by the civil aviation authority of the State.
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: <ul style="list-style-type: none"> ✓ passed on to the associated meteorological organizations and VAACs, in accordance with national/regional arrangements; ✓ fully and immediately disseminated across the organization, in particular to adjacent sectors and the associated NOTAM Office (NOF);

		<ul style="list-style-type: none"> ✓ passed on to the neighbouring sectors and ACCs (if necessary); ✓ passed on to the regional ATFM centre if existing (e.g. CFMU in Europe); ✓ passed on to the national/regional authority responsible for the handling of contingency situations. <p><i>Note: The order is depends on what the State deems appropriate.</i></p>
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.

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

4.2.2.1 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.



4.3 *Post-Flight Operations Roles & Responsibilities and order of reporting*

	Participants	Roles & Responsibilities
1.	Civil and/or military pilots/airlines having observed or encountered an eruption or volcanic contamination	To file the volcanic ash report with as much detailed information as 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 institutes - where appropriate)	To analyse the information stored in the regional central data repository and provide the research outcomes for lessons learnt 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.

4.4 *Tools for presenting and sharing the volcanic ash information*

4.4.1 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 the 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) Updated volcanic ash activity reports issued by meteorological stations.
- k) 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**ACTION TO BE TAKEN BY METEOROLOGICAL WATCH OFFICES IN THE EVENT OF A VOLCANIC ERUPTION**

1. Upon receiving information on a volcanic eruption and/or the existence of volcanic ash, the MWO shall:
 - a) issue a volcanic ash warning SIGMET message valid for 6 (six) hours. The addressing in the SIGMET should include the SADIS, the international OPMET data banks, and the regional OPMET data bank of Brasilia. Keep in constant coordination with the ACC to ensure consistency in the issuance and content of SIGMETs and NOTAM/ASHTAMs.
 - b) if the eruption has occurred within its area of responsibility, coordinate the issuance of the VONA with the volcanological agency, if it has not been received yet;
 - c) notify the designated VAACs so that they will provide relevant details of the eruption to the FIRs under the jurisdiction of the ACC, also asking them for the corresponding volcanic ash advisory (VAA) with information on the extent and trajectory of volcanic ash;
 - d) notify the ACC as soon as possible if the volcanic ash cloud can be identified through meteorological radar images or meteorological satellite images/data, and if so, provide information regularly on the horizontal and vertical extent of the cloud and its trajectory, using the advisory received from the VAAC as the source; and
2. If an MWO becomes aware of the occurrence of pre-eruption activity, a volcanic eruption, or the presence of an ash cloud through any other source, said information will be transmitted immediately to the ACC. Then, the aforementioned procedure will be followed.
3. In case any other meteorological office becomes aware of the occurrence of pre-eruption activity, a volcanic eruption, or the presence of an ash cloud through any other source, said information will be transmitted immediately to the MWO so that it may be relayed to the ACC and the appropriate VAACs.

APPENDIX E**ACTION TO BE TAKEN BY THE VOLCANIC ASH ADVISORY CENTRES (VAACs) IN THE EVENT OF A VOLCANIC ERUPTION**

1. Upon becoming aware of the occurrence of pre-eruption activity, a volcanic eruption, or the presence of an ash cloud through an MWO or any other source, the VAACs should:
 - a) Start running the volcanic ash dispersion/trajectory models to provide the relevant advisories (VAA/VAG) to the MWOs, the ACCs, the appropriate ATFM units, and the Operators concerned;
 - b) Review the satellite data/images and reports from pilots flying in the affected area during the event, in order to establish if the volcanic ash cloud is identifiable and, if so, to determine its extent and movement;
 - c) Inform the associated ATFM units about the volcanic event;
 - d) Prepare and issue advisories on the extent and forecast trajectory of volcanic contamination (VAA) in message format for delivery to MWOs, ACCs, ATFM units, and aircraft Operators within the area of responsibility of the VAAC, in addition to other VAACs, WAFCs, and the regional OPMET data bank of Brasilia.
 - e) Monitor all incoming satellite information and any other available information that will help determine the movement of the volcanic ash cloud;
 - f) Continue issuing advisories (VAA/VAG) to MWOs, ACCs, ATFM units, and Operators concerned. These VAA/VAGs will be issued with a validity of T+0, T+6, T+12, and T+18 hours, at least at 6-hour intervals. They will be issued more frequently if necessary. The procedure will continue until such time that the volcanic ash is no longer discernible from satellite data, no more reports of volcanic ash are received from the affected area, and no more eruptions from the volcano are reported; and
 - g) Keep in regular contact with the VAACs and the meteorological offices concerned, and if possible, with the Smithsonian Institute Global Volcanism Network, in order to keep updated information on the status of volcanoes in the area of responsibility.

