International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Eighth Meeting of the GREPECAS Aeronautical Meteorology Subgroup (AERMETSG/8)
Santiago, Chile, 9 to 13 October 2006

Agenda Item 3: **Implementation of the International Airways Volcanic Watch (IAVW) in the CAR/SAM Regions**

Draft Guide for the Development of Emergency Plans in Airports affected by volcanic ash

(Presented by the Rapporteur of the Task Force on Volcanic Ash)

SUMMARY

The purpose of this working paper is to present, for the consideration of the members of the Subgroup, a Draft Guide for the development of Emergency Plans in Airports affected by volcanic ash.

1. Introduction

1.1 As a result of intense upper winds, the elements emitted by a volcano in activity, for example volcanic ash, are notoriously dispersed involving a large airspace extension, affecting commercial flights operating through these areas.

1.2 It should be considered that this situation, which also generates the transportation of volcanic ash, not only affects the airspace, but also they fall and are placed in the ground surface in zones sometimes very distant from the source of emission.

1.3 For this reason the States should be aware to distinguish the concepts of volcanic danger and volcanic risk, noting that to determine volcanic risk it is necessary to have available the evaluation of the location of all the airports that could be affected, taking into account the location of active volcanic centres and indirect effects, mainly those resulting from the transportation of volcanic ash, which interfere affecting adversely socio-economic activities of important sectors.

1.4 To mitigate these effects, it is necessary to create a National Plan to Manage National Emergencies of each State, which evidence the need to create an Inter-disciplinary Committee to be in charge of the general coordination and the designation of responsibilities, through the development of clear and operationally feasible guidelines, which should contain all the decisions and coordinations derived in the coordination meetings and subsequent corrections originated from the practice of the plan, as well as the weak spots presented and emerging from the subsequent analysis of a real volcanic emergency.

1.5 It should be constituted by representatives of the different areas which could be affected by this type of phenomenon, being each of them responsible to prepare their action plans to front the emergency, within their corresponding area.

1.6 It should also be considered that because of the diversity of the group, there is the possibility that differences in the determination or evaluation of the different parameters to be considered may arise, since there will always be an element of personal opinion in the interpretation given to the different demonstrations of volcanic activity, which could generate confusion within the working group.

1.7 Likewise, all these factors could sometimes be complemented by the uncertainty or concern to under- or over-estimate the real magnitude of the event, which could generate loss of confidence, false alarms or panic among the final addressees of the information.

1.8 Based on the above, the need to carry out Committee coordination meetings so that each representative of the different sectors involved present, among other things, their means, objectives, needs and requirements, is expressed, so that joint actions and action plans are generated in order to avoid duplication of tasks, rationalize means available and improve system functionality.

1.9 In summary, as possible, for the development of the emergency plan, the following factors should be considered:

1. Risk identification and analysis and evaluation of its consequences.

2. Risk zone.

3. Evaluation of the event in real time for the timely application of protective measures.

4. Composition of the Plan operational structure, considering the inclusion of specialized organizations and the necessary technical personnel.

5. Awareness of all the staff involved in the development of the Plan providing detailed and accurate information, both concerning risk comprehension, and information on the development of the Plan.

6. Establishment of alert systems, so that the emergency actions are highly preventive.

7. Planning of specific measures, both for protection and assistance.

1.10 A Guide for the development of Emergency Plans in Airports affected by volcanic ash is presented as **Appendix A** to this working paper, which was put into effect in 2005 by Argentina in all the aerodromes controlled, to be used as reference, with appropriate adjustments, by those States that might be interested.

2. Actions proposed to the meeting

2.1 The meeting is invited to:

a) take note of the information container in this working paper;

b) formulate other actions resulting from the discussion of this working paper.

APPENDIX A

CAR/SAM AIRPORT EMERGENCY PLANNING GUIDE

NATURAL DISASTERS

VOLCANIC ASH

OCTOBER 2006

1. GENERAL

1.1 The planning of airport emergency procedures is aimed at having the personnel and the means ready to face any event that might affect airport operations, minimising its impact on commercial aviation activities and even on its surroundings.

1.2 To that end, it is necessary to have Airport Emergency Plans for each potential hazard that could affect the aerodrome, defining the procedures for coordinating the action to be taken by the various units and/or airport services and, if necessary, the organisations of the surrounding community that could be of assistance in responding effectively to such emergency.

1.3 Volcanic ash is a phenomenon that can affect aircraft operations, ground equipment and airport facilities. Therefore, specific procedures are required on this topic.

1.4 The development of such procedures should be based on the following documentation of the International Civil Aviation Organization:

a) Doc. 9137 AN 898 Airport Services Manual (Part 7) – Airport Emergency Planning.

b) Doc. 9691 AN 954 Manual on Volcanic Ash, Radioactive Material, and Toxic Chemical Clouds.

c) Doc. 9766 AN 968 Handbook on the International Airways Volcanic Watch.

1.5 It should also be noted that this guide contains the general guidelines for emergency planning and, consequently, such plans must be adapted and developed for each airport according to its specific needs.

1.6 For the specific case of volcanic ash, a guide for the development of an emergency plan for this type of natural phenomenon is presented below.

2. BASIC COMPOSITION OF AN AIRPORT EMERGENCY COMMITTEE

2.1 In the first phase of the Emergency Plan, it is necessary to know and list the units that would be part of the Airport Volcanic Emergency Committee, discriminated by area of interest, and define the roles and responsibilities of each.

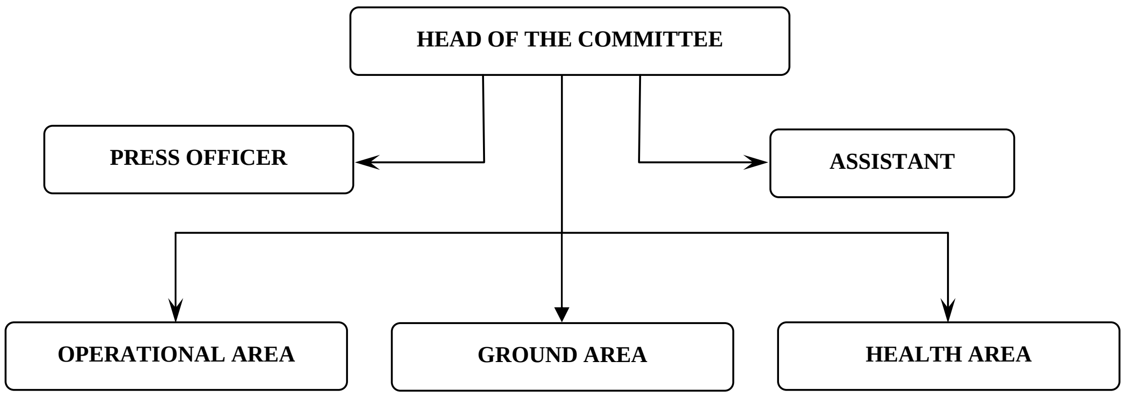
2.2 From the above-mentioned units, it is necessary to determine who will be designated as head of the committee, who will be in charge of making decisions and organising the action to be taken, through the various heads of the corresponding areas, to minimise damages caused by a phenomenon of this type. In this regard, it would be advisable for the head of the Committee to be the head of the airport or whoever is designated in his/her place by the State aeronautical authority.

3. MISSION OF THE AIRPORT VOLCANIC ASH EMERGENCY COMMITTEE

3.1 The mission of the Committee is to draft the Airport Emergency Plan in coordination and with the advice of the heads of the Operational, Ground, and Health Areas.

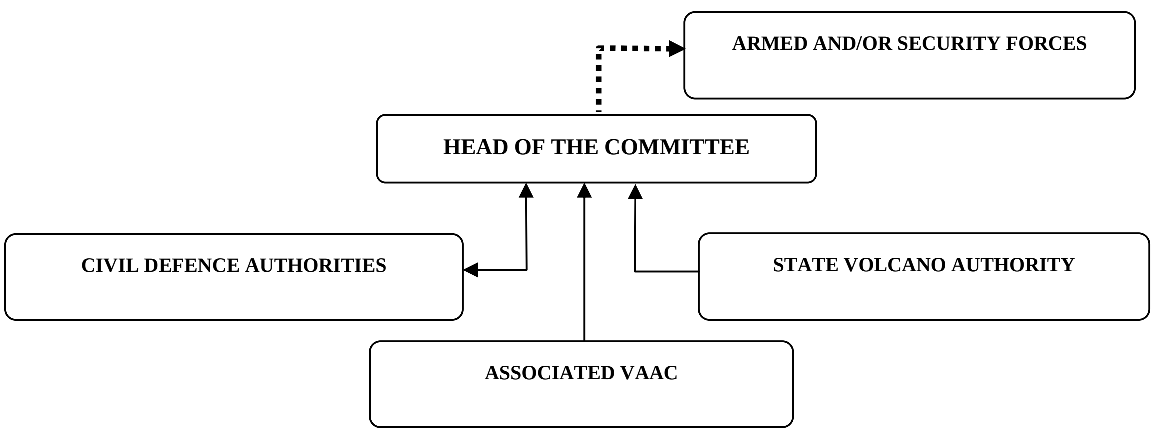
4. COMPOSITION OF THE COMMITTEE

4.1 In general terms, the basic composition of the Airport Volcanic Ash Emergency Committee would be as follows:



4.2 It would be convenient for the Committee to receive advice from the State Volcano Authority and the associated VAAC, in order to estimate the size of the event and its possible evolution. Local civil defence authorities should also participate, in order to coordinate their tasks within the various areas, thus avoiding duplication of efforts and, especially, to exchange information and thus provide elements of judgment to the areas for their specific task of protecting citizens and their goods.

4.3 Another element that should be considered as a potential component of the Committee are the Armed Forces or local Security Forces, since they can provide logistics and human support to meet the requirements that may emerge and which exceed the operational capacity of its primary areas.

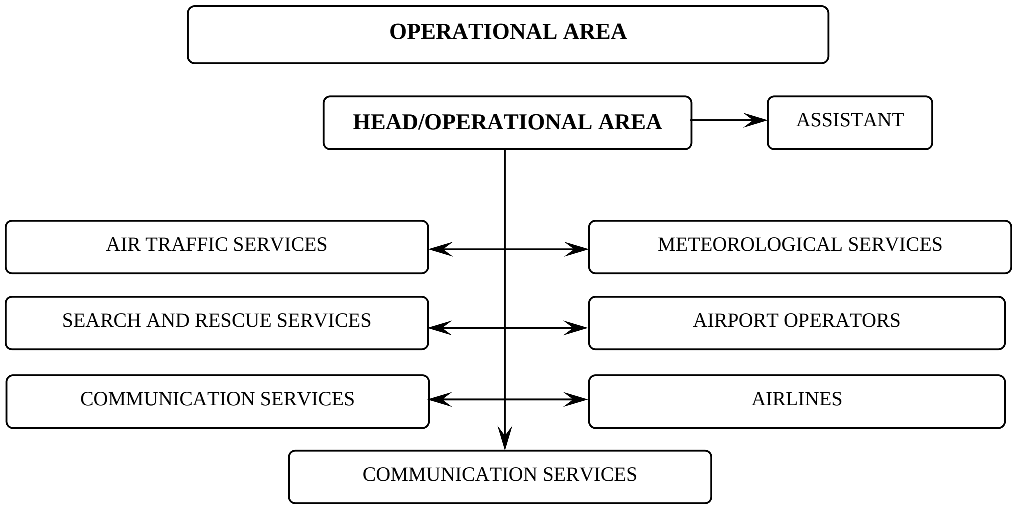


5. TASKS AND FUNCTIONS

5.1 Head of the Emergency Committee:
Coordinates and makes sure that the tasks to be carried out in each area are consistent with the corresponding Emergency Plan; is responsible for confirming the validity and feasibility of its implementation, and of summoning the Committee to a meeting in the event of an actual emergency. He/she has an Assistant responsible for fulfilling any task entrusted to him/her, and keeping up to date the full names and phone numbers of the committee members in the Call Plan.

