INTERNATIONAL CIVIL AVIATION ORGANIZATION

MID REGION
ATM CONTINGENCY PLAN

Version 5.0 March 2024

This concept was developed by the ICAO MID ATM SG.

Approved by MIDANPIRG/21 and published by the
ICAO MID Office, Cairo

RECORD OF AMENDMENTS

The MID Region ATM contingency plan should be reviewed and updated by the ATM Sub-Group and presented to MIDANPIRG for endorsement.

The table below provides a means to record all amendments. An up-to-date electronic version of the Plan will be available on the ICAO MID Regional Office website.

Edition Date	Description	Pages Affected
15 July 2014	First edition	• Focal Points • Status of Contingency Agreements
26 November 2014	Second edition	• Focal Points • Introduction • Chapter 2 (CCT)
11 June 2015	Third edition	• Chapter 2 (CCT) • Chapter 2 Notification Procedure
20 April 2016	Fourth edition	• Focal Points • Editorials
08 March 2024	Fifth edition	All pages

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1. GLOSSARY

1.1 Abbreviations and Acronyms

ACC	Area Control Centre
AGA	Aerodromes and Ground Aids
AIC	Aeronautical Information Circular
AIG	Accident investigation and prevention
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AHRS	Attitude and Heading Reference System
ANP	Air Navigation Plan
ANSP	Air Navigation Service Provider
AOCG	ATM Operational Contingency Group
AOR	Area of Responsibility
ASM	Airspace Management
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
AU	Airspace User
AUP	Airspace Use Plan
BPE	Basic Plan Element
CCC	Central Coordinating Committee
CCT	Contingency Coordination Team
CDR	Conditional Route
CNS	Communication, Navigation and Surveillance
DME	Distance Measuring Equipment
EGPWS	Enhanced Ground Proximity Warning System
FIC	Flight Information Center
FIR	Flight Information Region
FLAS	Flight Level Allocation Scheme
GNSS	Global Navigation Satellite System
IATA	International Air Transport Association
ICARD	ICAO Codes and Routes Database
IRU	Inertial Reference Unit
LOA	Letter of Agreement
MET	Meteorological service
MIDANPIRG	MID Air Navigation Planning and Implementation Regional Group
MIDRMA	Middle east Regional Monitoring Agency
MoU	Memorandum of Understanding
NOTAM	Notice to Airmen
PBN	Performance-based Navigation
PFD	Primary Flight Display
RNAV	Area Navigation
RVSM	Reduced Vertical Separation Minimum
SAR	Search and Rescue
SMS	Safety Management System
SSP	State Safety Programme
SUP	Supplement
TAWS	Terrain Awareness Warning System
TDS	Traffic Data Sample

ToR	Terms of Reference
TOS	Traffic Orientation Scheme

1.2 Terminology and Definition

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

Air traffic management (ATM). The dynamic, integrated management of air traffic and airspace (including air traffic services, airspace management and air traffic flow management) — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

Air traffic management system. A system that provides ATM through the collaborative integration of humans, information, technology, facilities, and services, supported by air and ground- and/or space-based communications, navigation and surveillance.

Conditional route (CDR). A non-permanent ATS route or portion thereof which can be planned and used under specified conditions.

A Conditional Route may have more than one category, and those categories may change at specified times:

a) *Category One - Permanently Plannable CDR:* CDR1 routes are in general available for flight planning during times published in the relevant national Aeronautical Information Publication (AIP). Updated information on the availability in accordance with conditions published daily AUP notification.

b) *Category Two - Not Plannable CDR:* CDR2 routes are not available for flight planning; however, ATC Units may issue tactical clearances on such route segments.

Note: *some regional contingency routes published in MID Air Navigation Plan (Doc 9708) under note 5 (Conditional Route).*

Global navigation satellite system (GNSS). A worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation.

Performance-based navigation (PBN). Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Regional ATS route. An ATS route shall be considered as the MID regional ATS route network provided that:

a) Cross-bordered (at least initiate/terminate from FIR boundary);

b) Route designator shall be assigned in accordance with Annex 11, Appendix 1 and the ICARD requirement; and

c) Published in ICAO ANP- Middle East Region (Doc 9708), Volume II, Table ATM II-MID-1 MID Region ATS Route Network.

CHAPTER 1

INTRODUCTION

Purpose

1.1 The various circumstances surrounding each contingency situation preclude the establishment of exact detailed procedures to be followed. The purpose of this plan is to assist in providing for the safe and orderly flow of international air traffic in the event of disruptions of air traffic services and related supporting services and in preserving the availability of major world air routes within the air transportation system in such circumstances.

1.2 The MID Region Air Traffic Management Contingency Plan is primarily for the information to operators and pilots planning and conducting operations in MID Region. This plan also intended to provide guidance to deal with a range of contingency situations and promote a regional harmonized response to contingencies that affect or may affect continuous provision of ATS in the MID Region and provide guidelines for the development of States national contingency plan in line with ICAO provision in Annex 11 paragraph 2.32.

Note 1: *Guidance material relating to the development, promulgation and implementation of contingency plans is contained in Annex 11, Attachment C.*

Note 2: *additional ATM contingency planning principles and template is contained in this document* ***Appendix A*** *and* ***Appendix B*** *respectively.*

1.3 Contingency plans are intended to provide alternative facilities and services to those provided in the regional air navigation plan when those facilities and services are temporarily not available.

1.4 Also contingency plans should be designed to provide alternative routes, using existing airways in most cases, which will allow aircraft operators to fly through or avoid airspace within their jurisdiction taking into consideration the nature of the MID Region airspace and the need to keep operators and other stakeholders informed. The Plan urges the MID states to publish individual contingency plans and contingency routes at their states level to meet the requirement of the operation at regional level to allow aircraft operators to fly through their airspace.

Note 1*: this plan is developed to provide* ***alternative*** *routes for each regional main flows based on MID ANP, Volume II, Part I, table Gen II-1 (Homogeneous ATM areas and/or major traffic flows identified in the MID region) as well as* ***Appendix C*** *on this document, which will allow aircraft operators to circumnavigate airspace in the MID Region, as deemed necessary, due to a perceived risk to the safety of flight with a minimum of disruption to flight operations.*

Note 2: *based on States TDS reports and routing options to MIDRMA, MID Office is responsible to update the main regional routing options at* ***Appendix C*** *accordingly.*

Note 3: *to achieve the requirement in note 1, ICAO MID office based on ANP Volume II, Table I, ATS routes table, periodically should provide MID region ATS route network gap analysis report to ATM SG and RDWG meetings to take the required decisions and actions for further enhancement.*

Contingency level and category

1.5 The plan describes a hierarchy of contingency levels and categories of contingency events as follows:

a) Hierarchy of contingency plans:

i. **Level 1**, for internal State plans dealing with domestic coordination actions for the ANSPs;

ii. **Level 2**, for coordinated (inter-State) contingency plans involving two or more States; and

iii. **Level 3,** to detail contingency arrangements in the event of partial or total disruption of ATS designed to provide alternative routes, using existing airways in most cases, which will allow aircraft operators to fly through or avoid airspace within the relevant Flight Information Regions (FIRs).

b) Categories of contingencies:

i. **Category A – Safe Airspace, but Restricted or No ATS**, due to causal events such as pandemic, earthquake affecting the provision of ATS, or ATM system failure or degradation;

ii. **Category B – Not Safe Airspace**, due to causal events such as volcanic ash cloud or military activity; and

iii. **Category C – Airspace Not Available**, due to causal events such as national security – normally a political decision.

Note: *any instance of "Airspace Not Available" in this document refers only to a State's sovereign airspace and is not applicable to "High Seas airspace".*

Objectives

1.6 The objectives of the Plan are:

a) to ensure timely, harmonized and appropriate responses to all events that may cause disruption to the provision of ATS;

b) to provide a contingency response framework for MID States to ensure continuation of aircraft operations in affected FIR(s); and

c) to provide a greater degree of certainty for airspace and aerodrome users during contingency operations.

1.7 In order to meet these objectives, the Plan:

a) provides uniform policy and guidance for responding to reasonably foreseeable operational restrictions, including short, medium and long term actions, prevention of overload of the ATSUs affected by contingency measures and guidance for implementation and resumption;

b) provides a framework for the review of the status of ATS contingency plans and preparedness of MID Region States;

c) enables to identify and reinforce areas where ATS contingency planning requires improvement;

d) provides principles for ATS contingency planning;

e) provides contingency planning templates for States; and

f) defines the ToR for the MID Contingency Coordination Team (CCT).

CHAPTER 2

MID STATES' CONTINGENCY PLAN REQUIREMENTS

States requirements

2.1 As indicated in Annex 11, Chapter 2, Para 2.32 as well as material related to contingency planning in Annex 11, Attachment C, States Air traffic services authorities shall develop and promulgate contingency plans for implementation in the event of disruption, or potential disruption, of air traffic services and related supporting services in the airspace for which they are responsible for the provision of such services. Such contingency plans shall be developed with the assistance of ICAO MID as necessary, in close coordination with the air traffic services authorities responsible for the provision of services in adjacent portions of airspace and with airspace users concerned. The States contingency plans should be supported by contingency agreements with adjacent ACCs as well as regional arrangements.

2.2 The responsibility for appropriate contingency action in respect of airspace over the high seas continues to rest with the State(s) normally responsible for providing the services until, and unless, that responsibility is temporarily reassigned by ICAO to (an)other State(s).

2.3 Similarly, the responsibility for appropriate contingency action in respect of airspace where the responsibility for providing the services has been delegated by another State continues to rest with the State providing the services until, and unless, the delegating State terminates temporarily the delegation. Upon termination, the delegating State assumes responsibility for appropriate contingency action.

2.4 States are reminded of their obligations under Annex 11, to conduct a safety risk assessment and implement appropriate risk mitigation measures to achieve the best arrangements which will avoid hazards to civil aircraft. Operators are reminded of their obligations under Annex 6 — Operation of Aircraft, to conduct a safety risk assessment and take appropriate risk mitigation.

Note 1: *when conducting safety risk assessments in accordance with Annex 11, para 2.19, coordination should include information that is as specific as possible regarding the nature and extent of threats and their consequences for civil aviation. All parties involved need to ask, and answer, sufficient and correctly phrased questions to enable them to complete a thorough safety risk assessment. For example, the stated risk from an anti-aircraft weapon may be initially given in terms of the threat range as understood from the point of view of effective defence; the range at which the weapon could pose an accidental threat to civil aviation may be greater.*

Note 2: *States shall take into consideration the following ICAO provisions and requirements as well as their national regulations to conduct safety assessment:*

- *Annex 6 (Operation of Aircraft);*
- *Annex 11 (Air Traffic Services);*
- *Doc 9554 (Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations);*
- *Doc 9859 (Safety Management Manual (SMM)).*
- *State Safety Programme (SSP)*
- *ANSPs Safety Management Manual (SMM)*

2.5 Time is essential in contingency planning if hazards to air navigation are to be reasonably prevented. Timely introduction of contingency arrangements requires decisive initiative and action, which again presupposes that contingency plans have, as far as practicable, been completed and agreed among the parties concerned before the

occurrence of the event requiring contingency action, including the manner and timing of promulgating such arrangements. Based on that States should take preparatory action, as appropriate, for facilitating timely introduction of contingency arrangements. Such preparatory action should include:

a) preparation of ***general contingency plans*** for introduction in respect of generally foreseeable events affecting the provision of air traffic services. States providing services in airspace over the high seas should take appropriate action to ensure that adequate air traffic services will continue to be provided to international civil aviation operations. Also States providing air traffic services in their own airspace or, by delegation, in the airspace of (an)other State(s) should take appropriate action to ensure that adequate air traffic services will continue to be provided to international civil aviation operations concerned, which do not involve landing or take-off in the State(s) affected by contingency situation;

b) ***assessment of risk*** to civil air traffic due to military conflict or acts of unlawful interference with civil aviation as well as a review of the likelihood and possible consequences of natural disasters, totally/partially CNS failure/degradation including GNSS vulnerabilities and Cybersecurity attack or public health emergencies. Preparatory action should include initial development of special contingency plans in respect of the above circumstances that are likely to affect the availability of airspace for civil aircraft operations and/or the provision of air traffic services. It should be recognized that avoidance of particular portions of airspace on short notice will require special efforts by States responsible for adjacent portions of airspace and by international aircraft operators with regard to planning of alternative routings and services, and the air traffic services authorities of States should therefore, as far as practicable, endeavour to anticipate the need for such alternative actions;

Note 1*: in order to develop the required contingency plan and respective safety assessment matrix in term of likelihood and severity for provision of air traffic services, States shall take into consideration the nature and frequency of contingency situations have been occurred in their ATS unit during last 5 years.*

Note 2*: to reduce impact of CNS equipment failure or degradation on air traffic operation and ATS, States shall ensure that the required equipment and backup in accordance with the requirements of ICAO Annex 10 (Aeronautical Telecommunications) and Doc 9613 (Performance-based Navigation (PBN) Manual), ICAO Doc 9849 (Global Navigation Satellite System (GNSS) Manual) and ICAO Cybersecurity Policy Guidance are in place and operational.*

Note 3*: States shall assess the contingency readiness of their operations and provide the information resulting from this assessment to the ICAO MID Regional Office and CCT meeting.*

Note 4: *processes should be implemented to ensure the outcomes of any testing, pre-activation or activation of a contingency plan or any contingency exercise are reviewed and analysed. accordingly, lessons learned shall be incorporated in contingency procedures and ATCOs training manual.*

Note 5*: the State shall be responsible for ensuring that its ATM contingency plan comply with the SSP requirements.*

Note 6: *States should include in their contingency plans provisions related to the spread of communicable diseases such as COVID-19, based on the ICAO guidance related to the Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA). In this respect, the success story related to Qatar Civil Aviation Authority (QCAA) is at* ***Attachment A****.*

Note 7: *the required guideline to deal with GNSS vulnerabilities and Cybersecurity attack are at* ***Appendix D*** *(RASG-MID SAFETY ADVISORY – 14 (RSA-14) April 2019) and* ***Appendix E*** *(Cybersecurity Policy Guidance) respectively.*

c) ***monitoring*** of any developments that might lead to events requiring contingency arrangements to be developed and applied. States should consider designating persons/administrative units to undertake such monitoring and, when necessary, to initiate effective follow-up action;

d) ***designation/establishment of a central agency and focal point*** which, in the event of disruption of air traffic services and introduction of contingency arrangements, would be able to provide, 24 hours a day, up-to-date information on the situation and associated contingency measures until the system has returned to normal. A coordinating team should be designated within, or in association with, such a central agency for the purpose of coordinating activities during the disruption;

e) ***proactively nominate State focal point(s) to ICAO MID*** who will be responsible and accountable for informing ICAO MID in case of a contingency raised at that FIR, actively participate in the regional CCT meeting and update the meeting regarding progress of contingency and committed to carry out required follow up on decisions taken in CCT meetings with national and regional stakeholders;

f) State should ***periodically review its national contingency plan*** and coordinate any amendments with neighbouring States and ICAO MID Office; and

g) States are required to carry out ***recurrent training*** such as provision of procedural control services annually for ATCOs, in order to maintain their competency to deal with variety of contingency situation like ATS surveillance failure.

Note: *MIDANPIRG 19 meeting encouraged the MID States and ANSPs to maximize the use of realistic simulation to mitigate ATCOs skill fadeout.*

2.6 During the contingency operations, States concerned should take necessary measures to grant special over flight permissions to those flights avoiding the affected airspace.

State contingency plan and structure

2.7 The various circumstances surrounding each contingency situation preclude the establishment of exact detailed procedures to be followed. The outlines here in and in ***Appendices A*** & ***B*** are intended as a general guide to MID states to develop their own national contingency plan.

Basic Plan Elements

2.8 The plan includes BPEs, which define the minimum recommended considerations for inclusion in Levels 1, 2 and 3 Contingency Plans. The BPEs should include procedures and equipment related to administration, ASM, ATM, Pilot/Operator, CNS, aeronautical support services (AIS, NOTAM and MET), as well as related contact details. ***Appendix F*** of this document lists the required BPE.

Contingency Plan Coordination and Operations meetings

2.9 Each State should establish an ATM contingency Central Coordinating Committee (CCC) meeting for the development, maintenance, activation and conduct of contingency plans (level 1, 2 & 3), and for the forming and convening of an ATM Operational Contingency Group(s) (AOCG) meeting.

Note*: States may set up an appropriate Committee and a Group with different names.*

2.10 Representatives from all relevant authorities including regulatory, military, meteorological as well as representatives of AUs, ANSP, airports should be part of CCC meeting.

Note: *as a result of the contingency, an aircraft that is flying over contingency airspace may "deviate significantly from its intended track" or "reports that it has been lost" or "has been observed or reported to be operating in a given area but whose identity has not been established". In this respect, adjacent FIRs should take into consideration*

that "strayed" and "unidentified aircraft" may be reported at their respective FIRs. To handle this circumstance in the most safe and efficient manner, States are required to develop coordination procedure with relevant military authority and follow procedure in ICAO Doc 4444, paragraph 15.5.1.

2.11 The AOCG meeting should be convened by the CCC with a primary responsibility to oversee the day-to-day operations under the contingency arrangements, and coordinate operational ATS activities, 24 hours a day, throughout the contingency period. The ToRs of the AOCG will be determined by the CCC. The AOCG meeting should include any necessary specialist input from ATM (ATS, ASM, ATFM), CNS, MET, AIM, AGA SAR and SMS.

