



International Civil Aviation Organization

**THE FOURTH MEETING OF ASIA/PACIFIC METEOROLOGICAL
HAZARDS TASK FORCE (MET/H TF/4)**

Beijing, China, 19 – 21 March 2014

Agenda Item 3: Guidance material

- a) **Monitor the developments of IAVWOPSG and METWSG with reference to guidance on radioactive cloud and tsunami**

SUMMARY OF SURVEY RESULTS – RADIOACTIVE CLOUD

(Presented by the Secretariat)

SUMMARY

This paper presents a summary of the results of a survey of the present capabilities of Asia/Pacific States to prepare and issue SIGMETs for radioactive clouds.

1. INTRODUCTION

1.1 The First Meeting of the Asia/Pacific Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF/1), held in Bangkok, Thailand from 23 to 25 March 2011, agreed to determine current capabilities of States in providing information to aviation on radioactive cloud (METWARN/I TF/1 Action Agreed 1/10 refers) to enable an assessment of training and guidance requirements to be undertaken and assist in the development of frameworks for regional contingency plans.

1.2 In view of the above, the third meeting of the Meteorological Hazards task Force (MET/H TF/3), held in Bangkok, Thailand, from 13 to 15 March 2013, recommended the results of the survey be reviewed at the next meeting (MET/H TF/4) along with results from a new survey to update the status of current capabilities of States in providing information to aviation on radioactive cloud (MET/H TF/3 Action Agreed 3/1 refers).

2. DISCUSSION

2.1 The original survey from METWARN/I TF/1 Action Agreed 1/10 was conducted by State letter issued on 25 April 2011. Seventeen States in the APAC region responded. The findings were presented to the fifteenth meeting of the APAC Meteorology Sub-Group (MET SG/15), held in Bangkok, Thailand, from 25 to 29 July 2011 (CNS/MET SG/15 - WP/51 refers) and forwarded to the sixth meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/6), held in Dakar, Senegal, from 19 to 23 September 2011, which was tasked with developing guidance material on the issuance of SIGMETs for radioactive cloud.

2.2 The follow-up survey in response to MET/H TF/3 Action Agreed 3/1 was distributed in State letter Ref.: T 4/7.5:AP031/14 (MET) issued on 17 February 2014 (copy provided in **Attachment 1**). Noting that the deadline for responses from States was 17 March 2014, at the time of presentation, 11 States' responses were available for analysis/discussion. The findings are discussed briefly in the paragraphs below, compared with results from the original survey conducted in 2011. The table of all responses to the survey received in 2014 is provided in **Attachment 2**.

2.3 **Question 2:** Does your State have procedures in place to receive products and information from a WMO regional specialized centre (RSMC) concerning the accidental release of radioactive materials into the atmosphere, as prescribed in Annex 3 (Chapter 3, 3.4)?

	Procedures to receive radioactive information from RSMC	Yes	No	No response
2011	Number of States	10	2	5
2014	Number of States	4	3	1

2.4 **Question 2a:** Does your State have the expertise, dispersion models, guidance material and training to issue information on radioactive cloud for your Flight Information Region.

	Expertise, models, guidance and training to issue radioactive cloud information	Yes	No	No, with clarification
2011	Number of States	6	9	2
2014	Number of States	5	6	1

2.5 In responding to the question above, in 2011 States raised concerns about the suitability of using existing models to forecast for specific flight information purposes, the appropriateness of current upper level dispersion charts, the need for further guidance material and the requirement for additional training. In 2014, the responses were evenly split between “yes” and “no”; one State noted that expertise, models and guidance was available, but training was not.

2.6 **Question 3:** Does your State have provisions to issue a SIGMET for radioactive cloud (RDO ACT) in accordance with ICAO Annex 3 (Appendix 6, for a radioactive cloud that affects your Flight Information Region(s)?

	Provision to issue SIGMETs for radioactive cloud	Yes	No
2011	Number of States	9	8
2014	Number of States	7	4

2.7 **Question 4:** Does your State have provisions to issue a “NOTAM” for a radioactive cloud that affects your Flight Information Region(s)?

	Issue NOTAM	Yes	No
2011	Number of States	10	7
2014	Number of States	8	2

2.8 **Question 5:** What is the source of information for NOTAM for radioactive cloud?

2.9 In response to the question above, in 2011 numerous sources of information were identified including RSMCs, various national agencies responsible for radiation/atomic energy (including NZ National Radiation Laboratory; Atomic Energy Authority of Sri Lanka, Australian Radiation Protection and Nuclear Safety Agency) and State weather agencies. In 2014, the responses were similar and included the most scientifically credible sources e.g., governmental institutions, and RSMCs.

2.10 **Question 6:** What criteria and thresholds are used by your State in the decision to issue information on a radioactive cloud?

	Criteria or thresholds used	None available/defined	Specified thresholds (discussed below)	N/A
2011	Number of States	4	6	4
2014	Number of States	6	1	4

2.11 In 2011, the question above resulted in a variety of answers suggesting that further guidance and clear international thresholds would assist States. In 2014, the responses also indicated that criteria and thresholds used to issue information on a radioactive cloud were not clearly defined.

2.12 **Question 7:** What sources of information would your State use to determine the height and area covered by a radioactive cloud?

2.13 In response to this question numerous sources of information were identified in 2011 including RSMCs, models (including several HY-SPLIT models), the International Monitoring System (IMS) associated with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification, and various national agencies responsible for radiation/atomic energy. In 2014, the responses indicated that the RSMC(s), models and most creditable sources of information would be used; one State would use pilot reports, NOTAM and SIGMET.