5.2 Press officer:
Coordinates all the tasks related to the centralised release of information issued by the Committee to the media.

5.3 Operational area
Is in charge of all tasks concerning factors that have an impact on the aeronautical activities carried out at an airport.



5.3.1 Head of the Operational Area:
Coordinates and supervises all tasks related to factors that impact aeronautical activities at the airport and its surroundings. Advises the Head of the Committee and develops the operational requirements corresponding to the area under his/her responsibility.

5.3.2 Assistant to the Head of the Operational Area:
Assists the Head of the Operational Area in all the tasks entrusted to him/her. Is also responsible for keeping up to date the full names and phone numbers contained in the Call Plan of the area under his/her responsibility, submitting them to the Head of the Operational Area, and through the latter, to the Assistant to the Head of the Committee.

5.3.3 Air Traffic Services:
Coordinate as necessary with aircraft in the air and on the apron, and advise the Head of the Committee on airport operating conditions. In the event that volcanic ash affects an airborne aircraft, they alert the necessary services to address the emergency. Coordinate the issuance of the corresponding ASHTAMs.

5.3.4 Communication Services:
Must create a communication network for prompt communication among the different components of the Committee, and assign exclusive telephone lines for their operational use.

5.3.5 Meteorological Services
Are in charge of collecting meteorological data on volcanic ash and those obtained from dispersion models (SIGMETs, VAS messages, etc.) by the associated Meteorological Watch Office (MWO); finding out the meteorological conditions of alternate aerodromes in the event flights need to be re-routed; and coordinating their

tasks based on the specific instructions of the associated Volcanic Ash Advisory Centre and/or the corresponding MWO.

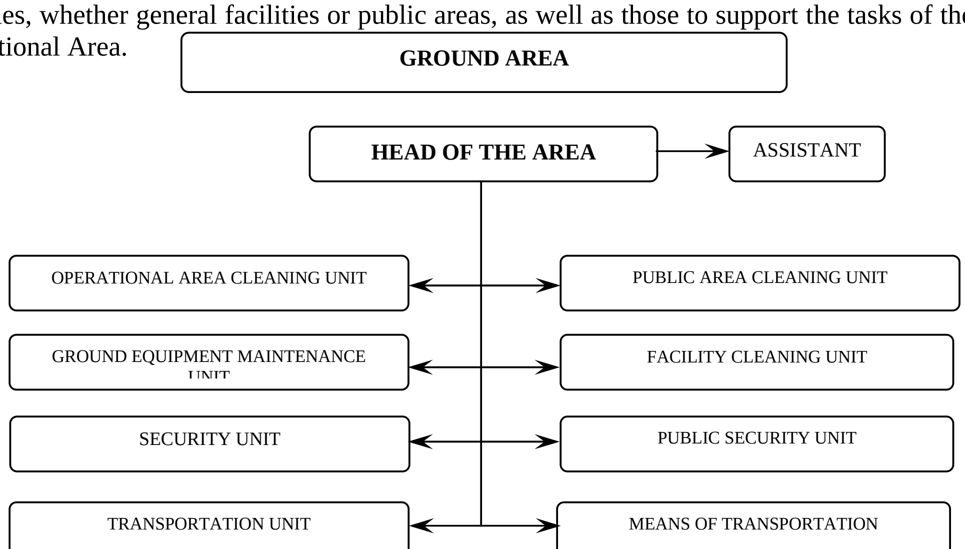
5.3.6 Airlines:
Coordinate all those tasks within their area of jurisdiction, such as flight cancellation, information, referral, passenger service, etc.

5.3.7 Airport operator
Coordinates the tasks required to keep airport ground areas and ground support equipment in operating conditions, to meet user needs within the airport, and provides personnel to cover positions in support of the various tasks.

5.3.8 Search and rescue services
On occasions, an airborne aircraft that takes in volcanic ash may suffer loss of power or engine failure, so the Emergency Plan should consider the possibility of an air accident. Therefore, this plan should supplement the Air Accident Emergency Plan.

5.3.9 Fire-fighting services
Should be available, not only in the event of an air accident, but also in case of damages caused by volcanic ash, for instance, the overheating and subsequent fire in the equipment, water sweeping of volcanic ash in operating areas, etc.

5.4 Ground area:
This is the area responsible for all tasks related to factors that have an impact on airport facilities, whether general facilities or public areas, as well as those to support the tasks of the Operational Area.



5.4.1 Head of the ground area
Coordinates and supervises all those tasks related to factors that have an impact on airport facilities, whether general facilities or public areas, as well as to those to support the tasks of the Operational Area. Gives advice to the Head of the Committee and develops the operational requirements corresponding to the area under his/her responsibility.

5.4.2 Assistant to the head of the ground area:
Assists the Head of the Ground Area in all tasks delegated to him/her. Is also responsible for keeping up to date the full names and phone numbers contained in the Call Plan for the area under his/her responsibility, submitting them to the Head of the Ground Area and, through the latter, to the Assistant to the Head of the Committee.

5.4.3 Cleaning units for the operational area, public area and facilities:
They are in charge of removing volcanic ash in their respective areas of jurisdiction, in order to minimise the inconveniences they cause.

5.4.4 Ground equipment cleaning unit:
Like the previous ones, it removes ash from equipment that requires specialised personnel due to its operating characteristics or the delicate nature of its components, in order to ensure its good operating condition, as is the case of computer equipment, VOR, ILS, etc.

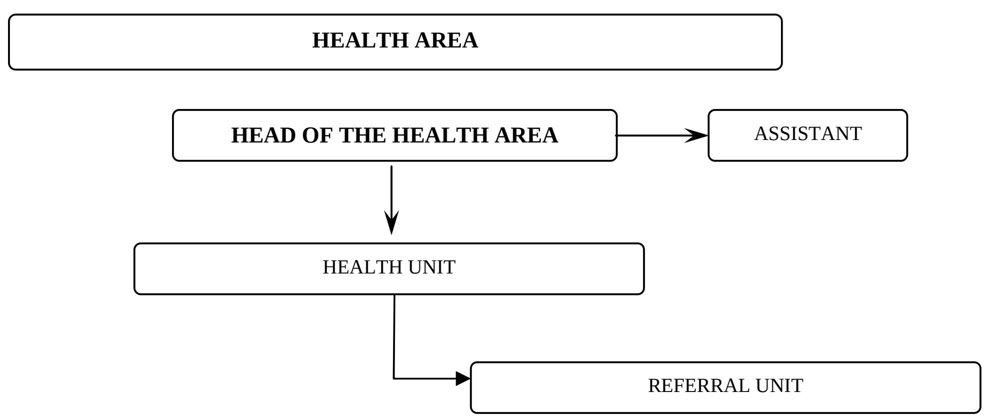
5.4.5 Airport security unit:
Is responsible for maintaining order within operational and public areas within the airport.

5.4.6 Public security unit:
On occasions, its assistance is required to maintain an orderly flow in places such as parking lots, perimeter of the airport, points of entry and exit of vehicles authorised to carry personnel and passengers.

5.4.7 Transportation unit
Is responsible for coordinating and rationalising tasks that require the use of vehicles to carry personnel to fulfil different tasks, evacuate passengers to more comfortable places, carry materials, machinery, etc. as requested by the various areas participating in the emergency.

5.4.8 Local means of transportation:
It should be noted that, in case of a volcanic emergency, the requirements of the Transportation Unit may exceed its operational capacity and it may be convenient to have local public transportation available.

5.5 Health area:
This area is responsible for all those tasks related to primary medical care and first aid for all individuals and/or passengers who might have been affected by volcanic ash.



5.5.1 Head of Health Area:
Coordinates all tasks related to factors that impact medical care for all those individuals who might be affected by volcanic ash.

5.5.2 Assistant to the Head of the Health Area:
Assists the Head of the Health Area in all those tasks delegated to him/her. Is also responsible for keeping up to date the full names and phone numbers contained in the Call Plan for the area under his/her responsibility, submitting them to the Assistant to the Head of the Committee.

5.5.3 Health units:
A primary care unit is necessary to provide first aid to individuals who have been affected, and if applicable, to refer them to more complete medical centres. This unit must keep in mind that an event of these characteristics will mainly cause bronchopulmonary and ophthalmic health problems, as well as skin abrasions.

5.5.3 Referral unit:
Coordinates with the Ground Area the evacuation to more complete medical centres of patients of the Health Unit who require care that exceeds its capacity or means.

6. SAFETY

6.1 Pursuant to ICAO Doc. 9137-AN898 Airport Services Manual (Part 7) – Airport Emergency Planning, emergency plans, in order to be safe, should take into account the following:

a) Pre-emergency planning
During this phase, the members of the Emergency Committee and their roles and responsibilities are defined, communication networks are established, the plan is tested, test results are analysed, and the relevant corrections are subsequently made. In this phase, it is very important to take into account the feasibility of the project. Although all aspects, even the smallest ones, must be considered, this should not hinder the completion of the activities themselves.

b) Operations during the emergency
The actual operation of the Emergency Plan is verified, and note is taken of aspects that had not been considered, actual response times, and the performance of the various areas involved.

c) Post-emergency operational analysis
Once the crisis is over, a thorough analysis should be made of all action taken, and a final report should be prepared for distribution to the various heads of the participating areas, and also to the heads of the various supporting groups of the Committee (volcano authority, Civil Defence, etc.). They should hold meetings with the subordinate personnel and, as a result of those meetings, correct their weak points in each area. Subsequently, a report should be prepared showing all possible solutions.

d) Modification and/or update of the Emergency Plan
Once the analysis described in paragraph c) has been completed, a meeting shall be convened between the Head of the Committee, the Heads of the Areas, and the Heads of the Supporting Groups, to analyse the reports of each of them, and based on that, the corresponding modifications and/or updates shall be made to the Emergency Plan.

e) Reporting modifications and/or updates to the personnel involved
Based on the agreements reached at the meeting mentioned in paragraph d), the Emergency Plan shall be modified and/or updated, and this reported to the personnel involved through the respective Heads of Area and/or Supporting Groups.

7. OPERATIONAL AND TRAINING REQUIREMENTS

a) Implementation of an Operational Communication System:
The key to ensuring the good operation of the Emergency Plan is to have an agile, updated, and operating communication system in order to minimise the response time of the personnel responsible for the various tasks. To that end, it is absolutely necessary to know the full names, addresses and phone numbers, and above all, to periodically review and keep up to date the lists in which they appear. In this regard, the attached Annex Delta contains a sample call plan for an emergency committee.

b) Training and coordination of the various aeronautical users:
Each airport should provide training and update the procedures for coordination among air traffic services, airport operators, airlines and any other aeronautical sector it deems necessary, in order to coordinate tasks, explain procedures, and answer questions concerning the interpretation of the Emergency Plan.