2.12 The ToR of the AOCG should be developed for contingency plans (level 1, 2 & 3) not only cover, but also be extended to:

a) review and update of the Contingency Plan as required;
b) organize contingency teams in each of the specialized areas listed under 2.11;
c) keep in contact with and update all affected airspace and AUs and other relevant stakeholders;
d) exchange up-to-date information with the adjacent ATS authorities concerning contingency activities;
e) notify the designated organizations of the contingency situation in advance and/or as soon as possible thereafter;
f) take necessary action for issuing NOTAMs in accordance with the contingency plan or as otherwise determined by CCT. Where the contingency situation is sufficiently foreseeable the relevant notification should be issued at least 48 hours in advance of the contingency events; and
g) liaise with the ICAO MID Regional Office and CCT through accredited focal point.

Level 1 (Domestic) Plans

2.13 Level 1 contingency plans for Category A, B and C events, conforming with the principles and including the Basic Plan Elements of the Regional ATM Contingency Plan, should be developed and implemented for all ATS units.

2.14 Performance-based training and procedures for response to ATM contingency operations for all staff providing related ATS, including ATC, FIC, AIS, Aeronautical Telecommunication and CNS equipment maintenance staff should be developed and regular inter-unit coordinated exercises of all Level 1 contingency plans should be implemented.

Level 2 Contingency Arrangements

2.15 Level 2 contingency arrangements should be formalized for all cases where the pre- activation or activation of a Level 1 contingency plan would impact upon ATS within the Area of Responsibility (AoR) of a neighboring State.

2.16 These arrangements should include procedures for the tactical definition and promulgation by NOTAM of contingency ATS routes and levels, if required, to avoid airspace affected by Category B conditions with proper coordination with relevant adjacent FIR(s) and ICAO MID Office.

Level 3 Contingency Plans

2.17 Each State shall establish and publish its ATM Contingency Plan to comply with Annex 11 SARPs and regional agreements. All States providing ATS in the MID Region shall submit their Level 3 ATM contingency plan to the ICAO MID Regional Office, to then be published in ICAO MID and State websites repository for such purpose. A template for Level 3 contingency plans is provided in ***Appendix B***.

Note: *notification, by NOTAM, of anticipated or actual disruption of air traffic services and/or related supporting services should be dispatched to users of air navigation services as early as practicable. The NOTAM should include the associated contingency arrangements. In the case of foreseeable disruption, the advance notice should in any case not be less than 48 hours.*

States Focal Points

2.18 The List of the MID States ATM contingency focal points is at ***Appendix G***. In case of changes in their focal point or contact details, the States shall be responsible for notifying ICAO MID through the official channel. Also, this list should be reviewed and updated, as appropriate at least once a year through ATM SG meetings.

States contingency notification and publication

2.19 Based on paragraph 1.5, the status of contingency event in terms of level and category shall be assessed by relevant State to cascade the information to ICAO MID and other stakeholders through the legitimate channels.

2.20 In the worst-case scenario (level 3, category C), it is likely that the relevant ACC would be able to broadcast on appropriate frequencies that contingency procedures have been initiated before evacuation. In this circumstance, in conformity with regional and national contingency plans the relevant States should notify the appropriate authorities in adjacent FIRs and ICAO MID.

Note: *State contingency plan shall include an authorization to ICAO MID Regional Office to activate the plan and CCT on its behalf upon confirmation received from the State focal point refer to* ***Appendix G*** *that the provision of ATS is subject to significant degradation or disruption which is necessary to perform the expected level of services.*

2.21 For the broadcast of an evacuation warning on appropriate frequencies, it should be communicated in the form of following:

"Emergency evacuation of [ATC unit]) is in progress. No air traffic control service will be provided by [ATC unit]. Use extreme caution and monitor [control frequencies], emergency frequencies and air to air frequencies. Contact the next air traffic control unit as soon as possible".

2.22 Where State is unable to issue the required NOTAM, in accordance with its contingency agreement with adjacent FIRs, an alternative adjacent FIR acting on behalf of the State will issue the required NOTAM after notification has been received through legitimate channel.

2.23 Details of contingency Track Orientation Scheme (TOS) and associated Flight Level Allocation Scheme (FLAS) related to contingency plans (level 1, 2 & 3) shall be published in the State AIP Section ENR 3.5.

2.24 Relevant sections of contingency plans (level 1, 2 & 3) that may have an effect on international flights should be made available on the public internet website of the State/ANSP, and the hyperlink provided to ICAO MID Regional Office for inclusion in the MID Region ATM Contingency Plan.

2.25 State national ATM contingency plans (Level 3) should be published on both website of the State/ANSP as well as ICAO MID region.

Note 1: *information of a sensitive nature such as that related to matters of national security need not be included in published contingency plans.*

Note 2: *air navigation deficiencies may be raised against the provisions of Annex 11 for States that do not publish their own national contingency plan and related agreement with adjacent FIRs and fail to report promulgation of their national ATM contingency plan to MID Office.*

2.26 ASHTAM specifying alternate routing or other ATFM measures related to a volcanic eruption or volcanic ash cloud should be issued separately from the ASHTAM issued in accordance with Annex 15, 5.4.2 and Doc 10066, 5.2.5, 5.4.2, Appendices 3, 5 and 7.

Status Reporting of State ATM Contingency Plans

2.27 States shall report the status of their contingency planning to the ICAO MID Regional Office, as follows:

a) promulgation of the national ATM Contingency Plan, together with the hyperlink to the website location of the Plan, or a copy of the approved contingency plan;

b) State Contingency Points-of-Contact; and

c) the establishment of contingency arrangements and agreements with each adjacent FIR.

2.28 States shall report the status of implementation of the performance expectations of their ATM contingency plan at least once annually, by 31 September each year to ICAO MID for review by ATM SG meeting.

CHAPTER 3

ICAO ROLE AND COMMON REGIONAL PROCEDURES

General

3.1 ICAO MID will initiate and coordinate appropriate contingency action in the event of disruption of air traffic services and related supporting services affecting international civil aviation operations provided by a State wherein, for some reason, the authorities cannot adequately discharge the responsibility referred to in 1.1. In such circumstances, ICAO MID will work in coordination with States responsible for airspace adjacent to that affected by the disruption and in close consultation with other related ICAO office(s) and international organizations concerned. ICAO will also initiate and coordinate appropriate contingency action(s) at the request of States which has been agreed by CCT meeting.

3.2 ICAO will be available for monitoring developments that might lead to events requiring contingency arrangements to be developed and applied and will, as necessary, assist in the development and application of such arrangements. During the emergence of a potential crisis, a CCT will be established in the ICAO MID and at ICAO Headquarters, and arrangements will be made for competent staff to be available or reachable 24 hours a day. The tasks of these teams will be to monitor continuously information from all relevant sources, to arrange for the constant supply of relevant information received by the State AIS at the MID States and Headquarters, to liaise with international organizations concerned and their regional organizations, as appropriate, and to exchange up-to-date information with States directly concerned and States which are potential participants in contingency arrangements. Upon analysis of all available data, permission for initiating the action considered necessary in the circumstances will be obtained from the State(s) concerned.

3.3 ICAO MID office is responsible to:

a) assess conformity of States national contingency plans with MID region ATM contingency plan;

b) monitor the status of MID States' Contingency Plans and agreement with adjacent FIRs as presented in ***Appendix H***;

c) act as the Secretariate of the CCT;

d) conduct post-implementation review to identify what needs to be improved for the future;

e) carry out periodically communication drills and other simulation exercises to rehearse response to contingency scenarios;

f) keep up to date the list of MID region ATM contingency focal point contact details at ***Appendix G***;

g) periodically conduct ATS route network gap analysis;

h) keep up to date the list of MID main regional routing options at ***Appendix C***;

i) develop regional DME/DME and Surveillance coverages respectively at ***Attachments B*** and ***C*** as the additional safety net to support operation of air traffic during GNSS vulnerabilities.

Note*: based on MIDANPIRG Conclusion 20/50, States are encouraged to share Surveillance data with adjacent FIRs.*

j) provide update information in to CCT meeting and prepare required report to ATM SG.

3.4 The ICAO MID Regional Office will coordinate with ICAO HQ and the concerned Regional Offices regarding any amendment related to the Regional Contingency Plan.

3.5 ICAO MID contingency plan, MID States contingency plan Level 3 as well as agreements are available to users through the ICAO MID website https://www.icao.int. In order to maintain the effectiveness of the plan, stakeholders are encouraged to provide the ICAO MID Regional Office (icaomid@icao.int) with their comments/suggestions and updates, on yearly basis.

Contingency Coordination Team (CCT)

Objectives and responsibilities

a) upon notification, activate the regional contingency arrangement;

b) enhance and expedite individual and regional response to contingencies or possible contingencies scenarios that may affect the ATS and all other activities related to ensuring that air transport operations can be maintained to provide continual ATS provision in the MID Region, identifying threats and communicating possible solutions;

c) liaise with States, international/regional organizations to support the exchange of information and improve the regional response to contingencies;

d) exchange information with international/regional organizations and humanitarian aid agencies such as Red Crescent and WFP;

e) exchange up-to-date information with States directly concerned and States which are potentially engaged in contingency arrangements;

f) review document prepared by the relevant States regarding safety and security assessment;

g) make the required consensus regarding actions and decision to be taken including but not limited to *development of contingency plan*, *development of Letter of Procedure*, *set date and time of implementation*, *content of required NOTAM* and etc.;

h) support the adequate implementation of the measures established in the individual contingency plans developed by CCT and monitor the progress of the contingency. The following valid, reliable and relevant information expected to be monitored, gathered and shared:

   i. information regarding any situation, condition or phenomena that may threat the safe and continuous provision of air traffic/air transport services in the MID Region;

   ii. possible and/or actual contingency measures, proposed or implemented;

   iii. relevant information from ATM, AIM, AGA, safety, security, etc.;

   iv. expected impact to operations;

   v. time and date of the beginning of the contingency measures;

   vi. airspace/airport availability for landing and overflying traffic and airspace to be avoided;

vii. availability of facilities and their limitation on provision of ATS;

viii. availability and status of contingency routes;

ix. status and availability of services by neighboring States/ATS units;

x. States progress reports and challenges to cover at least the following areas:

- status of hotspot areas;
- capacity constraints;
- status of CNS equipment and facilities;
- status of voice communication/coordination and data exchange with adjacent FIRs;
- changes to aeronautical publications; and
- any development having an impact on the implementation of the plan.

xi. procedures to be followed by airlines;

xii. feedback from humanitarian aid, including ability to provide aid, flight permissions, and status on the ground; and

xiii. any other details with respect to the disruption and actions being taken by aircraft operators.

Note: *to perform the requirement of the above item, IATA is responsible for providing the CCT with the required feedback from AUs.*

i) make a decision to deactivate CCT.

Note 1: *States which anticipate or experience disruption of air traffic services and/or related supporting services should advise, as early as practicable, the ICAO MID, and other States whose services might be affected. Such advice should include information on associated contingency measures or a request for assistance in formulating contingency plans.*

Note 2: *detailed coordination requirements agreed in CCT meeting should be reflected in the contingency plan, Letter of Procedure (LoP), agreement between States concerned to promulgate common NOTAM text at a commonly agreed effective date.*

Note 3: *notification, by NOTAM, of anticipated or actual disruption of air traffic services and/or related supporting services should be dispatched to users of air navigation services as early as practicable. The NOTAM should include the associated contingency arrangements. In the case of foreseeable disruption, the advance notice should in any case not be less than 48 hours.*

Note 4*: since State who is subject to contingency situation may encounter additional hidden challenges and shortcoming like degradation of ATCOs competency or CNS infrastructure, CCT shall take into account those requirements to develop recovery plan based on step-by step approach before terminating CCT activity.*

Note 5: *notification by NOTAM of discontinuance of contingency measures and reactivation of the services set forth in the regional plan should be dispatched as early as practicable to ensure an orderly transfer from contingency conditions to normal operation.*

Membership

3.6 A CCT should compose of members/focal points from the followings:

a) Core members

- ICAO (HQ and Regional Office(s)). MID ATM Officer will serve as the Secretary;
- IATA Africa & the Middle East (AME);
- States and ANSPs concerned ; and

b) Observers

- Other States, Regional and international Organizations, Agencies, Associations, when deemed necessary, as temporary members.

Activation

3.7 Activation of the MID CCT will be based on;

a) the relevant State requested directly to ICAO MID; or

b) recommendation from ICAO MID (feedback from IATA and States) which is confirmed by the concerned State.

Note 1: *the plan might be also activated in cases when airspace users decided to circumnavigate airspace(s) due to a perceived risk to the safety of flight with a minimum of disruption to flight operations caused by man-made or natural events, which might have negative impact on provision of ATS services on the relevant FIR i.e. CNS equipment failure (fully or partially) consequences not only decrease airspace capacity over that FIR, but also significantly increase and change the flow of the traffic in other airspace(s).*

Note 2: *the MID region main AUs shall inform IATA, when they have a plan to change significantly on their flow of traffic due to any reason highlighted in "Note 1". Accordingly, IATA should inform ICAO MID, if deemed necessary.*

Working methods

a) CCT will conduct at least one test activation or table-top exercise every year during the month of May (actual date to be determined based on availability of majority of participant members).

b) once activated, the CCT will be conducted based on decision taken by previous meeting.

c) use the following for sharing/exchange of information.

i. e-mail notification;
ii. daily teleconferences, if required;
iii. bulletin (in case of significant changes); and
iv. CCT summary of discussion.

Contingency Plan

3.8 Development of a contingency plan is dependent upon circumstances, including the availability, or not, of the airspace affected by the disruptive circumstances for use by international civil aviation operations. Sovereign airspace can be used only on the initiative of, or with the agreement or consent of, the authorities of the State concerned regarding such use. Otherwise, the contingency arrangements must involve bypassing the airspace and should be developed by adjacent States or by ICAO in cooperation with such adjacent States. In the case of airspace over the high seas or of undetermined sovereignty, development of the contingency plan might involve, depending upon circumstances, including the degree of erosion of the alternative services offered, temporary reassignment by ICAO of the responsibility for providing air traffic services in the airspace concerned.

Note: *a contingency plan should be acceptable to providers and users of contingency services alike, i.e. in terms of the ability of the providers to discharge the functions assigned to them and in terms of safety of operations and traffic handling capacity provided by the plan in the circumstances.*

3.9 Development of a contingency plan presupposes as much information as possible on current and alternative routes, navigational capability of aircraft and availability or partial availability of navigational guidance from ground-based aids, surveillance and communications capability of adjacent air traffic services units, volume and types of aircraft to be accommodated and the actual status of the air traffic services, communications, meteorological and aeronautical information services. The principles and requirements in ***Appendix A*** should be considered for development of any contingency plan.

CHAPTER 4

ATM VOLACANIC ASH CONTINGENCY PLAN

4.1 The MID Region ATM Volcanic Ash Contingency Plan (MID ATM VACP) was developed based on the VACP prepared by the International Volcanic Ash Task Force (IVATF) in August 2012. The MID ATM VACP sets out standardised guidelines and procedures for the provision of information to airlines and en-route aircraft before and during a volcanic eruption. The plan and its appendices are at ***Attachment D*** to this Document.

4.2 The MID ATM VACP includes the pre-eruption, start of eruption, ongoing; and recovery phases. It is to be highlighted that most MID States would practice the ongoing and recovery phases only as the pre-eruption and start of eruption phases would only apply to the States where volcanoes erupt. Furthermore, the MID Region would receive volcanic ash advisories and volcanic ash advisories in graphic form from the Volcanic Ash Advisory Center (VAAC) Toulouse.

4.3 Volcanic contamination, of which volcanic ash is the most serious, is a hazard for safe flight operations. Mitigating the hazards posed by volcanic ash in the atmosphere and/or at the aerodrome cannot be resolved in isolation but through collaborative decision making (CDM) involving all stakeholders concerned. During an eruption, volcanic contamination can reach and exceed the cruising altitudes of turbine-powered aircraft within minutes and spread over vast geographical areas within a few days. Encounters with volcanic ash may result in a variety of hazards including one or more of the following:

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

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

c) windscreens rendered partially or completely opaque;

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

e) the erosion of external and internal aircraft components;

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

g) the aircraft may have to be manoeuvred in a manner that conflicts with other aircraft; and

h) volcanic ash deposition on a runway may degrade aircraft braking performance, most significantly if the volcanic ash is wet; and in extreme cases, this can lead to runway closure.

4.4 Operators are required by ICAO Annex 6 – Operation of Aircraft to implement appropriate mitigation measures for volcanic ash in accordance with their safety management system (SMS), as approved by the State of the Operator/Registry. The guidelines provided in the MID ATM VACP document assume that the ICAO requirements regarding safety management systems have been implemented by the operators. Detailed guidance on Safety Risk Assessments (SRAs) for flight operations with regard to volcanic ash contamination can be found in the manual on Flight Safety and Volcanic Ash – Risk Management of Flight Operations with Known or Forecast Volcanic Ash Contamination (ICAO Doc 9974).

4.5 Based on the above, States' regulatory provisions and arrangements should be reviewed to ensure that, in accordance with the guidance provided in ICAO Doc 9974:

a) aircraft operators are to include in their SMS an identifiable safety risk assessment for operations into airspace forecast to be, or at aerodromes known to be, contaminated with volcanic ash; and

b) safety oversight procedures are used for the evaluation of operators' capability to conduct flight operations safely into airspace forecast to be, or aerodromes known to be, contaminated with volcanic ash.

