



METEOROLOGY PANEL



INTERNATIONAL CIVIL AVIATION ORGANIZATION

Meteorology Panel (METP)

Working Group on Meteorological Operations Group (WG-MOG)

International Airways Volcano Watch (IAVW) Work Stream

11th Meeting

(METP/WG-MOG/11-IAVW)

Washington D.C., United States of America, 18 to 19 November 2019

MEETING REPORT



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1. **AGENDA ITEM 1: OPENING OF THE MEETING**

1.1 The 11th Meeting of the Meteorology Panel (METP) Working Group on Meteorological Operations Group (WG-MOG) International Airways Volcano Watch (IAVW) Work Stream (METP/WG-MOG/11 - IAVW) took place in Washington D.C., United States of America, at the premises of RTCA, Inc., from 18-19 November 2019.

1.2 Ms Karan Hofmann, Program Director – Aviation Technology of RTCA, Inc., welcomed the participants to RTCA, Inc., and provided information on the RTCA building facilities.

1.3 Mr. Colin Hord, Policy Lead MET/AIM Civil Aviation Authority of the United Kingdom (CAA UK), and Rapporteur of the METP WG-MOG, chaired the meeting assisted by Ms Paula Acethorp, Chief Meteorological Officer, Civil Aviation Authority of New Zealand and IAVW work stream lead.

1.4 Mr Hord opened the meeting at 09:00 local time, thanking the local hosts for the hospitality and the excellent arrangements made for the meeting. He thanked the attendees for traveling to Washington D.C. and noted that on this occasion all VAACs had provided a representative. Mr Hord reminded the meeting that it was important to look forward and consider how to solve problems and issues as they arise in response to ICAO's Global Air Navigation Plan and that the focus should be on meeting the ICAO aspirations in future aviation travel.

2. **AGENDA ITEM 2: INTRODUCTION**

2.1 The meeting adopted the agenda presented in information paper (IP) IP/03.

2.2 Referenced study notes (SN) and IPs were made available on the ICAO METP MOG public website, under: <https://www.icao.int/airnavigation/METP/Pages/MOG.aspx>.

2.3 The list of attendees is contained in [Appendix A](#).

3. **AGENDA ITEM 3: MATTERS RELATING TO IAVW**

3.1 **Status of outstanding WG-MOG (IAVW) actions**

3.1.1 **MOG/8/1: VAAC KPIs**

3.1.1.1 The meeting was reminded by the WG-MOG IAVW Work Stream Lead, Ms Paula Acethorp, that the guidance around timeliness and compliance VAAC Key Performance Indicators (KPIs) was agreed via electronic correspondence in late 2018 and finalised in February 2019. The results for these agreed KPIs were included for each VAAC in the Combined VAAC Management Report (see paragraph 3.2). In addition, two trial timeliness KPIs and one developmental accuracy KPI were established, with preliminary results discussed under agenda item 3.3.

3.1.2 **MOG/8/2: Increased ASH/NO ASH pilot reports.**

3.1.2.1 The representative for IATA, Mr. Graham Rennie confirmed that the request for increased ASH / NO ASH reports was raised with operators at the IATA FOSTF (Flight Operations Support Task Force) meeting held 5-6 March 2019, in Dallas, USA.

3.1.2.2 The meeting noted that there can be difficulties receiving a pilot report via local Air Traffic Control (ATC) and it was important to liaise with local ATC to receive these and to also liaise through regional initiatives (e.g. through volcanic ash exercises and stakeholder meetings).

3.1.3 **MOG/8/3:** Increasing volcanic ash encounter reports

3.1.3.1 The meeting was reminded of the action that states:

That, the METP Secretariat be invited to liaise with the FLTOPSP Secretariat to inform them of the need to ensure that all aircraft encounters with volcanic ash are reported using the Volcanic Activity Report (VAR) form, in accordance with PANS-ATM (ICAO Doc 4444).

3.1.3.2 On 15 August 2019, the METP Secretariat, by way of electronic communication, contacted the Flight Operations Panel (FLTOPSP) Secretariat, to highlight the need to ensure that all aircraft encounters with volcanic ash are reported using the Volcanic Activity Report (VAR) form, in accordance with PANS-ATM (ICAO Doc 4444). At the sixth meeting of the FLTOPSP (FLTOPSP/6), held from 7 to 11 October 2019 in Montreal, working paper (WP/17) was presented to the meeting by the FLTOPSP Secretariat, outlining the outcomes of METP WG-MOG/8 IAVW and noting the above request.

3.1.3.3 FLTOPSP/6 was informed that the pilot reports were not just used for the promulgation of information regarding volcanic ash activity, but also to assist with refining the criteria used to determine the severity of ash encounters. FLTOPSP/6 noted that if the information provided in the pilot reports is incomplete, this could affect the reliability of the ash-encounter severity index provided in Table F-1 of Doc 9691 - *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds*. The Rapporteur of the FLTOPSP Volcanic Ash sub group (VASG) reminded FLTOPSP/6 that issues related to the use of the VAR template had been identified in the work related to job card FLTOPSP.024, in particular that there was insufficient guidance and training for pilots on the use of this form. It was proposed that there was a need to address the root causes of the lack of pilot reporting before asking for more reports. Comments on issues relating to the reporting of volcanic ash encounters were then provided in a Flimsy to FLTOPSP/6, in particular highlighting the form itself from a human factors perspective. FLTOPSP/6 drafted a recommendation:

Recommendation x/x: That the Panel provide comments and feedback to the METP regarding the reporting of Volcanic Ash Encounters, based on comments provided during the meeting as presented in Appendix X.

3.1.3.4 Taking the foregoing into account, the MOG/11 meeting noted it would be useful to review the VAR template with a view to modernising it (including assessing it from a human factors perspective) and ensuring it is sufficiently succinct so that, for example, it could fit on an aircraft's cockpit data display (i.e., ACARS or CPDLC screen). After some discussion, the meeting formed the following action:

Action Agreed 11/1 — Volcanic Activity Report

That; an ad hoc group consisting of Soledad Osores, Jeff Osiensky, Marcel Roux, Graham Rennie, Klaus Sievers and Rory Clarkson (with Marcel as Task Lead) be tasked to review the efficacy of

the Volcanic Activity Report as detailed in PANS-ATM (ICAO Doc 4444), taking into account human factors considerations, and present the findings to the next MOG-IAVW meeting.

3.1.4 **MOG/8/4:** Severity Index Update

3.1.4.1 Ms Paula Acethorp advised the meeting that the METP Secretariat had confirmed by electronic correspondence on 17 May 2019 that the *Ash-Encounter Severity Index* located in Table F-1 in Appendix F to the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691) had been updated, and by further correspondence on the 13 August 2019 confirmed that it was published by ICAO on 26 June 2019.

3.1.4.2 Dr David Schneider, informed the meeting that the database of encounters was still in the process of being updated and would be available soon (section 3.4 refers).

3.1.5 **MOG/8/5:** Re-suspended volcanic ash in VONA (Doc 9766)

and;

MOG/8/7: Aviation colour code in VAA and status of the VONA

3.1.5.1 SN/01 addressed MOG/8/5 and also part a) (ii) of MOG/8/7, proposing a template for the Volcano Observatory Notice for Aviation (VONA) to be included in Amendment 80 to Annex 3, incorporating options to report re-suspended ash as appropriate. While consideration was given to the suitability of the VONA elements to be disseminated in IWXXM format, further work may be required to refine the template in this regard.

3.1.5.2 Mr Ian Lisk, WMO advisor, reported that the wider State volcano observatory (SVO) community appear to be very much in favour of this initiative but that there may be implementation challenges associated with it amongst those countries (States) most in need. The meeting noted that a Volcano Observatory Best Practices workshop was running concurrently this week in Mexico City and it was understood that there would be some discussion of the proposed VONA template.

3.1.5.3 The meeting noted that few SVOs may have the capability to disseminate the VONA using aeronautical fixed services (AFS) due to the absence of connectivity. Similarly, production and dissemination in the IWXXM format could be challenging. Furthermore, even those SVOs that might work with their associated VAACs or Meteorological Watch Offices (MWOs) to disseminate the VONA in the required formats may struggle with completing all the elements of the VONA template immediately after an eruption due to other emergency response obligations such as the issuance of warnings to local populations in immediate danger. The meeting made some suggestions to reduce the total number of VONA elements, including moving the colour and shape of the ash cloud to the remarks section. It was also noted that, practically speaking, there was little new information being added into the template. In fact, the template was simply isolating each component of the existing VONA elements. Further, the meeting was also reminded that the intended audience of the VONA was the operators and VAACs, not modellers.