1. The aforementioned should be considered as a guide of Basic Services to deal with an emergency caused by volcanic ash, but, depending on the needs and local availability, some of them may be added or deleted, always keeping in mind ICAO recommendations, especially that described in Document 9691, which says that ***"each State shall develop procedures to meet its requirements and shall meet its obligations with ICAO, providing the necessary support to air traffic in order to ensure the safety of aircraft"***.

2. The following Annexes are attached as guiding documents and are part of the Guide:

1°) Annex "ALFA": Procedures to be carried out by air traffic authorities.

2°) Annex "BRAVO": Procedures to be carried out by airport operators.

3°) Annex "CHARLIE": Procedures recommended for mitigating the impact of volcanic ash on airports.

4°) Annex "DELTA": Model Call Plan for the Airport Volcanic Ash Emergency Committee.

5°) Annex "ECO": Extract from the Handbook on the International Airways Volcano Watch

ANNEX ALFA

PROCEDURES TO BE CARRIED OUT BY AIR TRAFFIC AUTHORITIES

Extracted from Chapter 5.2 AIR TRAFFIC MANAGEMENT of Doc. 9691: Manual on volcanic ash, radioactive material and toxic chemical clouds

Volcanic eruptions and the resulting ash clouds can cause significant disturbances in air traffic operations and, in some cases, may lead to life-threatening situations for people on board en-route aircraft. The purpose of this section is to describe the impact of a volcanic ash episode on air traffic services and, especially, area control centres (ACCs). This section is divided into four titles: detection and reporting of an event; coordination and alerting process; ACC air traffic procedures, and reporting by radio and on the ground.

COORDINATION AND ALERTING PROCESS

The first report of the occurrence of a volcanic eruption and the resulting ash clouds may come from one or many sources. Unless the volcano is located in a very remote place, there will probably be more than one report of the eruption. The proliferation of reports can quickly overwhelm the communication system, since the public will resort en masse to local communication networks to report and obtain information about the extent and danger of the eruption. Aeronautical organisations are not the only ones interested finding out about the extent of the danger for their users. Governments in general will respond promptly to protect the life and property of the public, aeronautical interests being only one of their special concerns.

In order for the ACC to make informed decisions on the effect that the eruption and volcanic ash might have on the airspace under its jurisdiction, and for the WMO to prepare a volcanic ash SIGMET, including the “outlook”, it is necessary to have access to expert advice. To that end, ICAO has designated nine volcanic ash advisory centres (VAACs). VAACs provide guidance on the trajectory of ash clouds and on the flight levels that might be affected by the cloud. The WMO is responsible for using this information, as well as data from other sources, in the issuance of volcanic ash SIGMETs. The same information provided to the WMO by the VAAC is normally forwarded to the ACC for transmittal to airborne aircraft and for initiating an ASHTAM/NOTAM. In addition to information on volcanic activity, the ASHTAM/NOTAM includes information on the air routes affected by volcanic ash and guidance on alternate routing. Volcanic ash SIGMETs are issued by the WMO according to the standards and recommended practices of Annex 3, and are normally issued after the meteorologists have verified the reported information. ACC supervisors use the SIGMETs for airspace management within their area of responsibility, including the closing of the airspace, rerouting or changes to aircraft routes. SIGMET information is also broadcast by the ATS to pilots, so that they can avoid ash clouds. All decisions on aircraft route changes are coordinated among the ATS, the pilots, and flight dispatchers.

ACC air traffic procedures

If a report is received or a volcanic ash cloud is forecast in the flight information region under the responsibility of the ACC, from any of the aforementioned sources, the following procedures are followed:

a) immediately relay all available information to pilots whose aircraft may be affected, to make sure they are aware of the position of ash clouds and the affected flight levels;

b) propose a new route to avoid the area where it is known or forecast that there will be ash clouds;

c) remind pilots that volcanic ash clouds are not detected by aircraft or air traffic radar systems. The pilot should assume that radar would not provide any advance warning of the location of ash clouds;

d) if an aircraft informs the ACC that it has entered a volcanic ash cloud and reports a hazardous situation;

   1) consider that the aircraft is in an emergency situation;
   2) the aircraft should not be cleared to climb with turbine engine until the aircraft has left the ash cloud; and
   3) no attempt should be made to provide evasive radar vectoring without pilot approval.

Experience has shown that the evasive manoeuvre recommended for an aircraft that has entered an ash cloud consists of reversing the heading and start descending if the terrain permits it. However, the ultimate responsibility for this decision lies with the pilot.

The air traffic authority should develop an Emergency Plan containing the sequential steps that need to be taken in order to respond in a coordinated and controlled manner to an event of this type. It should clearly state the responsibilities of the area administrator, the area supervisor, the person in charge of traffic management and the controllers. It should also list the officials to be contacted, the type of messages to be sent and how to act.

Controllers must be trained and be aware that aircraft encountering ash clouds may suffer a complete loss of power in their turbines and that it is necessary to be extremely cautious so as not to enter ash clouds. Since it is very difficult to determine particle-size distribution in ash clouds, or their subsequent impact on aircraft engines and integrity, controllers must be aware of the serious consequences of an the encounter between an airborne aircraft and an ash cloud. The following items describe the damage that might be caused by the intake of volcanic ash in an engine and the impact of ash on aerodrome operations:

a) ash clouds may extend hundreds of miles horizontally and reach the stratosphere vertically, reason why pilots should not try to cross or fly over the cloud;
b) volcanic ash can block the pitot-static system of an aircraft, in which case airspeed readings would not be reliable; and
c) friction conditions in runways where volcanic ash has recently settled will have an impact on aircraft braking action. The effect is greater on wet runways. One must be aware of the consequences of the ingestion of volcanic ash in the engines during landing and taxiing. At departure airports, it is recommended that pilots avoid conducting operations when volcanic ash is visible in the air. Instead, they should wait until the particles have settled before starting the take-off run, to prevent the engines from ingesting ash particles.

Reporting by radio and on ground

The ACC is a critical communication link between the pilot, the flight dispatcher, and the meteorologists during a volcanic eruption. During volcanic ash episodes in their flight information region (FIR), ACCs have two main communication functions. First and foremost, they must be able to communicate directly with airborne aircraft that might encounter ash clouds. Based on the information provided in the volcanic ash SIGMET and in the volcanic ash advisory message, and in cooperation with WMO meteorologists, air traffic controllers should provide the pilot, if possible, with the flight levels being affected by ash clouds as well as their foreseen trajectory and drift. Using air communications, the ACCs can coordinate alternate routes that will allow pilots to get away from volcanic ash clouds.

Likewise, through the issuance of a NOTAM on volcanic activity or an ASHTAM, the ACC can disseminate information on the status and activity of the volcano, even in the case of increased volcanic activity prior to an eruption. NOTAMs, ASHTAMs, SIGMETs, and special air reports (AIREPs) are very necessary for flight dispatchers in terms of flight planning. Airlines need to be informed as early as possible about the conditions of a volcano for strategic flight planning and for traveller safety.

Flight dispatchers must be in communication with airborne pilots so that the pilot, the flight dispatcher, and air traffic control can coordinate decisions regarding available alternate air routes. However, it should not be assumed in advance that an aircraft that is expected to encounter a volcanic ash cloud would have the optimum air route available to avoid the cloud. Other aspects will need to be taken in account, such as current traffic levels or other air routes, and the amount of fuel reserve available for flights that might drift to other routes, so that affected aircraft may deviate to such air route.

> NOTAMs on volcanic activity and ASHTAMs provide information on the activity of a volcano when a change or expected change in such activity is of significance for operations. These messages are issued by the ACC based on information received from any of the observation sources and/or any advisory information provided by the associated VAAC. In addition to providing information on the activity status of a volcano, the NOTAM or ASHTAM also contains information on the location, extent, and movement of ash clouds, and on air routes and flight levels affected.
>
> ICAO Annex 15, Aeronautical Information Services, contains complete guidance on the issuance of NOTAMs and ASHTAMs, as well as a colour-coded graph of volcano activity levels. The alert in the colour-coded graph can be used to provide information on the condition of the volcano, using “red” for a serious condition, that is, volcanic eruption in process with an ash column or cloud reported above FL 250, and, on the other end of the scale, “green” when the volcanic activity has ceased and the volcano has returned to its normal condition. It is very important that NOTAMs on volcanic ash and ASHTAMs be cancelled as soon as the volcano returns to its normal pre-eruption condition, the volcanologists do not expect new eruptions, no ash cloud is detectable, and no reports are received in that respect from the FIR involved.

It is essential that the procedures to be followed by ACC personnel during a volcanic eruption or an ash cloud event, as described in the previous paragraphs, be translated into instructions to local personnel (with the necessary adjustments to local circumstances). It is also essential for these procedures and instructions to be part of the basic training to be provided to all air traffic service personnel whose functions require them to take action according to the procedure.

ANNEX BRAVO

PROCEDURES TO BE CARRIED OUT BY AIRPORT OPERATORS

> ** ***Extracted from Chapter 5 Part 5.1 Aerodromes of Doc. 9691: Manual on volcanic ash, radioactive material and toxic chemical clouds.***

Volcanic ash could also have serious effects on aerodromes located downwind of a volcanic ash column. Ashes settle on the aerodrome and its surroundings, contaminating electronic, electrical, and mechanical equipment on the ground, and, if no precautions are taken, will affect parked or taxiing aircraft in the aerodrome. Problems caused by volcanic ash on runways include reduced friction coefficient for landing aircraft, especially when ashes are wet, and serious degradation of local visibility, since the ash on the ground is disturbed by exhaust gases from aircraft engines during taxiing, landing and take-off. In fact, not much ash needs to settle on the aerodrome (actually, as little as 1 mm) before the aerodrome has to close down for aircraft operations.

The effect of volcanic ash on electronic, electrical and mechanical equipment is very similar to the aforementioned effects on aircraft equipment. Volcanic ash can easily penetrate all areas, except those better sealed, and this applies to both small electronic components and to hangar and maintenance areas. Cooling, lubrication and filter systems often get so contaminated that it is impossible to fully clean the equipment and it needs to be replaced. Mechanical moving parts, especially bearings, brakes, and transmissions, are subject to faster abrasion because filters and lubrication systems get plugged or contaminated. There may be special issues with high-tension circuits and components, especially if ash is rain-soaked and becomes highly conductive. This causes short-circuits, arc contact, and flame bursts that can ignite the components of the power distribution system. If rain falls on the ashes, they can easily absorb large amounts of water. Wet ash has the consistency of wet cement, and when it falls on top of hangars, it can even make them collapse, as occurred at the US Air Force Clark base in the Philippines during the eruption of Mount Pinatubo in 1991. If wet ash deposits on parked aircraft (especially aircraft with back-mounted engine), the centre of gravity can be displaced significantly and the aircraft may overturn if not secured to a tail pole.

Depending on the amount of ash falling on the aerodrome, surface winds (which keep ashes in suspension) and local rain (which help deposit the ashes), medical problems in various degrees may ensue. Under very dry and very windy conditions, as was the case in the aerodromes (and major cities) in Argentina following the eruption of the volcano in Mount Hudson in the eastern part of Chile in 1991, many medical problems can arise. In this case, they were mainly bronchopulmonary and ophthalmic problems and skin abrasions. Under more humid conditions and, especially, if it rains and there are light winds in general, reports on medical problems tend to be less frequent and serious.