4.6 Distribution of applicable Aeronautical Information Services (AIS) and Meteorological (MET) messages related to volcanic ash are set out in relevant ICAO Annexes, specifically Annex 15–Aeronautical Information Services and Annex 3 – Meteorological Service for International Air Navigation.

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

4.8 Some aircraft types or engine technologies are more vulnerable to volcanic ash contaminants than others; therefore, any specific mitigation measures to be applied would have to take into account any such variance. Considering that a commercial aircraft travels about 150 km (80 NM) in 10 minutes and that volcanic ash can rise to flight levels commonly used by turbine-engine aircraft in half that time, a timely response to volcanic eruptions and volcanic ash in the atmosphere is essential.

4.9 It is imperative that information on the volcanic activity is disseminated as soon as possible. In order to assist staff in expediting the process of originating and issuing relevant AIS and MET messages, a series of templates should be available for different stages of the volcanic activity. For the list of ICAO registered volcanoes see the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (ICAO Doc 9691). Volcanoes name, number and nominal position should be available at the State's International NOTAM office. Volcanic ash exercises (VOLCEX) should be conducted at a frequency determined by the ICAO Region concerned, in order to ensure the smooth implementation and effectiveness of the contingency plan in case of an actual volcanic eruption.

4.10 This document has been prepared and is in line with a proposal for amendment to the Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444) paragraph 15.8 Procedures for an ATC unit when a volcanic ash cloud is reported or forecast — which is expected to become applicable in November 2014.

4.11 Also based on the above reference, States' airspace and airport management policies and procedures should be reviewed to ensure that:

a) Airspace affected by volcanic ash cloud should not be 'closed'.

b) Specification in ASHTAM of alternate routing or other ATFM measures to manage airspace constraints arising from volcanic ash cloud should be solely for the purpose of ensuring the predictability and regularity of air traffic and should be based on an assessment of capacity and demand in airspace affected by volcanic ash and/or by aircraft avoiding the volcanic ash cloud.

c) ASHTAM specifying alternate routing or other ATFM measures related to a volcanic eruption or volcanic ash cloud should be issued separately from the ASHTAM issued in accordance with Annex 15, 5.4.2 and Doc 10066, 5.2.5, 5.4.2, Appendices 3, 5 and 7.

d) Aerodromes should only be closed by NOTAM for periods of observed volcanic ash contamination of the surface of the aerodrome movement area.

e) Airport capacity limitations of alternate aerodromes, including apron capacity, should be considered, and recommendations for the use of other alternates considered for inclusion in ASHTAM as mentioned in c, above.

f) If required by State regulations, any declaration of a Danger or Restricted Area should be confined to the pre-eruptive or erupting volcano and the area containing its forecast or observed ejecta.

4.12 General considerations during the development of an ATM contingency plan for volcanic ash and anticipated flight crew issues when encountering volcanic ash are provided in Appendices A and B, respectively.

APPENDIX A

ATM CONTINGENCY PLANNING PRINCIPLES AND REQUIREMENTS

A.1 All ATS units should have a Level 1 Contingency Plan to ensure the safe transit of international traffic in the event of disruption or withdrawal of ATS, or unsafe airspace conditions.

A.2 The overriding principle is that safety has primacy over efficiency and optimal levels and routes.

A.3 Contingency operations over the concerned airspace will necessitate lower than airspace capacity to ensure safety.

Note 1: *collaborative ATFM measures should be the first priority response to Category A events, and for the management of deviating traffic during Category B and C events.*

Note 2*: amended ATS routes, whether published or promulgated Ad hoc, may be prescribed as part of the ATFM response to expected demand and capacity imbalance caused by contingency events.*

A.4 Reassignment of responsibility for providing air traffic services in airspace over the high seas or in delegated airspace should be considered.

A.5 If the State is not able to issue the required NOTAM(s), the relevant authority of this State shall agree with adjacent FIR under MoU to publish required NOTAM on its behalf in accordance with ICAO provisions in Annex 15.

A.6 System and ATC service redundancy is the most effective contingency capability.

A.7 All Contingency Plans should define the following where applicable:

a) re-routing of traffic to avoid the whole or part of the airspace concerned, normally involving establishment of additional routes or route segments with associated conditions for their use such as implementation of FLAS, if required;

Note 1: *establishment of a simplified route network such as unidirectional route through the airspace concerned together with a FLAS is highly recommended.*

Note 2: *contingency FLAS planning should include consideration of allocating the optimum flight levels to routes used by long haul aircraft, depending on the traffic density on the route, wherever practicable.*

b) provisions for tactical definition and coordination of additional routes/FLAS and priority for access to accommodate selected non-scheduled operations such as humanitarian, medical, evacuation, Red Cresent and WFP;

c) priority determination for routine scheduled and non-scheduled flights;

d) define ground and airborne navigation requirements if necessary;

Note*: the aircraft minimum operational requirement to operate over contingency airspace should include procedures to "display navigation and anti-collision lights", "transponders set on a discrete code assigned by ATC or, if code not assigned, select code 2000", "apply Strategic Lateral Offset Procedures (SLOP) (PANS-ATM, paragraph 16.5)",*

"ACAS operational and pilot watch for conflicting traffic both visually and by reference to ACAS" and if agreed by CCT meeting, "keep ADS-B operational" at all times;

e) specified minimum longitudinal separation between consecutive aircraft entering the contingency airspace;

***Note 1**: to maintain an increased agreed longitudinal separation, aircraft needs to maintain assigned speed, during entire flight within contingency airspace except in cases of emergency.*

***Note 2**: emergency and weather deviation descent procedures are contained in ICAO Doc 4444, paragraph 15.1.4 and paragraph 15.2.4 respectively.*

***Note 3:** contingency ATS routes should provide minimum lateral separation of 80 NM between aircraft that are not vertically separated under a FLAS, except where CCT upon safety assessment agreed to implement reduced lateral separation specified in ICAO Doc 4444.*

***Note 4:** States and CCT should specify any necessary buffers to minimum lateral separation requirements where meteorological phenomena may require aircraft to deviate from the ATS route to maintain flight safety. Information on the buffers should be provided in operational information provided on pre-activation or activation of the contingency plan.*

***Note 5:** minimum longitudinal spacing between aircraft operating on the same contingency route and not vertically separated should be 15 minutes or 120 NM. However, this may be reduced to 10 minutes or 80 NM in conjunction with application of the Mach number technique where authorized by the relevant authority and agreed in the LoA or CCT arrangement.*

f) contingency communication arrangements including means of communication within contingency airspace (Air - Ground and Ground – Ground) and communications transfer arrangements for aircraft entering and leaving the airspace;

***Note**: communication arrangements should include procedure for aircraft to maintain continuous listening watch on specified VHF frequencies in specified areas where air-ground communications are uncertain or non-existent as well as requirement for pilots to continuously guard the IATA In-flight Broadcast Procedure (IFBP).*

g) details of delegation of ATS arrangements (if any); and

h) contingency points of contact.

A.8 Level 2 Contingency Arrangements (arrangements between neighboring FIRs) should be included in bi-lateral or multi-lateral agreements between States in all cases where activation of any Level 1 Contingency Plan will impact upon a neighboring State's ATS Unit.

A.9 Level 1 Contingency Plans should include, either in detail or by reference, any relevant Level 2 Contingency Arrangements.

A.10 Close cooperation between neighboring FIRs, together with supporting mechanisms for the tactical definition and promulgation of contingency routes for the avoidance of Category B and C is essential.

A.11 Contingency ATS routes should be published in State AIP to permit the storing of route details in AUs' navigation databases.

A.12 State appropriate ATS authority or CCT should redefine classification of the airspace which is subject to contingency operation.

A.13 Alternate aerodromes should be specified where necessary in Level 1 contingency plans for airport control towers and terminal airspace.

A.14 The adjacent contingency FIRs should take into consideration that “strayed” and “unidentified aircraft” may be reported at their respective FIRs. To handle this circumstance, States are required to develop coordination procedures with relevant military authority and follow procedure in ICAO Doc 4444, paragraph 15.5.1.

A.15 States and ANSPs are required to maximize the use of realistic simulation to mitigate ATCOs skill fadeout.

A.16 Airspace affected by volcanic ash cloud should not be closed to international civil aviation.

A.17 Closure of airports affected by volcanic ash deposition should be supported by a safety assessment conducted in collaboration between airport operator, aircraft operators and the ANSP, in accordance with their respective SMS.

APPENDIX B

CONTINGENCY PLAN TEMPLATE

OBJECTIVE

B.1 This contingency plan contains arrangements to ensure the continued safety of air navigation in the event of partial or total disruption of ATS and is related to ICAO Annex 11- *Air Traffic Services*. The contingency plan should be designed to provide alternative routes, using existing airways in most cases, which will allow aircraft operators to fly through or avoid airspace which is subject to contingency.

AIR TRAFFIC MANAGEMENT

ATS Responsibilities

B.2 Tactical ATC considerations during periods of overloading may require re-assignment of routes or portions thereof.

B.3 Alternative routes should be designed to maximize the use of existing ATS route structures and CNS services.

***Note**: airspace should be designed in a way to minimize potential confliction of different traffic flows. In doing so, the establishment of unidirectional route as well as implementation of FLAS might be required.*

B.4 In the event that ATS cannot be provided within designated FIR or portion thereof, the State with coordination of ICAO MID, adjacent FIRs and if required, CCT shall publish the corresponding NOTAM/ASHTAM indicating the following:

a) time and date of the beginning of the contingency measures;

b) airspace available for landing and overflying traffic, and airspace to be avoided;

c) details of the facilities and services available or not available and any limits on ATS provision (e.g., ACC, Approach (APP), Tower (TWR) and Flight Information Service (FIS)), including an expected date of restoration of services if available;

d) information on the provisions made for alternative services;

e) ATS contingency routes;

f) procedures to be followed by adjacent ATS units;

g) procedures to be followed by pilots; and

h) any other details with respect to the disruption and actions being taken that aircraft operators may find useful.

B.5 If the State is not able to issue the required NOTAM(s), the relevant authority of this State shall agree with adjacent FIR under MoU to publish required NOTAM on its behalf.

Separation

B.6 Separation criteria will be applied in accordance with the Procedures for Air Navigation Services in ICAO Doc 4444 as well as decision that may be taken by CCT meeting.

Level Restrictions

B.7 Where possible, aircraft on long-haul international flights shall be given priority with respect to cruising levels.

Other measures

B.8 Other measures related to the closure of airspace and the implementation of the contingency scheme in the relevant FIR may be taken as follows:

a) suspension of all VFR operations;

b) delay or suspension of general aviation IFR operations; and

c) delay or suspension of commercial IFR operations.

TRANSITION TO CONTINGENCY SCHEME

B.9 During times of uncertainty when airspace closures seem possible, aircraft operators should be prepared for a possible change in routing while en-route, familiarization of the alternative routes outlined in the contingency scheme as well as what may be promulgated by a State via NOTAM, AIC, SUP or AIP.

B.10 In the event of airspace closure that has not been promulgated, ATC should, if possible, broadcast to all aircraft in their airspace, what airspace is being closed and stand by for further instructions.

B.11 ATS providers should recognize that when closures of airspace or airports are promulgated, individual airlines might have different company requirements as to their alternative routings. ATC should be alerted to respond to any request by aircraft and react commensurate with safety.

TRANSFER OF CONTROL AND COORDINATION

B.12 The transfer of control and communication between ATS units should be at the common FIR boundary unless there is mutual agreement between adjacent ATS units. ATS providers should also review current coordination requirements in light of contingency operations or short notice of airspace closure.

PILOTS AND OPERATOR PROCEDURES

B.13 Pilots need to be aware that in light of current international circumstances, a contingency routing requiring aircraft to operate off of normal traffic flows, could result in an intercept by military aircraft. Aircraft operators must therefore be familiar with international intercept procedures contained in ICAO Annex 2 –Rules of the Air, paragraph 3.8 and Appendix 2, Sections 2 and 3.

B.14 Pilots need to continuously guard the VHF emergency frequency 121.5 MHz and should operate their transponder at all times during flight, regardless of whether the aircraft is within or outside airspace where

Secondary Surveillance Radar (SSR) is used for ATS purposes. Transponders should be set on a discrete code assigned by ATC or select code 2000 if ATC has not assigned a code.

***Note**: additional safety net such as implementation of IFBP or SLOP may be considered by CCT meeting during contingency situation.*

OVERFLIGHT PERMISSION

B.15 Aircraft operators should obtain overflight permission from States for flights operating through their jurisdiction of airspace, where required. In a contingency situation, flights may be rerouted at short notice and it may not be possible for operators to give the required advanced notice in a timely manner to obtain approval. States responsible for the airspace in which contingency routes are established should consider making special arrangements to expedite flight permission in these contingency situations.

CONTINGENCY UNIT

B.16 The ATM national contingency unit assigned the responsibility of monitoring developments that may dictate the enforcement of the contingency plan and coordination of contingency arrangements. The contact details of this unit shall include the followings:

Name of Agency:
Contact Person:
Telephone:
Fax:
Email:

B.17 During a contingency situation, the State designated focal point in national contingency unit will coordinate with the adjacent ATS units and liaise with the ICAO MID Regional Office as well as CCT as appropriate.

CONTINGENCY ROUTE AND LEVEL SCHEME

B.18 Aircraft operators should file their flight plans using the alternative contingency routes and levels in accordance with contingency NOTAM(s) in order to operate in the airspace which is subject to contingency measures.

B.19 All aircraft should establish and maintain contact on published VHF or HF frequencies with the relevant ATS units responsible for the airspace being traversed.

APPENDIX C

MID MAIN REGIONAL ROUTING OPTIONS

C.1 This Contingency Plan has been developed based on existing ATS routes and making use of appropriate contingency routes in the MID Region. Priority has been given to safety considerations and to ensuring that to the extent possible, ATC operations are not complicated. Temporary routes may be established where necessary.

Note 1: *these alternative routes including permanent and temporary as well as conditional route (CDR) are based mainly on the existing route network or established earlier for this purpose. Concerned States and CCT in consultation with AUs, might establish additional temporary routes to be able to accommodate extra traffic in a safe manner.*

Note 2: *regional ATS routes which are allocated for provision of service during contingency situation are available in ANP Volume II, Table I, ATS route table under the condition of "Note 5-CDR" which will be used during specified period by issuing required NOTAM.*

C.2 The contingency routings are designed to take into consideration that disruptions to normal traffic flows have the potential to create an additional burden and complexity to ATC. Therefore, temporary contingency routes would be designed to be safe and instantly manageable by ATC. This may require additional track miles to be flown by the aircraft operator.

