

**Doc 9974**  
**ANB/487**



# Flight Safety and Volcanic Ash

Risk management of flight operations with known or forecast  
volcanic ash contamination

Approved by the Secretary General  
and published under his authority

First Edition — 2012



International Civil Aviation Organization

- c) The operator should complete the safety risk assessment as part of the SMS before initiating operations into airspace forecast to be, or aerodromes known to be, contaminated with volcanic ash. During its normal oversight of its operators, a CAA should normally evaluate the safety risk assessment as an identifiable process of the operator's SMS.
- d) An operator should have satisfied its CAA regarding the likely accuracy and quality of the information sources it uses in its SMS and its own competence and capability to interpret such data correctly in order to reliably and correctly resolve any conflicts that may arise among data sources.
- e) The operator should revise its safety risk assessment when changes occur that are material to the integrity of the safety risk assessment.
- f) The operator's safety risk assessment should take into account data published by the relevant TCHs regarding the susceptibility of the aircraft they operate to volcanic cloud-related airworthiness effects, the nature of these effects and the related pre-flight, in-flight and post-flight precautions to be observed by the operator.
- g) The operator should ensure that personnel needing to be familiar with the details of the safety risk assessments receive all relevant information (both pre-flight and in-flight) in order to be in a position to apply appropriate mitigation measures as specified by the safety risk assessments, especially when the situation deviates from any scenario contemplated in them.
- h) The operator should ensure that reports are immediately submitted to the nearest ATS unit using the VAR/AIREP procedures followed up by a more detailed VAR on landing together with, as applicable, an ASR and AML entry for:
  - 1) any incidents related to volcanic clouds;
  - 2) any observation of volcanic ash activity; and
  - 3) any time that volcanic ash is not encountered in areas where it was forecast to be.

## 2.5

### Procedures

- a) The operator should have documented procedures for the management of operations into airspace forecast to be, or aerodromes known to be, contaminated with volcanic ash.

*Note 1.— Procedures should include crew action in the event that they encounter a volcanic ash cloud (related guidance material is being developed).*

*Note 2.— Procedures should include collaboration with ATM and aerodrome operators to coordinate any delays and/or service recommencement on aerodrome(s) affected by volcanic ash.*

- b) These procedures should ensure that, at all times, flight operations remain within the accepted safety boundaries, as established through the SMS, despite any variations in information sources, equipment, operational experience or procedures. Procedures should include those for flight crew, flight planners, dispatchers, operations, engineering and maintenance personnel such that they are equipped to evaluate correctly the risk of flights encountering airspace contaminated by volcanic clouds and to plan accordingly.
- c) Maintenance and engineering personnel should be provided with procedures allowing them to correctly assess the need for, and execute, relevant maintenance or other engineering interventions.

- d) The operator should retain, or employ via a third party, sufficient qualified and competent staff to generate well-supported operational risk management decisions, and ensure that its staff is appropriately trained and current.

*Note.— It is not intended that the operator be precluded from securing necessary resources from other competent parties.*

- e) The operator should make the necessary arrangements to give its flight operations staff the opportunity to be involved in volcanic ash exercises conducted in their area of operations.

## 2.6 Information

Before and during eruptions, information valuable to the operator is generated by various meteorological and volcanological agencies worldwide. The operator's risk assessment and mitigating actions need to take account of, and respond appropriately to, the information likely to be available during each phase of the eruptive sequence from pre-eruption through to the end of eruptive activity. Further material is provided in Appendix 5.

### THE TYPE CERTIFICATE HOLDER

2.7 In fulfilling its primary responsibility for the safety of operations, the operator is dependent on the TCH of the equipment it operates for information, such as maintenance monitoring, or recognition of encounter, necessary to inform its safety risk assessment when volcanic clouds are a hazard.

2.8 Therefore, TCHs should make available to operators a range of information important to the operator's safety risk assessment related to the hazards associated with volcanic clouds. This information should be kept updated as future knowledge is acquired.