For airports with a likely threat of volcanic ash, the following aspects must be considered:

a) ongoing provisions prior to an eruption;
b) provisions during the volcanic eruption, from the initial fall of ashes on the airport to its closure; and
c) clean-up following the eruption and re-opening of the airport.

An exchange of opinions on the aforementioned aspects, and a discussion of the various examples of actual reactions by airport authorities during volcanic eruptions took place at a seminar on the "impact of volcanic ash on airports" held in Seattle in 1993.

Ongoing provisions prior to an eruption

Provisions concerning the fall of volcanic ash on the aerodrome could be contained in the part of the airport emergency plan dealing with natural disasters, or could be developed as an independent document. In either case, the plan must include a complete set of procedures that define the roles and responsibilities of all civil aviation personnel and of other airport organisations and, if applicable, from outside the airport, in case the volcanic eruption threatens to accumulate volcanic ash on the airport. The measures to be taken in such a case to ensure that the airport can apply prompt and efficient emergency procedures include:

a) storing in advance the minimum materials required to cover and seal open spaces in aircraft and engines, ground equipment, some strategic buildings, electronic computer equipment, etc. (*e.g.*, insulating tape, plastic bags);
b) arranging in advance to have a source of cleaning material (in addition to normal stock), heavy equipment and large volumes of water to collect, clean up and remove volcanic ash;
c) arranging in advance for an approved convenient area to pile and cover or, at least, stabilise volcanic ash outside the airport; and
d) arranging in advance to have an auxiliary electric power generating source.

During the volcanic eruption

From the initial fall of ash in the airport to its closure

When a report is received of an eruption that might deposit volcanic ash at the airport, protection measures should immediately be taken, such as storing non-essential equipment, sealing and covering open parts of aircraft and aircraft engines, ground equipment, strategic buildings, electronic or computer equipment, etc. Airport authorities must determine the feasibility or the need to continue aircraft operations at the airport. Various considerations, sometimes conflicting, should be weighted for making that decision. It could be that many aircraft will be dispatched before ash seriously affects airport operations. This would reduce the number of aircraft and passengers left on the ground exposed to the fall of ashes. However, this continuous operation of aircraft might eventually damage aircraft engines or reduce local visibility due to the constant movement of ash on the runways; thus, subsequent operations would need to wait longer until ashes fully settle. Maintaining the auxiliary ground equipment in operation under volcanic ash conditions is extremely difficult, since it involves turbines, compressors and air conditioning devices that normally use minimum or reduced filtering. The auxiliary ground equipment frequently fails before ashes make it impossible to continue aircraft operations, thus preventing aircraft take-off anyway. In order to maximise the time during which aircraft can continue operating at the airport--if necessary, on a restricted basis--, the following procedures have been recommended for aircraft ground operations:

a) limit reverse thrust during take-off. Use of a maximum reverse thrust may affect visibility and cause ash ingestion in the engines;
b) the presence of a light layer of ashes that darkens runway markings could have a negative impact on braking. The effects of a heavy layer of ash are unknown. Caution must be applied when ashes are wet, since surfaces will be very slippery and braking action will be less effective;
c) brakes will wear faster; however, properly sealed bearings should not be affected;
d) static operation of the engines should be avoided above idle power;
e) taxiing should not be done with a single engine; use all engines for taxiing; however, check the operational manual for specific aircraft/engine combinations;
f) thrust during taxiing should be limited to that necessary to keep low taxiing speed;
g) avoid operations when ashes are visible in the air; wait until ashes have settled before starting take-off run;
h) use a take-off procedure with taxiing;
i) restrict use of auxiliary power unit on the ground to engine start-up; and
j) avoid using air conditioning on the ground if circulation fans can maintain a comfortable temperature. If air conditioning is required on the ground, operate it a maximum cold setting if ashes are visible, and place vehicles equipped with dust filters in the terminal building in advance if available. Use air bleed for take-off if this configuration is permitted

in operational procedures. For operating an air conditioning set, consult the operations manual.

While the restriction on aircraft operations continues, the open parts of parked aircraft, ground equipment that is not in use, strategic buildings, electronic and computer equipment, etc. should be sealed. As the number of aircraft operations drops, more and more ground equipment units can be taken out of service, cleaned, lubricated, filters can be replaced, and the equipment can be covered and stored. It might be necessary to completely close the airport. The worst-case scenario would be a long series of volcanic eruptions that might keep the airport closed for weeks.

Clean-up after an eruption

The complexity and extent of this task should not be underestimated. Depending on the amount of ash that falls, the volume of ashes to be removed from the airport can be enormous. Ashes need to be removed from the airport because they will not just be carried away by the wind or just disappear, but rather will remain in suspension and contaminate everything again. The situation may become stable to a certain extent, depending on the amount of ashes and local weather conditions, the soil on which ashes have been placed could be ploughed along parallel grass strips, but, in general, there is no other choice but to completely remove ashes from the airport.

ANNEX CHARLIE

RECOMMENDED PROCEDURES TO MITIGATE THE IMPACT OF VOLCANIC ASH ON AIRPORTS

Extracted from
"Mitigating the impact of volcanic ash on airborne aircraft and support systems"
by J.R. Labadie
First International Symposium on volcanic ash and safety

1. INTRODUCTION

1.1 The techniques used to reduce the impact of volcanic ash can be grouped in three broad categories: 1) keep ashes away, 2) keep ashes that do enter under control, and 3) dispose of ashes. These categories are rather an illustration that some of the mitigation techniques will be applicable in the three cases. Continuous mitigation measures will be required as long as ashes are present. Deposited ashes will easily return to the atmosphere, and a 2-mm layer can be as bothersome as a 50-mm layer.

1.2 The most effective technique to reduce damages caused by ashes to the equipment is to avoid using such equipment: turn it off, close it, take it indoors, or seal the area until ashes can be removed. This tactic is acceptable only for short periods of time, since operations must be resumed at some point in time. In any case, removal techniques will not completely eliminate all the ashes. Ash residues will remain on the ground and will be blown into the air by vehicles passing by and aircraft taking off. Therefore, an accelerated and intensive programme of inspection, maintenance, clean up, and monitoring will be necessary during and after the ash deposition period.

1.3 Cleaning the environmental air and keeping it clean is key to reducing problems during operations and maintenance. It is useless to blow off the ashes from a circuit board since ashes are fine enough to remain suspended for several minutes. The difficulty of trying to do maintenance work in an environment already contaminated with ash is obvious. Clean-room procedures can be used to isolate an area and keep it free of ashes, but only under ideal circumstances. Some pieces of equipment, like aircraft engines, are so big that they cannot be treated in that manner. Tents or canvas can be used to reduce gross contamination. However, fine particles of volcanic ash may enter through very small holes and seams; and this is what makes volcanic ash so harmful for critical equipment.

1.4 Some mitigation procedures can cause other problems or can be counterproductive, depending on the circumstances. For instance, adding a filter to a computer system will reduce the amount of contamination caused by ashes but will also reduce airflow. The resulting increase in temperature can modify the operating characteristics of delicate components or even cause some damage. Adding a bigger fan would increase airflow, but not all computers, especially the small ones, can be easily modified. Another example is the use of humidity to control ashes. Wet rugs will increase relative humidity and will help keep ashes on the ground, but wet or even humid ashes are conductive.

1.5 No method by itself will be absolutely effective. A combination of procedures has proven to be the best method to control volcanic ash. Constant monitoring and a reassessment of the effects of ashes and the mitigation process will be required to achieve the most effective balance between operational requirements and the desired level of damage reduction. The following sections summarise ash mitigation techniques for given aircraft and support systems.

2. AIRCRAFT SYSTEMS

2.1 The basic mitigation tactic used for protecting aircraft systems is to avoid exposure to ashes. The airports and airfields watched following the eruption of Mount Saint Helen were simply shut down during the occurrence until ashes had been removed. Airline traffic routes were modified, keeping them far from airports that had been affected by the ashes.

2.2 Sealing aircraft seams, vents and other holes with insulating tape will keep most of the ashes away, especially if the aircraft is under cover. Keeping positive pressure within aircraft components will help to keep them free of ashes, but it is difficult, sometimes impossible, to pressurise a grounded aircraft without causing damage to ground equipment. Techniques include the following:

a) blowing or sucking ashes with a vacuum cleaner before washing, because, otherwise, ashes would tend to move towards the ports, vents or command surfaces;
b) washing down residues without scrubbing or sweeping;
c) washing the landing gear under the aircraft, air conditioning intakes, and engines;
d) checking the pH (acidity) of aircraft and engine surfaces; and
e) neutralising acidic residues by adding petroleum-based solvent to the wash water.

2.3 All of the aforementioned techniques require time, personnel and equipment. They all have a significant impact on the level and scope of operations and their continuity. These techniques have been tested at significantly reduced operational levels, but there are doubts about its efficacy in normal (or quasi-normal) operations. For example:

a) sealing an aircraft would require 4 to 5 hours, and withdrawing all the seals and insulating tapes would take 1 to 2 hours. It is very difficult to fully seal an aircraft given the many ports, vents, seams and joints;
b) the accumulation of ash on sealed hatches and doors and around them would cause pressurisation problems; and
c) vents in fuel tanks must be open during loading, unloading and transfer of fuel. If vents get plugged with ashes or if they get sealed, the tanks might collapse. A vacuum of 4-5 psi is enough to make them collapse.

3. RUNWAYS

3.1 If aircraft operations are not suspended, runways must be constantly cleaned up, since ashes get suspended again by the wind when aircraft take-off and with the movement of vehicles on the surface. No agreement has been reached regarding the proper use of water for cleaning up runways. Some people believe that water turns ashes into mud (or hardens it), while others believe that it is impossible to control ashes without first wetting them. Runways with open levelling get cleaned up on their own to a certain extent, since engine jets during take-off drive ashes out of crevices. The basic techniques include:

a) wetting ashes with a spraying truck;
b) picking up ashes with conveyor belts or front loaders;
c) accumulating ashes in dumping areas;
d) sweeping and washing down residues;
e) sweeping, vacuuming and then washing down ashes (the best for aprons, etc.);
f) pushing ashes to the edge of the runway, and ploughing and covering them with an agglomerant like Coherex or liquid lignin;
g) putting dispersants on runway edges to prevent ashes from going back into suspension due to the aircraft engine jet or wing end vortex; and
h) maintaining residues wet in taxiways and ramps.

Note.— It should be noted that wet ash is slippery when pilots carry out aircraft manoeuvres on the ground and during landing and take-off.