Note*: it is recognized that operators may incur economic penalties during application of the contingency scenarios by imposing additional track miles or implementation of air traffic flow management measures when deemed necessary.*

C.3 The alternative routings were given "CR" designators based on various scenarios that may be implemented. It is to be highlighted that the scenarios drawn on the charts were developed based on the existing route network, and do not reflect new routes. Furthermore, one scenario could be used to avoid different FIRs, subject to users' requirements. The scenarios are detailed in the Table below:

CR	FIR(s) to be Avoided	Routing options	Remarks
CR 1	Amman, Beirut and Damascus	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Jeddah, Bahrain, Doha, UAE, Muscat, Karachi/Mumbai ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat ▪ Ankara, Tehran, Bahrain/Doha/UAE/Muscat ▪ Nicosia, Cairo, Jeddah, Bahrain, Doha, UAE, Muscat	
CR 2	Baghdad and Kuwait	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, Doha, UAE, Muscat, Karachi/Mumbai ▪ Tel Aviv, Amman, Jeddah, Bahrain, Doha, UAE, Muscat, Karachi/Mumbai ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Tehran, Bahrain/Doha/UAE/Muscat	

		▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, Doha, UAE, Muscat ▪ Tel Aviv, Amman, Jeddah, Bahrain, Doha, UAE, Muscat	
CR 3	Bahrain	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Amman, Jeddah, Doha, UAE, Muscat, Karachi/Mumbai ▪ Tel Aviv, Amman, Jeddah, Doha, UAE, Muscat, Karachi/Mumbai ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Tehran, Doha/UAE/Muscat ▪ Ankara, Baghdad, Kuwait, Doha, UAE and Muscat ▪ Nicosia, Cairo, Amman, Jeddah, Doha, UAE, Muscat ▪ Tel Aviv, Amman, Jeddah, Doha, UAE, Muscat ***Northeast Africa from/to Gulf States*** ▪ Cairo, Jeddah, Doha/UAE/Muscat ***Gulf States from/to APAC region*** ▪ Jeddah, Doha, Tehran, Karachi ▪ Jeddah, Doha, UAE, Muscat, Mumbai/Karachi	
CR 4	Doha	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, UAE, Muscat, Karachi/Mumbai ▪ Tel Aviv, Amman, Jeddah, Bahrain, UAE, Muscat, Karachi/Mumbai ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Tehran, Bahrain/UAE/Muscat ▪ Ankara, Baghdad, Kuwait, Bahrain, UAE and Muscat ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, UAE, Muscat ▪ Tel Aviv, Amman, Jeddah, Bahrain, UAE, Muscat ***Northeast Africa from/to Gulf States*** ▪ Cairo, Jeddah, Bahrain/UAE/Muscat ***Gulf States from/to APAC region*** ▪ Bahrain, Tehran, Karachi ▪ Bahrain, Jeddah, Muscat, Mumbai/Karachi	
CR 5	Cairo	***EUR/NAT region from/to Gulf States*** ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat ▪ Ankara, Tehran, Bahrain/Doha/UAE/Muscat ▪ Tel Aviv, Amman, Jeddah, Bahrain, UAE, Muscat ***Northeast Africa from/to EUR/NAT region*** ▪ Juba/Addis Ababa, Khartoum, Tripoli, Malta ▪ Juba, Khartoum, Jeddah, Amman, Tel Aviv ▪ Asmara, Jeddah, Amman, Tel Aviv ▪ Mogadishu/Djibouti/Addis Ababa, Sana'a, Jeddah, Amman, Tel Aviv ***North Africa from/to Gulf States and Asia*** ▪ N'djamena, Khartoum, Jeddah, Doha, UAE, Muscat, Mumbai ▪ Malta, Nicosia, Tel Aviv, Amman, Jeddah, Bahrain, Doha, UAE, Muscat, Mumbai	

CR 6	Tehran	***Northeast of Tehran FIR from/to Gulf States*** ▪ Turkmenbashi, Ashgabat, Turkmenabad, Kabul, Karachi, Muscat, UAE, Doha, Bahrain ▪ Baku, Yerevan, Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE, Muscat ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat ▪ Tel Aviv, Amman, Jeddah, Bahrain, Doha, UAE, Muscat ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, Doha UAE, Muscat ***EUR/NAT region from/to APAC region*** ▪ Ankara, Yerevan/Tbilisi, Baku, Turkmenbashi, Ashgabat ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat, Karachi/Mumbai ▪ Tel Aviv, Amman, Jeddah, Bahrain, Doha, UAE, Muscat, Karachi/Mumbai ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, Doha UAE, Muscat, Karachi/Mumbai ***Gulf States from/to APAC region*** ▪ Kuwait, Bahrain, Doha, UAE, Muscat, Mumbai/Karachi	
CR 7	Jeddah	***EUR/NAT region from/to Gulf States*** ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat ▪ Ankara, Tehran, Bahrain/Doha/UAE/Muscat ▪ Tel Aviv, Amman, Baghdad, Kuwait, Bahrain, Doha, UAE, Muscat ***EUR/NAT region from/to APAC region*** ▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, UAE and Muscat, Karachi/Mumbai ▪ Ankara, Tehran, Karachi ▪ Tel Aviv, Amman, Baghdad, Kuwait, Bahrain, Doha, UAE, Muscat, Karachi/Mumbai ***Northeast Africa from/to Europe*** ▪ Mogadishu, Sana'a, Asmara, Khartoum, Cairo, Nicosia/Athens ▪ Djibouti, Asmara, Khartoum, Cairo, Nicosia/ Athens ***Northeast Africa from/to APAC region*** ▪ Khartoum, Asmara, Sana'a, Mumbai ▪ Addis Ababa/Mogadishu, Sana'a, Mumbai ***South and east Africa from/to Gulf States*** ▪ Mogadishu/Addis Ababa, Sana'a, Muscat, UAE, Doha	
CR 8	Khartoum	***EUR/NAT region from/to Northeast Africa*** ▪ Nicosia/Athens, Cairo, Jeddah, Asmara ***Western Africa from/to Northeast Africa*** ▪ N'djamena/Brazzaville, Juba, Addis Ababa	
CR 9	UAE	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Amman, Jeddah, Muscat, Mumbai ▪ Tel Aviv, Amman, Jeddah, Muscat, Mumbai ***EUR/NAT region from/to Gulf States*** ▪ Ankara, Tehran, Bahrain/Doha/Muscat	

		▪ Ankara, Baghdad, Kuwait, Bahrain, Doha, Jeddah, Muscat ▪ Nicosia, Cairo, Amman, Jeddah, Bahrain, Doha, Muscat ▪ Tel Aviv, Amman, Jeddah, Bahrain, Doha, Muscat ***Northeast Africa from/to Gulf States*** ▪ Cairo, Jeddah, Bahrain, Doha, Muscat ***Gulf States from/to APAC region*** ▪ Bahrain, Doha, Tehran, Karachi ▪ Bahrain, Doha, Jeddah, Muscat, Mumbai/Karachi	
CR 10	Muscat	***EUR/NAT region from/to APAC region*** ▪ Ankara, Tehran, Kabul/Karachi ▪ Nicosia, Cairo, Amman, Jeddah, Sana'a, Mumbai ▪ Tel Aviv, Amman, Jeddah, Sana'a, Mumbai ***South and east Africa from/to Gulf States*** Mogadishu/Addis Ababa, Sana'a, Jeddah, Doha, UAE	
CR 11	Sana'a	***Northeast Africa from/to APAC region*** ▪ Khartoum, Asmara, Jeddah, Muscat, Mumbai ▪ Addis Ababa/Mogadishu, Mumbai ***Northeast Africa from/to Europe*** ▪ Djibouti, Asmara, Khartoum, Cairo, Nicosia/ Athens ***South and east Africa from/to Gulf States*** ▪ Addis Ababa, Asmara, Jeddah, UAE, Doha	
CR 12	Tripoli	***Western Europe from/to northeast Africa and Gulf States*** ▪ Malta, Cairo, Khartoum, Asmara/Addis Ababa/Juba ▪ N'djamena, Khartoum, Asmara/Addis Ababa/Jeddah, Doha, UAE, Muscat	

C.4 ICAO MID Office will proactively carry out the following actions based on the aforementioned CRs and taking into account the main flows of the MID region in line with the annual TDS and routing options reports submitted by MID States to MIDRMA.

a) periodically conduct ATS route network gap analysis; and
b) with participation of IATA, and MID States, prepare required proposal to ATM SG and ASM WG to develop MID ATS route network.

APPENDIX D

GNSS VULNERABILITIES

INTRODUCTION

D.1 GNSS supports positioning, navigation and timing (PNT) applications. GNSS is the foundation of Performance Based Navigation (PBN), automatic dependent surveillance – broadcast (ADS-B) and automatic dependent surveillance – contract (ADS-C). GNSS also provides a common time reference used to synchronize systems, avionics, communication networks and operations, and supports a wide range of non-aviation applications.

D.2 GNSS Vulnerability has been identified as a safety issue and one of the main challenges impeding the implementation of PBN in the MID Region. The MIDANPIRG/16Kuwait, 13-16 February 2017 recognized the impact of the GNSS signal interference and vulnerabilities and agreed that the subject should be addressed by the RASG-MID in order to agree on measures to ensure effective reporting of GNSS interferences, which could be mandated by the States' regulatory authorities. The meeting invited the RASG-MID to consider the development of a RASG-MID Safety Advisory (RSA) related to GNSS vulnerabilities, highlighting the Standard Operating Procedures (SOP) for pilots, including the reporting procedures.

D.3 The RASG-MID/6 (Bahrain, 26 – 28 September 2017) agreed that IATA and ICAO MID Office should develop a RSA on GNSS vulnerabilities.

D.4 With the increasing dependence on GNSS, it is important that GNSS vulnerabilities be properly addressed. This Safety Advisory provides guidance on set of mitigation measures that States would deploy to minimize the GNSS vulnerabilities impact on safety and air operation. The RSA also includes the regional reporting and monitoring procedures of GNSS anomaly with the aim to analyze the threat and its impact on performance and assess the effectiveness of the mitigation measures in place.

DESCRIPTION

D.5 Dependence on GNSS is increasing as GNSS is used for an ever-expanding range of safety, security, business and policy critical applications. GNSS functionality is being embedded into many parts of critical infrastructures. Aviation is now dependent on uninterrupted access to GNSS positioning, navigation and timing (PNT) services.

D.6 Aviation relies heavily on GNSS for area navigation and precision approach. Aircraft avionics such as the Flight Management Systems (FMS) require GNSS timing for a large number of onboard functions including Terrain Avoidance Warning System (TAWS) or Enhanced Ground Proximity Warning Systems (EGPWS). Onboard avionics are highly integrated on commercial aircraft and are very dependent on GNSS timing data. At the same time, GNSS vulnerabilities are being exposed and threats to denial of GNSS services are increasing.

D.7 There are several types of threat that can interfere with a GNSS receiver's ability to receive and process GNSS signals, giving rise to inaccurate readings, or no reading at all, such as radio frequency interference, space weather induced ionospheric interference, solar storm, jamming and spoofing. The disruption of GNSS, either performance degradation in terms of accuracy, availability and integrity or a complete shutdown of the system, has a big consequence in critical infrastructure. For example, local interference in an airport could degrade position accuracy or lead to a total loss of the GNSS based services, which could put safety of passengers in jeopardy.

D.8 There are two types of GNSS Interference Sources; Intentional and Unintentional sources, the latter is not considered a significant threat provided that States exercise proper control and protection over the electromagnetic spectrum for both existing and new frequency allocations. Solar Effect, Radio Frequency Interference and On-board systems are examples of Unintentional GNSS interference sources. However, the Intentional sources such as Jamming and spoofing are considered as serious threats to the continued safety of air transport.

D.9 GNSS Jamming occurs when broadcasting a strong signal that overrides or obscures the signal being jammed. The GNSS jamming might occur deliberately by a military activity or by Personal Privacy Devices (PPDs). GNSS jamming has caused several GNSS outages in the MID Region.

D.10 In some States, military authorities test the capabilities of their equipment and systems occasionally by transmitting jamming signals that deny GNSS service in a specific area. This activity should be coordinated with State spectrum offices, Civil Aviation Authorities and ANS providers. Military and other authorities operating jamming devices should coordinate with State/ANS providers to enable them to determine the airspace affected, advise aircraft operators and develop any required procedures.

D.11 Spoofing is another source of intentional GNSS Interference, which is a deliberate interference that aims to mislead GNSS receivers into general false positioning solution.

D.12 Detailed information about the GNSS Implementation and Vulnerabilities can be found in MID DOC 010 – The Guidance on GNSS implementation in the MID Region.

RISK ASSESSMENT

D.13 The risk assessment covers affected operations during en-route, terminal, and approach phase of flights. In addition, the aircraft impact at table (1), which presents an overview of different potential impacts from GNSS interference, needs to be considered for risk assessment.

D.14 Understanding the different types of threat and how likely they are to occur is key to conducting an accurate risk assessment. Broadly, the threat types break down as follows:

Threat Source	Threat Category	Description	Impact on the User
Solar Storms	Unintentional	Electromagnetic interference from solar flares and other solar activity "drowns out" the satellite signals in space.	Loss of signal, or range errors affecting the accuracy of the location or timing information.
Jamming	Intentional	Locally-generated RF interference is used to "drown out" satellite signals.	Loss of signal (if the jammer is blocking out all satellite signals) or range errors affecting the accuracy of the location or timing information.
Spoofing	Intentional	Fake satellite signals are broadcast to the device to fool it into believing it is somewhere else, or at a different point in time.	False location and time readings, with potentially severe impacts on automated and autonomous devices and devices that rely on precise GNSS timing.
RF Interference	Unintentional	Noise from nearby RF transmitters (inside or outside the device) obscures the satellite signals.	Loss of signal (if the transmitter is blocking out all satellite signals) or range errors affecting the accuracy of the location reading (if the receiver is at the edge of the transmitter's range).

Signal Reflection	Unintentional	Reflection due objects such as buildings	GNSS signals can reflect off relatively due to distant objects, such as buildings, which would cause gross errors in position accuracy if the receiver falsely locks onto the reflected signal instead of the direct signal.
User Error	Unintentional	Users over-rely on the GNSS data they are presented with, ignoring evidence from other systems or what they can see.	Can lead to poor decision-making in a range of scenarios.

Table 1: Threat types

D.15 Depending on the nature of the interference and the nature of the application, a user may be affected in several ways; the impact may range from a small nuisance to an economic, operational or a safety impact. The detailed risk assessment methodology is addressed at Appendix B.

MITIGATION STRATEGIES

D.16 To minimize the risks associated with GNSS vulnerabilities, several mitigation strategies can be deployed to reduce the likelihood and impact of the threat.

Reducing the likelihood of GNSS interferences

D.17 The likelihood of interference depends on many factors such as population density and the motivation of individuals or groups in an area to disrupt aviation and non-aviation services. To reduce the likelihood of GNSS interference, the following measures may be applied:

a) effective spectrum management; this comprises creating and enforcing regulations/laws that control the use of spectrum and carefully assessing applications for new spectrum allocations.

b) the introduction of GNSS signals on new frequencies will ensure that unintentional interference does not cause the complete loss of GNSS service (outage) although enhanced services depending upon the availability of both frequencies might be degraded by such interference.

c) State should forbid the use of jamming and spoofing devices and regulate their importation, exportation, manufacture, sale, purchase, ownership and use; they should develop and enforce a strong regulatory framework governing the use of intentional radiators, including GNSS repeaters, pseudolites, spoofers and jammers. The enforcement measures include:

- detection and removal of jammers/interference sources; and
- direct or indirect detection (e.g. use of dedicated interference detection equipment).

d) education activities to raise awareness about legislation and to point out that ‘personal’ jammers can have unintended consequences.

e) multi-constellation GNSS would allow the receiver to track more satellites, reducing the likelihood of service disruption.

Reducing the impact of the GNSS vulnerabilities

D.18 The GNSS signal disruption cannot be ruled out completely and States/ANSPs must be prepared to deal with loss of GNSS signals, and that States conduct risk assessment and implement mitigation strategies. The risk and impacts from these threats can be managed by evaluating the growing threat of GNSS interference, jamming and spoofing.

D.19 The disruption of GNSS signals will require the application of realistic and effective mitigation strategies to both ensure the safety and regularity of air services and discourage those who would consider disrupting aircraft operations. There are three principal methods, which can be applied in combination:

a) taking advantage of on-board equipment, such as Inertial Reference System (IRS). IRS provides a short-term area navigation capability after the loss of GNSS updating. Many air transport aircraft are equipped with IRS and these systems are becoming more affordable and accessible to operators with smaller, regional aircraft. Most of these systems are also updated by DME;

b) development of contingency procedures and processes to enable operations in a fallback mode in case of loss of GNSS (aircrew and/or ATC). Procedural (aircrew or ATC) methods can provide effective mitigation in combination with those described above, taking due consideration of:

   i. the airspace classification;
   ii. the available ATC services (radar or procedural);
   iii. the avionics onboard
   iv. aircrew and air traffic controller workload implications;
   v. the impact that the loss of GNSS will have on other functions, such as ADS-B based surveillance; and
   vi. the potential for providing the necessary increase in separation between aircraft in the affected airspace.

c) taking advantage of conventional navigation aids and radar, conventional aids can provide alternative sources of guidance.

D.20 The regulator should conduct safety oversight of the service provider's GNSS based Services and validate the safety aspects of mitigation strategies, considering the impact on ATM operations. Details on Risk assessment process including some examples are at Appendix B.

D.21 The data analysis of the reported GNSS vulnerabilities incidents for the period from January 2015 to June 2018 showed that the impact of the GNSS interference on Aircraft Operations in the MID Region were as follows:

a) Loss of GPS1 (fault)/ Loss of GPS2 (fault)
b) Observation of "Map shift" on Navigation display
c) Switching to an alternative navigation mode (IRS displayed, VOR/DME)
d) Degraded PBN Capability (NAV Unable RNP)
e) GPS POS Disagree
f) EGPWS warning
g) ADS-B Traffic triggered

Monitoring

D.22 The success of many of countermeasures is dependent on having a detailed understanding of the threats. In order to establish this understanding and to maintain an up-to-date knowledge of the threats - in terms of both types and number of threats – it is necessary to States to monitor the threat environment and the impact on performance.

D.23 Monitoring and reporting is required to inform stakeholders of the threats that exist. This would help directly with enforcement (detecting and removing sources of interference) as well as monitoring the response to changes in legislation or education activities.

D.24 Receiver autonomous integrity Monitoring (RAIM) provides integrity monitoring by detecting the failure of a GNSS satellite. It is a software function incorporated into GNSS receivers.

D.25 In the event of GNSS performance degrading to the point where an alert is raised, or other cause to doubt the integrity of GNSS information exists, the pilot in command must discontinue its use and carry out appropriate navigation aid failure procedures. Should RAIM detect an out-of-tolerance situation, an immediate warning will be provided. When data integrity or RAIM is lost, aircraft tracking must be closely monitored against other available navigation systems.

D.26 States may consider the deployment of GNSS threat monitoring system, which allows monitoring of local GNSS interference environment; signal recording and monitoring for situational awareness of any drop in signal quality or signal outage and ground validation of GNSS-based flight procedures. The detection equipment may include localization utilities.

With reference to ICAO Doc 9849:

Given the variety of avionics designs, one service status model cannot meet all operators' requirements. A conservative model would produce false alarms for some aircraft. A less conservative model would lead to missed detection of a service outage for some and false alarms for others. Regardless, only the aircrew, not ATC, is in a position to determine whether, for example, it is possible to continue an ABAS-based instrument approach. In contrast, ATC has access to ILS monitor data and can deny an ILS approach clearance based on a failure indication. The real time monitor concept is neither practical nor required for GNSS ABAS operations. It may be practical for SBAS and GBAS, but implementation would depend on a valid operational requirement.