2.14 In 2011, several States reaffirmed the issue that determining the vertical extent of radioactivity is problematic and is normally only estimation.

2.15 **Question 8:** What kind of guidance material would be of use from ICAO to support the requirement to issue a SIGMET for a radioactive cloud?

	Guidance	None	Specifics	N/A	No answer
2011	Number of States	2	10	2	3
2014	Number of States	1	8	1	1

2.16 In 2011, several States highlighted the opportunity to provide similar guidance and products to those prepared for Volcanic Ash, including a new product similar to a Volcanic Ash Advisory, to leverage off existing procedures and transmissions. In 2014, the responses included SIGMET guidance for radioactive cloud and simulation models; the United States provided a practical example of how a radiation advisory product may look, based on the existing ICAO volcanic ash advisory information.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) review the information in this paper;
- b) provide updates to the survey as necessary; and
- c) discuss implications with respect to requirements for training and guidance on the provision of information on radioactive material.



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авиации

منظمة الطيران
المدني الدولي

国际民用
航空组织

Ref.: T 4/7.5:AP031/14 (MET)

17 February 2014

Subject: Survey on APAC States/Territories' capabilities
in providing information to aviation on radioactive material

Action Required: Reply at your earliest convenience, preferably,
not later than 17 March 2014.

Sir/Madam,

I have the pleasure to refer to the Third Meeting of the Asia/Pacific Meteorological Hazards Task Force (MET/H TF/3) of APANPIRG held in Bangkok, Thailand, from 13 to 15 March 2013. The group agreed that there was a need to review the status of present capabilities of Asia/Pacific States/Territories to prepare and issue SIGMET information for radioactive cloud (Action Agreed 3/1 refers). In particular, the group agreed to request updated information from States based on the 2011 survey¹ conducted to assist the International Airways Volcano Watch Operations Group (IAVWOPSG) in developing guidance material on the issuance of SIGMET information for radioactive cloud. *Note: a summary of the results of the 2011 survey is included in the Attachment (including the table of survey responses at Appendix C) for your ease of reference.*

You may recall that, in its considerations on the development of guidance material on the issuance of SIGMET information for radioactive cloud, the IAVWOPSG reviewed the results of the 2011 Asia/Pacific survey. The IAVWOPSG has agreed to develop a draft concept of operations in support of international air navigation on how best to provide information on the release of radioactive material into the atmosphere, and to assess the provision of information and guidance on radioactive material released into the atmosphere and review the provisions of Annex 3 and Doc 9691 regarding radioactive material (IAVWOPSG Action Agreed 6/29 and 7/37 refer).

In view of the above developments, it would be timely to review the current capabilities of States in providing SIGMET information for radioactive cloud.

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¹ State letter Ref: T 4/7.5:AP064/11 (MET); issued in response to the First Meeting of the Asia/Pacific Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF/1) of APANPIRG held in Bangkok, Thailand, from 23 to 24 March 2011 (Action Agreed 1/10 refers).

Thank you for taking the time to complete the survey or to provide updates to your previous responses, which will further assist the regional group in determining the regional requirements for, and the global group in developing, guidance material on the issuance of SIGMET on radioactive cloud. *Note: the survey is contained in the Attachment (at Appendix A).* In order to facilitate a review of the survey results by the fourth meeting of the Asia/Pacific Meteorological Hazards Task Force (MET/H TF/4), I would appreciate receiving your response at your earliest convenience, **preferably no later than 17 March 2014.**

Accept, Sir/Madam, the assurances of my highest consideration.


Arun Mishra
Regional Director

Attachment: CNS/MET SG/15 – WP/51



International Civil Aviation Organization

**FIFTEENTH MEETING OF THE
COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND
METEOROLOGY SUB-GROUP (CNS/MET SG/15) OF APANPIRG**

Bangkok, Thailand, 25 – 29 July 2011

Agenda Item 11: Implementation of SIGMET and warnings

1) Review of METWARN/I TF/1 meeting

SUMMARY OF SURVEY RESULTS – RADIOACTIVE CLOUD

(Presented by Co-chairs, METWARN/I TF)

SUMMARY

This paper presents a summary of the results of a survey of the present capabilities of Asia/Pacific States to prepare and issue SIGMETs for radioactive clouds, which has been undertaken by the Asia/Pacific Meteorological Advisories and Warnings Implementation Task Force.

This paper relates to – **Strategic Objectives:**

A: **Safety** – Enhance global civil aviation safety

Global Plan Initiatives:

GP!-18 Aeronautical Information

GPI-19 Meteorological Systems

1. Introduction

1.1 The Asia/Pacific Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF) was established by the CNS/MET SG/14 to address regional implementation issues associated with meteorological advisories and warnings and to develop a framework of contingency plans related to volcanic ash, tropical cyclones, radioactive material and Tsunami.

1.2 At the First Meeting of METWARN/I TF, held in Bangkok, Thailand from 23 to 25 March 2011, the group agreed that there was a need to determine current capabilities of States in providing information to aviation on radioactive cloud (Action Agreed 1/10 refers) to enable an assessment of training and guidance requirements to be undertaken and assist in the development of frameworks for regional contingency plans.

1.3 The information collected in the survey will also be used to provide feedback to the International Airways Volcano Watch Operations Group (IAVWOPSG) meeting in September 2011,

which is tasked with developing guidance material on the issuance of SIGMETs for radioactive cloud.

1.4 The survey was also timely due to the accidental release of radioactive material at the Fukushima Nuclear Power Plant in Japan in March 2011.

1.5 A State letter was sent out on the 25th April 2011 (see appendix A), and asked eight questions. Seventeen States in the APAC region responded. The findings are summarized below.