4. LANDING AIDS AND AIR TRAFFIC CONTROL

4.1 Protection of landing aids and air traffic control systems require periodical clean up, maintenance and monitoring. Likewise, deactivating unnecessary equipment will reduce its exposure to ashes. Exposed lighting and signalling systems, radar antennas, and any equipment that needs air-cooling are particularly vulnerable to contamination by ash and damage. Commercial power supply failures will require standby generators, which are also vulnerable to damage by ashes. Protection techniques include the following:

a) replacement of Teflon-insulated antennas.- since ashes are difficult to remove and will cause short-circuits, ceramics insultation should be used;
b) sealing of relay boxes and removal of signalling and lighting equipment to prevent the entry of ashes;
c) increasing the cleaning and maintenance of systems that cannot be sealed or require air-cooling;
d) vacuuming or blowing ashes to remove them or cleaning contact relays;
e) using high-pressure water on exposed antenna rotor bearings and lubricating them again;
f) covering exposed joints, seams and bearings;
g) sealing buildings, controlling points of access, vacuuming shoes and clothing; and
h) reducing operational levels; turning off unused equipment, minimising broadband displays, and reducing the consumption of air conditioning and electric power.

5. AUXILIARY GROUND EQUIPMENT

5.1 Everybody agrees that auxiliary ground equipment is critical for flight operations. If the auxiliary ground equipment fails because of the ashes, aircraft cannot operate. Unfortunately, there are more problems than solutions in the area of ash contamination of ground equipment.

5.2 Gas engines, air compressors, and air conditioning equipment operate by taking in large volumes of air. This equipment only has coarse filters or has none (and filters cannot be added without affecting its operation). The use of air conditioning equipment to maintain the pressure in aircraft compartments will only help blow ashes into the aircraft, thereby ruining air conditioning equipment. The techniques used include the following:

a) constant cleaning and maintenance;
b) the equipment must not be washed, since water turns ashes into mud and will flow to the interior of the equipment;
c) exhausters;
d) frequent changes of oil and filters; and
e) changing the design to include better filtering.

6. COMPUTER SYSTEMS

6.1 The most widely recommended tactic to prevent damages is to disconnect all computer and electronic systems until ashes have been completely removed from the area and the equipment. Computer headers and disks, as well as high-tension circuits are particularly vulnerable to ash disturbance and damage. Ashes in the digital circuits will not represent a serious problem due to the low voltage involved. High-tension or high-impedance circuits are very vulnerable to leaks caused by semi-conductive ashes. Acidic ashes are conductive and corrosive. Continuous cleaning and aggressive protection of computer systems should permit continued operation under any condition, except when ashes fall intensely. The techniques used include the following:

a) clean and condition the surrounding air to maintain ashes away from the equipment;
b) passing a piece of cotton over the filters used in clean rooms was considered to be the best method to filter particles, but it reduces airflow. One solution is to use bigger fans to maintain the required airflow. Rack-mounted equipment can be modified to add a bigger fan, but smaller instruments or components with a built-in fan would require a change in design to increase ventilation capacity;
c) use of strapped filters would increase the surface but reduce airflow by approximately 20 percent;
d) moistening the circulating air (*e.g.,* wet rugs) will help control the repeated entry of ashes;
e) ash deposited on the equipment can be blown with compressed air. If the air is too dry, static discharges might damage delicate components (*e.g.,* integrated circuits); if the air is too humid, ashes will coalesce. The best for pressurised air is a relative humidity of 25 to 30 percent;
f) cleaning with a combination of pressurised water and detergent, and using a hot-water rinse is very effective, but the process requires at least partial dismantling of the equipment;
g) ashes can have a high static charge and be difficult to dislodge and thus require brushes to dislodge particles;
h) changing filters more frequently; using pre-filters;
i) changing to absolute filters that block particles of 1 mm and even smaller;
j) keeping computers turned on, so that they can act as filters, but keeping disk drives turned off;
k) maintaining a configuration of a room within another room, restricting access, making the air circulate again, and accelerating clean-up of the critical area.

7. RADAR AND OPTICAL SYSTEMS

7.1 Most radar equipment must be turned off during severe contamination with ashes in areas where ashes fall more intensely. Therefore, there will not be many problems, probably with the exception of the clean up and control of residual ashes. The simpler mitigation techniques consist of ceasing operations. Clean-up techniques include the following:

a) repairing and cleaning high-tension circuits;
b) washing antenna rotor bearings, lubricating again and covering exposed bearings;
c) optical components that have accumulated ash must be blown or washed with large amounts of water. They must not be swept, brushed or scrubbed, since this would cause abrasion in optical systems;
d) making sure that, when washing down ashes, they do not get into optical instrument fittings in the aircraft (*e.g.,* sextants);
e) disconnecting non-essential radar equipment to reduce air conditioning load and power requirements;
f) transferring radar coverage to other facilities; combining sectors;
g) removing and replacing chamber bearings and cleaning gear drives; and
h) protecting video tapes from ashes, since this will cause “detachment” and scratches.

8. ASH MITIGATION PLANS

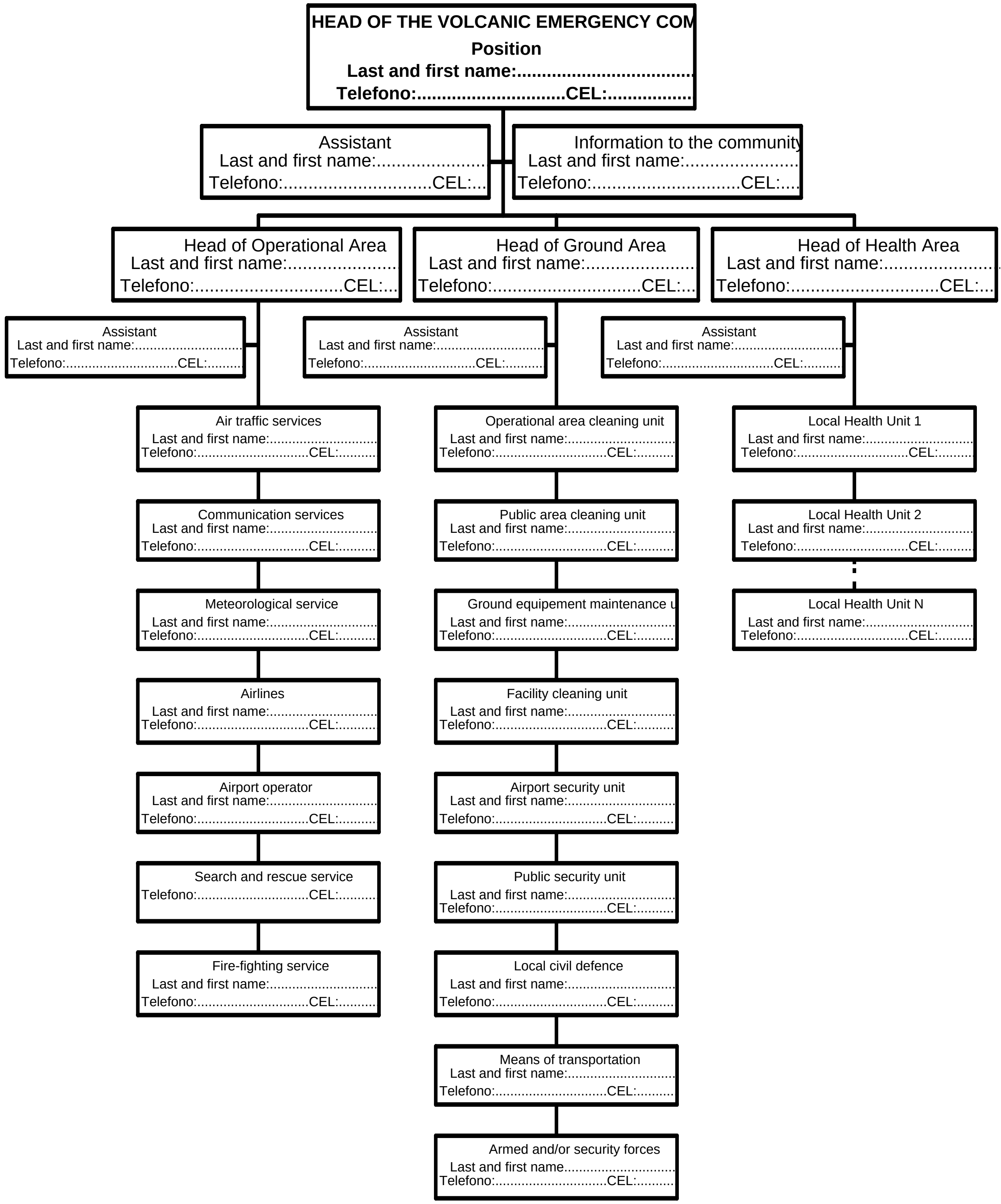
8.1 The methods for reducing the impact of volcanic ash are “technically simple” and rely more on procedures than on technical solutions. They also make intensive use of labour and resources. A normal reserve of routine items, such as filters, lubricants, spare parts, cleaning supplies, etc., may be consumed faster than replaced if the normal ordering process is used. Prior planning is required to reduce the impact of ashes. Some of the measures included in the plan are:

a) analyse the vulnerability of equipment and facilities to determine which would be more affected by the ashes, which would be adequately protected, and which would need modification in the long run or earlier than that;
b) prepare a priority list of facilities that need maintenance while in operation, as compared to those that may be shut down or disconnected while ashes continue to fall;
c) make sure that, in case of danger, alerting and information channels with volcanological/geological organisations, meteorological services, local media and state and local governments are kept open;
d) establish plans and procedures for alerting and reporting, reducing operations, expediting maintenance, protecting critical facilities, and removing ashes;
e) alert air traffic controllers and airport operations personnel to promptly advise aircraft when "surveillance" and "advisory" reports are received. Normal air traffic and meteorological radars cannot detect volcanic ash. Therefore, extensive "prohibited areas" should be established at night or under adverse meteorological conditions, once the advisories are issued. The personnel should be alerted about ashes falling from the clouds, lightning, lightning bolts, etc.;
f) store spare parts for critical equipment, filters, seals, clean-up and removal equipment;
g) plan prolonged clean-up and maintenance activities, including 24-hour operations, increase labour and train cleaning crews; and
h) make sure that sufficient water and backup power are available to support clean-up operations in case of failure of regular power sources.

Ash clean-up operations can take weeks or months in the event of multiple eruptions. Effective mitigation of the effects of volcanic ash depends on pre-planning, the readiness and mobilisation of resources, and persistence.

ANNEX DELTA

CALL PLAN FOR THE AIRPORT VOLCANIC EMERGENCY COMMITTEE.........