APPENDIX F**RECOMMENDED ACTIONS BY STATES OF THE OPERATOR/REGISTRY WITH REGARDS TO AIRCRAFT OPERATIONS IN THE EVENT OF A VOLCANIC ERUPTION****Safety Risk Assessment for Flights in the Proximity of Airspace with Volcanic Ash****1. Introduction**

1.1 It is recommended that the States of Registry or States of the Operator, as appropriate, that intend to allow operators under their jurisdiction to operate in areas contaminated with volcanic ash, request the latter to conduct safety risk assessments before initiating operations.

1.2 The safety risk assessment should be completed before planning operations in airspace and/or to/from aerodromes that might be affected by volcanic ash.

2. Applicability

2.1 To all Operators conducting flights in airspace and/or to/from aerodromes that might be affected by volcanic ash.

3. Recommendations

3.1 *ICAO Annex 6, Chapter 3, paragraph 3.3 Safety Management*, recommends that the States of the Operator or of Registry, as appropriate, request all Operators that are planning to operate in areas where volcanic ash is expected, to conduct safety risk assessments before planning their operations. Safety risk assessments should require the following from the Operators:

- a) conduct their own risk assessment and develop operational procedures to address any remaining risk;
- b) establish the appropriate maintenance inspections of damage caused by ash; and
- c) ensure that any incident related to volcanic ash is reported through the AIREPs, followed by the corresponding Volcanic Activity Report (VAR).

3.2 Appendix G provides a guide for the preparation of the safety risk assessment.

APPENDIX G

EXAMPLE OF A SAFETY RISK ASSESSMENT PROCESS

1. Introduction

1.1 The safety risk assessment process is described in the *Safety Management Manual (Doc. 9859)*. The process involves the identification of hazards associated to the activity (in this case, airspace in the proximity of volcanic ash or flights to/from aerodromes affected by volcanic ash), taking into account the severity of the consequences of the phenomenon (severity), the possibility or likelihood of occurrence, whether the resulting risk is acceptable and falls within the safety performance margins of the organisation (acceptability) and finally, the adoption of actions to reduce the safety risk to an acceptable level (mitigation).

2. Hazard identification

2.1 Hazard is considered to be any situation or condition with the potential of having adverse consequences. Appendix H contains a suggested non-exhaustive list of topics.

3. Safety risk assessment

3.1 Risk is the determination of the probability and severity of the adverse consequences resulting from a hazard.

3.2 All stakeholders should be consulted to help the Operator decide on the possibility of a hazard causing harm and to assist in the mitigation of any perceived safety risk.

3.3 The safety risk from each hazard should be assessed using a suitable calibrated safety risk assessment matrix. The *Safety Management Manual (Doc 9859)* contains an example of a safety assessment matrix. An alternative that is aligned with the safety management system (SMS) of the organisation could be equally appropriate. The safety risk analysis should take into account the severity of the adverse consequences resulting from a particular hazard and their probability of occurrence.

3.4 The severity of any adverse consequences resulting from a particular hazard should be assessed using a properly calibrated severity scale. The *Safety Management Manual (Doc 9859)* contains examples of such scales. An alternative that is aligned with the safety management system (SMS) of the organisation could be equally appropriate. It should be borne in mind that, for any flight, safety deviations resulting from an encounter with volcanic ash could be quite significant.

3.5 Risk probability

3.5.1 The possibility or likelihood of adverse consequences resulting from a particular hazard should be assessed. The probability must be consistent with the duly calibrated probability scale. The *Safety Management Manual (Doc 9859)* contains examples of these probability scales. An alternative that is aligned with the safety management system (SMS) of the organisation could be equally appropriate.

3.5.2 When assessing the probability or possibility of adverse consequences resulting from a particular hazard, the following factors should be taken into account:

- The degree of exposure to the hazard. The SAM Volcanic ash contingency plan.

- Any historic incident or data on a hazardous event that affects safety. This can be derived from the industry, regulators, other Operators, air navigation service providers, internal reports, etc.
- The expert opinion of the main stakeholders.

3.5.3 The results of this assessment should be recorded in a hazard register, also known as “risk register”. Appendix I contains an example of the hazard register.