2. Discussion

2.1 The first question related to points of contact for radioactive cloud warnings in each state. The information is provided in appendix B. A copy of survey responses is included in appendix C.

2.2 **Question 2: Does your State have procedures in place to receive products and information from a WMO regional specialized centre (RSMC) concerning the accidental release of radioactive materials into the atmosphere, as prescribed in Annex 3 (Chapter 3, 3.4)?**

Procedures to receive radioactive information from RSMC	Yes	No	No response
Number of States	10	2	5

2.3 **Question 2a: Does your State have the expertise, dispersion models, guidance material and training to issue information on radioactive cloud for your Flight Information Region.**

Expertise, models, guidance and training to issue radioactive cloud information	Yes	No	No, with clarification
Number of States	6	9	2

2.4 In responding to this question States raised concerns about the suitability of using existing models to forecast for specific flight information purposes, the appropriateness of current upper level dispersion charts, the need for further guidance material and the requirement for additional training.

2.5 **Question 3. Does your State have provisions to issue a SIGMET for radioactive cloud (RDO ACT) in accordance with ICAO Annex 3 (Appendix 6, for a radioactive cloud that affects your Flight Information Region(s)?**

Provision to issue SIGMETs for radioactive cloud	Yes	No
Number of States	9	8

2.6 Question 4. Does your State have provisions to issue a “NOTAM” for a radioactive cloud that affects your Flight Information Region(s)?

Issue NOTAM	Yes	No
Number of States	10	7

2.7 Question 5. What is the source of information for NOTAM for radioactive cloud?

2.8 In response to this question numerous sources of information were identified including RMSCs, various national agencies responsible for radiation/atomic energy (including NZ National Radiation Laboratory; Atomic Energy Authority of Sri Lanka, Australian Radiation Protection and Nuclear Safety Agency) and State weather agencies.

2.9 6. What criteria and thresholds are used by your State in the decision to issue information on a radioactive cloud?

Criteria or thresholds used	None available/defined	Specified thresholds (discussed below)	N/A
Number of States	4	6	6

2.10 This question resulted in a variety of answers. Hong Kong, Australia, the Republic of Korea and Singapore replied that whenever radioactive material is released into the atmosphere and the radioactive material is affecting or expected to affect their Flight Information Region, either based on internal information or the information received from a RSMC), a SIGMET for radioactive cloud would be issued.

2.11 In the USA, while there is guidance available on acceptable levels of radiation exposure this guidance may or my not be applicable to a direction issuance of a SIGMET and is under review and evaluation.

2.12 In some states, the criteria and thresholds used when issuing information on a radioactive cloud rests with their national radiation/atomic energy body.

2.13 Philippines provided technical details of their criteria:
1) Threshold of 10mSv of avertable does in<2 days to recommend sheltering
2) Threshold of 50 mSv of avertable does i<1 week to recommend evacuation.
3) Threshold of 100mGy of avertable committed absorbed does to the thyroid due to radioiodine to recommend iodine prophylaxiz
4) Threshold of 30 mSv in a month to initiate relocation and 10 mSv in a month to terminate relocation; if this does accumulate in a month is not expected to fall below this level for a year or two, permanent resettlement is recommended.

2.14 The variety of responses provided here suggests further guidance and clear international thresholds would assist states.

2.15 Question 7. What sources of information would your State use to determine the height and area covered by a radioactive cloud?

2.16 In response to this question numerous sources of information were identified including RSMCs, models (including several HY-SPLIT models), the International Monitoring System (IMS) associated with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification, and various national agencies responsible for radiation/atomic energy.

2.17 Several States reaffirmed the issue that determining the vertical extent of radioactivity is problematic and is normally only estimation.

2.18 **Question 8. What kind of guidance material would be of use from ICAO to support the requirement to issue a SIGMET for a radioactive cloud?**

Guidance	None	Specifics	N/A	No answer
Number of States	2	10	2	3

2.19 Several States highlighted the opportunity to provide similar guidance and products to those prepared for Volcanic Ash, including a new product similar to a Volcanic Ash Advisory, to leverage off existing procedures and transmissions.

2.20 Specific suggestions included:

- a Radiation Advisory (a new product similar to a VAA)
- Guidance on Nuclear Advisories similar to what is already available for Volcanic Ash Advisories.
- Better guidance from RSMCs in a form suitable for aviation purpose would be required to issue SIGMET.
- Complete guidelines/support/training in the regards of aviation specific products will be required.
- Guidance material such as transport model outputs on 3-dimensinal distribution of radioactive plume for different projection time.
- A guide on use and interpretation of the model outputs from RSMCs.
- A guide on threshold level or radiation concentration required for the issuance of SIGMET (potentially in Annex 3 and also Manual of Aeronautical Meteorological Practice (Doc 8896).
- A guide on the threshold level of radiation concentration of significance to aircraft operation.
- Identification of Regional Centres to issue advisories on Radioactive Clouds (Radioactive Cloud Advisory Centres) so that the Aeronautical Meteorological Offices could use these advisories and Authorities to issue SIGMET & NOTAMS.
- Training of officers to issue warnings in this field is also necessary and it is beneficial for Aeronautical Meteorologist if ICAO & WMO organizing a joint seminar in this field including officers from the National Atomic Energy Authorities.
- Guidance to IAEA on the requirement for real-time information on radioactive cloud parameters (source quantity, height, areal extent) is needed.