3.1.5.4 While the VONA could include a combination of conditional and mandatory elements, it was recognised that making all elements (aside from the STATUS indicator) mandatory assists in creating an associated IWXXM schema. The meeting agreed that following the elevation of the VONA from a Note to a Recommended Practice within Annex 3, it may be some time before it could be elevated further to a Standard, particularly given the likely IWXXM format requirement for which some SVOs may struggle to implement in the near to medium term. The meeting was reminded that there should be cost recovery in place for the SVOs to carry out their mandated duties in support of international civil aviation and that cost

recovery was a topic being addressed by the METP Working Group on MET Cost Recovery Guidance and Governance (WG-MCRGG).

3.1.5.5 Ms Paula Acethorp outlined the efforts by VAAC Wellington, the Civil Aviation Authority of New Zealand and GNS Science NZ in developing a web portal for use by SVOs in the South Pacific region. SVOs would securely log in to the portal, enter the VONA element details using a combination of dropdown and free text entry boxes, then VAAC Wellington would disseminate the VONA on behalf of the SVO to an agreed set of recipients. Mr Graham Rennie stated that users were very supportive of this initiative and noted that it would ensure consistency. Further, the meeting agreed that a universal portal for SVOs globally would be of value and for elevation of the VONA to succeed, a collaborative approach was crucial.

3.1.5.6 It was agreed that guidance and education material on the VONA, which also details its purpose, must be made available to operators, as it will be a crucial piece of information feeding in to pre-flight safety risk assessment processes. In addition, guidance material for SVOs and VAACs was also necessary, to ensure quality and consistency in VONA issuance and also in how they are used by VAACs. The meeting noted that volcanic ash exercises would be a useful way to ensure SVOs were familiar with the VONA template through use, ahead of entry in Annex 3.

3.1.5.7 Guidance would also be required for a SVO dealing with multiple volcanic ash re-suspension events as this may cause confusion when the volcano in both VONA (i.e. one VONA pertaining to an eruption and another VONA pertaining to re-suspended volcanic ash) is referred to as “UNKNOWN”. The meeting noted that the United States Geological Service, through a Disaster Assistance Programme (DAP), was planning to conduct a regional workshop in South America in 2021, which will assist in the education of SVOs in such matters.

3.1.5.8 Regarding the inclusion of re-suspended volcanic ash information in the VONA template, the meeting noted that there was little information on the risk that re-suspended volcanic ash poses to engines, given the likely concentration levels that would be experienced. Therefore, consideration may be required as to whether there needed to be clarification on the volume of volcanic ash being re-suspended before a VONA is issued.

3.1.5.9 Regarding the issue of potential information overload for aviation users, Mr Graham Rennie stated that IATA envisions that VONA information would not be relayed to pilots, except for when it provided imminent information of potentially dangerous pre-eruptive conditions (given that post-eruption, the VAAs will then be the primary source of information).

3.1.5.10 The meeting considered how Area Control Centres (ACCs) or Flight Information Centres (FICs) might utilise the VONA, given they are an important part of the aviation system and there could be confusion if they do not receive this situational awareness information that others hold, particularly for pre-eruptive activity. However, even though this is situational awareness information for ACCs, given the information issues already raised with NOTAMs/ASHTAMs being out of sync or inconsistent with VAAs, when considering the potential dissemination of VONA to ACCs/FICs, this issue must be considered (para 3.1.6.1 refers).

3.1.5.11 The meeting was reminded that action MOG/8/7 included the outstanding task for the WG-MOG Rapporteur to prepare a working paper to METP/5, to propose an amendment to Annex 3 concerning the removal of the aviation colour code from the VAA and the elevation in the status of the VONA from a Note to a Recommended Practice. Considering this, the meeting then formulated the following actions:

Action Agreed 11/2 — Aviation colour code in VAA and status of the VONA

That;

- a) An ad-hoc group consisting of WG-MOG Rapporteur, Larry Burch, Greg Brock, David Schneider and Paula Acethorp (with WG-MOG Rapporteur as Task Lead) finalise the proposed inclusions to Amendment 80 to Annex 3 – *Meteorological Service for International Air Navigation* with intended applicability in November 2022, regarding the removal of the aviation colour code from the VAA, the elevation in the status of the VONA from a Note to a Recommended Practice; and
- b) Upon completion of a), the WG-MOG Rapporteur prepare a working paper for METP/5 (September 2020) presenting a proposed amendment to ICAO Annex 3 – *Meteorological Service for International Air Navigation* (as part of Amendment 80 with intended applicability in November 2022) detailing the rationale for the removal of the aviation colour code from the VAA, the elevation in the status of the VONA from a Note to a Recommended Practice, and the proposed VONA template.

Action Agreed 11/3 —VONA Guidance Material

That; an ad-hoc group consisting of Graham Rennie, Anton Muscat, Philippe Hereil, Tristan King, Yuichi Imamura, David Schneider, Soledad Osoreo (with David Schneider as Task Lead) be tasked to create guidance for SVOs and VAACs to be included in the *Handbook on the International Airways Volcano Watch (IAVW) – Operational Procedures and Contact List* (ICAO Doc 9766) pertaining to the creation, dissemination and use of the VONA.

3.1.6 MOG/8/6: Re-Suspended Volcanic Ash in ASHTAM/NOTAM

3.1.6.1 SN/04 presented a review of the NOTAM and ASHTAM formats and associated guidance, in respect of the inclusion of information on re-suspended volcanic ash. The utility of these products in the context of other volcanic ash related information was also considered where, during a volcanic eruption, operators may receive, in quick succession, a VONA (potentially), a VAA, a SIGMET for volcanic ash, and a NOTAM for volcanic ash or ASHTAM on a single event, potentially all providing the same or very similar information, or in a worst case scenario, conflicting information.

3.1.6.2 After some further discussion, the meeting agreed on the following action:

Action Agreed 11/4 —Re-Suspended Volcanic Ash in NOTAM/ASHTAM

That;

- a) The WG-MOG Rapporteur to prepare a paper that will be submitted to the next Information Management Panel (IMP) meeting (through the UK IMP member) which details the proposed edits to Annex 15 – *Aeronautical Information Services, PANS-AIM* (Doc 10066) and *Aeronautical Information Services Manual* (Doc 8126) outlined in [Appendix B](#) to this report relating to the inclusion of guidance on the handling of re-suspended volcanic ash in NOTAM for volcanic ash and ASHTAM, plus further edits that may be required for *Aeronautical Information Services and Aeronautical Meteorological Services* (Doc 9377). Additionally, the paper will detail the associated issues of information overload and potential inconsistency; and

- b) Subject to the outcome of a), the WG-MOG Rapporteur will submit a working paper to METP/5 (September 2020) proposing changes to the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691) taking into account the proposed amendment given in [Appendix C](#) to this report.

3.1.7 **MOG/8/8:** Roadmap of the IAVW and ConOps

3.1.7.1 SN/07 presented a draft update to the Roadmap for the IAVW. The draft update was coordinated within the work stream via electronic correspondence and finalised in September 2019, and was presented as Attachment A to SN/07. SN/07 also presented a draft update to the Concept of Operations (ConOps) for the IAVW. The draft had been coordinated with the ad-hoc group in September 2019 and was presented as Attachment B to SN/07.

3.1.7.2 The meeting congratulated Mr Larry Burch on his work in progressing the Roadmap and ConOps. The meeting noted that the Roadmap is a valuable document for both operators and service providers, allowing them to better plan their own future system upgrades. It was agreed that this document should be more widely shared with other ICAO groups.

3.1.7.3 The meeting endorsed the updates to the Roadmap of the IAVW and ConOps of the IAVW, and agreed the following action:

Agreed Action 11/5 —Roadmap and ConOps of the IAVW

That;

- a) Version 4.0 of the Roadmap of the IAVW and Version 3.1 of the ConOps of the IAVW, be delivered to the METP Secretariat in order that it can be shared with other METP and associated working groups, other relevant Panels, and PIRGs as appropriate; and
- b) The WG-MOG IAVW Work Stream (with Tristan King and Larry Burch as co-Task Leads) continue to further progress these documents as required.