*Note.— An indication of the range of information that an operator might require is provided in Appendix 2.*

### THE CIVIL AVIATION AUTHORITY

2.9 ICAO's safety risk assessment process is described in the ICAO *Safety Management Manual (SMM)* (Doc 9859). An approach, aligned with an organization's approved SMS, would be equally appropriate.

2.10 The State is advised that the CAA exercising oversight of an operator that intends to undertake operations into airspace forecast to be, or aerodromes known to be, contaminated with volcanic ash should establish a methodology for evaluating the safety risk assessment process of the operator's SMS particular to volcanic ash. The operator should not be prevented from operating through, under or over, airspace forecast to be affected by a VAA, VAG or SIGMET provided it has demonstrated in its SMS the capability to do so safely. The guidance set out in Appendix 6 indicates a process that the CAA can use to achieve this outcome.

---

## APPENDIX 2

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

<i>Considerations</i>	<i>Actions</i>
<b>Preparation</b>	
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"> <li>— the features of the aircraft or engine that are susceptible to airworthiness effects related to volcanic ash;</li> <li>— the nature and severity of these effects;</li> <li>— the effect of volcanic ash on operations to/from contaminated aerodromes;</li> <li>— 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;</li> <li>— 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.</li> </ul>
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"> <li>— 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;</li> <li>— flight planning and operational procedures enable crews to avoid areas and aerodromes with unacceptable volcanic ash contamination;</li> <li>— flight crews are aware of the possible signs of entry into a volcanic ash cloud and execute the associated procedures;</li> <li>— engineering and maintenance personnel are able to assess the need for, and to execute, any necessary maintenance or other required interventions.</li> </ul>

<b>Considerations</b>	<b>Actions</b>
<b>Operator procedures</b>	
Provision of enhanced flight watch	<p>The operator should:</p> <ul style="list-style-type: none"> <li>— closely and continuously monitor VAA, VAR/AIREP, SIGMET, NOTAM and ASHTAM information, and information from its crews, concerning the volcanic ash cloud hazard;</li> <li>— ensure that its Operations Unit, or equivalent, and its crews, have access to plots of the affected area from SIGMETs and NOTAMs;</li> <li>— ensure that the latest information is communicated to its crews and planners in a timely fashion.</li> </ul>
Flight planning	<p>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.</p>
Departure, destination and alternates	<p>For the airspace to be traversed, or the aerodromes in use, the operator should determine, and take account of:</p> <ul style="list-style-type: none"> <li>— the degree of known or forecast contamination;</li> <li>— any additional aircraft performance requirements;</li> <li>— required maintenance considerations;</li> <li>— fuel requirements for re-routing and extended holding.</li> </ul>
Routing policy	<p>The operator should determine, and take account of:</p> <ul style="list-style-type: none"> <li>— the shortest period in and over the forecast contaminated area;</li> <li>— the hazards associated with flying over the contaminated area;</li> <li>— drift down and emergency descent considerations.</li> </ul>
Diversion policy	<p>The operator should determine, and take account of:</p> <ul style="list-style-type: none"> <li>— maximum allowed distance from a suitable alternate;</li> <li>— availability of alternates outside the forecast contaminated area;</li> <li>— diversion policy after a volcanic ash encounter.</li> </ul>
Minimum Equipment List / Dispatch Deviation Guide	<p>The operator should consider additional restrictions for dispatching aircraft with unserviceabilities which might affect:</p> <ul style="list-style-type: none"> <li>— air conditioning packs;</li> <li>— engine bleeds;</li> <li>— pressurization system;</li> <li>— electrical power distribution system;</li> <li>— air data computers;</li> <li>— standby instruments;</li> <li>— navigation systems;</li> <li>— de-icing systems;</li> <li>— engine driven generators;</li> <li>— Auxiliary Power Unit (APU);</li> <li>— Airborne Collision Avoidance System (ACAS);</li> <li>— Terrain Awareness Warning System (TAWS);</li> <li>— Autoland systems;</li> </ul>