3. Action by the Meeting

3.1 The meeting is invited to:

- a) note the information contained in this paper, and
- b) provide the information to IAVWOPSG



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منظمة الطيران
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国际民用
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Ref.: T 4/7.5:AP064/11 (MET)

25 April 2011

Subject: Survey on APAC States capabilities in providing
Information to aviation on radioactive material

Action required: Complete the survey and send to the
ICAO Asia Pacific Regional Office by **15 June 2011**

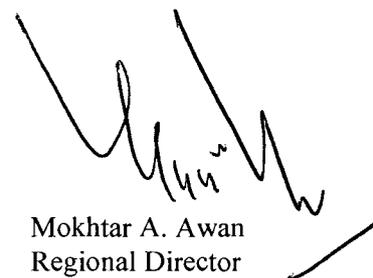
Sir/Madam,

I have the pleasure to refer to the First Meeting of the Asia/Pacific Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF/1) of APANPIRG held in Bangkok, Thailand from 23 to 24 March 2011. The group agreed that there was a need to determine current capabilities of States in providing information to aviation on radioactive cloud (Action Agreed 1/10 refers).

The International Airways Volcano Watch Operations Group (IAVWOPSG) is developing guidance material on the issuance of SIGMET on radioactive cloud. Members of this group present at the APAC METWARN/I TF meeting developed a survey in order to use this feedback to the IAWOPSG/6 meeting in September 2011. The survey is timely due to the accidental release of radioactive material at the Fukushima Nuclear Power Plant in Japan.

Thank you for taking the time to complete the survey which will assist the global group in developing guidance material on the issuance of SIGMET on radioactive cloud.

Accept, Sir/Madam, the assurances of my highest consideration.



Mokhtar A. Awan
Regional Director

Attachment:

Survey Questions – Radioactive Cloud

SURVEY QUESTIONS

RADIOACTIVE CLOUD

1. Name of State: _____
Point of Contact: _____
Name: _____
Title: _____
Email: _____
Phone: _____

2. Does your State have procedures in place to receive products and information from a WMO regional specialized centre (RSMC) concerning the accidental release of radioactive materials into the atmosphere, as prescribed in Annex 3 (Chapter 3, 3.4)?

2a) Does your State have the expertise, dispersion models, guidance material and training to issue information on radioactive cloud for your Flight Information Region?

a. _____yes

b. _____no

3. Does your State have provisions to issue a SIGMET for radioactive cloud (RDO ACT) in accordance with ICAO Annex 3 (Appendix 6, for a radioactive cloud that affects your Flight Information Region(s)?

a. _____yes

b. _____no

4. Does your State have provisions to issue a "NOTAM" for a radioactive cloud that affects your Flight Information Region(s)?

a. _____yes

b. _____no

5. If “yes” to questions 2, 3, and 4, what is your State’s source of information for the radioactive cloud?

6. What criteria and thresholds are used by your State in the decision to issue information on a radioactive cloud?

7. What sources of information would your State use to determine the height and area covered by a radioactive cloud?

8. What kind of guidance material would be of use from ICAO to support the requirement to issue a SIGMET for a radioactive cloud?

Appendix B: Points of Contact

Points of Contact for Radioactive Cloud					
Country	Agency/Organisation	Name	Title	Email	Phone
Australia	Bureau of Meteorology	Shona Rosengren	National Aviation Weather Service Manager	srav@bom.gov.au	+61 (3) 9669 4586
Bhutan	Department of Civil Aviation	Mr. Tashi Dukpa	Deputy Chief of Aviation Meteorology	aeromet@druknet.bt	+975 271404
Hong Kong, China	Hong Kong Observatory	Queenie CC Lam	Senior Scientific Officer	cclam@hko.gov.hk	+8852 2926 8437
India	Central Aviation Meteorology Division	Mr. R.R. Mali	Scientist	raiesh132002@yahoo.com ; aviationsection@yahoo.com	94 (11) 24619196
Japan					
Lao PDR	MWO	Mr. Vandhy Douangmala	Deputy Head of Division of Weather Forecast & Aeronautical Meteorology	vanhdy_d@yahoo.com	+856 (21) 263657, 520 038 Mobile: +856 (20) 22402743
Macao, China	Meteorological and Geophysical Bureau	Mr. Ku Chi Ming	Chief of Aeronautical Meteorological Centre	cmku@smg.gov.mo	+853 88986243
Malaysia	KLIA Meteorological Office	Mr. Ab Llah Che Cob	Director	ablah@met.gov.my	+603 8787 2388
New Zealand	SIGMETs Meteorological Service of NZ Ltd (MetService)	Mr. Marcel Roux	Manager Aviation Forecasting	marcel.roux@metservice.com	+64 (4) 4700 731
	Radiation National Radiation Laboratory (NRL)	Chris Ardouin & Tony Cotterill		chris_ardouin@nrl.moh.govt.nz ; tony_cotterill@nrl.moh.govt.nz	+64 (21) 720 345
Pakistan	Pakistan Meteorological Department	Mr. Naeem Shah	Chief Meteorologist	naeemshah1956@yahoo.com	+92 (21) 9926 1404
Palau	Palau National Aviation Administration	Peter Polloi	Administrator	pnaa@palaunet.com	+680 587 4363
Philippines	Philippines Nuclear Research Institute	Alumanda M. dela Rosa, Ph.D	Director, Philippines Nuclear Research Institute	amdelarosa@pnri@dost.gov.ph	+63 (2) 929 4719
Republic of Korea	KOREA Aviation Meteorological Agency	Oh Hyung-Gun	International Coordinator	ohg47@korea.kr	+82 (32) 7402803