Date of update	
Updated by:	
Signature:	

ANNEX ECO

Extracted from Doc. 9766 AN 968 HANDBOOK ON THE INTERNATIONAL AIRWAYS VOLCANO WATCH

OPERATIONAL PROCEDURES FOR THE DISSEMINATION OF INFORMATION ON VOLCANIC ERUPTIONS AND THE RESULTING VOLCANIC ASH CLOUDS IN AREAS WHERE THEY MIGHT AFFECT THE ROUTES USED BY INTERNATIONAL FLIGHTS, AND MEASURES TO BE TAKEN PRIOR TO ERUPTIONS

1. MEASURES TO BE TAKEN PRIOR TO ERUPTIONS

1.1 In order to effectively apply the aforementioned measures, those States whose flight information regions (FIR) contain active or potentially active volcanoes close to the routes used by international flights should take provisions to ensure that:

a) any information on increasing volcanic activity, volcanic eruption or volcanic ash cloud in areas which might affect the routes used by international flights, received from one or more sources of observation, such as volcanological, seismic, geological, meteorological facilities, or police/military networks and national aviation, is **immediately** forwarded to the corresponding area control centre/flight information centre(ACC/FIC);
b) the appropriate channels of communication are established between such sources of observation (especially volcano observation stations) and the closest ACC/FIC and meteorological watch office (MWO), to ensure that, in case of an eruption, information will reach the ACC/FIC/MWO as fast as possible;
c) through the corresponding national meteorological authorities, relevant access is provided to information from available geostationary meteorological and polar orbit satellites or other sources, such as volcanic ash advisory centres (VAAC), in order to obtain, to the extent possible, data on the extent and trajectory of volcanic ash clouds [see 4.1 a)];
d) the ACCs/FICs and MWOs, as well as the provider States corresponding to the VAACs, have access to volcanological advice, including telephone numbers that will respond 24 hours a day to get in touch with a volcanologist in case of an emergency;

   Note.— The appropriate forum to study the means necessary to implement the aforementioned measures is the national committee for natural catastrophes or some other similar consultative body.

e) the personnel at the international NOTAM office of the State is familiar with the issuance of ASHTAMs (or NOTAMs on volcanic ash);
f) the corresponding information for which the States are responsible in the aeronautical information publication (AIP), pursuant to Annex 15, Appendix 1, Section ENR 5.3.1, is included, preferably supplemented by maps of volcanoes located in the FIRs; and
g) ATM contingency arrangements concerning volcanic ash are made and published when applicable, for air routes crossing FIRs under the responsibility of the State, in coordination with adjacent FIRs.

1.2 Contracting States should establish a requirement for pilots to carry out and transmit a special aircraft observation, as established in Annex 3, 5.5.1 g) and h), in case of encountering or observing volcanic activity prior to an eruption, a volcanic eruption, or a volcanic ash cloud that might affect the safety of other aeronautical operations, and record it in the special air report form, according to Annex 3. Furthermore, the International Air Transport Association (IATA), the International Federation of Air Line Pilots' Associations (IFALPA) and the International Council of

Aircraft Owner and Pilot Associations (IAOPA) should draw this requirement to the attention of pilots.

Note.— Volcanic activity prior to an eruption within this context means that such activity is unusual or has increased, which could forebode a volcanic eruption.

1.3 It is essential that the aforementioned arrangements be harmonised in each of the States concerned and to maintain their efficacy. In the case of volcanic ash, the biggest hazard for transport reactors occurs during the initial hours following the eruption, reason why the reporting speed among all the links in the communication chain is crucial. It would be advisable for States to study the possibility of drafting letters of agreement between the interested parties, especially civil aviation and meteorological authorities and the volcanological organisation, clearly stating the responsibilities of each party.

2. MEASURES TO BE ADOPTED BY THE ACC IN THE EVENT OF VOLCANIC ERUPTION

In case of major volcanic activity prior to an eruption or of volcanic eruption, or if the presence of a volcanic ash cloud is reported in an area where it might affect the routes used by international flights, the ACC/FIC responsible for the corresponding FIR, upon receiving information about the event, should adopt the following measures:

a) **Immediately** communicate this information to airborne aircraft that might be affected by the volcanic ash clouds, and advise the relevant ACCs in adjacent FIRs. Issue a NOTAM or an ASHTAM[1] through the international NOTAM Office (NOF) of the State, in keeping with Annex 15, Chapter 5, giving details of the volcanic activity prior to an eruption, the volcanic eruption, and the volcanic ash clouds, including the name and geographical coordinates of the volcano, date and time of the eruption, flight levels and routes or route segments that might be affected and, as needed, the routes temporarily closed to air traffic. In the address list for the NOTAMs on volcanic activity or ASHTAMs, include the associated MWO (see Part 2 of this document), all the VAACs, the London World Area Forecast Centre (WAFC) at EGRRYMYX, the Washington WAFC at KWBCYMYX, which are responsible for issuing significant time forecasts (SIGWX) for the area concerned.

Note 1.— When issuing a NOTAM or ASHTAM on volcanic activity prior to an eruption, or on volcanic eruptions that do not produce ash plumes, it is recommended that the following be included in the text of the NOTAM or ASHTAM, if applicable:

“INCREASING VOLCANIC ACTIVITY REPORTED IN VOLCANO (NAME AND LOCATION IN LAT/LONG) AIRCRAFT ARE ADVISED TO BE CAUTIOUS UNTIL FURTHER NOTICE AND TO BE IN LISTENING WATCH FOR NOTAMs/SIGMETs FOR THE AREA”.

o

“VOLCANO (NAME AND LOCATION IN LAT/LONG) ERUPTING (DATE/UTC TIME) BUT NO ASH PLUMES REPORTED, AIRCRAFT ARE ADVISED TO AVOID FLYING LESS THAN... KMS FROM THE VOLCANO UNTIL FURTHER NOTICE, BE IN LISTENING WATCH FOR NOTAMs/SIGMETs FOR THE AREA”.

By using this type of precise language in a NOTAM or ASHTAM, there is no need to block vast segments of airspace to aircraft flights unnecessarily, until the presence of volcanic ash plumes/clouds is reported or is observed based on satellite data.

Note 2.— In order to ensure prompt delivery of initial information to aircraft, the first NOTAM or ASHTAM issued could simply indicate that an eruption or volcanic ash cloud has been reported, together with the date, time, and location. It is not necessary to wait to receive additional detailed information; that can be included in subsequent NOTAMs or ASHTAMs as it becomes available.

Note 3.— A colour code has been developed to reflect the level of volcanic activity alert for aviation, which could be used by some volcanological organisations to convey volcanic activity information to aviation. In those States where the volcanological organisation has already introduced colour coding, it would be advisable to include the colour code in the NOTAMs or ASHTAMs on volcanic activity. The colour code for the level of volcanic activity alert for aviation is as follows:

Alert level colour code	**Volcanic activity**
Red alert	**Volcanic eruption in progress. Ash plume/cloud above FL 250 reported.** ***OR*** **Dangerous volcano, likely eruption, the ash plume/cloud is expected to rise above FL 250.**
Orange alert	**Volcanic eruption in progress, but the ash plume/cloud does not reach or is not expected to reach FL 250.** ***OR*** **Dangerous volcano, likely eruption, but the ash plume/cloud is not expected to reach FL 250.**
Yellow alert*	**Volcano known to become active from time to time, and there has been a recent significant increase of volcanic activity, currently the volcano is not considered dangerous but caution is recommended.**
	OR **Following an eruption, that is, change from red or orange to yellow alert) — significant reduction of volcanic activity, currently the volcano is not considered dangerous, but caution is recommended.** **The “yellow” code can be used in the event of “regular” or “almost permanent” volcanic eruptions that do not normally reach FL 250, and which do not necessarily mean a “significant increase of volcanic activity”.**
Green alert	**Volcanic activity is considered to have ceased and the volcano is back to its normal state.**

The responsible volcanological organisation in the respective State should provide the area control centre with the colour code corresponding to the alert level, indicating the degree of volcanic activity and any changes with respect to the previous level of activity, that is, "RED ALERT FOLLOWING YELLOW" OR "GREEN ALERT FOLLOWING ORANGE".

b) Adopt emergency provisions, including the use of alternate routes to avoid the area that would likely be affected by the volcanic ash cloud, in coordination with the ACCs and FICs responsible for the adjacent FIRs.

c) Report the volcanic eruption or the existence of a volcanic ash cloud to the associated MWOs and the VAACs (including the delivery of all special air reports in keeping with Annex 11, 4.2.3), and keep in constant coordination with the MWOs so as to have consistency in the issuance and content of NOTAMs or ASHTAMs and SIGMETs.

d) Cancel the NOTAM or ASHTAM as soon as it is considered that the volcano has returned to its normal state, and the airspace is not contaminated with volcanic ash.

3. MEASURES TO BE TAKEN BY THE NOF IN CASE OF VOLCANIC ERUPTION

3.1 In the event of major volcanic activity prior to an eruption or of a volcanic eruption, or if the presence of a volcanic ash cloud is reported in an area in which it might affect the airspace in the FIR of the State where the NOF is designated, then the NOF should issue a ASHTAM (or a NOTAM on volcanic activity) based on the information provided by the ACC responsible for the FIR concerned. The NOTAM or ASHTAM will be cancelled as soon as it is considered that the airspace is not contaminated with volcanic ash.

3.2 In addition to sending the ASHTAM (or NOTAM) to other NOFs for whom the information is of direct importance for their operations, the NOF should prepare a separate message to be sent to the VAAC responsible for the FIRs concerned. This message should be sent through the AFTN to the AFTN switching centres defined in Table 4-1, but the ASHTAM (or NOTAM) must be first encapsulated in a dummy abbreviated WMO heading. This allows the receiving MET or AFTN switching centre to transmit the ASHTAM (or NOTAM) to the corresponding VAAC through internal MET communication circuits.

For example:

A NOTAM issued by the Guayaquil NOF would be sent to the Washington VAAC in the following manner, indicating the four sections of the message:

1	**ZCZC** **GG KWBCYMYX** **151840 SEGUYNYX**	**ENCAPSULATION OF THE CUSTOMARY AFTN HEADING**
2	**NWEQ31 SEGU 151840**	**ABBREVIATED WMO HEADING**
3	**A0623/00/00 NOTAMN** **Q) SEGU/QWWXX/IV/NBO/W/000/250/080 128S 07826W** **A) SEGU** **B) 0002151830** **D) SIGNIFICANT VOLCANIC ACT TUNGURAHUA VA MOV W. AWY RESTRICTIONS AND ALT RTE NOTIFIED BY ATC**	**NOTAM *PER SE***
4	**NNNN**	**END OF CUSTOMARY AFTN ENCAPSULATION**

A similar example, in this case of an ASHTAM issued by the Tegucigalpa NOF, would be sent to the Washington VAAC as follows:

ZCZC
GG KWBC YMYX
170630 MHTGYNYX
NWM031 MHTG 170630

ASHTAM

C. VOLCANO SAN CRISTÓBAL.14004-02
D. 124211N0870024W
E. YELLOW ALERT
F. SFC/11000FT
G. E/SE
H. VOR/DME MGA A317 TUKOR CNL
I. VOR/DME MGA A317 TUKOR RTE AVBL. ALT RTE MGA VOR/DME A502 BERTA GABOS A317. VOR/DME/CAT/ABVL
J. NATIONAL INSTITUTE FOR TERRITORIAL STUDIES. SEISMOLOGY DEPT.
K. CAUTION GENERAL AVIATION WIND 60KM/H E/SE OF THE VOLCANO

NNNN

4. MEASURES TO BE ADOPTED BY THE METEOROLOGICAL WATCH OFFICE (MWO) IN CASE OF VOLCANIC ERUPTION

4.1 Upon receiving information from the ACC/FIC about a volcanic eruption or the presence of a volcanic ash cloud, the MWO shall adopt the following measures:

a) inform the VAAC designated to provide advisory on volcanic ash trajectories in the FIR under the responsibility of the State, about volcanic eruptions or volcanic ash clouds observed, provide the available relevant details, and ask for advice on the extent and trajectory of volcanic ash. Concretely, special air reports on volcanic activity prior to an eruption, volcanic eruptions or the presence of volcanic ash clouds received by the MWO should be transmitted to its associated VAACs, the London WAFC at EGRRYMYX, the Washington WAFC at KWBCYMYX, the Vienna international OPMET data bank at LOZZMMSS, which are responsible for issuing SIGWX forecasts for the corresponding area;

   Note 1.— The areas of responsibility of the VAACs and MWOs to which information on volcanic ash advisories should be sent, are shown in the ICAO regional air navigation plans, and in Part 2 of this document.