3.1.8 **MOG/8/9:** Quantitative Volcanic Ash Information and Forecasts

3.1.8.1 The meeting was reminded that a request was made to the fourth meeting of the METP Working Group on Meteorological Information and Service Development (WG-MISD) Volcanic Ash/Sulphur Dioxide (VASD) Work Stream, held 20 November 2018 in Wellington, New Zealand, to consider the work done by the World Meteorological Organization (WMO) / International Union of Geophysics and Geodesy (IUGG) Volcanic Ash Scientific Advisory Group (VASAG) on the state of the science with quantitative volcanic ash contamination information and forecasts. The MISD/VASD/4 meeting had consequently formulated an action to identify the user needs, current capabilities, short-fall analysis, and concept definition, pertaining to quantitative volcanic ash contamination information, and to formulate preliminary performance requirements (WG-MISD/4 Action 4/3 refers).

3.1.8.2 The meeting noted that the upcoming MISD/VISD/5 meeting, to be convened immediately following this MOG meeting, will address the progress made since last year.

3.1.9 **MOG/8/10:** Use of Infrasound Data in Support of IAVW

3.1.9.1 SN/08 presented the progress made in the use of infrasound data in support of IAVW, in the extension of the collaboration initiated between IDC (International Data Centre) of the CTBTO (Preparatory Commission of the Comprehensive Nuclear-Test-Ban Treaty Organization) and VAAC Toulouse in 2007.

3.1.9.2 Mr Philippe Hereil of VAAC Toulouse informed the meeting that progress had been made on the Volcanic Information System (VIS), which was intended to provide notifications of possible volcanic activity based on infrasound observations by stations from the International Monitoring System (IMS) of the CTBTO and other near- and far-field national or research infrasound installations. A prototype of an alerting bulletin had been designed for VAAC Toulouse in the case of an explosive eruption in its areas of responsibility.

3.1.9.3 Data from recent Etna, Stromboli, Aoba and Ambrym eruptions was tested, showing that the VIS was capable of detecting large eruptions. Smaller eruptions, however, showed that the VIS was highly dependent on propagation conditions to the closest station. Further work was still required to improve the VIS capabilities, including incorporating data from local infrasound networks, where possible.

3.1.9.4 The meeting noted that infrasound monitoring was a complementary technique and that it provided information on volcanoes that are not well monitored.

3.1.9.5 After some discussion, the meeting formulated the following action:

Action Agreed 11/6: Use of infrasound data in support of IAVW

That, an ad-hoc group consisting of Soledad Osoreo, Marcel Roux and Philippe Hereil (with Philippe as Task Lead), be tasked to:

- a) Pursue, in collaboration with CTBTO and the ARISE (Atmospheric Dynamics Research Infra-Structure in Europe) community, the further development and testing of the volcanic information system (VIS), with the objective to establish a real-time operational system for use by all VAACs; and
- b) Report the results back to the next meeting of the WG-MOG IAVW Work Stream.

3.1.10 **MOG/8/11:** Consolidated VAAC Management Report Inclusions. Refer to paragraph 3.2.

3.2 VAAC Consolidated Management Report

3.2.1 SN/09 delivered the Combined VAAC Management Report, combining both mandatory and optional sections for each VAAC. The report focused on key changes and initiatives from each VAAC including, inter alia, dispersion model updates, user outreach, collaborations, competency frameworks, future developments (as related to the IAVW roadmap) and general operational improvements.

3.2.2 The meeting agreed that the consolidated report from the VAACs was a great initiative, giving an overview of each of the VAACs operations in a clear and easy to read format. Mr Graham Rennie stated that the report was much appreciated by users, in particular the high level actions that follow events over the year. The meeting noted that the report detailed that there were in the order of 10,000 advisories issued over the past year across the nine VAACs, reflecting the significant amount of work VAACs carry out collectively.

3.2.3 It was noted that the number of advisories did not match the number of graphics issued for some VAACs. Reasons for this include:

- “Re-broadcast” advisories do not always have an associated graphic supplied
- The “initial advisory” and “final advisory” do not always have an accompanying graphic.

3.2.4 The meeting was reminded that globally consistent information is the user requirement and the VAACs must adhere to this. Mr Rennie stated that users would expect to see an associated graphic if a VAA has been issued, therefore issuing a VAA without an associated graphic opens up the possibility of an operator who only uses the graphic not using the latest information.

3.2.5 Annex 3 section 3.1.3 refers to the creation of a graphical advisory and notes “The volcanic ash advisory information listed in Table A2-1, when prepared in graphical format, shall be as specified in Appendix 1 and issued using the portable network graphics (PNG) format.” A number of different interpretations were voiced on what this section means, as it appeared to give a conditional action as to whether or not the graphic was issued. It was also discussed whether a re-broadcasted VAA should have an accompanying graphic. At this meeting no decision was made with regards to the requirement for a graphic to accompany all advisories.

3.2.6 Regarding initial volcanic ash advisories, Mr Rennie noted that users would prefer some indication on the FCST elements that a volcanic ash forecast is not yet available (*not* using “NO VA EXP”), and it was suggested that the phrase “NOT AVBL” could be used.

Postscript: It has been further noted that there is no equivalent phrase allowable for the T+0 time step, to indicate this information is not yet available. The MOG-IAVW Work Stream Lead will facilitate further discussion to determine what, if any, changes may be necessary to Table A2-1 of Annex 3 to ensure initial VAAs do not cause any confusion and, if required, accordingly submit a paper to METP/5 to propose those changes.

3.2.7 Some discussion was held on the issuance of initial volcanic ash advisories for volcanoes that regularly erupt. The agreement was that if there is no active advisory in place, and if there is evidence that new activity is underway, an initial advisory must be issued immediately.

3.2.8 Suggestions for future inclusions to the consolidated report included:

- Reducing the length by starting with an executive summary (that could be distributed separately) and putting some more explanatory sections in appendices, considering file size for email distribution
- Short case studies from some of the ‘busier’ VAACs
- Suggestion to add a line to the bottom of the advisory summary table to total all VAAs for the reporting year
- Include a “false alarm” VAA column in the advisory summary table
- Make test VAA results more clearly indicated in the advisory summary table
- Information on significant satellite imagery, modelling and technical changes introduced by the VAACs
- Shortening the reporting period to ensure there is adequate time to prepare the report – suggested period to be from the end of the last report to one month prior to the study note due date
- Emphasise key learning points from any volcanic ash exercises from a VAAC perspective (para 3.6.3 refers.)

3.2.9 It was agreed for the following Combined VAAC Management report, the following action was agreed.

Action Agreed 11/7: Combined VAAC Management Report

That; Dov Bensimon and Marcel Roux (with Dov as Task Lead) be tasked to prepare the next consolidated management report for delivery at the next meeting of the WG-MOG IAVW Work Stream, taking into account the suggestions for report inclusions made during this meeting.

3.3 **Review of trial VAAC KPIs**

3.3.1 Outcomes of, and thoughts on, the trial VAAC KPIs were presented by each VAAC, including their difficulties with (and planned improvements of) forecaster software, the importance of SVO communication, the quality and dissemination of VONA, multiple ideas on how accuracy can be measured and even the culture shift required to measure this information.

3.3.2 Mr Graham Rennie highlighted that users value all information received – and if volcanic ash is obscured by meteorological cloud, they still want to know about it.

3.3.3 It was suggested that atmospheric model wind data may serve as a proxy for accuracy on ash cloud movement. The meeting noted that it would be useful to know how that changes with time, and that it would also be good to have discussion on improving the source term accuracy.

3.3.4 The meeting agreed that it would be useful to understand which States provide VONA and which volcanoes are monitored – this may provide a baseline/starting point from which to measure improvements in volcano monitoring and VONA issuance.

3.3.5 Dr David Schneider noted that the VONA takes time to issue, and so there has to be consideration on the evaluation of the data available before the VONA can be issued. The issue of a VONA is often preceded by a phone call, with a VONA following sometime later – so an initial VAA is still very important.

3.3.6 Mr Klaus Sievers noted that for pilots, the most important KPIs are whether the ash is where it was forecast to be, in all four dimensions, with the timing of the advisory to be issued as quickly as possible. In saying that, the meeting recognised that there are still challenges in observing ash clouds to understand the vertical extent.

3.3.7 The meeting noted the importance of root cause analysis to understand the cause of any delays in issuing advisories, to allow for systemic improvements to be made. Regarding exercises, to increase the realism of the processes, it was suggested that ‘surprise tests’ could be scheduled.

3.3.8 It was also noted that a volcanic ash cloud having “no impact” would be an ultimate success measure, particularly when we move into a quantitative ash forecasting environment.