Aircraft operators with access to prediction software specific to their particular ABAS/RAIM avionics will find it advantageous to employ that software rather than use the general notification service. In the case of SBAS and GBAS, operators will rely on service status notifications.

Reporting

D.27 ANSP must be prepared to act when anomaly reports from aircraft or ground-based units suggest signal interference. If an analysis concludes that interference is present, ANS providers must identify the area affected and issue an appropriate NOTAM.

D.28 From the perspective of the aircrew, a GNSS anomaly occurs when navigation guidance is lost or when it is not possible to trust GNSS guidance. In this respect, an anomaly is similar to a service outage. An anomaly may be associated with a receiver or antenna malfunction, insufficient satellites in view, poor satellite geometry or masking of signals by the airframe. The perceived anomaly may also be due to signal interference, but such a determination requires detailed analysis based on all available information.

D.29 In case of GNSS anomaly detected by aircrew, **Pilot** action(s) should include:

a) reporting the situation to ATC as soon as practicable and requesting special handling as required; and

b) filing a GNSS Interference Report using the Template at Appendix A, and forwarding information to the IATA MENA (sfomena@iata.org) and ICAO MID Office (icaomid@icao.int) as soon as possible, including a description of the event (e.g. how the avionics failed/reacted during the anomaly).

D.30 **Controller** action(s) should include:

a) recording minimum information, including aircraft call sign, location, altitude and time of occurrence;
b) cross check with other aircraft in the vicinity;
c) broadcasting the anomaly report to other aircraft, as necessary;
d) notify the AIS Office in case NOTAM issuance is required; and enable the fallback mode and implement related procedure and process (contingency measures).

D.31 **ANSP** action(s) should include:

a) ensuring the issuance of appropriate advisories and NOTAM, as necessary;
b) attempting to locate/determine the source of the interference, if possible;
c) notifying the agency responsible for frequency management (the Telecommunication Regulatory Authority);
d) locate and eliminate source in cooperation with local regulatory & enforcement Authorities;
e) tracking and reporting all activities relating to the anomaly until it is resolved; and
f) review the effectiveness of the mitigation measures for improvement.

D.32 **ICAO MID Office** action(s) should include:

a) collect anomaly related information and determine the course of action required to resolve reported anomalies;
b) follow-up with State having interference incident to ensure implementation of required corrective actions;
c) coordinate with concerned adjacent ICAO Regional Office(s) to follow-up with States under their accreditation areas, when needed; and
d) Communicate with ITU Arab Office and Arab Spectrum Management Group to resolve frequent interference incidents, when needed.

Appendix D - Appendix A

GNSS interference reporting form to be used by pilots.
** Mandatory field*

Originator of this Report:	
Organization:	
Department:	
Street / No.:	
Zip-Code / Town:	
Name / Surname:	
Phone No.:	
E-Mail:	
Date and time of report	
Description of Interference	
*Affected GNSS Element	[ ] GPS
	[ ] GLONASS
	[ ] other constellation
	[ ] EGNOS
	[ ] WAAS
	[ ] other SBAS
	[ ] GBAS (VHF data-link for GBAS)
Aircraft Type and Registration:	
Flight Number:	

*Airway/route flown:	
Coordinates of the first point of occurrence / Time (UTC):	UTC: Lat: Long:
Coordinates of the last point of occurrence / Time (UTC):	UTC: Lat: Long:
*Flight level or Altitude at which it was detected and phase of flight:	
Affected ground station (if applicable)	Name/Indicator; [e.g. GBAS]
*Degradation of GNSS performance:	[ ] Large position errors (details): [ ] Loss of integrity (RAIM warning/alert): [ ] Complete outage (Both GPSs), [ ] Loss of GPS1 or Loss of GPS 2 [ ] Loss of satellites in view/details: [ ] Lateral indicated performance level changed from:___to [ ]Vertical indicated performance level changed from: __ to __ [ ] Indicated Dilution of Precision changed from __ to__ [ ] information on PRN of affected satellites (if applicable) [ ] Low Signal-to-Noise (Density) ratio [ ] Others
*Problem duration:	[ ] continuous for 20 minutes [ ] intermittent

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Appendix D - Appendix B

Risk Assessment

Threats and vulnerabilities

A threat assessment should be performed to determine the best approaches to securing a GNSS against a particular threat. Penetration testing exercises should be conducted to assess threat profiles and help develop effective countermeasures.

Table (B1) presents an overview of different potential impacts from GNSS interference. This is a snapshot of impacts based on input from two manufacturers and not intended to be a comprehensive list of all impacts:

Effect	Affected Operation	Impact
Loss of GNSS-based navigation	Enroute/ Terminal/ Approach	Aircraft with Inertial Reference Unit (IRU) or Distance Measuring Equipment (DME)/DME may have degraded RNP/RNAV. Aircraft may deviate from the nominal track May increase workload on aircrew and ATC May result in missed approach or diverting to other runway in case the aerodrome operating minima cannot be met through conventional precision or visual approaches. Conventional ATS routes, SIDs and STARs would be used.
Larger than normal GNSS position errors prior to loss of GNSS	Enroute/ Terminal/ Approach	Interference could cause the GNSS position to be pulled off but not exceed the HAL (2NM , 1NM, 0.3NM for enroute, terminal and approach phases, respectively).
Loss of EGPWS/ TAWS	Enroute/ Terminal/ Approach	Reduced situational awareness and safety for equipped aircraft. Terrain Awareness and Warning System (TAWS) is required equipment for turbine powered airplanes > 6 passengers. Loss of GPS results in loss of terrain/obstacle alerting. Position errors as GPS degrades can result in false or missed alerts.
Loss of GPS aiding to AHRS	Flight Control	Can result in degradation of AHRS pitch and roll accuracy with potential downstream effects such as was experienced by a Phenom 300 flight.
Loss of GNSS to PFD/MFD	All flight phases	Can result in: - Loss of synthetic vision display and flight path marker on PFD - Loss of airplane icon on lateral and vertical electronic map displays, georeferenced charts, and airport surface maps without DME-DME or IRU - Loss of airspace alerting and nearest waypoint information without DME-DME or IRU Overall loss of situational awareness to flight crew and increased workload.
No GNSS position for ELT	Search and Rescue	Loss of GNSS signal could result in larger search areas for the Emergency Locator Transmitters (ELTs)

Table B1: Potential Impact from GNSS

Consequence/Impact of risk occurring

Category	Scale	Effect on Aircrew and Passengers	Overall ATM System effect
Catastrophic	1	Multiple fatalities due to collision with other aircraft, obstacles or terrain	Sustained inability to provide any service.
Major	2	Large reduction in safety margin; serious or fatal injury to small number; serious physical distress to air crew.	Inability to provide any degree of service (including contingency measures) within one or more airspace sectors for a significant time.
Moderate	3	Significant reduction in safety margin.	The ability to provide a service is severely compromised within one or more airspace sectors without warning for a significant time.
Minor	4	Slight reduction in safety margin.	The ability to provide a service is impaired within one or more airspace sectors without warning for a significant time
Negligible	5	Potential for some inconvenience.	No effect on the ability to provide a service in the short term, but the situation needs to be monitored and reviewed for the need to apply some form of contingency measures if the condition prevails.

Table B2: Impact of Risk Occurring

Likelihood of risk occurring

The definitions in the table (B3) were adopted for estimating the likelihood of an identified risk occurring, for this purpose, six situations are considered:

Event is expected to occur	
1	More frequently than hourly
2	Between hourly and daily
3	Between daily and yearly
4	Between yearly and 5 yearly
5	Between 5 and 50 years
6	Less frequently than once every 50 years

Table B3: Likelihood of risk occurring

Assessment of the level of risk and risk tolerance

All identified risks were reviewed and provided for each an overall risk ranking which is a combination of the two characteristics of consequence and likelihood. For example, a risk with a major consequence but a "5" likelihood would be described as having an "A" or "unacceptable" risk rating. The conversion of the combination of consequence and likelihood into a risk rating has been achieved by use of the following matrix.

Likelihood Criteria		**Consequence Criteria**				
Event expected to occur:		**Catastrophic 1**	**Major 2**	**Moderate 3**	**Minor 4**	**Insignificant 5**
1	**More frequently than hourly**	A	A	A	A	C
2	**Between hourly and daily**	A	A	A	B	D
3	**Between daily and yearly**	A	A	B	C	D
4	**Between yearly and 5 yearly**	A	B	C	C	D
5	**Between 5 and 50 years**	A	B	C	D	D

6	**Less frequently than once every 50 years**	B	C	D	D	D

Table D-2.4

The previous matrix provides a guide to determine which risks are the highest priorities from the perspective of the timeliness of the corrective action required. The following table outlines the position in more definitive terms.

Safety tolerability risk matrix

Risk Index Range	Description	Recommended Action
A	Unacceptable	Stop or cut back operation promptly if necessary. Perform priority/immediate risk mitigation to ensure that additional or enhanced preventive controls are put in place to bring down the risk index to the moderate or low range.
B	High Risk	Urgent action. Perform priority/immediate risk mitigation to ensure that additional or enhanced preventive controls are put in place to bring down the risk index to the moderate or low range.
C	Moderate Risk	Countermeasures actions to mitigate these risks should be implemented.
D	Low Risk	Acceptable as is. No further risk mitigation required

Table B5: Risk Tolerability Matrix

Sample risk assessment

The risk assessment table (B6) could be used to identify and capture the threats, select the risk rating based on the risk matrix above considering the existing controls. In addition, recommended actions could be selected to minimize the risk.
L = Likelihood
C = Consequence
R = Risk

Threat	Initial Risk			Existing controls	Accept/Reduce	Recommended controls	Residual Risk		
	L	C	R				L	C	R

Table B6: Sample Risk Assessment tables

The table (B7) below is an example of risk assessment for approach phase of flight, the detailed Risk assessment process is at Appendix B
L = Likelihood
C = Consequence
R = Risk

Threat	Initial Risk			Existing controls	Accept/Reduce	Recommended controls	Residual Risk		
	L	C	R				L	C	R
Between daily and yearly	3	2	A	-Error message notification by avionic	Reduce	1) using of on-board equipment (IRS); 2)Interference detector by ANSPs 3)executing miss approach	3	4	C

Table B7: Example Risk Assessment for Approach phase of flight

Another example risk assessment for en-route phase of flight at table (B8)
L = Likelihood
C = Consequence
R = Risk

Threat	Initial Risk			Existing controls	Accept/Reduce	Recommended controls	Residual Risk		
	L	C	R				L	C	R
Between 5 and 50 years (short time GNSS outage)	5	5	D	-Error message notification by avionic -Regulations/ law to protect the GNSS signal	Accept	-			

Table B8: Example risk assessment for enroute phase of flight

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APPENDIX E

ICAO CYBERSECURITY POLICY GUIDANCE

Introduction

E.1 This guidance is in line with the ICAO Aviation Cybersecurity Strategy, and the Cybersecurity Action Plan, which action item CyAP0.1 recommends that the International Civil Aviation Organization (ICAO) develops a model Cybersecurity Policy for reference by Member States and industry when developing their own national/internal policies.

E.2 The model Cybersecurity Policy is included in Appendix A to this guidance.

Scope

E.3 The model Cybersecurity Policy outlined in Appendix A of this document addresses the protection and resilience of international civil aviation's critical infrastructure against cyber threats, and the multilateral collaboration requirement within civil aviation as well as with external authorities such as military, cybersecurity, and national security.

Objectives

E.4 The model Cybersecurity Policy is intended to serve as a guide to help States and industry focus resources and actions to achieve a systemic approach to cybersecurity in civil aviation, including current and legacy systems. The ultimate goal is for States and stakeholders to be able to develop a system-of-systems approach that enables civil aviation to be protected against cyber threats, and to respond to and recover from cyber incidents in a timely fashion, and, therefore, to withstand new threats without significant disruptions.

E.4 The main outcomes expected from implementing a Cybersecurity Policy are:

E.4.1 Ensure civil aviation is protected against cyber threats

The protection of civil aviation against cyber-attacks is addressed through the implementation of ICAO cybersecurity Standards and Recommended Practices, procedures, and guidance material. It includes the implementation of robust risk management practices, the identification of critical infrastructure, and the implementation of a holistic multilayered approach to cybersecurity. This approach should ensure that a successful attack on one layer does not compromise other layers of the system and/or lead to loss of safety, security or continuity of critical functions. The system should also adopt a continuous improvement approach to ensure that necessary enhancements to planned technical or procedural evolutions are coordinated, implemented, and kept up to date.

E.4.2 Ensure civil aviation is cyber-resilient

A cyber-resilient civil aviation system is a system that, under attack, can maintain its critical functionalities: i.e., supports safe and secure flight operations with minimal, if any, disruption. The system should also include appropriate cooperation and information-sharing mechanisms between aviation stakeholders, such as government, industry and, where appropriate, with civil law enforcement and military authorities.

E.4.3 Ensure civil aviation is self-strengthening by adopting a "Security by Design" approach

Adopting a security by design approach for civil aviation requires, at the outset of a system's conception, consideration of security objectives that need to be achieved during a system's design process, along with traditional operational and safety objectives. Ensuring the security of critical elements and processes "by design" changes the

security paradigm from reactive to proactive, and fosters the development of a self-protected civil aviation system, therefore enabling it to evolve and enabling improved security and resilience.

E.4.4 Ensure coordination of aviation cybersecurity within civil aviation and with concerned non-aviation stakeholders

In order to ensure a consistent and complementary approach to aviation cybersecurity across aviation disciplines, the civil aviation system must ensure the comprehensive management of cyber risks to civil aviation by coordinating the safety and security aspects of aviation cybersecurity. In addition, coordination of aviation cybersecurity should extend beyond civil aviation to other concerned entities such as national/regional/international cybersecurity authorities, law enforcement, military, etc.

Elements of the Cybersecurity Policy

E.5 This section provides guidance on the elements included in the model Cybersecurity Policy in Appendix A. It is therefore recommended to be read together with the model Cybersecurity Policy.

E.5.1 Governance and Organization

E.5.1.1 States should designate an Appropriate Authority for Aviation Cybersecurity (AA/Cyber) with an overall mandate and responsibility for aviation cybersecurity and cyber resilience.

E.5.1.2 There is no one-size-fits-all model as to where the AA/Cyber would fit within individual States' civil aviation organizational structures. The decision would be impacted by several considerations related to the national aviation and relevant non-aviation set-up in terms of entities and mandates. It is important however that the AA/Cyber be provided with the required resources and authority to be able to discharge its mandate, including the negotiation and coordination with non-aviation concerned stakeholders.

E.5.1.3 Overall, the designated AA/Cyber should:

a) determine, in coordination with the national competent authority for cybersecurity, the roles and responsibilities to be undertaken by each authority;
b) lead the development of aviation cybersecurity regulations;
c) clearly define roles and responsibilities for the different civil aviation domains within the national competent authority for civil aviation;
d) coordinate the definition of roles and responsibilities of civil aviation entities overseen by the national competent authority for civil aviation through the national safety and security programmes;
e) define the elements of civil aviation cybersecurity culture and monitor its implementation;
f) define regulations, processes, requirements, and roles for cybersecurity crisis management, including testing requirements and frequencies; and
g) coordinate cross-cutting aviation cybersecurity issues with relevant non-aviation stakeholders involved in aviation cybersecurity such as information sharing and incident investigation.

E.5.2 Risk Management

E.5.2.1 Managing cybersecurity risks should draw on aviation safety and security risk management frameworks in order to develop an integrated and accurate assessment of cybersecurity threats and risks, and ensure the development and implementation of effective mitigation measures that take into account safety requirements and the implications of mitigation measures on safety and continuity of civil aviation.

E.5.2.2 All data and systems should have identified ownership at all times. Identifying and maintaining ownership establishes accountabilities and supports the management of data and systems from adoption to disposal. As such, rules and processes should be established by the owners to include physical locations of data and systems, access rights, management rights, and security requirements based on data and system classification. This will

eventually support adequate usage of data and systems by the right people, setting and implementing quality control standards, and resolve issues and conflicts.

E.5.3 Critical Systems Security

E.5.3.1 Defence in depth principles should be applied to protect critical systems. Defence in depth integrates people, technology, and operations capabilities to establish variable barriers across multiple layers and missions of the organization. It is an approach to cybersecurity in which a series of defensive mechanisms are layered in order to protect critical systems, data and information. This multilayered approach with intentional redundancies increases the security of a system as a whole and addresses many different attack vectors.

E.5.3.2 The AA/Cyber should ensure that civil aviation entities identify and adequately protect their critical systems as well as develop the ability to detect, respond to, and recover from cyber incidents.

E.5.4 Data Security

E.5.4.1 Periodic offline secure backup of critical data should be considered as an enabler to support information availability and integrity. It is however paramount to develop a robust backup policy, in line with risk assessments, since an offline backup taken while a cyber-attack is in progress would be already compromised and therefore cannot be used to restore access to critical information.

E.5.4.2 Encryption of sensitive data should be considered as an enabler to support information confidentiality. It is however important to define, in line with risk assessments, processes for the use of encryption that strike the appropriate balance between the level of confidentiality and operational performance requirements, especially for "live" data required for flight safety, as well as taking into account the resources needed to manage the data.

E.5.4.3 Processes should be established to ensure continuity of critical functions in case of loss of data availability and/or integrity.

E.5.5 Supply Chain Security

E.5.5.1 Entities should ensure that software and hardware used in critical aviation functions comply with cybersecurity requirements throughout the life cycle of aviation systems, from design and development through operation and maintenance, continuing through the safe and secure disposal.