   Note 2.— The contact numbers to be used by the MWOs to report volcanic eruptions/volcanic ash clouds to the VAACs appear in Table 4-2.

b) advise the associated ACC/FIC as soon as possible whether the volcanic ash cloud is identifiable in satellite images/data and, if possible, provide periodic information on horizontal and vertical extent and trajectory of the cloud based on the advisory information received from the VAAC; and
c) issue a SIGMET message on volcanic ash with a validity of six hours, attaching a “projection” of the ash cloud trajectory extending 12 hours following the 6-hour initial validity period, based on the advisory information provided by the VAAC involved. Include in the SIGMET address

list all the VAACs [see 4.4.1 a)], the London world area forecast centre (WAFC) at EGZZVANW, the Washington WAFC at KWBCYMYX, the Vienna international OPMET data bank at LOZZMMSS, which are responsible for issuing SIGWX forecasts for the corresponding area. Coordinate constantly with the associated ACCs/FICs to ensure consistency in the issuance and content of the SIGMETs, NOTAMs and ASHTAMsd.

Note 1.— The associated ACC/FIC should automatically appear in the address list for all SIGMETs issued by the MWO.

Note 2.— In order to ensure a prompt transmission of the initial information to the aircraft, the first SIGMET issued may simply contain information stating that an ash cloud has been reported, indicating date, time and location. It is not necessary to wait for additional detailed information, not even information on the SIGMET "projection", before issuing the first SIGMET. That information could be included in subsequent SIGMETs as it becomes available.

4.2 If the MWO becomes aware of activity prior to an eruption, a volcanic eruption, or a volcanic ash cloud from a source other than the associated ACC/FIC, the information must be **immediately** sent to its associated ACC/FIC, after which the procedures described in 4.4.1 will be followed.

4.3 If a meteorological office learns about activity prior to an eruption, a volcanic eruption or a volcanic ash cloud from any source, the information must be **immediately** sent to the associated MWO to be relayed to the ACC/FIC.

5. MEASURES TO BE TAKEN BY THE VOLCANIC ASH ADVISORY CENTRES (VAACs) IN CASE OF VOLCANIC ERUPTION

5.1 Upon receiving information from the ACC or MWO, or any other source*, about a reported volcanic eruption or a volcanic ash cloud observed in the FIR under the responsibility of the MWO, the VAAC should:

* When an initial report on an eruption is received from a source other than the ACC/MWO, the information must be immediately transmitted by telephone to the ACC or the corresponding MWO, after which the procedures described in a) a g) shall be followed.

a) run the volcanic ash trajectory/dispersion computer model in order to provide advisory information on volcanic ash trajectories to the MWOs, ACCs and airlines* concerned;
b) examine the satellite images/data of the corresponding area that were received at the time of the event in order to see if a volcanic ash cloud can be identified and, if so, its extent;
c) prepare and issue advisory information on the extent and expected trajectory of the volcanic ash cloud to the MWOs, ACCs and airlines* concerned in the area of responsibility of the VAAC, the London WAFC at EGRRYMYX, the Washington WAFC at KWBCYMYX, the Vienna international OPMET data bank at LOZZMMSS, other VAACs responsible for the issuance of SIGWX forecasts in the area concerned;

The volcanic ash advisory message should contain the following information:

type of message
— VOLCANIC ASH ADVISORY

time and date of issuance and name of issuing VAAC
— time (UTC), day/month/year; issuing volcanic ash advisory centre

name and reference number of the volcano
— name (if known) and reference number of the volcano [International Association of Vulcanology and Chemistry of the Earth's Interior (IAVCEI)]

State or area where the volcano is located and its latitude/longitude

— name of the State or area (*e.g.*, oceanic) and latitude/longitude of the volcano

sources of information

— volcanological agency or special AIREP, etc.

* **The advisory information received from the VAACs is aimed at assisting the MWOs in the preparation of SIGMETs, especially their "projection". However, in order to provide airline operators with advance information on volcanic ash as soon as possible, an AFTN address (EGLLSITV) has been provided in the SITA network where VAACs can send their advisories, so that SITA may then distribute them to airline operators. SIGMETs on volcanic ash will be disseminated in keeping with the OPMET exchange tables of the relevant regional air navigation plan.**

** **Satellite broadcasts by the London and Washington WAFS will include volcanic ash advisories in graphical format. The appendix to Annex 3 (Amendment 71 to Annex 3, effective 5 November 1998) contains a sample of the graphical format.**

details of the eruption

— time (UTC), day/month/year of the eruption

details of the ash cloud

— vertical length (in flight levels), horizontal length in kilometres (nautical miles), and boundaries (in degrees and minutes) of the ash cloud

trajectory of the ash cloud

— general description of the direction and speed at which the ash cloud is moving in selected flight levels

ash cloud movement forecast

— forecast of ash cloud boundaries, in degrees and minutes, in the selected flight levels, 6, 12 and 18 hours after the time of issuance of the advisory

next alert

— expected time of issuance of the next advisory.

In order for VAACs to begin tracking volcanic ash based on satellite data and volcanic ash trajectory projections, the MWOs should inform the designated VAAC immediately after learning of a volcanic eruption or of volcanic ash observed in the FIR under their responsibility, in keeping with 4.4.1 a). In particular, special air reports on volcanic activity prior to an eruption, volcanic eruption, or volcanic ash cloud received by the MWOs should be promptly transmitted to the corresponding VAAC and the other addresses, according to 4.4.1 a);

d) verify all subsequent satellite information to assist in the tracking of volcanic ash cloud movement;

e) continue issuing updated advisory information for the MWOs, ACCs and airlines* concerned, at least at 6-hour intervals and, preferably, more frequently, until it is considered that the volcanic ash cloud can no longer be identified based on satellite data, no more reports on volcanic ash are received from the area, or no new eruptions of the volcano are reported;

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* **Advisory information sent by the VAACs is aimed at assisting the MWOs in the preparation of SIGMETs, especially their "projection". However, in order to provide airline operators with advance information on volcanic ash as soon as possible, an AFTN address (EGLLSITV) has**

been provided in the SITA network to which the VAACs can send their advisories, so that SITA may then distribute them to airline operators. SIGMETs on volcanic ash shall be disseminated in keeping with the OPMET exchange tables of the relevant regional air navigation plan.

f) stay in contact periodically with other VAACs, as necessary, as well as with the global volcano network of the Smithsonian Institution, in order to keep abreast of volcanic activity in the area of responsibility of the VAAC; and

in case the volcanic ash clouds cross the boundaries of the areas of responsibility of the VAACs, the first VAAC should continue to be responsible for issuing advisories until the transfer of responsibility between the two VAACs has been agreed upon.

Note.— This means that while the volcanic ash cloud is over the common boundary, only one of the VAACs will issue advisories about the event at a given time, but the two VAACs must send such advisories to the MWOs and ACCs in their respective areas of responsibility.

The two VAACs should insert a note in their corresponding “last”/“first” advisory of the series of messages and graphs, indicating that the “transfer”/“acceptance of transfer” will take place with that message/graph.

5.2 Regarding the VAACs that have not yet developed a computer model to forecast volcanic ash dispersion, upon receiving information from the MWO or from any other source located within their area of responsibility, about the occurrence of a volcano eruption or the presence of a volcanic ash cloud in the FIR under the responsibility of the MWO, the VAAC should immediately get in touch with the Washington VAAC, asking that the United States volcanic ash forecast trajectory and deposition (VAFTAD) model be run and the relevant trajectory forecasts be provided.

PROCEDURES ESTABLISHED IN ANNEX 15 "AERONAUTICAL INFORMATION SERVICES" CHAPTER 5 NOTAM AND MANOPER PART III AIS RELATED TO VOLCANIC ASH

1. According to the "Handbook on the international airways volcano watch (IAVW), operational procedures for the dissemination of information on volcanic eruptions and the resulting volcanic ash clouds in areas where they might affect the routes used by international flights, and measures to be taken prior to the eruptions" (Part 4 – ICAO Doc 9766-AN / 968), that established in Annex 15 "Aeronautical Information Services" Chapter 5 NOTAM and MANOPER Part III AIS applies.

2. In case of receiving information from the ACC/FIC, aerodrome or national meteorological service about major volcanic activity prior to an eruption, or about a volcanic eruption, or the presence of a volcanic ash cloud is reported in an area where it might affect the routes used by international or domestic flights, a NOTAM or ASHTAM should be issued in keeping with Chapter 5 NOTAM paragraph 5.5 item u) of the MANOPER Part III AIS.

3. The ASHTAM (whose completion instructions appear as Appendix C) provides information about the status of activity of a volcano when a change in the volcanic activity is or is foreseen to be significant for operations. It also provides information about the location, extent and movement of the ash cloud, and the air routes and flight levels affected. This information is provided using the colour-coded volcano alert level.

4. The issuance of a NOTAM or, if the necessary data are available, of an ASHTAM providing information about a volcanic eruption, should not be delayed until the complete information from A) to K) (for the ASHTAM format) is available, but rather should be issued immediately after receiving a report that an eruption has occurred or is foreseen to occur, or that a change in its significance for operations has occurred or is foreseen to occur due to the status of activity of the volcano, or that there is an ash cloud. In case an eruption is expected and, therefore, there is no evidence at that moment of the existence of an ash cloud, boxes A) to E) should be completed, and in boxes F) to I), indicate "not applicable". Similarly, if a volcanic ash cloud is reported, for instance, through a special air report, but at that moment there is no information about the originating volcano, the ASHTAM should be issued in principle writing in boxes A) to E) the words "unknown", and boxes F) to K) should be filled in as applicable, based on the special air report, until new information is received. Under other circumstances, if concrete information is not available for any of the boxes A) to K), write "NIL".

5. **The maximum period of effectiveness of ASHTAMs is 24 hours. New ASHTAMs should be issued when the alert level changes**.

6. The aforementioned NOTAM or ASHTAM should give details of the volcanic activity, including the name and geographical coordinates of the volcano, date and time of the eruption, flight levels and routes or route segments that might be affected, and, as needed, routes temporarily closed to air traffic. These last three items should be coordinated with the ACC/FIC corresponding to the affected area.