Country	Agency/Organisation	Name	Title	Email	Phone
Samoa	Ministry of Works, Transport/Infrastructure (MWTI)	Mr. Vaaelua Nofo Vaaelua	Chief Executive Officer	nvaaelua.mwti@samoa.ws	21611 Ext. 11
Singapore	Meteorological Service Singapore, NEA	Ms. Lim Lay Eng	Director, Business and Corporate Affairs	Lim_Lay_Eng@nea.gov.sg	+65 6545 7196
Sri Lanka	Department of Meteorology, Meteorological Office, Bandaranaike Airport, Katunayake, Sri Lanka	A.K. Karunanayake	Meteorologist in Charge, Katunayake Airport	athu1970@yahoo.com	+94 (11) 2252721, 2252319
Thailand	Thai Meteorological Department	Mrs. Yaovapa Tanadchangeaeng	Director, Bureau of Aeronautical Meteorology	yaovapa@tmd.go.th	+66 (2) 1340007
USA	FAA	Mr. Steven R. Albersheim	Aviation Weather Planning & Requirements	Steven.Albersheim@faa.gov	+1 (202) 385 7185

**SURVEY QUESTIONS
RADIOACTIVE CLOUDS
Appendix C**

No.	Q1	Q2	Q2a	Q3	Q4	Q5	Q6	Q7	Q8	Point of Contact	Name	Title	Email	Phone
1	Australia	Yes. Australia provides the RSMC for EER for RA V.	Expertise - Yes Dispersion model - Yes (HYSPLIT) although suitable upper level dispersion charts need to be developed Guidance material - No Training - No	Yes – but have never issued one.	yes	IAEA request WMO RSMC support for EER. The Melbourne RSMC will prepare EER products as explained in the document attached. For an Australian source, ARPANSA (Australian radiation Protection and Nuclear Safety Agency) may be able to provide source information, but procedures do not exist currently.	No criteria/thresholds are defined. The modelled release amounts/type are taken from the official request from IAEA. Usually it is just a nominal amount of 1 Bq, which means nothing except as a tracer of some radioactive material. The concentration contours in the EER products our RSMC produce therefore cannot be interpreted in any meaningful way by the aviation industry except as an indication of where there might be some non-zero amount pollutant.	Australia has limited ways to determine the height and area covered by radioactive cloud, other than our dispersion model, which is focused on ground deposition rather than accurate atmospheric dispersion. ARPANSA may be able to provide information on height and area, but formal procedures do not exist at this stage.	Standard criteria and thresholds for issue of SIGMETs are needed. Guidance to IAEA on the requirement for real-time information on radioactive cloud parameters (source quantity, height, areal extent) is needed.					
2	Bhutan		no	no	no	no	none	none	none	Department of Civil Aviation	Mr. Tashi Dukpa	Deputy Chief of Aviation Meteorology	aeromet@druknet.bt	+975 271404
3	Hong Kong, China	yes	yes	yes	yes	Messages from the International Atomic Energy Agency (IAEA) and transport model outputs from Regional Specialized Meteorological Centres (RSMCs). In case of accidental radioactive release from the nuclear power stations in Guangdong close to Hong Kong, the radioactive cloud information will also be provided based on transport model outputs, information from the relevant Guangdong nuclear emergency authority as well as the ground and flight measurements within Hong Kong.	Whenever radioactive material is released into the atmosphere and the radioactive material is affecting or expected to affect Hong Kong Flight Information Region, the SIGMET for radioactive cloud will be issued as soon as practicable but not more than 4 hours before the expected time of occurrence. The period of validity is normally 3 hours.	refer to answer in Q5	Guidance material such as transport model outputs on 3-dimensional distribution of radioactive plume for different projection time. In addition, a Guide on (a) use and interpretation of the model outputs from RSMCs; (b) threshold level or radiation concentration required for the issuance of SIGMET (b) threshold level of radiation concentration of significance to aircraft operation.	Hong Kong Observatory	Queenie CC Lam	Senior Scientific Officer	cclam@hko.gov.hk	+852 2926 8437
4	Macao, China		No	No	No					Meteorological and Geophysical Bureau	Mr. Ku Chi Ming	Chief of Aeronautical Meteorological Centre	cmku@smg.gov.mo	+853 88986243
5	India	No	No	No	No	Not applicable	Not Applicable	WMO Regional Specialized Centre	Similar to the guidance materials available for Tropical Cyclone and Volcanic Ash SIGMETs	Central Aviation Meteorology Division	Mr. R.R. Mali	Scientist "E"	rajesh132002@yahoo.com ; aviationsection@yahoo.com	+94 (11) 24619196
6	Japan	yes	yes	yes	yes						Mr Jun			
7	Lao PDR		No	No	No	N/A	N/A	N/A	N/A	MWO	Mr. Vandhy Douangmala	Deputy Head of Division of Weather Forecast & Aeronautical Meteorology	vandhy_d@yahoo.com	+856 (21) 263657, 520 038 Mobile: +856 (20) 22402743
8	Malaysia	yes	yes	yes	yes	The source of information is from RSMC Melbourne as an Environmental Emergency Response (EER Centre)	ssomsri: 1) Trajectory forecast for the radioactive cloud. 2) Wind speed and wind direction forecast. 3) Type of radioactive cloud	1) Malaysia HY-SPLIT Model for determining the height of radioactive cloud. 2) RSMC Melbourne information charts for determining the area covered by radioactive cloud.	1) ASIA/PAC SIGMET Guide (4th Edition - Sept. 2007), Amended - April 2011. 2) ICAO Doc 9691 - Manual on Volcanic Ash, Radio Material and Toxic Chemical Clouds	KLIA Meteorological Office	Mr. Ab Liah Che Cob	Director	ablah@met.gov.my	+603 8787 2388