3.3.9 The meeting agreed to the following action:

Action Agreed 11/8: Trial and Development KPIs

That an ad hoc group consisting of Paula Acethorp, the VAACs, David Schneider, Klaus Sievers, Graham Rennie (with Paula as Task Lead) further develop the KPIs that are reported in the Combined VAAC Management report.

3.4 **Updates to Guidance Material (Handbook, Manual, etc.)**

3.4.1 SN/05 presented by IFALPA representative Mr Klaus Sievers, requested an update on the MOG/5 action:

Action Agreed 5/7–VA aircraft encounter information

That the WMO/IUGG VASAG be invited to:

- a) Review the findings from the German DLR and the USGS with regard to aircraft encounters with the aim to collaboratively update Appendix F of Doc 9691-Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds and;*
- b) Review the proposed volcanic ash encounter severity index in view of its potential inclusion in Appendix F of Doc 9691-Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds.*

3.4.2 Mr Sievers noted that while part (b) of the action had been addressed, part (a) still remained incomplete. Furthermore, he asked that a regular review of the aircraft encounter database be instituted.

3.4.3 The meeting noted that the proposal from IFALPA regarding the ash encounter severity index was not rejected at the last MOG-IAVW meeting but was taken into consideration when updating the index, with a focus on the impact to the aircraft and not the people on board. The work on updating the encounters database is ongoing, with completion expected in the near term.

3.4.4 Dr Rory Clarkson of ICAAIA noted that the manufacturers would appreciate more information on volcanic ash encounters and noted that those that overhaul engines may not recognise the evidence of an ash encounter.

3.4.5 The meeting agreed that an up-to-date encounter database would be a valuable resource, to enable the whole aviation community to learn from these encounters. It was noted that State civil aviation regulators may hold information on volcanic ash encounters.

3.4.6 The meeting then agreed to the following action:

Action Agreed 11/9: VA aircraft encounter information

That; David Schneider complete the update of the volcanic ash encounter database and pass it to the METP Secretariat by end of January 2020 for inclusion in Appendix F of *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691).

3.5 **Holistic review of the IAVW**

3.5.1 The MOG Rapporteur, Mr Colin Hord noted that while he was a member of the group undertaking this review, it was a METP action and not a MOG-IAVW action. Since the last METP meeting

there had been no known activity as follow-up to METP/4 Recommendation 4/1 — Holistic review of the IAVW.

3.6 Volcanic ash exercises

3.6.1 IP/04 presented the outcomes of the APAC VOLCEX 19/01 exercise, simulating the eruption of Raoul Island (situated in the Kermadec Islands, between New Zealand and Fiji), with volcanic ash spreading from the Auckland Oceanic to the Nadi Flight Information Region. Highlights included the usefulness of using the social media tool WhatsApp to share supplementary information and overcome language difficulties by using written communication. It was also noted that education on the STATUS indicators for VAAs and SIGMETs is required for operators to be able to ensure they get the data that they need, and that non-operational data does not enter the operational system.

3.6.2 Mr Yuichi Imamura outlined, via PowerPoint presentation, the aims and outcomes of the VOLCEX 19/02 exercise, which demonstrated a handover of the ash cloud by VAAC Tokyo to VAAC Darwin. The use of the Japan Meteorological Agency (JMA) collaboration web tool was very useful in aiding the exercise and helped overcome any language difficulties.

3.6.3 While the meeting noted the usefulness of sharing outcomes from volcanic ash exercises, the exercises don't necessarily align with the METP Job Card addressing the IAVW, outside of supporting VAAC back-up testing and user education and outreach. However, any important lessons learned could be included in future Combined VAAC Management reports.

4. AGENDA ITEM 4: MOG (IAVW) WORK PLAN AND ACTIVITIES

4.1 WG-MOG Job Card and links to WG-MISD

4.1.1 SN/10 presented the current METP Job Card addressing the IAVW (METP.003.02) assigned by the Air Navigation Commission. The meeting noted that it would be worthwhile including a reference to pre-eruptive notification in the context of the IAVW, given the discussion on elevating the status of the VONA. In addition, it was proposed that ICAO Doc 9974 - *Flight Safety and Volcanic Ash* and the IAVW Roadmap and ConOps be added to the list of reference documents within the Job Card. The WG-MOG formulated the following action accordingly:

Action Agreed 11/10: Proposed update to Job Card METP.003.02 addressing the IAVW

That the WG-MOG Rapporteur present the proposed update to Job Card METP.003.02 addressing the IAVW, as given in [Appendix D](#) to this report, to the METP/5 meeting (September 2020) for consideration.

4.2 Review of MOG Terms of Reference in relation to IAVW

4.2.1 The meeting reviewed the [Terms of Reference](#) (ToR) of the WG-MOG, with minor changes to the terms proposed.

Action Agreed 11/11: MOG Terms of Reference

That the METP Secretariat be requested to update the MOG Terms of Reference on the MOG website, as outlined in [Appendix E](#) to this report.

4.2.2 The meeting also noted that the membership list of the MOG was outdated on the public ICAO site, the WG-MOG Rapporteur agreed that it should be updated.

Action Agreed 11/12: MOG Membership

That the WG-MOG Rapporteur be tasked with updating the WG-MOG membership list.

5. AGENDA ITEM 5: LINKAGES TO ICAO METP

5.1 Report on outcomes from METP MG CWGP/1 relating to the IAVW

5.1.1 The WG-MOG Rapporteur outlined the proceedings of the first METP Management Group Cross Working Group Progress (CWGP) meeting held from 12 to 15 November 2019 in Daytona Beach, United States, which was set up due to increasing concern over the widening and increasingly complex work expected to be undertaken by the MET Panel. This work is becoming difficult for the Rapporteurs to coordinate and so the CWGP meeting was an opportunity to take stock and review what was working well and what could be improved within the METP structure. The need for a succession plan was also addressed, given the impending retirement of some of the METP management group.

5.1.2 The meeting discussed several proposals for how ICAO and WMO constituent bodies (such as panels/committees and working groups/expert teams) could work more closely together, particularly given that the composition of existing groups often contain many of the same experts nominated by States and international organizations. No decisions were taken by CWGP at this stage, but ideas on taking a more integrated approach were discussed, particularly in view of WMO governance reform that was already underway.

5.2 IAVW matters relating to AMD 80 to ICAO Annex 3

5.2.1 None raised, with the exception of SN/01 proposing the elevation of the VONA to a recommended practice (section 3.1.5 refers).

6. AGENDA ITEM 6: IDENTIFICATION OF NEW AND ADDITIONAL TASKS

6.1 New Tasks

6.1.1 SN/03 proposed a review of bulletin headers to be used in the event of VAAC back-up, noting that there are inconsistencies across various back-up arrangements and that due to a variety of message header parsing options, users may not always receive the advisories issued during a back-up event.

6.1.1.1 The meeting noted that any of the proposed options could result in confusion, however it was agreed that having the VAAC providing the back-up services issuing advisories using the bulletin header of the VAAC being backed up (including the same location identifier) is likely the easiest way to ensure that users whom regularly receive a standard bulletin would also receive a back-up bulletin. It was agreed that it would be useful for all VAACs to standardise this approach.

6.1.1.2 Mr Graham Rennie noted that operators being aware of the whether a VAA has been provided in a back-up capacity feeds into the operator's risk management process, including understanding whether supplementary products will be available and their familiarity of the VAAC providing the back-up service.

6.1.1.3 The meeting formulated the following decision and action:

Decision 11/1 VAAC Back-up Headers:

That VAACs, when acting in a back-up capacity to another VAAC:

- a) shall use the same product and location ID in the bulletin header as used by the VAAC they are backing up (with header number ii as appropriate), and
- b) shall add a comment in the remarks section of the VAA when providing back-up to notify users in the form of “Issued by VAAC nnnnn on behalf of VAAC nnnnn”

Action Agreed 11/13: VAAC Back-up Arrangements

That, in light of Decision 11/1, an ad hoc group consisting of Yuichi Imamura, Anton Muscat, Jamie Kibler, Dov Bensimon, Jarrad Denman and Marcel Roux (with Jarrad as Task Lead) will:

- a) review and update the current volcanic ash bulletin Table 4.3 “Volcanic ash advisory bulletin headers” in the *Handbook on the International Airways Volcano Watch (IAVW) – Operational Procedures and Contact List* (Doc 9766), and liaise with the METP Secretariat to incorporate this update; and
- b) Determine which VAAC name should be in the VAAC element of the back-up VAA

6.1.2 Mr Klaus Sievers presented SN/06 which outlined some safety implications of recent volcanic eruptions. The meeting thanked Mr Sievers for raising these issues with the MOG-IAVW work stream.