	<ul style="list-style-type: none"> <li>— provision of crew oxygen; and</li> <li>— supplemental oxygen for passengers.</li> </ul> <p><i>(Note.— This list is not exhaustive.)</i></p>
--	--

<b>Considerations</b>	<b>Actions</b>
<b>Flight Crew Procedures</b>	
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"> <li>— pre-flight planning;</li> <li>— in-flight monitoring of volcanic ash cloud affected areas and avoidance procedures;</li> <li>— diversion policy;</li> <li>— communications with ATC;</li> <li>— in-flight monitoring of engine and systems potentially affected by volcanic ash cloud contamination;</li> <li>— recognition and detection of volcanic ash clouds;</li> <li>— in-flight indications of a volcanic ash cloud encounter;</li> <li>— procedures to be followed if a volcanic ash cloud is encountered;</li> <li>— unreliable or erroneous airspeed;</li> <li>— non-normal procedures for engines and systems potentially affected by volcanic ash cloud contamination;</li> <li>— engine-out and engine relight;</li> <li>— escape routes; and</li> <li>— operations to/from aerodromes contaminated with volcanic ash.</li> </ul> <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"> <li>— make an AML entry related to any actual or suspected volcanic ash encounter whether in-flight or at an aerodrome;</li> <li>— confirm, prior to flight, completion of maintenance actions related to an AML entry for a volcanic ash cloud encounter on a previous flight.</li> </ul>
Incident reporting	<p>The operator should specify crew requirements for:</p> <ul style="list-style-type: none"> <li>— reporting an airborne volcanic ash cloud encounter (VAR);</li> <li>— post-flight volcanic ash cloud reporting (VAR);</li> <li>— reporting non-encounters in airspace forecast to be contaminated;</li> <li>— filing a mandatory occurrence report as required by the State.</li> </ul>

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

*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 3

### HAZARDS AND RISKS TO BE CONSIDERED BY AIRCRAFT OPERATORS

(when conducting a Safety Risk Assessment for volcanic ash operations)

1) Process/ activity	2) Hazards	3) Existing defences	4) Additional defences (from this SRM exercise)	5) Unsafe Event [UE] (and intermediate consequences)		6) Existing recovery measures (from UE)	7) Additional recovery measures (from this SRM exercise)	8) Ultimate (Worst) consequence/risk
				UE	Intermediate consequences			
<b>Flight planning</b>	Hazard No.1 – Regulatory or operator requirements concerning volcanic regions operations <b>not correctly incorporated</b> into the flight planning process	See Note	See Note	Inadvertent volcanic ash encounter (with intermediate consequences as indicated on the right )	a) Pitot/static probes blockage  b) Severe window abrasion  c) Turbine and compressor damage (all engines)	See Note	See Note	Loss or erroneous indications from equipment dependent on the pitot/static signals, e.g. airspeed  Loss or reduced vision through forward cockpit windshields  Loss or reduced thrust on all engines/aircraft forced landing
					d) etc.	See Note	See Note	



<b>Flight planning</b>	Hazard No. 2 – Information on volcanic ash concentration <b>not properly communicated</b> to crews at pre-flight briefing	See Note	See Note	See Note	See Note	See Note	
	Hazard No.3 etc.	See Note	See Note	See Note	See Note	See Note	
<b>Volcanic ash communication with flight crew</b>	Hazard No.1 – Communication not transmitted to in-flight crew as required		Inadvertent volcanic ash encounter (with safety implications)			Loss or reduced thrust on all engines/aircraft forced landing	
	Hazard No. 2 – Communication not received by in-flight crew		Inadvertent volcanic ash encounter (with safety implications)			Loss or reduced thrust on all engines/aircraft forced landing	
<b>Etc.</b>	Hazard No.3, etc.						

Note.— Columns 3, 4, 6 and 7 to be addressed by the Operator's safety risk assessment process on volcanic region operations.