E.5.5.2 Service Level Agreements can be leveraged to include cybersecurity requirements for hardware and software as well as for the update, upgrade, and patching in case of discovered vulnerabilities.

E.5.6 Physical Security

E.5.6.1 Examples of physical security controls of relevance to aviation cybersecurity include, inter alia, defining physical access management and control policies, background checks of personnel with administrative rights on systems/databases, or with access to sensitive and/or critical data, recommendations for separation of duties and/or rotation in personnel with access to, or ability to modify critical systems, etc.

E.5.7 Information, Communication, Technology (ICT) Security

E.5.7.1 Examples of ICT security controls of relevance to aviation cybersecurity include, inter alia, access control policies and application of least privilege principles, software/hardware firewalls and network security, cryptography, organizational password policies, end-point protection, network monitoring and detection of anomalies, network separation, device management, etc.

E.5.8 Incident Management and Continuity of Critical Functions

E.5.8.1 The AA/Cyber should define regulations, processes, requirements, and roles for cyber incidents management, recovery and continuity of critical systems.

E.5.8.2 Existing crisis management and business continuity plans should be leveraged to include response to and recovery from cyber incidents.

E.5.8.3 Testing emergency response and business continuity plans should be periodically conducted with the aim to improve the plans as well as the capabilities of responders. Testing should include all relevant stakeholders and comprise a combination of Table Top Exercises (TTX) as well as live tests.

E.5.9 Cybersecurity Culture

E.5.9.1 Cybersecurity culture should be implemented across all aviation entities.

E.5.9.2 Cybersecurity culture should be endorsed by organizational leadership, and should include a programme to be undertaken by all personnel.

E.5.9.3 The programme should include recurrent cybersecurity education (including principles of cyber hygiene practices), awareness on latest threats, training, and testing (both as part of training and live simulation of attacks) to assess the level of cyber awareness/hygiene.

E.5.9.4 Cybersecurity culture should include elements from safety and security cultures, e.g. self-reporting, reporting of suspicious behaviour/practice, just culture, etc.

Appendix E - Appendix A
Model Cybersecurity Policy

1. **Introduction**

1.1 This cybersecurity policy shall be the framework for further development and implementation of aviation cybersecurity. It shall be published, disseminated to relevant stakeholders, and periodically reviewed.

1.2 Further guidance material shall be developed to support the implementation of this cybersecurity policy.

2. **Scope**

2.1 Aviation cybersecurity shall address the security and resilience of the civil aviation system, as well as support the collaboration with concerned non-aviation entities and authorities, including national cybersecurity authority, national security, law enforcement and military, as appropriate.

2.2 Aviation cybersecurity shall be coordinated at the national level with aviation safety, aviation security, critical infrastructure protection, cyber defence and military.

2.3 Aviation cybersecurity shall be coordinated at the international level with equivalent Foreign Appropriate Authorities designated for Aviation cybersecurity.

3. **Objectives**

3.1 The overall objectives of this aviation cybersecurity policy are to ensure the security, resilience, and self-strengthening of the civil aviation system against cyber threats and risks, and to ensure the coordination of aviation cybersecurity with concerned national authorities and entities.

4. **Governance and Organization**

4.1 In accordance with [Regulation/Legislation Reference for the designation], [Entity Name] shall be the Appropriate Authority for Aviation Cybersecurity (AA/Cyber) with an overall mandate for aviation cybersecurity and cyber resilience.

4.2 The AA/Cyber shall:

a) engage with the national competent authority for cybersecurity in order to define the civil aviation cybersecurity roles and responsibilities to be undertaken by each authority;
b) coordinate and contribute to the development of aviation cybersecurity regulations;
c) define, coordinate, and provide support to aviation safety and aviation security appropriate authorities to include aviation cybersecurity requirements, including oversight and quality control elements, in the national SSP and the National Civil Aviation Security Programme (NCASP);
d) define, support, and monitor the implementation of the cybersecurity culture programme by all civil aviation stakeholders;
e) define regulations, processes, requirements, and roles for cybersecurity crisis management; and
f) coordinate cross-cutting aviation cybersecurity issues with relevant non-aviation stakeholders involved in aviation cybersecurity.

5. **Risk Management**

5.1 Cybersecurity shall be intelligence driven, threat based and risk managed.

5.2 Risk management shall be an integral part of overall systems' life cycle.

5.3 All data and systems shall have identified ownership at all times.

6. **Critical Systems Security**

6.1 Critical functions, systems, and infrastructure shall be identified through risk management processes.

6.2 Security by design approach, coupled with Defence in depth principles, shall be applied to protect critical systems.

6.3 Redundancy of critical systems shall be considered as an enabler for system security.

7. **Data Security**

7.1 Data and information shall be protected during storage and transmission, in line with its sensitivity profile.

8. **Supply Chain Security**

8.1 End-to-end management of software/hardware supply chain shall be part of aviation cybersecurity management.

8.2 Software and hardware used in critical aviation functions shall comply with cybersecurity requirements throughout the life cycle of aviation systems.

9. **Physical Security**

9.1 Physical security (including personnel security) shall be part of aviation cybersecurity management.

9.2 Physical security shall safeguard people, infrastructure, facilities, equipment, material, and documents from unlawful interference and protect critical aviation systems from unauthorized physical access.

9.3 Physical security shall contribute to risk management through supporting the identification of threat actors and/or the likelihood of attacks on civil aviation critical infrastructure.

10. **Information, Communication, Technology (ICT) Security**

10.1 ICT security shall be part of aviation cybersecurity management.

10.2 ICT security shall define and implement logical security measures as well as contribute to cyber incident management, recovery, and operation continuity processes.

10.3 ICT security shall contribute to risk management through the identification of vulnerabilities, attack vectors, and monitoring the evolution of the aviation cybersecurity threat landscape.

11. **Incident Management and Continuity of Critical Functions**

11.1 Safety of operations and continuity of critical functions shall be the main drivers in incident management processes.

11.2 Testing crisis management and recovery plans shall be an integral part of incident management.

12. **Cybersecurity Culture**

12.1 An education, awareness, training, and exercise plan shall be an integral part of aviation cybersecurity management.

12.2 Cybersecurity culture shall be fully coordinated with existing safety and security cultures.

12.3 Cybersecurity culture shall be supported by robust internal and, to the extent possible, external information sharing practices.

APPENDIX F

BASIC PLAN ELEMENTS

Element 1: Administration

a) record of signatories, version control and records of amendment.

b) definition of the objectives, applicable airspace and operations, and exclusions.

Element 2: Plan Management

c) list of States and FIRs affected, and the agreed methods of notification in the event of pre-activation, activation and termination of the plan.
Contingency events may arise with insufficient advance notice to permit pre- activation of contingency plans

d) details of the arrangements in place for management of the plan, including:

i. provisions for a Central Coordinating Committee to authorize and oversee the activation of the plan and arrange for ATS restoration in the event of an extended outage;
ii. ATM Operational Contingency Group for 24-hour coordination of operational and supporting activities under the plan, and
iii. the ToRs, structure and contact details for the CCC and AOCG.

e) details of testing, review, and reporting actions:

i. Schedule of table-top and simulator testing;
ii. Post-Activation Review (PAR) requirements:

- completion of a preliminary PAR report within 28 days of any activation or testing of contingency plans, including any recommendations to address deficiencies and implement improvements in contingency plans, arrangements, procedures and training.
- a more comprehensive PAR report should be prepared for major contingency events, or any contingency event involving an air safety incident investigation.
  A full PAR analysis of major events could take many months to complete.
- input to the PAR from all parties affected by or involved in the response to the contingency is actively sought and considered;
- bi-lateral or multi-lateral PAR for activation or testing of Level 2 contingency arrangements; and
- Timely reporting to ICAO MID and other affected States of anticipated or experienced disruptions requiring activation of contingency plans.

Note: Annex 11 states that: States anticipating or experiencing disruption of ATS and/or related supporting services should advise, as early as practicable, the ICAO MID Regional Office and other States whose services might be affected. Such advice should include information on associated contingency measures or a request for assistance in formulating contingency plans.

f) inclusion of contingency plans/procedures in ATS training and refresher training programmes.

Element 3: Airspace

g) procedures and determinants for implementation and activation of Special Use Airspace (SUA) including, where necessary, Restricted or Prohibited Areas in territorial airspace, or Danger Areas over the high seas.

h) criteria for airspace classification changes and associated separation and CNS requirements.

i) Collaborative Trajectory Options for Category A, B and C events, and for Large Scale Weather Deviations (LSWD).

Element 4: ATM Procedures

j) details of re-routing to avoid the whole or part of the airspace concerned, normally involving establishment of:
    i. strategic and tactical collaborative trajectory options providing additional routes or route segments with associated conditions for their use; and/or
    ii. a simplified route network through the airspace concerned, together with a FLAS, to ensure that a standard minimum vertical separation is applied where less than a specified minimum lateral separation exists between routes.

k) details of how domestic traffic, departing and arriving flights and SAR, humanitarian and State aircraft flights will be managed during the contingency period.

l) procedures for transition from normal services levels to contingency services, and resumption of normal service.

m) procedures for joining or departing a contingency route.

n) details of reduced levels of service, if any, within the affected airspace.

o) establishment of arrangements for controlled access to the contingency area to prevent overloading of the contingency system, utilizing allocated airspace entry times or, where ATFM capability exists, tactical ATFM measures.

p) procedures for adjacent service providers to establish longitudinal spacing at the entry point, and to maintain such separation through the airspace;

q) reassignment of responsibility for providing ATS, to the extent possible, in non-sovereign airspace and to international aircraft transiting sovereign airspace; and/or

r) coordination and communications transfer procedures for aircraft entering and leaving the affected airspace.

Element 5: Pilot/Operator Procedures

s) requirements for flight plan submission during the contingency period, including contingency route planning requirements, and arrangements if airspace is restricted or not available and no contingency route is available.

t) emergency procedures, including In-flight requirements for broadcast of position and other information, and for continuous listening watch, on specified pilot-pilot and GUARD Very High Frequency (VHF) frequencies.

u) requirements for display of navigation and anti-collision lights.

v) requirements for climbing and descending well to the right of the centreline of specifically identified routes.

w) requirements for all operations to be conducted in accordance with Instrument Flight Rules (IFR), including operating at IFR flight levels from the relevant Table of Cruising Levels in Appendix 3 of Annex 2 – Rules of the Air, except where modified by a FLAS.

Element 6: Communications Facilities and Procedures

x) provision and operation of adequate air-ground communications, Aeronautical Fixed Telecommunication Network (AFTN) and ATS direct speech links.

y) specification of radio frequencies to be used for particular contingency routes.

z) log-on and connection management for Controller Pilot Data-link Communications (CPDLC) aircraft, where appropriate.

aa) use of Automatic Dependent Surveillance-Contract (ADS-C) automatic position reporting in lieu of voice position reporting to ATS.

Element 7: Aeronautical Support Services including AIS (AIM), NOTAM and MET

bb) AIP Information regarding the contingency planning, and notification by ASHTAM/NOTAM of anticipated or actual disruption of ATS and/or supporting services, including associated contingency arrangements, as early as practicable and, in the case of foreseeable disruption, not less than 48 hours in advance.

cc) reassignment to adjacent States of the responsibility for providing meteorological information and information on status of navigation aids.

Element 8: Contact Details

dd) contact details for the Rescue Coordination Centre (RCC) responsible for the affected FIR, and coordination arrangements.

ee) contact details of adjacent States ANSPs and other International Organizations participating in the contingency plan.

ff) prior notification requirements for adjacent FIR activation of Level 2 contingency arrangements.

Note: The first priority response to any short notice contingency response should be the immediate handling of the air situation, followed by the activation of the contingency plan.

APPENDIX G

MID REGION ATM CONTINGENCY FOCAL POINTS

Note: *since the nature of contingency is vary, ICAO MID is responsible to develop the exact list of contingency focal point and member of contingency coordination team (CCT) for each event accordingly.*

NAMES	PHONE (WORK)	PHONE (HOME)	MOBILE PHONE	FAX	E-MAIL	OTHER CONTACT DETAILS
BAHRAIN						
Mr. Abdulla Al Qadhi	+9731732 1116		+973 36639955	+973 17321 9966	aalqadhi@mtt.gov.bh	Bahrain ACC Duty Supervisor Tel: 973 1732 1081/1080 Fax : 973 1732 1029 Email : bahatc@caa.mtt.bh
EGYPT						
Mr. Wael Ezzat Mahoud Mohamed Ammar	-	-	+201006013734	+20222680629	wael.ammar@nansceg.net	General Director of Cairo ACC
Mr. Amr Ibrahim Abdel Latiff			+201001556447	+202422681375 +20222681371	amraircommander@gmail.com	ANS Inspector Egyptian Civil Aviation Authority
IRAN						
Mr. Hamed Rahbar Modami	+982163146614		+989125228809		rahbar@airport.ir	Deputy of G.D in Area Control Center of ATM
Mr. Seyed Hamid Reza Sanei			+989125935990		h-saanei@caa.gov.ir	Iran CAA, Director of Aerodromes and ANS oversight

NAMES	PHONE (WORK)	PHONE (HOME)	MOBILE PHONE	FAX	E-MAIL	OTHER CONTACT DETAILS
IRAQ						
Mr. Fadhil Getea	+9641813337 0		+964 7828844998		atc@iraqcaa.com	Director ATS
JORDAN						
Mr. Ahmad Odeh	+962 6 4892282		+962 796993321	+962 6 4891653	ahmad.odeh@carc.gov.jo	Director of Air Navigation Services Administration
KUWAIT						
Mr. Adel S. Boresli	+965 24710268		+9659903655 6	+965 24346221	as.buresli@dgca.gov.kw	Director Air Navigation
LEBANON						
Mr. Kamal Nasserddine	+ 9611 628178		+961 71309409	+961 1 629023	ATM@beirutairport.gov.lb	AFTN OLBAZPZX Chief Air Navigation Dept.
LIBYA						
Mr. Mohamed E. Bakar	+21861360 5535		218-91 219 4477	218-21 360 5535	mohamed.bakar@caa.gov.ly	Director of ATM
OMAN						
Mr. Mubarak Gheilani	+966-12-6848121		+966-548184040	+966-12-6854016	m.alghelani@paca.gov.om	Director ATS
SAUDI ARABIA						
Mr. Ahmed Sami Abughallab	+966 12671 7717 Ext 1818		966-50 567 4867	+9662 6401005	Asabughallab@sans.com.sa	
SUDAN						
Mr. Abubakr Elsiddig Elamin	+2491837849 64		+2499121467 45	+249183784964	abubakratco@live.com	ATM Director ANS P.O. Box 137 code 11112, Khartoum, Sudan
SYRIA						
Mr.Hassan Hamoud	+9631154010 180	+9631164 60395	+963 988235106	+963 11 540101801	ans@scaa.sy hamoud_hasan@yahoo.com	ATM Director P.O.BOX:6257 Damascus, Syria

NAMES	PHONE (WORK)	PHONE (HOME)	MOBILE PHONE	FAX	E-MAIL	OTHER CONTACT DETAILS
UNITED ARAB EMIRATES (UAE)						
Mr. Ahmed Al Jallaf	+9712 599 6888		+97150 614 9065	+9712 599 6883	aljallaf@szc.gcaa.ae	Assistant Director General, ANS, GCAA 9712 599 6999 SCZ
Mr. Muayyed Al Teneiji	971-2 5996830		+971 56 685 4505	+9712 5996836	mteneiji@szc.gcaa.ae	Senior Director ATM
YEMEN						
Mr. Younis Al-Khader	+9672343722	+9672238 600	+9677775237 76	+9672343722	airnavcnsaden@gmail.com	
Mr. Ashhab Omar	+9672343722	+9672366 089	+9677778482 15	+9672343722	ashhabx@gmail.com	
Mr. Ahmed Mohammed Al-Koobati	+9671344675	+9671214 375	+9677772413 75	+9671344047	CAMA70@yahoo.com	Director Air Navigation Operation
Mr. Abdullah Abdulwareth Aleryani	+9671345403	+9671344 254	+9677771906 02	+9671345403	ernlabd@gmail.com	D.G ACC/FIC
IATA (Africa and Middle East)						
Ms. Lindi-Lee Kirkman			+9629152201 1		kirkmanl@iata.org	Regional Head of Operations, ATM and Infrastructure Africa & Middle East
Mr. Protus Seda			+27 716875948		sedap@iata.org	Assistant Director Operations, ATM and Infrastructure (Africa and Middle East)
ICAO MID						
Mr. Ahmad Amireh	+202 2267 4840/5 ext 4120		+2010502144 80	202 2267 4843	aamireh@icao.int icaomid@icao.int	RO ATM/SAR
Mr. Ahmad Kaveh	+202 2267 4840/5 ext 4122		+2010321824 88		akaveh@icao.int icaomid@icao.int	RO ATM
ICAO APAC						
Mr. Hiroyuki Takata					htakata@icao.int	RO ATM/SAR
ICAO ESAF						
Ms. Keziah Ogutu			+2547273662 93		kogutu@icao.int	RO ATM/SAR
ICAO EUR/NAT						
Mr. Sven Halle			+3367048782 2		shalle@icao.int	RO ATM/SAR
ICAO WACAF						
Mr. Tchanda Serge Guy	+22133 869 24 13		+2217638791 39		stchanda@icao.int	RO ATM/SAR
ICAO Headquarters						
Mr. Chris Dalton	+1514 954-6711		+1514862853 7		cdalton@icao.int	C/AMO