7. When issuing a NOTAM or ASHTAM on major volcanic activity prior to an eruption, or on volcanic eruptions that do not produce ash plumes, the following should be included in the text of the NOTAM field E) or ASHTAM field K), if applicable:

> "Increasing volcanic activity reported in volcano (name and location in LAT/LONG) aircraft are advised to be cautious until further notice and to be in listening watch for NOTAMs/SIGMETs for the area" or
>
> "Volcano (name and location in LAT/LONG) in eruption on (date/UTC time) but no ash plume reported, aircraft are advised to avoid flying less than ……… Km from the volcano until further notice, and to be in listening watch for NOTAMs/SIGMETs for the area"

8. In addition to sending the ASHTAM (or NOTAM) to the regular distribution lists, the NOF shall prepare a separate message to be sent to the Volcanic Ash Advisory Centre (VAAC) responsible for the FIR involved, and to the Meteorological Watch Offices, according to the following address list:

At the international level:

1) Washington World Area Forecast Centre (WAFC)	**KWBCYMYX**
2) London World Area Forecast Centre (WAFC)	**EGRRYMYX**
3) Vienna International operational meteorological (OPMET) data bank	**LOZZMMSS**
4) Brasilia International operational meteorological (OPMET) data bank (OPMET)	**SBBRYZYX**
5) SITA network	**EGLLSITV**
6) SAM SADIS	**EGZZMSAM**

At the regional level:

To the following Meteorological Watch Offices (WMOs):

	Antofagasta	**SCFAZXMR**
CHILE	Puerto Montt	**SCTEZXMR**
	Punta Arenas	**SCCIZXMR**
	Santiago	**SCZZMAMX**
	Aeroparque	**SABEYMYX**
	Ezeiza	**SAEZYMYX**
ARGENTINA	Comodoro Rivadavia	**SAVCYMYX**
	Córdoba	**SACOYMYX**
	Mendoza	**SAMEYMYX**
	Resistencia	**SAREYMYX**
PARAGUAY	Asunción	**SGZZMAMX**
	Brasilia	**SBBRYMYX**
	Curitiba	**SBCRYMYX**
	Manaus	**SBEGYMYX**
BRAZIL	Recife	**SBRFYMYX**
	Rio de Janeiro	***SBGLYMYX***
	Sao Paulo	***SBGRYMYX***
PERU	Lima	**SPIMYMYX**
URUGUAY	Montevideo	**SUZZMAMX**
BOLIVIA	La Paz	**SLZZMAMX**

9. This message should be sent through the AFTN to the AFTN switching centres mentioned in the previous paragraph, but the ASHTAM (or NOTAM) must be first encapsulated in a dummy abbreviated heading of the World Meteorological Organization (WMO). This allows the receiving MET or AFTN switching centre to transmit the ASHTAM (or NOTAM) to the corresponding VAAC through internal MET communication circuits.

10. The dummy WMO abbreviated heading to be used in the customary AFTN heading is made up by three groups, as follows:

T1 T2 A2 A2 ii CCCC YYGGgg

For the NOTAMs on volcanic ash and the ASHTAMs sent from the NOF to the VAAC responsible for its area, the dummy WMO heading:

- T1T2 will always be “NW”;
- A1A2 will always be the WMO State geographic sign “AG”.
- ii will always be “31”;
- CCCC will always be the ICAO four-letter location indicator corresponding to the NOF;
- MMYY is the date; MM= month, YY= day
- GGgg is time in hours and minutes, in integers.

For example, a NOTAM issued by the Ezeiza NOF will be sent to the Buenos Aires VAAC as follows, indicating the four sections of the message:

1	ZCZC GG SABMTMYX 151840 SAEZYNYX	ENCAPSULATION OF THE CUSTOMARY AFTN HEADING
2	NWAG31 SAVF 11151840	WMO ABBREVIATED HEADING
3	A0623/02 NOTAMN Q) SAVF/QWWXX/IV/NBO/W /000/250/4554S 07258W A) SAVF B) 0211151830 E) SIGNIFICANT VOLCANIC ACT CERRO HUDSON VA MOV W. AWY RESTRICTIONS AND ALT RTE NOTIFIED BY ATC	
4	NNNN	END OF CUSTOMARY ENCAPSULATION

A similar example, in this case, an ASHTAM issued by the Ezeiza NOF, will be sent to the Washington VAAC as follows:

ZCZC
GG KWBCYMYX
170630 SAEZYNYX
NWAG31 SAVF 11170630

ASHTAM
VASA 0623/02 SAVF 0211151840
ASHTAM 0623
A) SAVF
B) 0211151830
C) CERRO HUDSON VOLCANO 1508-057
D) 4554S07258.1W
E) YELLOW ALERT
F) SFC/11000FT
G) E/SE
H) VOR/DME BAL - ETASO W58 CNL
I) VOR/DME BAL – ASADO G675 RTE AVBL.
J) BUENOS AIRES VOLCANIC ASH ADVISORY CENTRE
K) CAUTION GENERAL AVIATION WIND 60KM/H E/SE
OF VOLCANO

NNNN

11. If in doubt when completing fields C) to G) inclusive, and fields J) and K) of the ASHTAM, consult the Buenos Aires Volcanic Ash Advisory Centre:

Tel:	Operational	5167-6767 ext. 18238 / 233 (tel and fax)/ 5167-6709
	Administrative	51676707 or 5167-6767 ext. 18235
	AFTN	SABMYMYX// SAZZMAMX
E-mail	Operational	bue.vaac@meteofa.mil.ar
		metaer@meteofa.mil.ar
	Administrative	glores@meteofa.mil.ar

Appendix C – ASHTAM Form

<table>
<tr><td rowspan="2">(COM heading)</td><td>(PRIORITY INDICATOR)</td><td colspan="3">[ADDRESSEE INDICATOR(S)]</td></tr>
<tr><td>(DATE AND TIME FILED)</td><td colspan="3">(ORIGINATOR INDICATOR)</td></tr>
<tr><td>(Abbreviated heading)</td><td>(VA SERIAL NUMBER)
V A S A</td><td>(LOCATION INDICATOR)</td><td>DATE/TIME OF ISSUANCE</td><td>(OPTIONAL GROUP)</td></tr>
</table>

ASHTAM	(SERIAL NUMBER)
(AFFECTED FLIGHT INFORMATION REGION)	A)
[DATE/(UTC) TIME OF ERUPTION]	B)
(NAME AND NUMBER OF VOLCANO)	C)
(LATITUDE AND LONGITUDE OR RADIAL OF VOLCANO AND DISTANCE FROM NAVAID)	D)
(COLOUR-CODED ALERT LEVEL FOR VOLCANOS, INCLUDING PREVIOUS LEVELS, IF ANY)	E)
(EXISTENCE AND HORIZONTAL/VERTICAL SIZE OF VOLCANIC ASH CLOUD)	F)
(DIRECTION IN WHICH THE ASH CLOUD IS MOVING)	G)
(AIR ROUTES OR AIR ROUTE SEGMENTS AND FLIGHT LEVELS AFFECTED)	H)
(CLOSED AIRSPACE AND/OR AIR ROUTE SEGMENTS, AND AVAILABLE ALTERNATE ROUTES)	I)
(SOURCE OF INFORMATION)	J)
(OBSERVATIONS IN SIMPLE LANGUAGE)	K)
NOTE: Box titles between parentheses ( ) are not transmitted.	

SIGNATURE OF ORIGINATOR (not transmitted)

GUIDANCE TO COMPLETE THE ASHTAM FORM

1. Abbreviated heading

1.1. After the customary heading of AFTN communications, the abbreviated heading “TT AA iiii CCCC MMYYGGgg (BBB)” is included to facilitate the automatic processing of ASHTAM messages in the computerised data banks. The explanation of the symbols is given below:

TT =	**ASHTAM data designator= VA;**
AA =	**State geographic designator, *e.g.*, SA = Argentina (see Location indicators - AIP Argentina GEN 2.4)**
iiii =	**ASHTAM serial number, expressed by a set of four figures;**
CCCC =	**four-letter location indicator corresponding to the flight information region concerned [see Location indicators (Doc. 7910), Part 5, addresses of centres responsible for the FIRs/UIRs];**
MMYYGGgg =	**date/time of report, where:** **MM = month, *e.g.*, January = 01, December = 12** **YY = day of the month** **GGgg = hours (GG) and minutes (gg) (UTC time)**

Note. – The parenthesis in (BBB) means that it is an optional group.

Example: Abbreviated heading of the ASHTAM corresponding to the Ezeiza FIR, report dated 7 November at 0620 UTC: VASA 0001 SAEZ 11070620.

2. Box A

Flight information region affected, equivalent in simple language to the location indicator contained in the abbreviated heading, in this example “Ezeiza FIR”.

3. Box B

Date and time (UTC) of first eruption.

4. Box C

Name and number of the volcano as they appear in the ICAO Manual on volcanic ash, radioactive material and toxic chemical “clouds” (provisional title), and in the World map of volcanoes and major aeronautical features.

5. Box D

Latitude/longitude, in whole degrees, or radial, of the volcano, and distance from the volcano to the navaid (as described in the ICAO Manual on volcanic ash, radioactive material and toxic chemical “clouds” and in the World map of volcanoes and major aeronautical features).

6. Box E

Colour code to indicate the level of alert of volcanic activity, including previous activity levels, expressed as follows:

Colour-coded alert level	***Status of volcano activity***
RED ALERT	VOLCANIC ERUPTION IN PROGRESS. ASH PLUME/CLOUD ABOVE FL 250 REPORTED OR DANGEROUS VOLCANO, LIKELY ERUPTION, ASH PLUME/CLOUD IS EXPECTED TO RISE ABOVE FL 250.
ORANGE ALERT	VOLCANIC ERUPTION IN PROGRESS, BUT ASH PLUME/CLOUD DOES NOT REACH NOR IT IS EXPECTED TO REACH FL 250 OR DANGEROUS VOLCANO, LIKELY ERUPTION, BUT THE ASH PLUME/CLOUD IS NOT EXPECTED TO REACH FL 250.
YELLOW ALERT	VOLCANO KNOWN TO BECOME ACTIVE FROM TIME TO TIME, AND THERE HAS BEEN A RECENT SIGNIFICANT INCREASE OF VOLCANIC ACTIVITY, CURRENTLY THE VOLCANO IS NOT CONSIDERED DANGEROUS, BUT CAUTION IS RECOMMENDED ***OR*** OR (FOLLOWING AN ERUPTION, THAT IS, CHANGE FROM RED OR ORANGE TO YELLOW ALERT) – SIGNIFICANT REDUCTION OF VOLCANIC ACTIVITY, CURRENTLY THE VOLCANO IS NOT CONSIDERED DANGEROUS, BUT CAUTION IS RECOMMENDED.
GREEN ALERT	VOLCANIC ACTIVITY IS CONSIDERED TO HAVE CEASED AND THE VOLCANO IS BACK TO ITS NORMAL STATE.

Note.- the colour code to indicate the level of alert regarding volcanic activity and any change with respect to the previous state of activity should be notified to the area control centre by the volcanological organisation, e.g., "RED ALERT FOLLOWING YELLOW" OR "GREEN ALERT FOLLOWING ORANGE".

7. Box F

If a volcanic ash cloud of significance for operations is reported, state the horizontal length and the bottom/top of the ash cloud using latitude/longitude (in whole degrees), and the altitudes in thousand of meters (feet) and/or the radial and the distance from the originating volcano. Information can be initially based only on a special air report, but subsequent information can be more detailed, based on the advisory information from the responsible meteorological watch office and/or the volcanic ash advisory centre.

8. Box G

Indicate the direction in which the ash cloud is expected to move at selected levels, based on the advisory of the responsible meteorological watch office and/or the volcanic ash advisory centre.

9. Box H

Indicate the air routes and route segments and flight levels that are affected or are expected to be affected.

10. Box I

Indicate the airspaces, air routes or route segments that are closed and the available alternate routes.

11. Box J

Source of information, *e.g.*, “special air report” or “volcanological organisation”, etc. The source of information should always be indicated, whether or not the eruption or the ash cloud actually occurred.

12. Box K

In addition to the above, include all information of significance for operations, in simple language.

- END -