**SURVEY QUESTIONS
RADIOACTIVE CLOUDS
Appendix C**

No.	Q1	Q2	Q2a	Q3	Q4	Q5	Q6	Q7	Q8	Point of Contact	Name	Title	Email	Phone
1	Australia	Yes. Australia provides the RSMC for EER for RA V.	Expertise - Yes Dispersion model - Yes (HYSPLIT) although suitable upper level dispersion charts need to be developed Guidance material - No Training - No	Yes – but have never issued one.	yes	IAEA request WMO RSMC support for EER. The Melbourne RSMC will prepare EER products as explained in the document attached. For an Australian source, ARPANSA (Australian radiation Protection and Nuclear Safety Agency) may be able to provide source information, but procedures do not exist currently.	No criteria/thresholds are defined. The modelled release amounts/type are taken from the official request from IAEA. Usually it is just a nominal amount of 1 Bq, which means nothing except as a tracer of some radioactive material. The concentration contours in the EER products our RSMC produce therefore cannot be interpreted in any meaningful way by the aviation industry except as an indication of where there might be some non-zero amount pollutant.	Australia has limited ways to determine the height and area covered by radioactive cloud, other than our dispersion model, which is focused on ground deposition rather than accurate atmospheric dispersion. ARPANSA may be able to provide information on height and area, but formal procedures do not exist at this stage.	Standard criteria and thresholds for issue of SIGMETs are needed. Guidance to IAEA on the requirement for real-time information on radioactive cloud parameters (source quantity, height, areal extent) is needed.					
9	New Zealand	yes At present, these are not considered to be suitable for aviation purpose.	no	yes This would be limited to the NZ FIR (NZZC)	Yes	New Zealand National Radiation Laboratory	The criteria and thresholds used when issuing information on a radioactive cloud rests with NRL	NZ has access to the International Monitoring System (IMS) associated with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification for determining the areal coverage. However, the vertical extent of radioactivity is more problematic and is normally estimated with the help of computer models	a) Guidance on Nuclear Advisories similar to what is already available for Volcanic Ash Advisories; b) Guidance from the RSMC Melbourne in a form suitable for aviation purpose would be required to issue SIGMET for the Auckland Oceanic FIR (NZZO)	SIGMETs Meteorological Service of NZ Ltd (MetService) Radiation National Radiation Laboratory (NRL)	Mr Marcel Roux Chris Ardouin & Tony Cotterill	Manager Aviation Forecasting	marcel.roux@metservice.com chris_ardouin@nrl.moh.govt.nz tony_cotterill@nrl.moh.govt.nz	+64 (4) 4700 731 +64 (21) 720 345
10	Pakistan		no	no	no	N/A	Presently this office is not issuing this type of SIGMET therefore there is no set criteria. However, the criteria set by the WMO/ICAO will be followed when the need arises.	Pakistan is not issuing such type of SIGMET, so it has to establish the source as and when required.	Complete guidelines/support/training in the regards will be required	Pakistan Meteorological Department	Mr. Naeem Shah	Chief Meteorologist	naeemshah1956@yahoo.com	+92 (21) 9926 1404
11	Palau	no	no	no	no		None	None	None	Palau National Aviation Administration	Peter Polloi	Administrator	pnaa@palaunet.com	+680 587 4363
12	Philippines	yes PAGASA is a recipient of information from WMO regional specialized centre during nuclear and radiological emergencies.	No Philippines have some capability to issue information on radioactive cloud but not specific for flight information purposed	No	No	1) Owner and operator of the nuclear facility 2) Local weather bureau, i.e. PAGASA 3) Local CTBTO Monitoring Station (Tanay, Rizal) 4) International Atomic Energy Agency 5) WMO Regional Specialized Meteorological Centre	1) Threshold of 10mSv of avertable does in<2 days to recommend sheltering 2) Threshold of 50 mSv of avertable does i<1 week to recommend evacuation. 3) Threshold of 100mGy of avertable committed absorbed does to the thyroid due to radioiodine to recommend iodine prophylaxiz 4) Threshold of 30 mSv in a month to initiate relocation and 10 mSv in a month to terminate relocation; if this does accumulate in a month is not expected to fall below this level for a year or two, permanent resettlement is recommended.	Source term provided by the operator of the nuclear installation operator. Release condition. Meteorological condition. Weather condition.		Philippines Nuclear Research Institute	Alumanda M. dela Rosa, Ph.D	Director, Philippines Nuclear Research Institute	amdelaarosa@pnri@dost.gov.ph	+63 (2) 929 4719
13	Republic of Korea	yes	yes	yes	yes	WMO RSMC (Japan, China, Russia) or Korea Meteorological Administration (KMA)	Observed or expected within Incheon FIR	Information from KMA or WMO RSMC	International criteria of SIGMET for a radioactive cloud	Korea Aviation Meteorological Agency	Oh Hyung-Gun	International Coordinator	ohg47@korea.kr	+82 (32) 7402803
14	Samoa	No	No	No	Yes	Christchurch NOTAM Office	Not Applicable	Not Applicable	Not Applicable Fiji MET Office issues SIGMET for Samoa	Ministry of Works, Transport/Infrastructure (MWTI)	Mr. Vaaelua Nofu Vaaelua	Chief Executive Officer	nvaaelua.mwti@samoa.ws	21611 Ext. 11
15	Singapore	Yes	yes	yes	yes	Simulation from the RSMCs and models run in-house	SIGMET will be issued in the event of receipt of NEM from VAAC London or simulation from RSMC indicates that the radioactive cloud is expected to affect FIR.	Based on simulation models	The current simulation models from RSMC are based on unit Bq of release. Clarification regarding the threshold of ash concentration requiring issuance of SIGMET would be useful.	Meteorological Service Singapore, NEA	Ms. Lim Lay Eng	Director, Business and Corporate Affairs	Lim_Lay_Eng@nea.gov.sg	+65 6545 7196