3.6 *Risk tolerance*

3.6.1 At this stage of the process, the safety risks should be classified acceptable or unacceptable. The *Safety Management Manual (Doc 9859)* provides an appropriate set of definitions for Risk Classification.

3.6.2 Appropriate mitigation measures should be considered for each hazard identified, recorded in the hazard register and implemented. Mitigation measures must be adopted in order to reduce safety risks to an acceptable level, but additional mitigation measures should also be considered, when reasonably feasible, if they will further reduce the safety risk beyond the acceptable level. Thus, the mitigation process would reduce the safety risk to values as low as reasonably feasible.

3.6.3 Not all hazards may be suitably mitigated; in such cases, the operation should not proceed.

3.7 *Mitigation actions*

3.7.1 Risk mitigation actions by themselves may introduce new hazards. When the organisation has an effective SMS, it must contain procedures for continuous monitoring of hazards and risks, with the support of qualified personnel to accept mitigation actions. Operators that do not have an effective SMS should repeat the safety risk assessment at regular intervals, applying any mitigation measures, in accordance with any changes in the original risk assessment. This ensures continuous safety management/monitoring.

3.8 *Records*

3.8.1 The results of safety risk assessments should be documented and disseminated throughout the organisation, and submitted to the Operator’s National Safety Authority. Actions should be completed and any mitigation verified and supported by evidence prior to the start of operations.

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

3.8.3 Any safety performance monitoring requirements should also be identified and met through the organisation’s safety risk assessment process.

APPENDIX H

**PROCEDURES TO BE CONSIDERED BY AN AIRCRAFT OPERATOR
WHEN CONDUCTING A SAFETY RISK ASSESSMENT**

<i>Considerations</i>	<i>Actions</i>
Preparation	
Type Certificate Holder	<p>The operator should obtain advice from the TCHs of the aircraft and engines it operates concerning operations in potentially contaminated airspace and/or to/from aerodromes contaminated by volcanic ash. This advice should set out:</p> <ul style="list-style-type: none"> ✓ the features of the aircraft or engine that are susceptible to airworthiness effects related to volcanic ash; ✓ the nature and severity of these effects; ✓ the effect of volcanic ash on operations to/from contaminated aerodromes; ✓ the related pre-flight, in-flight and post-flight precautions to be observed by the operator including any necessary amendments to Aircraft Operating Manuals, Aircraft Maintenance Manuals, Master Minimum Equipment List/Dispatch Deviation or equivalents required to support the operator; ✓ the recommended continuing airworthiness inspections associated with operations in volcanic ash-contaminated airspace and to/from volcanic ash contaminated aerodromes; this may take the form of instructions for continuing airworthiness or other advice.
Operator personnel or their service providers	<p>The operator should publish procedures for flight planning, operations, engineering and maintenance ensuring that:</p> <ul style="list-style-type: none"> ✓ personnel responsible for flight planning are equipped to evaluate correctly the risk of encountering volcanic ash cloud-contaminated airspace, or aerodromes, and can plan accordingly; ✓ flight planning and operational procedures enable crews to avoid areas and aerodromes with unacceptable volcanic ash contamination; ✓ flight crews are aware of the possible signs of entry into a volcanic ash cloud and execute the associated procedures; ✓ engineering and maintenance personnel are able to assess the need for, and to execute, any necessary maintenance or other required interventions.

<i>Considerations</i>	<i>Actions</i>
Operator procedures	
Provision of enhanced flight watch	The operator should: <ul style="list-style-type: none"> ✓ closely and continuously monitor VAA, VAR/AIREP, SIGMET, NOTAM and ASHTAM information, and information from its crews, concerning the volcanic ash cloud hazard; ✓ ensure that its Operations Unit, or equivalent, and its crews, have access to plots of the affected area from SIGMETs and NOTAMs; ✓ ensure that the latest information is communicated to its crews and planners in a timely fashion.
Flight planning	The operator should develop a safety risk assessment for planned flights into areas forecast to be, or aerodromes known to be, contaminated with volcanic ash which the CAA should evaluate during normal oversight of the operator's SMS. The operator's process should be sufficiently flexible to allow re-planning at short notice should conditions change.
Departure, destination and alternates	For the airspace to be traversed, or the aerodromes in use, the operator should determine, and take account of: <ul style="list-style-type: none"> ✓ the degree of known or forecast contamination; ✓ any additional aircraft performance requirements; ✓ required maintenance considerations; ✓ fuel requirements for re-routing and extended holding.
Routing policy	The operator should determine, and take account of: <ul style="list-style-type: none"> ✓ the shortest period in and over the forecast contaminated area; ✓ the hazards associated with flying over the contaminated area; ✓ drift down and emergency descent considerations.
Diversion policy	The operator should determine, and take account of: <ul style="list-style-type: none"> ✓ maximum allowed distance from a suitable alternate; ✓ availability of alternates outside the forecast contaminated area; ✓ diversion policy after a volcanic ash encounter.
Minimum Equipment List / Dispatch Deviation Guide	The operator should consider additional restrictions for dispatching aircraft with unserviceabilities which might affect: <ul style="list-style-type: none"> ✓ air conditioning packs; ✓ engine bleeds; ✓ pressurization system; ✓ electrical power distribution system; ✓ air data computers; ✓ standby instruments; ✓ navigation systems; ✓ de-icing systems; ✓ engine driven generators; ✓ Auxiliary Power Unit (APU); ✓ Airborne Collision Avoidance System (ACAS); ✓ Terrain Awareness Warning System (TAWS); ✓ Autoland systems; ✓ provision of crew oxygen; and ✓ supplemental oxygen for passengers. <p><i>(Note.— This list is not exhaustive.)</i></p>