6.1.2.1 Dr Jarrad Denman noted that with regards to the Mt Sinabung event described in SN/06 that it is an unpredictable volcano with high level eruptions with little notice, but it also has an aviation colour code assigned that operators can use in their risk management processes, along with other supplementary information. Mr Graham Rennie highlighted this is a good example for the necessity of pre-eruptive information.

6.1.2.2 Ms Soledad Osoros informed the meeting that VAAC Buenos Aires had reviewed the cases highlighted in SN/06 that were in the VAAC Buenos Aires area of responsibility and identified a number of improvement opportunities for the VAAC operations.

6.1.2.3 The meeting noted in response to Mr Sievers’ concerns that:

- The request to introduce a sulphur dioxide forecasting capability was currently being addressed by the METP WG-MISD under action MISD 4/1
- While the establishment of danger areas around volcanoes of concern is not within the remit of the MET Panel (rather it would more appropriate for the FLTOPS or ATMOPS Panels), the meeting noted this may cause issues along routes densely populated with volcanoes. However, this would depend on the criteria that was applied through the various regional approaches and volcanic ash contingency plans. The meeting also noted the need for information in the VONA on pre-eruptive activity, which is critical to support the risk management processes of operators.
- VAAC KPIs for timeliness and accuracy of volcanic ash advisories were now in place or being further developed

- Work on outreach activities to operators regarding the value of volcanic ash advisories may well be better lead by IFALPA, sharing the examples with operators shown in the paper and reporting on the activities of the MOG-IAVW group.

6.1.3 SN/02 outlined the collaboration efforts between VAACs Tokyo and Wellington in the operational introduction of the VAAC Collaboration Tool, developed by the JMA.

6.1.3.1 The meeting thanked JMA for making the tool available and agreed that it was important that all VAACs take part in collaboration exercises.

6.1.3.2 The meeting considered whether VAAC coordination efforts could have a negative effect on the timeliness of advisory issuance and agreed that putting a time limit on the collaboration would be of benefit. The meeting noted that regularly exercising collaboration supports the building of cross-VAAC relationships and so improves the collaboration during a real cross-border event.

6.1.4 SN/11 discussed a working paper presented at the 29th meeting of the Meteorology Group (METG/29) of the European and North Atlantic Planning Group (EANPG), regarding three proposals for the inclusion in meteorological reports of information on the deposition of volcanic ash at aerodromes.

6.1.4.1 The proposals were as follows:

- A possible inconsistency between Annex 3 Table A6-2 and ICAO Doc 8400 where “VADEPO” should probably be “VA DEPO”.
- Guidance for a manned aeronautical meteorological station on how to provide information on volcanic ash downfall and deposition at an aerodrome by means of the supplementary information of meteorological reports (RMK of METAR/SPECI).
- Creation of a new present weather description VD to identify volcanic ash downfall

6.1.4.2 The meeting recalled that volcanic ash deposition has been a long standing topic within the various meteorological groups over the years, including the predecessors of the METP. Given that a growing number of observations are now automated, it may be difficult to introduce a volcanic ash present weather detection capability.

6.1.4.3 With regards to how operators might make use of volcanic ash forecasts, the meeting noted that it would provide an operational challenge to determine what amount of volcanic ash deposition will cause an issue for aviation, given the mechanics of how it will be ingested into the engine. Further, the meeting was informed that there was no consistency globally amongst aerodrome operators, but that many would probably simply close the aerodrome.

6.1.4.4 The meeting noted that there was currently some provision in Annex 3 regarding including volcanic ash deposition (both observed and forecast) in aerodrome warnings, as well as in *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691). However, the meeting further noted that there are difficulties in disseminating aerodrome warnings widely (i.e. beyond the aerodrome concerned), and they may themselves trigger a series of further messages on volcanic ash (NOTAM for example) that may introduce confusion or overload.

It was also noted that there is provision in the TAF code to include volcanic ash where there is expected to be an associated reduction in visibility. As a consequence, the meeting agreed that including volcanic ash in a METAR or TAF could cover any of the scenarios in which volcanic ash may be present (re-suspension

or downfall). The meeting also discussed what guidance material was available on braking actions in those situations where volcanic ash deposits are on a runway. [Post Meeting Note: Guidance on this topic can be found at: <https://safetyfirst.airbus.com/landing-on-contaminated-runways/> as being indicative of standard practice, which says (following discussion on water, ice, snow): “In some situations though, the contaminant reported to be present on the runway may not make it possible to identify the corresponding performance level just by considering the contaminant type and depth. It is the case particularly when the contaminant is:

too variable as to its impact on aircraft performance: e.g. volcanic ash, hydraulic fluid spillage. Operations cannot, in general, be supported with specific performance information;”

6.1.4.5

6.1.4.6 After some further discussion, the meeting formulated the following action:

Action Agreed 11/14: Guidance relating to the inclusion of VA in METAR and TAF

That; an ad hoc group consisting of WG-MOG Rapporteur, Greg Brock, Yuichi Imamura, Marcel Roux, Graham Rennie, Philippe Hereil, Klaus Sievers and Paula Acethorp (with Philippe as Task Lead) review guidance material currently available for the application of VA to be used in METAR and TAF.

7. AGENDA ITEM 7: ADMINISTRATION AND NEXT MEETING

7.1 The meeting noted that WMO was planning the 8th International Workshop on Volcanic Ash in Iceland in October 2020 (tentatively week commencing 19 October 2020) and that it may provide an opportunity for the WG-MOG (IAVW) to meet before or after the WMO meeting. Mr Colin Hord, as WG-MOG Rapporteur, agreed that he would confirm arrangements, once finalised, and communicate matters pertaining to the next meeting in due course.

7.2 Mr Colin Hord advised the group that this would be his last meeting of the WG-MOG (IAVW), having been involved in the IAVW work since 2010. Mr Hord expressed his enjoyment of being involved in the work of the VAACs and working with the wider IAVW community. On behalf of the group, Mr Ian Lisk thanked Mr Hord for his efforts.

8. AGENDA ITEM 8: CLOSURE OF THE MEETING

8.1 The meeting expressed its gratitude to those from RTCA Inc. and the FAA for their kind hospitality and excellent arrangements during this meeting.

8.2 The Meeting was closed on 19th November 2019 at 16.35 hours by Mr. Colin Hord, Rapporteur of the METP WG-MOG.

Appendix A - List of Attendees

AFFILIATION	NAME	E-MAIL
ARGENTINA	OSORES, (Maria) Soledad	msosores@smn.gov.ar
AUSTRALIA	DENMAN, Jarrad	jarrad.denman@bom.gov.au
	KING, Tristan	tristan.king@bom.gov.au
CANADA	BENSIMON, Dov	dov.bensimon@canada.ca
FRANCE	HEREIL, Philippe	philippe.hereil@meteo.fr
JAPAN	IMAMURA, Yuichi	y_imamura@met.kishou.go.jp
NEW ZEALAND	ACETHORP, Paula (Work Stream Lead)	paula.acethorp@caa.govt.nz
	ROUX, Marcel	marcel.roux@metservice.com
UNITED KINGDOM	HORD, Colin (MOG Rapporteur)	Colin.Hord@caa.co.uk
	DUTTON, Jonathan	jonathan.dutton@metoffice.gov.uk
	MUSCAT, Anton	anton.muscat@metoffice.gov.uk
UNITED STATES	BURCH, Larry	burch@avmet.com
	FLOWE, Tammy	tammy.flowe@faa.gov
	HELMS, Tom	helms@avmet.com
	KIBLER, Jamie	jamie.kibler@noaa.gov
	OSIENSKY, Jeff	jeffrey.osiensky@noaa.gov
	SCHNEIDER, David	djschneider@usgs.gov
WMO	SMITH, Kristie	smith@avmet.com
	BROCK, Greg	gbrock@wmo.int
IATA	LISK, Ian	ian.lisk@metoffice.gov.uk
	RENNIE, Graham	grennie@qantas.com.au
ICCAIA	CLARKSON, Rory	rory.clarkson@rolls-royce.com
IFALPA	SIEVERS, Klaus	klaus.sievers@vcockpit.de

Appendix B - Inclusion of guidance on the handling of re-suspended volcanic ash in NOTAM for VA and ASHTAM in Annex 15, PANS-AIM and AIS Manual

Proposed edits for Annex 15 – Aeronautical Information Services

The text of the amendment is arranged to show ~~deleted text with a line through it~~ and new text highlighted with grey shading, as indicated in this sentence.