**SURVEY QUESTIONS
RADIOACTIVE CLOUDS
Appendix C**

No.	Q1	Q2	Q2a	Q3	Q4	Q5	Q6	Q7	Q8	Point of Contact	Name	Title	Email	Phone
1	Australia	Yes. Australia provides the RSMC for EER for RA V.	Expertise - Yes Dispersion model - Yes (HYSPLIT) although suitable upper level dispersion charts need to be developed Guidance material - No Training - No	Yes – but have never issued one.	yes	IAEA request WMO RSMC support for EER. The Melbourne RSMC will prepare EER products as explained in the document attached. For an Australian source, ARPANSA (Australian radiation Protection and Nuclear Safety Agency) may be able to provide source information, but procedures do not exist currently.	No criteria/thresholds are defined. The modelled release amounts/type are taken from the official request from IAEA. Usually it is just a nominal amount of 1 Bq, which means nothing except as a tracer of some radioactive material. The concentration contours in the EER products our RSMC produce therefore cannot be interpreted in any meaningful way by the aviation industry except as an indication of where there might be some non-zero amount pollutant.	Australia has limited ways to determine the height and area covered by radioactive cloud, other than our dispersion model, which is focused on ground deposition rather than accurate atmospheric dispersion. ARPANSA may be able to provide information on height and area, but formal procedures do not exist at this stage.	Standard criteria and thresholds for issue of SIGMETs are needed. Guidance to IAEA on the requirement for real-time information on radioactive cloud parameters (source quantity, height, areal extent) is needed.					
16	Sri Lanka	yes	no	yes	yes	Advisories and Warnings received from GTS 1) Atomic Energy Authority of Sri Lanka and Disaster Management Centre of Sri Lanka with the Department of Meteorology are jointly working on issuing information on radioactive clouds in Sri Lanka region.	Since Sri Lanka did not have any experience there were no criteria.	Information received from Atomic Energy Authority of Sri Lanka and the information received over GTS is expected to use to determine the height and area covered.	ICAO should identify Regional Centres to issue advisories on Radio Active Clouds (Radio Active Cloud Advisory Centres) so that the Aeronautical Meteorological Offices could use these advisories and Authorities to issue SIGMET & NOTAMS. Guidelines for Radio Active Clouds could be included in Annex 3 and also Manual of Aeronautical Meteorological Practice (Doc 8896). Training of officers to issue warnings in this field is also necessary and it is beneficial for Aeronautical Meteorologist if ICAO & WMO organizing a joint seminar in this field including officers from the National Atomic Energy Authorities.	Department of Meteorology, Meteorological Office, Bandaranaike Airport, Katunayake, Sri Lanka	A.K. Karunanayake	Meteorologist in Charge, Katunayake Airport	athu1970@yahoo.com	+94 (11) 2252721, 2252319
17	Thailand		No	No	No					Thai Meteorological Department	Mrs. Yaovapa Tanadchangeaeng	Director, Bureau of Aeronautical Meteorology	yaovapa@tmd.go.th	+66 (2) 1340007
18	USA	yes	yes to expertise, dispersion models, guidance material	yes	yes	Washington RSMC	While there is guidance available on acceptable levels of radiation exposure this guidance may or may not be applicable to a direction issuance of a SIGMET and is under review and evaluation	Washington RSMC	1) Agree on WMO IDs 2) Agree that a Radiation Advisory (A new product similarly to a VAA) would be the best way to leverage existing procedures and transmissions. 3) Below is a prototype of how information could be provided for a Radiation advisory would work	FAA	Mr. Steven R. Albersheim	Aviation Weather Planning & Requirements	Steven.Albersheim@faa.gov	+1 (202) 385 7185