<i>Considerations</i>	<i>Actions</i>
Flight Crew Procedures	
Standard operating procedures	<p>The operator should ensure that crews are familiar with normal and abnormal operating procedures and particularly any changes regarding:</p> <ul style="list-style-type: none"> ✓ pre-flight planning; ✓ in-flight monitoring of volcanic ash cloud affected areas and avoidance procedures; ✓ diversion policy; ✓ communications with ATC; ✓ in-flight monitoring of engine and systems potentially affected by volcanic ash cloud contamination; ✓ recognition and detection of volcanic ash clouds; ✓ in-flight indications of a volcanic ash cloud encounter; ✓ procedures to be followed if a volcanic ash cloud is encountered; ✓ unreliable or erroneous airspeed; ✓ non-normal procedures for engines and systems potentially affected by volcanic ash cloud contamination; ✓ engine-out and engine relight; ✓ escape routes; and ✓ operations to/from aerodromes contaminated with volcanic ash. <p><i>(Note.— This list is not exhaustive.)</i></p>
AML	<p>The operator should ensure that crews:</p> <ul style="list-style-type: none"> ✓ make an AML entry related to any actual or suspected volcanic ash encounter whether in-flight or at an aerodrome; ✓ confirm, prior to flight, completion of maintenance actions related to an AML entry for a volcanic ash cloud encounter on a previous flight.
Incident reporting	<p>The operator should specify crew requirements for:</p> <ul style="list-style-type: none"> ✓ reporting an airborne volcanic ash cloud encounter (VAR); ✓ post-flight volcanic ash cloud reporting (VAR); ✓ reporting non-encounters in airspace forecast to be contaminated; ✓ filing a mandatory occurrence report as required by the State.

<i>Considerations</i>	<i>Actions</i>
Maintenance Procedures	
Maintenance procedures	<p>An operator operating in, or near, areas of volcanic ash cloud contamination should:</p> <ul style="list-style-type: none"> ✓ enhance vigilance during inspections and regular maintenance and make appropriate adjustments to maintenance practices; ✓ have produced a continuing airworthiness procedure to follow when a volcanic ash cloud encounter has been reported or suspected; ✓ ensure that a thorough investigation is carried out of any signs of unusual or accelerated abrasions or corrosion or of volcanic ash accumulation; ✓ cooperate in reporting to TCHs and the relevant authorities its observations and experiences from operations in areas of volcanic ash cloud contamination; ✓ comply with any additional maintenance recommended by the TCH.

Note.— The above list is not exhaustive; the operator should develop its own list taking into account its specific equipment, experience, knowledge and type of operation.

APPENDIX I

SAMPLE OF A HAZARD RECORD (RISK RECORD)

HAZARD		Hazard consequence description	Existing controls	Outcome (Pre-mitigation)			Further mitigation required	Event (Post-mitigation)			Affected by the risk	Monitoring and review actions
N°	Description			Severity	Probability	Risk		Severity	Probability	Risk		

(Add rows if required)

APPENDIX J**SAMPLES OF SIGMET, NOTAM AND ASHTAM**

Publication *WMO N° 386 Volume I (Manual on the Global Telecommunication System) Part II (Operational Procedures for the Global Telecommunication System)* presents a guide of the World Meteorological Organization headers (WMO) referred in the pre-eruption Phase.