6.3.2.3 A NOTAM shall be originated and issued concerning the following information:

...

w) an operationally significant change in volcanic activity, the location, date and time of volcanic eruptions and/or horizontal and vertical extent of volcanic ash cloud (including re-suspended volcanic ash), including direction of movement, flight levels and routes or portions of routes which could be affected;

Proposed edits for PANS-AIM (Doc 10066)

The text of the amendment is arranged to show ~~deleted text with a line through it~~ and new text **highlighted** with grey shading, as indicated in this sentence.

5.2.5.1.5 Information concerning an operationally significant change in volcanic activity, volcanic eruption and/or volcanic ash cloud **(including re-suspended volcanic ash)** shall, when reported by means of an ASHTAM, contain the information in the order shown in the ASHTAM Format in Appendix 5.

Appendix 5

...

INSTRUCTIONS FOR THE COMPLETION OF THE ASHTAM FORMAT

1. *General*

1.1 The ASHTAM 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. This information is provided using the volcano level of alert colour code given in 3.5 below. **Alternatively, the ASHTAM can provide information on the observed or forecast re-suspension of existing volcanic ash deposits.**

1.2 In the event of a volcanic eruption **(or re-suspended volcanic ash)** producing ash cloud of operational significance, the ASHTAM also provides information on the location, extent and movement of the ash cloud and the air routes and flight levels affected.

1.3 Issuance of an ASHTAM giving information on a volcanic eruption, in accordance with paragraph 3 below, should not be delayed until complete information A) to K) is available but should be issued immediately following receipt of notification that an eruption has occurred or is expected to occur, or a change in the status of activity of a volcano of operational significance has occurred or is expected to occur, or an ash cloud is reported, **or a re-suspended volcanic ash event is forecast to occur.** In the case of an expected eruption, and hence no ash cloud evident at that time, items A) to E) should be completed and items F) to I) indicated as “not applicable”. Similarly, if a volcanic ash cloud is reported, e.g. by special air-report, but the source volcano is not known at that time, the ASHTAM should be issued initially with items A) to E) indicated as “unknown”, and items F) to K) completed, as necessary, based on the special air-report, pending receipt of further information. In other circumstances, if information for a specific field A) to K) is not available, indicate “NIL”.

....

3. *Content of ASHTAM*

3.1 *Item A* — Flight information region affected, plain-language equivalent of the location indicator given in the abbreviated heading, in this example “Auckland Oceanic FIR”.

3.2 *Item B* — Date and time (UTC) of first eruption **or when a re-suspension event begins.**

3.3 *Item C* — Name of volcano, and Smithsonian GVP volcano number of volcano as listed in The Volcanoes of the World database and available at the Smithsonian Institution Global Volcanism Program website/. ~~in the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691), Appendix E, and on the World Map of Volcanoes and Principal Aeronautical Features.~~

3.4 *Item D* — Latitude/Longitude of the volcano in whole degrees or radial and distance of volcano from NAVAID as listed in Doc 9691, Appendix E, and on the World Map of Volcanoes and Principal Aeronautical Features).

...

3.7 *Item G* - Indicate forecast direction of movement of the ash cloud (or clouds) at selected levels based on advice from the responsible meteorological watch office and/or volcanic ash advisory centre.

Proposed edits for Aeronautical Information Services Manual (Doc 8126)

The text of the amendment is arranged to show ~~deleted text with a line through it~~ and new text **highlighted** with grey shading, as indicated in this sentence.

Chapter 6

NOTAM

6.1.5 The circumstances which make it necessary to issue NOTAM are set out in **6.3.2.3** ~~5.1.1.1~~ of Annex 15. Because of their importance, these circumstances are repeated here for ease of reference.

“A NOTAM shall be originated and issued concerning the following information:

...

u) an operationally significant change in volcanic activity, the location, date and time of volcanic eruptions and/or horizontal and vertical extent of volcanic ash cloud (**including re-suspended volcanic ash**), including direction of movement, flight levels and routes or portions of routes which could be affected;

6.2.6 ASHTAM or NOTAM concerning volcanic activity (**or re-suspended volcanic ash**) must include in the address list the MWO associated with the origin as listed in Part 2 of the International Airways Volcano Watch (IAVW) (Doc 9766), all VAACS and the SADIS/ISCS Gateway at EGZZVANW.

Measures to reduce use of the AFS

[5.3.4]

6.2.7 In order to avoid excessive traffic on the AFS, NOTAM must be addressed only to NOF and further distribution within the State made by or through delegation from the NOF concerned. NOTAM used for notifying volcanic activity (**or re-suspended volcanic ash**) and ASHTAM must also be sent to volcanic ash advisory centres and must take into consideration the requirements for long-range operations. Furthermore, in exceptional cases, the direct exchange of SNOWTAM between adjacent aerodromes is permitted, should this be operationally necessary and if direct AFS circuits are available. The exchanges between NOF should, as far as practicable, be limited to the pre-ascertained requirements of the receiving States concerned by means of separate series for at least international and domestic flights.

....

Promulgation in series

6.3.5 When considering the needs of States it may be found that an adjacent State may want full information from the originating State while a more distant State may only require a subset of this information or may not be interested in temporary information of short duration. In order to reduce distribution to meet such variable requirements it may be found useful to arrange for NOTAM to be

promulgated in two or more series to allow for selective distribution. For example, NOTAM may be classified as follows:

...

V — NOTAM published in the ASHTAM format concerning the occurrence of pre-eruption volcanic activity, or an operationally significant change in volcanic activity, the location, date and time of volcanic eruptions and horizontal and vertical extent of volcanic ash cloud (including re-suspended volcanic ash), including direction of movement, flight levels and routes or portions of routes which could be affected.

6.7 ASHTAM

[5.1.1.1 u), 5.2.4 and Appendix 3]

6.7.1 A special series NOTAM, called ASHTAM, is used to notify an operationally significant change in volcanic activity, the location, date and time of volcanic eruptions and/or horizontal and vertical extent of volcanic ash cloud (including re-suspended volcanic ash), including direction of movement, flight levels and routes or portions of routes which could be affected. A specific format (see Appendix A, ~~Figure 6-A-5~~ Figure 6-A-6) is prescribed for this purpose. Use of the NOTAM Code and plain language is also permissible. When the ASHTAM Format is used, the information must be given in the order shown in that Format. The maximum period of validity of the ASHTAM is 24 hours. A new ASHTAM must be issued whenever there is a change in the level of alert. Instructions for the completion of the ASHTAM Format are reproduced in Appendix A to this chapter.

6.7.2 Information about volcanic activity or the presence of volcanic ash plumes (including re-suspended volcanic ash) may also be reported by NOTAM. To ensure speedy transmission of initial information to aircraft, the first ASHTAM or NOTAM issued may not contain more information than the fact that an eruption and/or ash cloud is reported at a given location at a given date and time.

Appendix C - Inclusion of guidance on the handling of re-suspended volcanic ash in the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691)

The text of the amendment is arranged to show ~~deleted text with a line through it~~ and new text **highlighted with grey shading**, as indicated in this sentence.

5.2 AIR TRAFFIC MANAGEMENT

5.2.1 General

Volcanic eruptions and the resulting ash cloud, **or a volcanic ash re-suspension event**, can cause major disruptions in air traffic operations and in some circumstances result in life-threatening situations for aircraft en route. The purpose of this section is to describe the impact on air traffic services and especially area control centres (ACC) during a volcanic ash episode. The section is divided under four headings: detection and reporting of an event; coordination and alert process; air traffic procedures for an ACC; and radio and ground notification.

5.2.2 Detection and reporting of an event

5.2.2.1 With the coming of modern jet aircraft has volcanic ash become of great concern to aviation. As stated earlier in this manual, the potential to cause a major aircraft accident is real. In addition, there are economic costs associated not only with the rerouting of aircraft and delays in the system, but also with physical damage to the aircraft and its equipment. During the past twenty years vulcanologists, geophysical scientists, meteorologists, pilots, dispatchers and air traffic control specialists have been working toward development and improvement of worldwide standards for the notification of a volcanic eruption and ash cloud, **or a volcanic ash re-suspension event**. The cumulative effort has resulted in the development of a series of messages used by aviation to notify all users concerned of a volcanic eruption and subsequent ash cloud as part of the ICAO International Airways Volcano Watch (IAVW), which is described in detail in Chapter 6. These are as follows:

....

5.2.2.2 The notification that an eruption has occurred or that volcanic ash in the atmosphere **(including re-suspended volcanic ash)** has been reported could reach air traffic services (ATS) units from one or more of the following sources and in a number of different formats:

....