APPENDIX H

STATUS OF CONTINGENCY AGREEMENTS IN THE MID REGION

STATE	CORRESPONDING STATES			REMARKS*
BAHRAIN	☒ IRAN ☒ KUWAIT	☒ QATAR ☒ SAUDI ARABIA	☒ UAE	Completed
EGYPT	☒ GREECE ☒ JORDAN	☒ LYBIA ☒ CYPRUS	☒ SAUDI ARABIA ☒ SUDAN	Completed
IRAN	☒ ARMENIA ☐ AZERBAIJAN ☐ TURKMENISTAN ☐ AFGHANISTAN	☒ BAHRAIN ☒ IRAQ ☐ KUWAIT ☒ OMAN	☒ PAKISTAN ☒ TURKEY ☒ UAE	7/11
IRAQ	☒ IRAN ☐ JORDAN	☐ KUWAIT ☒ SAUDI ARABIA	☐ SYRIA ☐ TURKEY	2/6
JORDAN	☒ EGYPT ☐ IRAQ	☐ ISRAEL ☒ SAUDI ARABIA	☐ SYRIA	2/5
KUWAIT	☒ BAHRAIN ☐ IRAN	☐ IRAQ	☒ SAUDI ARABIA	2/4
LEBANON	☐ CYPRUS	☐ SYRIA		0/2
LIBYA	☐ ALGERIA ☐ CHAD ☒ EGYPT	☐ MALTA ☐ NIGER	☐ SUDAN ☐ TUNIS	1/7
OMAN	☐ INDIA ☒ IRAN	☐ PAKISTAN ☐ SAUDI ARABIA	☒ UAE ☒ YEMEN	3/6
QATAR	☒ BAHRAIN	☐ SAUDI ARABIA	☒ UAE ☒ Iran	2/3
SAUDI ARABIA	☒ BAHRAIN ☒ EGYPT ☐ ERITREA ☐ IRAQ	☒ JORDAN ☒ KUWAIT ☐ OMAN ☐ QATAR	☐ SUDAN ☒ UAE ☐ YEMEN	5/11
SUDAN	☐ CENTRAL AFRICAN ☐ CHAD ☒ EGYPT	☐ ERITREA ☐ ETHIOPIA ☐ LIBYA	☐ SAUDI ARABIA ☐ SOUTH SUDAN	1/8
SYRIA	☐ IRAQ ☐ JORDAN	☐ LEBANON ☐ CYPRUS	☐ TURKEY	0/5
UAE	☒ BAHRAIN ☒IRAN	☒ OMAN ☒ QATAR	☒ SAUDI ARABIA	5/5
YEMEN	☐ DJIBOUTI ☐ ERITREA ☐ ETHIOPIA	☐ INDIA ☒ OMAN ☐ SAUDI ARABIA	☐ SOMALIA	1/7

☒ Agreement Signed ☐ Agreement NOT Signed *Signed Agreements / Total No. of required Agreements

ATTACHMENT A

MEASURES TAKEN BY QCAA AND ATS UNITS DURING COVID-19

The COVID-19 Worldwide pandemic had a significant impact on a global air transport industry and the provision of air navigation services with a massive decrease in aircraft movements during this period. Several recommendations /guidelines for contingency measures for a navigation service provider by ICAO, Eurocontrol, CANSO AND IFATCA were subsequently published to ensure the health of employees, mitigate any safety risks associated with impacted services to ensure continuous and safe provision of air traffic services. QCAA/AND have been closely monitored the rapidly developing situation prior to COVID-19 being formally declared as a pandemic including the active engagement/discussion with the Qatar National pandemic preparation committee spearheaded by QATAR Ministry of Public Health. The QCAA/Air Navigation Department took extraordinary measures to prevent the infection of essential employees and maintain a continuous and safe Air Traffic Services with support and guidelines provided by the Qatar Ministry of Public Health and the Aerodrome Operator (MATAR). Measures taken by AND to prevent the infection of staff to ensure continuous provision of air traffic services include but are not limited to the following:

1. Limit facility access to essential personnel (ATCO and ATCA, ATSEPs to maintain the ATM/CNS critical system and equipment that directly supports Air Traffic Service by allowing administration staff to work from home. Non-essential training and visitors 'access was suspended. Exceptions were made for the ATCO's training to maintain their currency and some exceptions were agreed and approved with the QCAA Regulatory Authority.

2. The ATC roster was adapted to ensure that minimum staff was available. Excess staff, due to the reduction in traffic, would be on standby at home to avoid crowded operational rooms. Standby teams were established in the event of any emergency situation/late notice staffing requirements and were rostered as additional cover.

3. Health and Safety measures were implemented such as the installation of hydro alcoholic distributors in the operational buildings, provision of wipes to disinfect the equipment touched by ATC personnel (mouse, keyboards, and VCCS panels).

4. Increase the frequently of facility cleaning, including periods of routine planned "deep cleaning" (OPS rooms, break rooms, wash rooms).

5. Due to the number of CWPs/Position available in excess of operational and back up requirements at OTBD, OTHH Towers and Doha Approach room, social distancing between different working position in the ATC rooms was implemented.

6. A procedure for operational rooms deep cleaning and sterilization was established. Contingency COVID-19 operations rooms to deliver air traffic service from alternatives/backup site in case of confirmed case reported in the main operation room were established to enable sterilization and deep cleaning of any affected areas.

7. Additional break rooms/space were provided to staff.

8. Essential staff vaccination was prioritized by the Air Navigation Department in coordination with the Qatar Ministry of Public Health.

9. Employees were encouraged to follow the Qatar Ministry of Public Health recommendations and measures (social distancing, health and safety measures: washing hands, staying at home if not feeling well and self-testing, not sharing their headsets, encourage employees to clean their own position) . These were promoted by e-mails, circulars and posters located within the building.

10. Implement temperature taking stations at the building entrance and Etheraz checks.

11. COVID rapid antigen tests were provided to employees requesting these.

12. Providing sterilization materials on the facility (units, break rooms, elevators).

Factors that played a major role in facilitating the implementation of these measures and the measures which were either recommended or required to be taken as advised or mandated by the local Public Health Authority:

- the size of the operational rooms
- the numbers of back up working positions available
- the aircraft movement decrease
- the number of essential staff
- the establishment of COVID contingency rooms
- the awareness and communication with the employees

ATTACHMENT B

MID REGION DME/DME COVERAGE

TDB

ATTACHMENT C

MID REGION SURVEILLANCE COVERAGE

TDB

ATTACHMENT D

INTERNATIONAL CIVIL AVIATION ORGANIZATION

MID REGION ATM VOLCANIC ASH CONTINGENCY PLAN

Edition 1.0:
December 2013

MID REGION AIR TRAFFIC MANAGEMENT VOLCANIC ASH CONTINGENCY PLAN

TABLE OF CONTENTS

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1. TERMINOLOGY

1.1. Areas of Contamination

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

1.2. Danger Areas

1.2.1. If it is considered that the volcanic event could pose a hazard to aviation, a danger area[2] may be declared by NOTAM. However, this option should only be applied over and in the proximity of the volcanic source. Normally, clearances will not be issued through the danger area unless explicitly requested by the flight crew. In this context it should be noted that the final responsibility for aircraft safety rests with the flight crew. Therefore, the final decision regarding route, whether it will be to avoid or proceed through an area of volcanic activity, is the flight crew's responsibility. Wherever this document discusses the possible establishment of danger areas, States are not prevented from establishing restricted or prohibited areas over the sovereign territory of the State if considered necessary by the State concerned.

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

1.3. Phases of An Event

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

Pre-Eruption Phase (when applicable)**:** The initial response, "raising the alert", commences when a volcanic eruption is expected.

Appropriate AIS and MET messages may be issued in accordance with Annex 15 and Annex 3 respectively, and disseminated to affected aircraft in flight by the most expeditious means. It should be noted that, sometimes volcanoes erupt unexpectedly without any alert being raised; hence the pre-eruption phase may be omitted.

Start of Eruption Phase (when applicable)**:** The start of eruption phase commences at the outbreak of the volcanic eruption and entrance of volcanic ash into the atmosphere and mainly pertains to aircraft in flight. Appropriate AIS and MET messages may be issued as appropriate in accordance with Annex 15 and Annex 3 respectively, and a danger area may be declared by NOTAM. Normally, clearances will not be issued through the danger area unless explicitly requested by the flight crew.

On-Going Eruption Phase: The on-going eruption phase commences with the issuance of the first Volcanic Ash Advisory (VAA) containing information on the extent and movement of the volcanic ash cloud following completion of the previous reactive responses. Appropriate AIS and MET messages may be issued as appropriate in accordance with Annex 15 and Annex 3, respectively.

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[1] Principally this will include volcanic ash advisory messages (issued by volcanic ash advisory centres) and SIGMET information on volcanic ash (issued by meteorological watch offices).

[2] Depending on the State's regulation, the area may be established as a "danger area", "restricted area "or "prohibited area". Over the high seas only "danger area" may be established.

Recovery Phase: The recovery phase commences with the issuance of the first VAA containing a statement that "NO VA EXP" (i.e. "no volcanic ash expected") which normally occurs when it is determined that no volcanic ash is expected in the atmosphere and the volcanic activity has reverted to its pre-eruption state.

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

1.3.2. Although the four distinct phases herein describe actions to be undertaken during an actual volcanic event, they are based on a theoretical scenario. Actual eruptions may not always be distinct with respect to ATM actions to be undertaken. Similarly, an eruption may occur without any pre-eruptive activity, or may cease and restart more than once. Hence, the first observation may be the presence of an ash cloud which is already some distance away from the volcano. It is essential that the contingency planning prepares the ATM system for an appropriate response depending on the actual conditions. Therefore, the "Pre-Eruption Phase" and "Start of Eruption Phase" described in this document are annotated "when applicable" in order to provide for flexibility in the application of the contingency plan in those parts of the world with insufficient volcano monitoring and alerting.

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

2. PRE-ERUPTION PHASE

2.1. General

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

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

2.1.3. The initial response, "raising the alert", commences when a volcanic eruption is expected. Initial awareness of the event may be by means of a Special AIREP/VAR and/or from information provided by meteorological or volcano-logical agencies. Arrangements in each State between designated volcano observatories, meteorological and air traffic management agencies should ensure that alerting information is provided expeditiously by the most appropriate means to provide continued safety of flight.

2.1.4. Emphasis is placed on raising awareness of the hazard and to protect aircraft in flight. The actions are based on well-prepared, well-exercised contingency plans and standard operating procedures. Aircraft are expected to clear or avoid the volcanic ash affected area based on standard operating procedures.

2.2. Originating ACC Actions *(eruption expected in its own flight information region)*

2.2.1. In the event of significant pre-eruption volcanic activity, which could pose a hazard to aviation, an area control centre (ACC)[3], on receiving information of such an occurrence, should carry out the following:

[3] Where the term "ACC" is used throughout this document, it is intended to also include all ATS facilities.

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

b) when so required by the State, define an initial, precautionary danger area in accordance with established procedures. The size of the danger area should encompass a volume of airspace in accordance with the information available, aiming to avoid undue disruption of flight operations;

i. if no such procedures have been established, the danger area should be defined as a circle with a radius of xxx km (xx NM)[4]. The circle should be centred on the estimated or known location of the volcanic activity;

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

c) advise the associated MET service provider(s) in accordance with national/regional arrangements unless the initial notification originated from such provider(s), who will then inform the appropriate air traffic flow management (ATFM) units;

d) alert flights already within the area concerned and offer assistance to enable aircraft to exit the area in the most expeditious and appropriate manner. Flight crews should be provided with all necessary information required to make safe and efficient decisions in dealing with the hazards in the defined area. Aircraft that are close to the area should be offered assistance to remain clear of the area. Flights which would be expected to penetrate the area should be re-cleared onto routes that will keep them clear;

e) immediately notify other affected ACCs of the event and the location and dimensions of the area concerned. The ACC should also negotiate any re-routings necessary for flights already coordinated but still within adjacent Flight Information Regions (FIRs) and provide any information on potential implications on traffic flow and its capability to handle the expected traffic. It is also expected that adjacent ACCs will be asked to reroute flights not yet coordinated to keep them clear of the area. It should be noted that flight crews may make the decision not to completely avoid the area based on, for example, visual observations; and

f) implement flow management measures if necessary to maintain the required level of safety.

Note 1. — In order to assist staff in expediting the process of composing the AIS messages, a series of templates should be available for this stage of the volcanic activity.

2.2.2. In addition to sending the relevant AIS messages to the normal distribution list, it will be sent to the relevant meteorological facilities.

[4] The size of the area is to be agreed in the region concerned and should be based on local knowledge as regards the volcano concerned.

2.3. Adjacent ACC Actions

2.3.1. During the pre-eruption phase, ATC will not normally initiate clearances through a danger area; however, it will inform aircraft about the potential hazard and continue to provide normal services. Adjacent ACCs should take the following action to assist:

a) when advised, re-clear flights to which services are being provided and which will be affected by the area; and

b) unless otherwise instructed, continue normal operations and:

i. if one or more routes are affected by the area, suggest re-routings to the affected aircraft onto routes clear of the area; and

ii. maintain awareness of the affected area.

2.4. ATFM Unit Actions

2.4.1. The ATFM unit and the associated Volcanic Ash Advisory Centre (VAAC) will determine how their initial communications will take place on the basis of bilateral agreements. Upon reception of preliminary information on volcanic activity from the lead VAAC, the ATFM unit should initiate actions in accordance with its procedures to ensure exchange of information in order to support CDM between air navigation service providers (ANSPs), Meteorological Watch Offices (MWOs), VAACs and aircraft operators concerned.

3. START OF ERUPTION PHASE

3.1. General

3.1.1. This phase commences at the outbreak of a volcanic eruption, with volcanic ash being ejected into the atmosphere. The focus of the processes in this phase is to protect aircraft in flight and at aerodromes from the hazards of the eruption through the collection and use of relevant information.

3.1.2. In addition to relevant actions described under the pre-eruption phase, major activities of the start of eruption phase such as the issuance of relevant AIS and MET messages in accordance with Annex 15 and Annex 3, respectively and provision of information and assistance to airborne traffic. Danger areas will be declared via NOTAM, as appropriate. This phase will last until such time as the on-going eruption phase can be activated.

3.2. **Originating ACC Actions** (eruption in its own FIR)

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

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

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

3.2.4. During the start of eruption phase the ACC should:

a) ensure that a NOTAM is originated to define a danger area delineated cautiously so as to encompass a volume of airspace in accordance with the limited information available. In determining the area, information on upper winds should be taken into account, if available. The purpose is to ensure safety of flight in the absence of any prediction from a competent authority of the extent of contamination;

b) maintain close liaison with MET facilities, who should issue appropriate MET messages in accordance with Annex 3;

c) devise and update ATFM measures when necessary to ensure safety of flight operations, based on these forecasts and in cooperation with aircraft operators and the adjacent ACCs using the CDM process;

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

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

f) issue appropriate AIS messages in accordance with Annex 15. Significant reductions in intensity of volcanic activity should take place during this phase and the airspace no longer is contaminated by volcanic ash. Otherwise, begin CDM planning for the on-going eruption phase in conjunction with aircraft operators, the appropriate ATFM unit and the affected ACCs.

3.3. Adjacent ACC Actions

3.3.1. During the start of eruption phase, adjacent ACCs should take the following actions:

a) maintain a close liaison with the appropriate ATFM unit and the originating ACC to design, implement and keep up to date ATFM measures which will enable aircraft to ensure safety of flight operations;

b) the adjacent ACC, in cooperation with the originating ACC and aircraft operators, should impose as required additional tactical measures to those issued by the appropriate ATFM unit;

c) maintain awareness of the affected area; and

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

3.4. ATFM Unit Actions

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

4. ON-GOING ERUPTION PHASE

4.1. The on-going eruption phase commences with the issuance of the first volcanic ash advisory (VAA) by the lead VAAC which contains information on the extent and movement of the volcanic ash cloud in accordance with Annex 3 provisions.

Note 2 - Volcanic ash advisory information in graphical format (VAG) may also be issued by the VAAC, containing the same information as its text-based VAA equivalent.

4.2. The VAA/VAG should be used to:

a) prepare appropriate AIS and MET messages in accordance with Annex 15 and Annex 3 provisions, respectively; and

b) plan and apply appropriate ATFM measures.

4.3. The volcanic contamination may affect any combination of airspace; therefore, it is not possible to prescribe measures to be taken for all situations. Furthermore, it is not possible to detail the actions to be taken by any particular ACC. The following guidance therefore may prove useful during the on-going eruption phase but should not be considered mandatory or exhaustive:

a) ACCs affected by the movement of the volcanic ash should ensure that appropriate AIS messages are originated in accordance with Annex 15. ACCs concerned and the appropriate ATFM unit should continue to publish details on measures taken to ensure dissemination to all concerned;

b) depending on the impact and/or extent of the volcanic ash, the appropriate ATFM unit may take the initiative to organize teleconferences to exchange the latest information on the developments, in order to support CDM, with the VAACs, ANSPs and MWOs and operators concerned;

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

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

5. RECOVERY PHASE

5.1. The recovery phase commences with the issuance of the first VAA/VAG containing a statement that "NO VA EXP" (i.e. "no volcanic ash expected") — which normally occurs when it is determined that the volcanic activity has reverted to its pre-eruption state and the airspace is no longer affected by volcanic ash contamination. Consequently, appropriate AIS messages should be issued in accordance with Annex 15.