NOTAM Offices should be reminded that ASHTAM (or volcanic ash NOTAM) should be distributed through AFTN/AMHS to their associated MWO, SADIS and all VAACs, in accordance with the standards contained in ICAO Doc. 9766, Chapter 4, paragraph 4.3.

1. SIGMET.**SAMPLE: FIRST SIGMET**

SEGU SIGMET 05 VALID 161314/161614 SEGU-
SEGU GUAYAQUIL FIR VA TUNGURAHUA 152-08 POS S0128 W07826
VA CLD OBS AT 1300Z FL190 MOV W=

SAMPLE: SIGMET WITH PROJECTION

SUEO SIGMET 3 VALID 071820/080020 SUMU-
SUEO MONTEVIDEO FIR VA ERUPTION CORDON CAULLE 1507-15 PSN S4052
W07220 OBS ASH CLOUD: SFC/FL180 VA CLD 35 NM WIDE LINE BTN S4052 W06630 -
S4127 W07053 - S4200 W06956 - S4318 W06907 - S4432 W06905
FCST ASH CLD +06HR: 071930Z SFC/FL180 S4052 W07220 - S4130 W0550 -
S4200 W06140 - S4400 W06130 - S4230 W06640 - S4052 W07220

2. NOTAM warning on pre-eruptive activity.**SAMPLE:**

(A0777/15 NOTAMN
Q) SAEF/QWWXX/IV/NBO/W/000/999/4052S07220W020
A) SAEF B) 1502260830 C) 1502261100
E) INCREASE VOLCANIC ACTIVITY, POSSIBLY INDICATING IMMINENT ERUPTION,
REPORTED FOR VOLCANO CORDON CAULLE 1507-141 S4031 W07212 CHILE. 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 SAEF AREA.
F) GND G) UNL)

3. NOTAM setting a dangerous zone after initial eruption.**SAMPLE:**

(A0778/15 NOTAMR A0777/15
Q) SAEF/QWWXX/IV/NBO/W/000/500/4052S07220W030
A) SAEF B) 1502260900 C) 1502261200
E) VOLCANIC ERUPTION REPORTED IN VOLCANO CORDON CAULLE
1507-141 S4031 W07212 CHILE. VOLCANIC ASH CLOUD REPORTED REACHING
FL500. AIRCRAFT ARE REQUIRED TO REMAIN AT LEAST XXXNM CLEAR OF
VOLCANO AND MAINTAIN WATCH FOR NOTAM/SIGMET FOR SAEF AREA.

F) GND G) 500)

4. NOTAM setting a dangerous zone including an Area of high (or high/médium or high/médium/low) contamination.

SAMPLE:

(A0779/15 NOTAMN

Q) SAEF/QWWXX/IV/NBO/W/000/500/4052S07220W030

A) SAEF B) 1502260900 C)1502261200

E) TEMPORARY DANGER ZONE HAS BEEN ESTABLISHED FOR VOLCANIC ASH
AREA OF HIGH CONTAMINATION IN AREA XXXXS XXXXXW XXXXS

XXXXXW XXXXS XXXXXW XXXXS XXXXXW

F) SFC

G) FL 350

5. NOTAM to define a Medium contamination area in a non-dangerous zone.

SAMPLE:

(A0780/15 NOTAMN

Q) SAEF/QWWXX/IV/NBO/W/000/20

A) SAEF B) 1502260900 C) 1502261200

E) VOLCANIC ASH AREA OF MEDIUM CONTAMINATION FORECAST IN AREAS XXXXS
XXXXXW XXXXS XXXXXW XXXXS XXXXXW XXXXS XXXXXW

F) SFC

G) FL200)

6. ASHTAM warning on pre-eruptive activity.

SAMPLE:

VASA 0002/15 SACF 1505051340

ASHTAM 0002

A) CORDOBA FIR

B) 1505051215

C) VOLCAN LASCAR 1505 – 10=

D) 2337S 06773W

E) YELLOW ALERT

F) 10000/15000FT

J) VOLCANIC ASH ADVISORY CENTRE - BUENOS AIRES

K) POSSIBLE AFFECTED ZONE BY VOLCANIC ASH SOUTH JUJUY, SALTA CENTER, LAST
ASH POSITION AT 1309 UTC LINE FROM 2750S 06210W UP TO 2655S 06040W POSSIBLE
ALTITUD FL 100/150

7. ASHTAM warning on pre-eruptive activity.

SAMPLE:

VASA 0002/15 SACF 1505051430

ASHTAM 0002

A) CORDOBA FIR

B) 1505051215

C) VOLCAN LASCAR 1505 – 10=

D) 2337S 06773W

E) RED ALERT

F) SFC/15000FT

J) VOLCANIC ASH ADVISORY CENTRE - BUENOS AIRES

K) AFFECTED ZONE BY VOLCANIC ASH SOUTH JUJUY, SALTA CENTER, NORTH SANTIAGO DEL ESTERO, SOUTH CHACO AND NORTH SANTA FE, LAST ASH POSITION AT 1420 UTC LINE FROM 2750S 06210W UP TO 2655S 06040W ALTITUD FL 100/150

8. ASHTAM warning on the reduction of the eruptive activity.

SAMPLE:

VASA 0002/15 SACF 1505051940

ASHTAM 0002

A) CORDOBA FIR

B) 1505051215

C) VOLCAN LASCAR 1505 – 10=

D) 2337S 06773W

E) YELLOW ALERT

F) SFC/15000FT

J) VOLCANIC ASH ADVISORY CENTRE - BUENOS AIRES

K) AFFECTED ZONE BY VOLCANIC ASH SOUTH JUJUY, SALTA CENTER, NORTH SANTIAGO DEL ESTERO, SOUTH CHACO AND NORTH SANTA FE, LAST ASH POSITION AT 1920 UTC LINE FROM 2750S 06210W UP TO 2655S 06040W ALTITUD FL 100/150

APPENDIX K

LIST OF CONTACTS OF MWO/NOF/CAA/ANSP/VULCANOLOGICAL INSTITUTE

State	Oficce	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
ARGENTINA							
MWO							
NOF	NOTAM INTERNACIONAL Ezeiza						
AAC	Aeronautical Information Department						
ANSP	ACC Ezeiza	SAEZ	EZEIZA	control.galicia@yahoo.com.ar nav.aer_atseze@yahoo.com.ar	SAEZZRZX	+5411 44802210/19 Annex: 57542 44802220/2269 Fax: 44802344	
	ACC Resistencia	SARE	RESISTENCIA	juanencinas@arnet.com.ar	SAREZRZX	0362 4440939 Conm. 0362 4436291/2/3 Annex: 32107 RTI 32107 Fax: 0362 4440939	
	ACC Córdoba	SACO	CORDOBA	lu3hfe@yahoo.com.ar	SACOZRZX	0351 4335350 0351 4756448 RTI 36458/48 Fax: 0351 4335350	
	ACC Mendoza	SAME	MENDOZA	leonardomaggipinto@yahoo.com.ar	SAMEZRZX	0261 4487486/ 4488986/4488840 Annex: 65337 RTI 65337	
	ACC Comodoro Rivadavia	SAVC	COMODORO RIVADAVIA	acccomodoro@gmail.com.ar	SAVCZRZX	0297 4548375 Annex: 50519 RTI 50519 Fax: 2974548375	

State	Office	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
	AIS	SABB		ais_dgcta@faa.mil.ar ricardosykes@gmail.com	SABBRXYX	+5411 5789-8451	
Vulcanological Institute							
BOLIVIA							
MWO	AASANA	SLLP	LA PAZ	mwo@asana.bo	SLLPYMYX	5912-2114232	
NOF	AASANA	SLLP	LA PAZ	ais@asana.bo	SLLPYNXX	5912-2316686 Int. 140	
AAC	AASANA	SLLP	LA PAZ	supervisor.acc@asana.bo	SLLPZRZX	5912-2810203	
ANSP	AASANA	SLLP	LA PAZ	fazuga@asana.bo	SLLPYBYX	5912-2124042	
AAC	DGAC	SLLP	LA PAZ	acastro@dgac.gob.bo	SLLPYAYX	5912-2114465	
Vulcanological Institute	San Calixto Observatory			osc@observatoriosancalixto.com		5912-2406706	
BRAZIL							
MWO							
NOF	NOF BRASIL			nofbrazil@cindacta1.aer.mil.br	SBRJYNYX	(55 61) 3364-8353	
AAC	AGENCIA NACIONAL DE AVIACIÓN CIVIL						
ANSP	DECEA			luizantoniolas@decea.gov.br	SBRJYGYX	(55 21) 2101-6088	
Vulcanological Institute	NIL						Brazil receives la information from VAAC Buenos Aires
AMAZONICA FIR							
MWO	CMV AMAZONICO	SBAZ	AMAZÓNICA	cmv-az@cindacta4.decea.gov.br	SBMUYFTH	(55 92) 3652-5375 (55 92) 3652-5384	
ACC	ACCAMAZONICO	SBAZ	AMAZÓNICA	accaz@cindacta4.dcea.gov.br	SBAZZRZX SBAZZQZX	(55 92) 3652-5318 FAX (55 92) 3652-5371	
BRASILIA FIR							
MWO	CMV BRASILIA	SBBS	BRASILIA	cmv-bs@cindacta1.aer.mil.br	SBBSYMYX	(55 61) 3364-8358	