5.2.4 Air traffic procedures for an ACC

5.2.4.1 If a volcanic ash cloud is reported or forecast **(including re-suspended volcanic ash)** in the flight information region for which the ACC is responsible, from any of the foregoing sources, the following procedures are followed:

....

5.2.5 Radio and ground notification

5.2.5.2 Similarly, the ACC through the issuance of a NOTAM for volcanic activity or an ASHTAM can disseminate information on the status and activity of a volcano, even for pre-eruption increases in volcanic activity. **Additionally, NOTAM for volcanic activity or an ASHTAM can disseminate information on the**

observed or forecast re-suspension of existing volcanic ash deposits. NOTAM, ASHTAM and SIGMETs together with special air reports (AIREPs) are critical to dispatchers for flight planning purposes. Airlines 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 their pilots en route so that a coordinated decision can be made between the pilot, the dispatcher and air traffic control regarding the alternative air routes that are available. It cannot be presumed, however, that an aircraft which is projected to encounter an ash cloud will be provided the most desirable air route to avoid the cloud. Other considerations have to be taken into account such as existing traffic levels on other air 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 to that air route.

5.2.5.3 For an active volcano, the NOTAM for volcanic activity and the ASHTAM provide 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 issued by the ACC through the respective NOF 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 or ASHTAM also provides information on the location, extent and movement of the ash cloud and the air routes and flight levels affected. Complete guidance on the issuance of the NOTAM and ASHTAM is provided in the Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM, Doc 10066). Included in the PANS-AIM 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 state. It is very important that NOTAM for volcanic ash and ASHTAM be cancelled as soon as the volcano has reverted to its normal pre-eruption status, no further eruptions are expected by vulcanologists and no ash cloud is detectable or reported from the FIR concerned.

...

5.3.2 Observation of volcanic eruptions/ash cloud

Generally speaking, few aerodrome meteorological offices/stations are actually located within sight of an active volcano or groups of volcanoes. Nevertheless, those which are, e.g. Kagoshima airport near Mt. Sakurajima in Japan, and Anchorage within sight of a number of Alaskan volcanoes, are expected to issue volcanic activity reports in the event an eruption and/or ash cloud is observed. This includes when the re-suspension of volcanic ash is observed or expected to occur, e.g. re-suspension of the volcanic ash deposits associated with the 1912 eruption of the Alaskan volcano Novarupta. This information is passed up the chain of communications to the MWO which is responsible for maintaining a meteorological watch over the FIR concerned. If the volcanic ash in the atmosphere affects the visibility at the aerodrome, then it is also reported in METAR/SPECI. Although less likely, if volcanic ash is affecting an aerodrome, the associated visibility reduction could also be forecast, i.e. at least the visibility values, not the occurrence of volcanic ash, in the terminal aerodrome forecast (TAF) for the aerodrome.

....

5.3.4 Volcanic ash advisory service

....

5.3.4.2 If the VAAC receives the initial information of an eruption and/or ash cloud from an ACC/FIC or MWO, the first step is to monitor available satellite data ground and satellite based observations to confirm

the existence and extent of the volcanic ash cloud. Next, based on all information available (which may involve consultation with volcanologists) the volcanic ash forecast transport and deposition model is activated and the resulting trajectory forecasts compiled into volcanic ash advisory information in an abbreviated plain language message, in IWXXM GML form and in graphical format. The former is transmitted to ACCs/FICs, MWOs and the two WAFCs by aeronautical fixed service telecommunication network (AFSTN), or global telecommunication system (GTS) or facsimile, as necessary. The graphical format advisory information is transmitted to the London and Washington WAFCs for distribution on the aeronautical fixed service (AFS) Internet-based services (i.e. Secure Aviation Data Information Service (SADIS) FTP and WAFS Internet file service (WIFS)). This graphical format may of course be used to provide individual MWOs with advisory information in response to specific requests.

...

5.3.5 World area forecast system (WAFS)

The two WAFCs in London and Washington have two responsibilities in respect of volcanic ash:

- a) to include a reference to the occurrence of an eruption using the standard symbol on SIGWX forecast charts; together with a reminder to pilots to check SIGMETs for the area concerned;
- b) to make available volcanic ash advisory information (in abbreviated plain language, IWXXM GML form and graphical format) on the AFS Internet-based services (i.e. SADIS FTP and WIFS).

The information provided in the SIGWX forecasts should be based on advice from the VAAC concerned, thereby ensuring consistency of information.

Note – re-suspended volcanic ash events are not included in SIGWX forecasts.

...

5.4.2.5 Flight planning/flight despatch

...

5.4.2.5.4 ~~Where an eruption is known or is believed to be of little operational impact (e.g. ash column of limited vertical extent), this should be stated in the SIGMET or NOTAM. Additionally, the SIGMET/NOTAM should be cancelled immediately after the threat has past. This will minimize disruptions to air navigation and strengthen the credibility of the warning system.~~

...

5.5.4 Geological information relevant to aviation safety

5.5.4.1 Geologists who study erupting volcanoes can assist in mitigating the hazards of volcanic ash through their knowledge of the following topics:

- a) nature of explosive vulcanism (dynamics of ash cloud formation and dispersal);
- b) volcanic ash (size, composition, mineralogy, physical properties, gas content);
- c) the prediction and warning of volcanic activity (monitoring volcanoes; communication with appropriate agencies);
- d) geological history of local active volcanoes; and
- e) the tracking and deposition of ash clouds; and
- f) the re-suspension of volcanic ash deposits.

....

5.5.6 Level of alert colour code

Many volcano observatories today utilize a level of alert colour code to convey in a shorthand form information about a volcano's state of unrest. The colour code recommended for use in providing information to aviation is given in the IAVW Handbook (Doc 9766). The classification of the level of activity for a volcanic eruption in terms of the colour code can only be done by experienced vulcanologists. In view of this, it is important for the civil aviation authority in a State in which there are active volcanoes to establish contact with the appropriate vulcanological agency and encourage the use of the aviation colour code when providing information to aviation. This ensures that the information provided may be included in the **NOTAM for VA or ASHTAM** in terms of the colour code.

...

6.4 ADVISORY AND WARNING PART OF THE IAVW

6.4.1 Area control centres and flight information centres

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6.4.1.2 Among its responsibilities, the ACC/FIC has to keep aircraft advised of operational information which could affect them. Such information may be exchanged between ACCs/FICs in adjacent FIRs by radio, telephone and by NOTAM. The NOTAM is a message in a specified format containing information concerning, inter alia, hazards, the timely knowledge of which is essential to personnel concerned with flight operations. NOTAM may be initiated by ACCs/FICs, for example for volcanic ash affecting certain air routes, and are exchanged on the aeronautical fixed **services telecommunication network** (AFSTN) between AIS units. In the case of information of immediate concern to aircraft, again volcanic ash would be a good example, the information received by an ACC/FIC in a NOTAM is transmitted immediately by radio to aircraft in flight concerned. NOTAM also form part of the briefing documentation for aircrew prior to take-off and at the flight planning stage. In addition to information on the volcanic eruption and/or volcanic ash cloud (including volcanic ash re-suspension), the NOTAM would normally include information on the air routes closed and alternative routing to avoid the ash cloud. It is essential that NOTAM for volcanic eruptions/ash cloud are cancelled as soon as it is considered that the volcano has reverted to its normal state and the airspace is no longer contaminated by volcanic ash, otherwise vast volumes of airspace may be unnecessarily denied to aircraft, thereby causing considerable extra costs to the airlines. A special series NOTAM called the ASHTAM has been introduced specifically for volcanic activity. States may choose to use either format, but are encouraged to use the ASHTAM because the name immediately denotes its content and facilitates the routing of the information to the aircraft quickly.

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6.4.2.3 In the event that a volcanic eruption ejects volcanic ash into the atmosphere in a particular FIR (or **volcanic ash re-suspension occurs**), or volcanic ash is transported into the FIR from an adjacent FIR by the upper winds, the MWO responsible for that FIR is required to issue a SIGMET for volcanic ash. Issuance of the first SIGMET simply indicating the existence of a volcanic ash cloud (including volcano name, location, possible ash height and direction, if known) from a particular volcano is a straightforward matter for any MWO. Reference to Chapter 3, 3.3 and 3.4, however, indicates that substantial technical capabilities are required of an MWO in order to issue subsequent SIGMETs. As a minimum, the MWO should have reliable reception of polar-orbiting and geostationary satellites, including AVHRR satellite

data and be in a position to manipulate, analyse and interpret the data in order to discriminate volcanic ash clouds from normal water/ice clouds. In addition, the MWO has to be able to forecast the trajectory of the volcanic ash cloud, which is a complex undertaking. It was appreciated from the beginning of the establishment of the IAVW that most MWOs do not have these capabilities. In view of this, ICAO has designated, on advice from WMO, nine VAACs whose responsibility is to provide advice to MWOs and ACCs/FICs in their area of responsibility of the extent and forecast movement of the volcanic ash. The MWOs should ensure that the information conveyed in SIGMET is consistent, to the extent practicable, with the information conveyed by the responsible VAAC in the volcanic ash advisory.