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

6. AIR TRAFFIC CONTROL PROCEDURES

6.1. If a volcanic ash cloud is reported or forecasted in the FIR for which the ATS unit is responsible, the following actions should be taken:

a) relay all pertinent information immediately to flight crews whose aircraft could be affected to ensure that they are aware of the ash cloud's position and levels affected;

b) request the intention of the flight crew and endeavour to accommodate requests for re-routing or level changes;

c) suggest appropriate re-routing to the flight crew to avoid an area of reported or forecast ash clouds; and

d) request a special air-report when the route of flight takes the aircraft into or near the forecast ash cloud and provide such special air-report to the appropriate agencies.

Note 3.— The recommended escape manoeuvre for an aircraft which has encountered an ash cloud is to reverse its course and begin a descent if terrain permits.

Note 4. — The final authority as to the disposition of the aircraft, whether to avoid or proceed through a reported or forecast volcanic ash cloud, rests with the flight crew.

6.2. When advised by the flight crew that the aircraft has inadvertently entered a volcanic ash cloud, the ATS unit should:

a) take such action applicable to an aircraft in an emergency situation; and

b) do not initiate modifications of route or level assigned unless requested by the flight crew or necessitated by airspace requirements or traffic conditions.

Note 5.— General procedures to be applied when a pilot reports an emergency situation are contained in Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444, *Chapter 15, 15.1.1 and 15.1.2).*

Note 6.— Guidance material concerning the effect of volcanic ash and the impact of volcanic ash on aviation operational and support services is provided in Chapters 4 and 5 of the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691).

7. ATFM PROCEDURES

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

7.2. The ATFM unit will apply ATFM measures on request of the ANSPs concerned. The measures should be reviewed and updated in accordance with updated information. Operators should also be advised to maintain watch for relevant AIS and MET messages for the area.

APPENDIX A

GENERAL CONSIDERATIONS DURING THE DEVELOPMENT OF AN ATM CONTINGENCY PLAN FOR VOLCANIC ASH

1. In a contingency plan relating to volcanic ash contamination, certain steps need to be taken to provide a coordinated and controlled response for dealing with an event of this nature. Responsibilities should be clearly defined to ATS personnel. The plan should also identify the officials who need to be contacted, the type of messages that are to be created, the proper distribution of the messages and how to conduct business.

2. ATS personnel need to be trained and be made aware of the potentially hazardous effects if an aircraft encounters a volcanic ash cloud. Some particular aspects include:

a) volcanic ash contamination may extend for hundreds, or even thousands of miles horizontally and reach the stratosphere vertically;

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

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

d) volcanic ash may result in the failure or power loss of one or all engines of an aircraft; and

e) aerodromes with volcanic ash deposition may be declared unsafe for flight operations. This may have consequences for the ATM system.

4. The area control centre (ACC) in conjunction with ATFM units serves as the critical communication link between affected aircraft in flight and the providers of information during a volcanic eruption. During episodes of volcanic ash contamination within the FIR, the ACC has two major communication roles. First and most important is its ability to communicate directly with aircraft enroute which may encounter the volcanic ash. Based on the information provided in SIGMET information for volcanic ash and volcanic ash advisories (VAAs), and working with MWOs, ATS personnel should be able to advise the flight crew of which flight levels are affected by the volcanic ash and the forecast movement of the contamination. Through various communication means, ATS units have the capability to coordinate with the flight crew alternative routes which would keep the aircraft away from the volcanic ash cloud.

5. Similarly, through the origination of a NOTAM/ASHTAM for volcanic activity the ACC can disseminate information on the status and activity of a volcano even for pre-eruption increases in volcanic activity. NOTAM/ASHTAM and SIGMET, together with AIREPs, are critical to dispatchers for flight planning purposes. Operators need as much advance notification as possible on the status of a volcano for strategic planning of flights and the safety of the flying public. Dispatchers need to be in communication with flight crew enroute so that a coordinated decision can be made between the flight crew, the dispatcher and ATS regarding alternative routes that are available. The ACC should advise the ATFM unit concerning the availability of alternative routes. However, it cannot be presumed that an aircraft which is projected to encounter ash will be provided with the most desirable route to avoid the contamination. Other considerations

have to be taken into account such as existing traffic levels on other routes and the amount of fuel reserve available for flights which may have to be diverted to other routes to allow for the affected aircraft to divert.

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

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

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APPENDIX B

ANTICIPATED FLIGHT CREW ISSUES WHEN ENCOUNTERING VOLCANIC ASH

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

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

b) acrid odour similar to electrical smoke;

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

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

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

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

g) because of the abrasive effects of volcanic ash on windshields and landing lights, visibility for approach and landing may be markedly reduced. Forward visibility may be limited to that which is available through the side windows; and/or

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

2. Simultaneously, ATS personnel can expect flight crews to be executing contingency procedures such as the following:

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

b) exit volcanic ash cloud as quickly as possible. The shortest distance/time out of the ash may require an immediate, descend and/or 180 degrees turn (if terrains permit);

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

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

e) land at the nearest suitable aerodrome; and

f) upon landing, thrust reversers may be used as lightly as feasible.

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APPENDIX C

COMMUNICATION AND DISSEMINATION OF PILOT REPORTS OF VOLCANIC ACTIVITY

1. INTRODUCTION

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

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

2. PURPOSES OF VOLCANIC ASH REPORTING AND DATA COLLECTION

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

a) locate the volcanic hazards;
b) notify immediately other aircraft (in-flight) about the hazard;
c) notify other interested parties: ANSPs (ATC, AIS, ATFM), VAACs, MWO, etc. to ensure the consistent production of appropriate information and warning products in accordance with existing provisions; and
d) analyse collected reports from the post-flight phase in order to:
   - identify areas of concern;
   - validate and improve volcanic ash forecasts;
   - improve existing procedures;
   - assist in defining better airworthiness requirements; and
   - share lessons learned, etc.

3. PHASE OF OPERATIONS

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

b) in-flight; and
c) post-flight.

3.2. The following section analyses these separately.

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

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

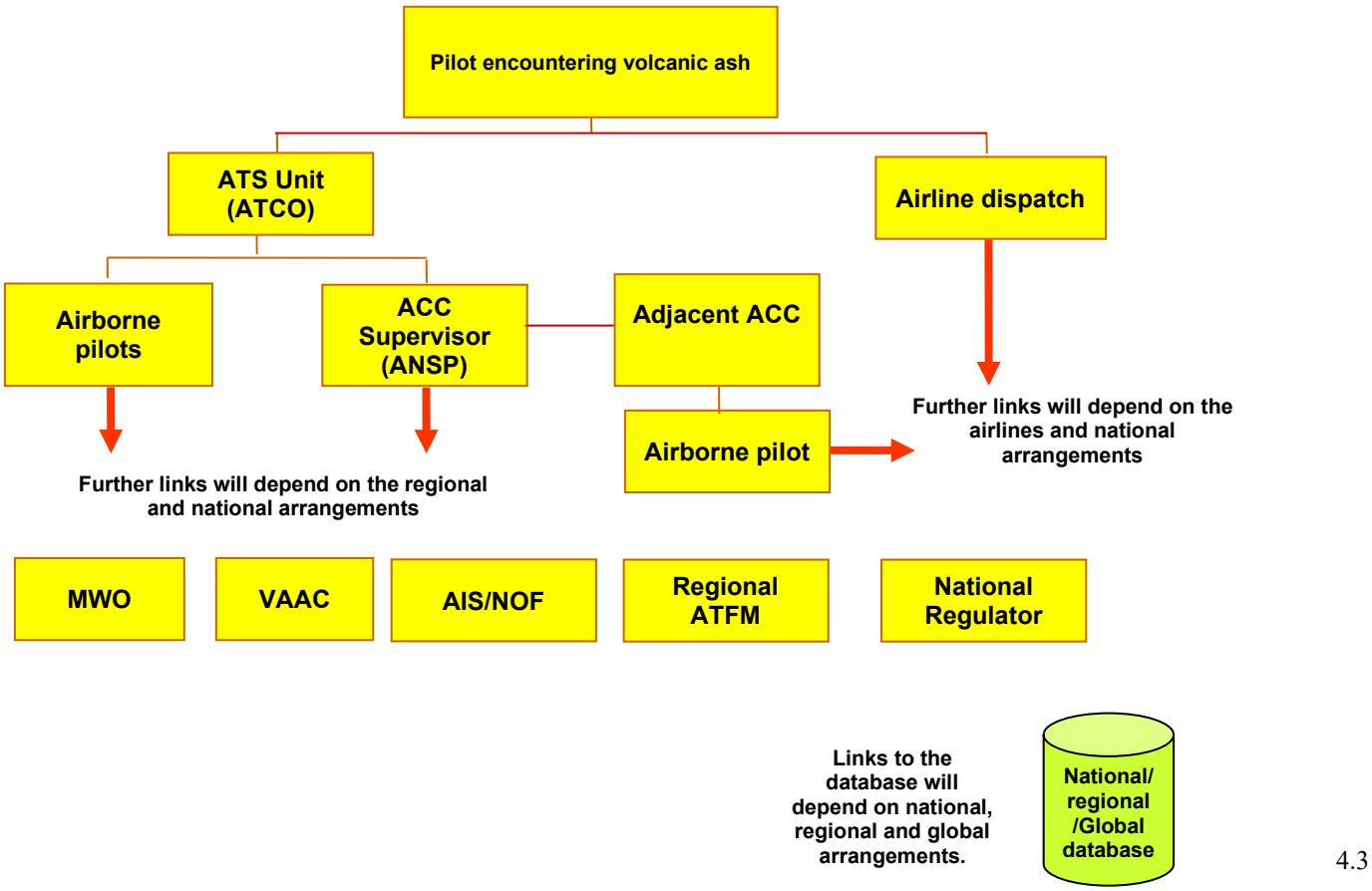
4.2. *In-Flight Phase*

4.2.1 Participants, Roles & Responsibilities:

Participants	Roles & Responsibilities
Pilots, civil and/or military, observing and/or encountering volcanic activity	To provide as much detailed information as possible about the type, position, colour, smell, dimensions of the volcanic contamination, level and time of the observation and forward VAR Part I immediately to the ATS unit with which the pilot is in radiotelephony (R/T) communication. Record the information required for VAR Part II on the appropriate form as soon as possible after the observation or encounter and file the report via data link, if available.
ATS unit receiving the information from the pilot encountering volcanic event	To ensure that information received by an air traffic controller from the pilot has been copied, clarified (if necessary), and disseminated to other pilots as well as to the ACC Supervisor. In addition, air traffic controllers could ask other pilots flying within the same area if they have observed any volcanic activity.
ATS unit/ACC Supervisor (if applicable) or other Air Navigation Service Provider responsible person	To use all means of communication and available forms to ensure that the information received from the air traffic controller has been: - passed on to the associated Meteorological organizations in accordance with national/regional arrangements; - fully and immediately disseminated across the organization, in particular to adjacent sectors and the associated NOTAM Office (NOF); - passed on to the neighbouring sectors and ACCs (if necessary); - passed on to the regional ATFM centre if existing (e.g. CFMU in Europe); - passed on to the national/regional authority responsible for the handling of contingency situations.
Neighbouring ANSPs (ACCs)	To ensure that information is provided to flight crews flying towards the area affected by the volcanic contamination; disseminated across the organization and the system prepared to cope with the possible changes of the traffic flows; and that the information is provided to the national authority responsible for the handling of contingency situations and passed on to the NOF and MWO as required.
MET Watch Office	To use the information originated by flight crews and forwarded by the ATS unit, in accordance with Annex 3.
VAAC	To use the information originated by flight crews, MWOs and other competent sources in accordance with Annex 3
AIS / NOF	To publish appropriate AIS messages in accordance with Annex 15
ATFM unit or centre (if existing)	To ensure that information received is stored and made available for information to all partners in its area of responsibility (ANSPs, airlines, VAAC, MET etc.). As part of the daily activity, coordinate ATFM measures with ACCs concerned.

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

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



4.3

Post-Flight Operations Roles & Responsibilities and order of reporting

Participants	Roles & Responsibilities
Civil and/or military pilots/airlines having observed or encountered an eruption or volcanic contamination	To file the volcanic ash report with as much detailed information as possible about the volcanic activity and/or encounter (position, colour, smell, dimensions, FL, time of observation, impact on the flight, etc.). Ensure that the VAR is filed and transmitted to the relevant recipients as soon as possible after landing (if not filed via data link already during the flight). Make an entry into the Aircraft Maintenance Log (AML) in case of an actual or suspected encounter with volcanic contamination.
ANSP	To provide a summary report of effects of the volcanic activity that affected its operations at least once per day to the national authority with as much detailed information as possible about the number of encounters, impact on air traffic management, etc.).
AOC Maintenance - Post flight Inspection	To report about the observation of the aircraft surfaces, engine, etc., and to provide the information to the national, regional or global central data repository, where applicable.

Investigation authority	All aeronautical service providers (including operators, ANSPs, airports, etc.) shall investigate the effects of a volcanic activity, analyse the information, search for conclusions, and report the investigation results and relevant information to the national supervisory authority and any central data repository.
National Authority	To handle the national central data repository and report to the regional/global central data repository if any. To analyse reports from its aeronautical service providers and take action as appropriate.
Regional Central Data Repository	To collect the national data and make them available to interested stakeholders under agreed conditions.
MWO	To use the national and regional information coming from national and regional central data repositories.
VAAC	To use the information originated by flight crews, and other competent sources to: a) validate its products accordingly and; b) improve the forecast.
Global Data Repository (and research institutes - where appropriate)	To analyse the information stored in the regional central data repository and provide the research outcomes for lessons learnt process.
Knowledge management (e.g. SKYbrary)	To use the post-flight lessons learnt and disseminate them to interested stakeholders.
ICAO	To review/revise ATM volcanic ash contingency plans.

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

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

a) Radiotelephony and Data link Communications;
b) VAR;
c) NOTAM/ASHTAM;
d) SIGMET;
e) VAA/VAG;
f) Central data repository e.g. CFMU Network Operations Portal (NOP);
g) Centralized web based sites with the regularly updated information and maps – e.g. http://www.eurocontrol.int/
h) Teleconferences;
i) Periodic Bulletins with the set of information defined by the data providers and data users; e.g. Smithsonian Institution Weekly Bulletin; and/or
j) Centralized internet-based sites for the sharing of lessons learnt (Knowledge management – e.g. SKYbrary http://www.skybrary.aero/index.php/Main_Page).

APPENDIX D

SIGMET and NOTAM EXAMPLES DURING VOLCANIC ASH

Volcanic Ash (VA) Cloud (CLD) in Kuwait FIR

WVKW31 OKBK 030900
OKBK SIGMET 1 VALID 030900/031500 OKBK-
OKAC KUWAIT FIR VA CLD OBS AT 0840Z W OF E48 FL180/320 MOV E 45KT NC FCST1500Z VA CLD APRX E OF E4730=

Cancellation SIGMET as volcanic ash cloud exits Kuwait FIR into Tehran FIR (sooner than expected)

WVKW31 OKBK 031400
OKBK SIGMET 2 VALID 031400/031500 OKBK-
OKAC KUWAIT FIR CNL SIGMET 1 030900/031500 VA MOV TO OIIX FIR=

VA CLD in Cairo FIR

WVEG31 HECA 030900
HECA SIGMET 1 VALID 030900/031500 HECA-
HECC CAIRO FIR VA CLD OBS AT 0840Z N OF LINE N3140 E2510 - N29 E30 W OF LINE N3150 E3359 – N29 E30 FL100/290 MOV SE 35KT NC FCST1500Z VA CLD APRX N OF LINE N3140 E2510 – N2806 E3435=

Cancellation SIGMET as volcanic ash cloud exits Cairo FIR into Jeddah FIR (sooner than expected)

WVEG31 HECA 031330
HECA SIGMET 2 VALID 031330/031500 HECA-
HECC CAIRO FIR CNL SIGMET 1 030900/031500 VA MOV TO OEJD FIR=

Example NOTAM based on SIGMET issued for Cairo FIR

Q) HECC/QWWXX/IV/NBO/W/100/290/999
A) HECC B) 1311030900 C) 1311031500
E) ATM AND ACFT TAKE NECESSARY ACTION DUE TO VOLCANIC ASH AREA OF HIGH/MEDIUM CONTAMINATION (FROM VOLCANO ETNA 211060, 37.734N 015.004E) AS FOLLOWS:
3400N 2410E – 3140N 2510E – 2900N 3000E – 3150N 3359E – 3330N 3000E – 3400N 2710E – 3400N 2410E
F) FL100 G) FL290

Special Air-Reports on Volcanic Ash

Special air-reports on volcanic ash sent to ACCs should then be sent via AFTN to the relevant Meteorological Watch Office (MWO) which is forwarded to the relevant Volcanic Ash Advisory Centre (VAAC) – for MID Region that is VAAC Toulouse.

SPECIAL AIREP □ACC □ MWO □ VAAC

Pilots should use the special air-reports format on volcanic ash as at Table A4-1 in Appendix 4 of ICAO Annex 3.

-- END --