State	Office	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
SANTIAGO FIR							
MWO	Santiago	SCEL	Santiago	centrometamb@dgac.gob.cl	SCELYMYX	(56) 224363224 (56) 224363735 Fax (56) 226019214	---
NOF	NOF Office-CHILE	SCSCYNYX	SCEZ SCEZ SCTZ SCCZ	nof@dgac.gob.cl	SCSCYNYX	(56) 228364033	---
AAC	Santiago Control Centre	SCEZ	Santiago	Sup.ccu@dgac.gob.cl	SCELZRZX	(56) 228364017 (56) 228364016	---
ANSP	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Vulcanological Institute	Vulcanological Observatory of Los Andes del Sur (OVDAS) Temuco, Chile	No	No	Chief National Network of Volcanic Watch Sr. Paul Duhart Cel. 81674526 paul.duhart@sernageomin.cl Sr. Luis Lara Cel 85948235 luis.lara@sernageomin.cl Mr. Alvaro Amigo Cel 66075489 alvaro.amigo@sernageomin.cl Chief Volcanic Monitoring Mr. Fernando Gil fernando.gil@sernageomin.cl	No	Operational cell OVDAS office 7808 4310 Telephone (56) 45 227 0700 (56) 45 227 0701 Cell 81 264314 Telephone (56) 45 227 0700	---
Vulcanological Institute	National Service of Geology and Mining (SERNAGEOMIN) Santiago, Chile	No	No	Chief applied Geology Sr. Waldo Vivallo waldo.vivallo@sernageomin.cl Chief Geological hazard Unit and OT Mr. Aníbal Fajardo anibal.fajardo@sernageomin.cl	No	Cell 85932407 Telephone (56) 2224825500	
PUERTO MONTT FIR							
MWO	Puerto Montt	SCTE	Puerto Montt	meteozoneasur@dgac.gob.cl	SCTEYMYX	(56) 65 2486361	---

State	Oficce	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
						Fax (56) 65 2486362	
NOF	---	---	---	---	---	---	---
AAC	Puerto Montt Control Centre	SCTZ	Puerto Montt	efernandezn@dgac.gob.cl	SCTEZRZX	(56) 65 2294121 (56) 65 2486235	
ANSP	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable
Vulcanological Institute	---	---	---	---	---	---	---
PUNTA ARENAS FIR							
MWO	Punta Arenas	SCCI	Punta Arenas	meteo_parenas@dgac.gob.cl	SCCIYMYX	(56) 61 2745464 (56) 61 2745423	
NOF	---	---	---	---	---	---	---
AAC	Punta Arenas Control Centre	SCCZ	Punta Arenas	ecortesv@dgac.gob.cl	SCCIZRZX	(56) 61 2745414 (56) 61 2745474 (56) 61 2745462	
ANSP	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable	Not aplicable
Vulcanological Institute	---	---	---	---	---	---	---
COLOMBIA							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							
ECUADOR							
MWO							

State	Office	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
NOF							
AAC							
ANSP							
Vulcanological Institute							
GUYANA FRANCESA							
MWO	Cayenne	SOCA	SOOO	prevision.guyane@meteo.fr		00594353536 00594353545	Christian.brevignon@meteo.fr
NOF	Cayenne	SOCA SOOO	SOOO	sna-ag-bria-cay-bf@aviation-civile.gouv.fr	SOCAZQZX	005946949166262 FAX: 005945944304124	
AAC	Cayenne		SOOO	jean-claude.feullerat@aviation-civile.gouv.fr		00594359301 Fax: 00594356166	Délégation Aviation civile en Guyane
ANSP	Cayenne	SOCA SOOO	SOOO	michel.arenos@aviation-civile.gouv.fr	SOCAZQZX	00594916262 FAX: 00594594359356	
Vulcanological Institute							
GUYANA							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							