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6.4.3.3 Under normal circumstances, a VAAC will either be notified by one of its associated State Volcano Observatories (SVOs) MWOs that a volcanic eruption has occurred in its area of responsibility (AOR) FIR or will observe the eruption using satellite observations. ~~and at the same time the MWO will request advisory information.~~ The VAAC immediately sends an “initial volcanic ash advisory” outlining basic details of the eruption, and initiates the computer volcanic ash transport and dispersion model in order to provide advice on the forecast trajectory of the volcanic ash. The VAAC then checks the latest satellite information from all available sources to assess if the ash is discernible from satellite data and, if so, its extent. This information is included in an updated volcanic ash advisory, which is sent to MWOs and ACCs/FICs in the AOR, adjacent VAACs and WAFCs. ~~passed immediately to the MWO and ACC/FIC together with the forecast volcanic ash trajectory if this is available at the same time. Initial confirmation that the volcanic ash is indeed detectable from satellite data and its extent is extremely important information for the MWO and ACC/FIC as it gives some initial measure of confidence for the ACC/FIC to reroute aircraft and/or activate, as necessary, ATC contingency arrangements.~~ The VAAC concerned thereafter continues to monitor satellite data and provides regular volcanic ash advisories trajectory forecasts to the MWO, ACC/FIC and airlines until such time as the eruption ceases and/or the airspace is no longer contaminated by ash. Arrangements have been made so that, if for any reason a VAAC is not in a position to provide the volcanic ash advisory (for example, due to an operational outage) trajectory forecast, one of the other VAACs will be requested to do so.

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**Figure I-6-4. Current status of ICAO Volcanic Ash Advisory Centres (VAACs) —
Areas of responsibility**

*(**needs updating to latest map**)*

Appendix D - Job Card 3 update

Proposed changes to Job Card 3 (additions in grey shade, deletions in strikeout)

METP.003.02		Further development of the International Airways Volcano Watch (IAVW)			
Source		MET Divisional Meeting 2014 (Recommendations 1/2 and 2/10 a))			
Problem Statement		The international airways volcano watch (IAVW) was established to provide notification (via advisory messages, warnings and other) regarding the existence of volcanic ash in the atmosphere, including pre-eruptive activity. The IAVW needs to be maintained and further the information provided into the future system wide information management (SWIM) in support of the ASBU methodology.			
Specific Details		<p>The IAVW consists of a number of international arrangements for monitoring the atmosphere and to provide notification to aircraft regarding volcanic activity, relevant data to detect volcanic ash, to forecast its movement and to provide advisory information to meteorological authorities taking human factors into account.</p> <p>It was recommended by the MET Divisional Meeting (Recommendation 2/6) that an appropriate ICAO expert group, in close coordination with the World Meteorological Organization (WMO), further develop the requirements for the IAVW consistent with the Fifth Edition of the Global Air Navigation Plan and the information produced by the system into the future system wide information management (SWIM) environment using, as a basis, the Operations (CONOPS).</p> <p>Further development should take into consideration the main legacy tasks from the international airways volcano watch operations group and consider human factors in accordance with recommendation 2/14.</p> <p>This development will be supported by the World Meteorological Organization (WMO), and the International Union of Geophysics and Meteorology (IUGM) organisations, scientific support initiatives and forums.</p>			
Expected Benefits		Provide information to support safety risk management of aircraft operations related to volcanic eruptions and areas of volcanic ash VA information produced, under the IAVW, into the SWIM environment in line with the GANP.			
Reference Documents		Annex 3 — Meteorological Service for International Air Navigation, Global Air Navigation Plan (Doc 9750), Manual on Volcanic Ash, ICAO Doc 9766, Clouds (Doc 9691), Handbook on the International Airways Volcano Watch (Doc 9766), Manual of Aeronautical Meteorological Practice between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services (Doc 9377), Meteorology (METP) Agenda Item 2, Appendix C. Roadmap for International Airways Volcano Watch (IAVW) in Support of International Air Navigation, Coordinated Information for International Air Navigation in Support of the Global Air Navigation Plan and the Aviation System Block Upgrades, EASBP (VACP), Flight Safety and Volcanic Ash (Doc 9974).			
Primary Expert Group:		Meteorology Panel (METP)			
	WPE No.	Document Affected or Actions Needed	Description of Amendment proposal or Action	Supporting Expert Group	Status
✓	1707	Actions	Assist ICAO in the coordination of the arrangements between the States/Provider States, international organizations and other stakeholders comprising the IAVW and in ensuring that the global requirements for IAVW information are met.		On-schedule
✓	1703	Annex 3	Proposals to update Annex 3 to meet current and evolving operational requirements in line with the GANP and to integrate IAVW information into the SWIM.		On-schedule
✓	1689	Electronic Air Navigation Plans (eANP)	Based on Annex 3 provisions, provide draft amendment proposals for eANPs as necessary		On-schedule
✓	1690	Manual of Aeronautical Meteorological Practice (Doc 8896)	Update related guidance material to support the implementation of Annex 3 Amendment.	WMO	On-schedule

✓	1691	Manual on Coordination between ATS, AIS and AMS (Doc 9377)	Update related guidance material to support the implementation of Annex 3 Amendment.	WMO	On-schedule
✓	1692	Manual on VARMTCC (Doc 9691)	Update related guidance material to support the implementation of Annex 3 Amendment.	WMO	On-schedule
✓	1694	Manual on IAVW (Doc 9766)	Update related guidance material to support the implementation of Annex 3 Amendment.	WMO	On-schedule
		Flight Safety and Volcanic Ash (Doc 9974)	Update related guidance material to support the implementation of Annex 3 Amendment.	WMO	On-schedule
		IAVW Roadmap and ConOps	Update to ensure that the global requirements for IAVW information are met.	WMO	On-schedule
Status:			Priority:	Initial Issue Date:	Date Approved by ANC:
Approved			-	17 June 2015	07 June 2017
RATIONALE					

Appendix E – METP MOG Terms of Reference update

METP-WG MET OPERATIONS GROUP (WG-MOG)

Terms of Reference

The aim of the MET Operations Group is to ensure that the following ICAO systems meet the agreed user requirements:

- WAFS
- SADIS / WIFS
- IAVW

In the longer term it is considered that other global MET related systems will be added to the remit of the working group. The MET Operations group should:

- a) Establish Key Performance Indicators for the provision of services based on the performance requirements in coordination with other METP WGs and final agreement by the METP
- b) Define the continuity / availability of services based on the performance requirements, in coordination with the other METP WGs and final agreement by the METP
- c) Arrange for the reporting of KPIs from each provider State (e.g. verification and timeliness metrics) which are aligned with user's operations
- d) Receive reports from each provider State on the management of their system(s)
- e) Set out, review and maintain the back-up arrangements and include relevant details in management reports
- f) Ensure that coordination and harmonisation takes place between WAFCs, VAACs and SADIS / WIFS providers
- g) Monitor, assess and provide advice on potential scientific and technological developments to meet the current, future and evolving performance requirements to the METP in coordination with WMO
- h) Assess the financial and technical implications of proposed developments to services and their implementation, and inform any relevant cost recovery groups accordingly
- i) Ensure that developments have measurable success criteria for implementation
- j) Establish the timescales, pre-operational tests and implementation of services

- k) Maintain and, when required, create guidance material on the implementation and provision of services
- l) Identify any weaknesses gaps or deficiencies in the current service provision and coordinate updates to the requirements with other METP WGs and other ICAO Panels
- m) Ensure that the necessary remedial actions are in place when necessary to overcome identified deficiencies
- n) Where necessary assist the Secretariat in the coordination of the arrangements between the various international organizations
- o) Maintain an up to date action list
- p) Review all Job Cards relevant to the ICAO systems
- q) Review the WAFS relevant CONOPS and Roadmap as appropriate
- r) Following each meeting provide a report and make it available on the METP website