State	Oficce	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
PANAMA							
MWO	TOCUMEN	MPTO	MPZL	meteortoc@aeronautica.gob.pa	MPTOYMYX	507-2382650 507-2382612	
NOF	TOCUMEN	MPTO	MPZL	aisnof@aeronautica.gob.pa	MPTOYNYX	(507) 238-2615 NOF (507) 238-4446 Fax	
AAC							
ANSP	CERAP	MPZLZQ	MPZL	cerap@aeronautica.gob.pa	MPZLZQZX	(507) 315-9871 (507) 315-9875	
Vulcanological Institute	Geoscience Institute UP			igcupa@gmail.com		507-523 5562 523-5560	
PARAGUAY							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							
PERU							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							

State	Office	ICAO Indicator	FIR	E-mail	AFTN	TELEPHONE FAX	Remarks
SURINAME							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							
URUGUAY							
MWO	Montevideo	SUMU	SUEO	pronostico.dmae@meteorologia. gub.uy	SUMUYYMX	(598) 260 40299 (598) 260 40242 Fax	
NOF							
AAC							
ANSP							
Vulcanological Institute							
VENEZUELA							
MWO							
NOF							
AAC							
ANSP							
Vulcanological Institute							

APPENDIX L

VONA FORMAT (Volcano Observatory Notice for Aviation) results from GREPECAS Conclusion 15/11 and is included as Appendix E to Doc 9766 – Handbook on the International Airways Volcano Watch (IAVW)

VOLCANO OBSERVATORY NOTICE FOR AVIATION-VONA	
Issued:	Universal (Z) date and time (YYYYMMDD/HHMMZ)
Volcano:	Name and number (per Smithsonian database at http://www.volcano.si.edu/world/)
Current Aviation Color Code:	As shown in Appendix 3 to ICAO Annex 15 (GREEN, YELLOW, ORANGE, OR RED in upper-case bold font)
Previous Aviation Color Code:	If it is the first notice put NIL. Lower case font bold
Source:	Name of Volcano Observatory (volcanological agency)
Notice Number:	Create unique number for each VONA that includes year
Volcano Location:	Latitude, longitude in NOTAM format (N or S deg min W or E deg min - XXXXS XXXXXW)
Area:	Regional descriptor or simply the State
Summit Elevation:	Height in metres (and feet) Example: 5000 m (16000 ft) of the ash cloud expelled
Volcanic Activity Summary:	Concise statement that describes activity at the volcano. If known, specify time of onset and duration (local and UTC) of eruptive activity. If eruption is ongoing at the time of VONA release, indicate “eruption and ash emission is continuing”
Volcanic Cloud Height:	Best estimate of ash-cloud top in nnnnn FT (nnnn M) above summit or AMSL (specify which) in metres (and in ft). Example: 6500 m (18000 ft). Give source of height data (ground observer, pilot report, radar, etc.). “UNKNOWN” if no data available, or “NO ASH CLOUD PRODUCED” or “NIL” if applicable.
Other Volcanic Cloud information:	Brief summary of relevant cloud characteristics such as colour of cloud, shape of cloud, direction of movement, etc. Specify if cloud height is obscured or suspected to be higher than what can be observed clearly. “UNKNOWN” if no data available, or “NO ASH CLOUD PRODUCED” or “NIL” if applicable.
Remarks:	Optional; brief comments on related topics such as monitoring data, observatory actions, volcano’s previous activity, etc.
Contacts:	Names, phone numbers (voice and fax), email addresses.
Next Notice:	“A new VONA will be issued if conditions change significantly or the colour code is changed”. Indicate if final notice for an event. Include URL of website where latest volcanic information is posted, or indicate if this is the final notification of an event.

SAMPLE OF VONA

VOLCANO OBSERVATORY NOTICE FOR AVIATION	
Issued:	20150605/1626Z
Volcano:	Volcano Ubinas N° 354020
Current Aviation Colour Code:	Orange
Source:	Instituto Geofísico del Peru
Notice Number:	092015
Volcano Location:	S1621 W07054
Area:	PERU
Summit Elevation:	5672m (18608.7 ft)
Volcanic Activity Summary:	At 11:26 local time (16:26 UTC), an emission of volcano Ubinas was registered with a duration of 58 seconds. The ash column flow up to 700 metres over the crater base and was spread by the wind to Southeast.
Volcanic Cloud Height:	700 m (3937 ft)
Other Volcanic Cloud information:	The ejected material was ash, colour gray.
Remarks:	The Southern Vulcanological Observatory of the <i>Instituto Geofísico del Peru</i> predicts that the ash ejection could be to the SOUTHEAST direction of the volcano.
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Next Notice:	WHEN SIGNIFICANT CHANGES ARE REGISTERED