Attachment 2 to MET/H TF/4 – WP/3

No.	Q1	Q2	Q2a	Q3	Q4	Q5	Q6	Q7	Q8	Point of Contact	Name	Title	Email	Phone
1	Japan	No	No	Yes	Yes	The most scientifically credible sources at the time the information is issued: e.g., the indoor evacuation area for inhabitants declared by the Japanese government, monitoring results announced officially and the opinions of governmental institutions.	No criteria and thresholds have been defined. The information is issued for the areas where radioactive cloud may affect the safety of aircraft operations based on scientifically credible sources.	The most scientifically credible sources at the time the information is issued: e.g., the indoor evacuation area for inhabitants declared by the Japanese government, monitoring results announced officially and the opinions of governmental institutions.	After elucidating the impact of radioactive cloud to aircraft operations, the criteria for the issuance of SIGMET for a radioactive cloud.	Japan Meteorological Agency	Takashi Mori	Director, Aeronautical Meteorology Division	aero-jma@met.kishou.go.jp	+81 3 3212 8968
2	Macao, CHINA	Yes	No	No, Macao is located within Hong Kong FIR, we have not MWO and no need to issue SIGMET	No	N/A	N/A	N/A	None	Macao Meteorological and Geophysical Bureau	Tang Iu Man	Chief of Aeronautical Meteorological Centre	imtang@smg.gov.mo	853-88986290
3	United States	Yes	yes to expertise, dispersion models, guidance material no to training	Yes	Yes Note: A NOTAM can be issued for hazardous situation in support of a TFR based on information provided by the appropriate authority of the location of the hazard.	Response: Washington RSMC	While there is guidance available on acceptable levels of radiation exposure this guidance may or may not be applicable to a direction issuance of a SIGMET and is under review and evaluation.	Washington RSMC	1) Agree on WMO IDs 2) Agree that a Radiation Advisory (A new product similar to a VAA) would be the best way to leverage existing procedures and transmissions. 3) Below is a prototype of how information could be provided for a Radiation advisory would work. Following what was done for VA, a similar format could be adopted by a Regional Specialized Meteorological Centre (RSMC) for the issuance of Radiological Activity Advisory (RAA). This product would have the same look of the current VAA and would mirror the current Annex 3 template for VAAs. An example RAA is below... FXXX20 KWNO 042118 RDOACT ADVISORY DTG: 20100804/2118Z RSMC: WASHINGTON RDOACT RELEASE: PEARL HARBOR HI LOC: N2121 W15759 AREA: HAWAIIAN ISLANDS RELEASE ELEV: 200 FT ADVISORY NR: 2010/003 INFO SOURCE: DEPT OF DEFENSE. HYSPLIT MODEL. RELEASE DETAILS: INITIAL RELEASE OCCURRED 04/2038Z EST RDOACT DTG: 04/2100Z EST RDOACT CLD: SFC/FL080 N2122 W15755 - N2117 W15749 - N2110 W15758 - N2117 W15805 - N2122 W15755 MOVING SW 15KT FCST RDOACT CLD +6HR: 05/0300Z SFC/080 N2122 W15755 - N2117 W15749 - N2058 W15815 - N2114 W15832 - N2122 W15755 4RMK: RDOACT CLD NOT DETECTED VIA SATELLITE IMAGE. ESTIMATED OBS AND FCST POSITIONS BASED ON RELEASE DETAILS AND HYSPLIT MODEL TRAJECTORY. NXT ADVISORY: 20100805/0300Z 2.2 Once the RSMC transmits the RAA, which follows identical dissemination paths of a VAA, the MWOs receive the information and then prepare a RDOACT SIGMET based on the RAA information. Below is an example RDOACT CLD SIGMET based on the RAA example above. KZAK SIGMET N4 VALID 042120/050120 PHFO- KZAK OAKLAND OCEANIC FIR RDOACT CLD FCST AT 2100Z WI N2122 W15755 - N2117 W15749 - N2110 W15758 - N2117 W15805 - N2122 W15755 SFC/FL080 MOV SW 15KT NC	FAA	Steven R. Albersheim	Aviation Weather Planning & Requirements	Steven.Albersheim@faa.gov	202-385-7185
4	Singapore	Yes	Yes	Yes	Yes	Simulation from the RSMCs and from models run in-house	SIGMET will be issued in the event of receipt of NEM from V AAC London or simulation from RSMC indicates that the radioactive cloud is expected to affect FIR.	Based on simulation models	The current simulation models from RSMC are based on unit Bq of release. Clarification regarding the threshold of ash concentration requiring issuance of SIGMET would be useful.	Meteorological Service Singapore	Patricia Ee Gek May	Director (Weather Services Department)	Pe_gek_may@nea.gov.sg	+6565422863
5	Mongolia		No	No	No	N/A	N/A	N/A	N/A	Aviation Meteorological Centre	B Bolormaa	Deputy Director	bolormaa.b@mcaa.gov.mn	976-11-283092
6	Indonesia	No	No	No	Yes		No criteria: and thresholds are defined		SIGMET Guide for radioactive cloud	Meteorological Climatological and Geophysical Agency	Drs Syamsill Huda, M.Si.	Head of Aviation and Marine Meteorological Centre	hsyarinsu11116@gmail.com	+62 -1 6544689
7	Hong Kong, China	Yes	Yes	Yes	Yes	Messages from the IAEA, transport model outputs from RSMCs and the ground and flight measurements within Hong Kong. In case of accidental radioactive release for the nuclear power stations in Guangdong close to HK, the radioactive cloud information will soon be provided based on locally run transport model outputs and information from the relevant Guangdong nuclear emergency authority.	IAEA's generic criteria for protective actions and other response action (ref: IAEA General Safety Guide No. GSG-2, 2011) is adopted as criteria for issuance of SIGMET whenever radioactive material is released into the atmosphere and the radioactive material is affecting HK FIR.	Refer to answer in Q5	Guidance material such as transport model outputs on 3-dimensional distribution of radioactive plume of different projection time. In addition, A Guide on (a) use and interpretation of the model outputs for aviation applications from RSMCs; (b) reference level of radiation concentration required for the issuance of SIGMET; (c) reference level of radiation concentration of significance to aircraft operation.	Hong Kong Observatory	Dr. Ping Wah Li	Senior Scientific Officer	pwli@hko.gov.hk	+852-2926-8437
8	Thailand	No	No	No						Thai Meteorological Department	Mr. Charoon Laohalerchai	Director, Bureau of Aeronautical	Charoom_lao@hotmail.com	+66(2) 134 0011 Ext 216

Attachment 2 to MET/H TF/4 – WP/3

No.	Q1	Q2	Q2a	Q3	Q4	Q5	Q6	Q7	Q8	Point of Contact	Name	Title	Email	Phone
9	AUSTRALIA	Yes	Yes Note: Dispersions model used is HYSPLIT. Australia provides the Melbourne RSMC for the Environmental Emergency Response (EER) system for WMO RA-V.	Yes	Yes	The International Atomic Energy Agency (IAEA) provides information to Melbourne RSMC to support EER. The Melbourne RSMC will prepare EER products. For an Australian source, ARPANSA (Australian Radiation Protection and Nuclear Safety Agency) may be able to provide source information, but specific procedures do not currently exist.	No specific criteria/thresholds are defined. The modelled release amounts/type are taken from the official request from IAEA. Usually it is just a nominal amount of 1 Bq. The concentration contours in the EER products that Melbourne RSMC produce therefore cannot be interpreted in any meaningful way by the aviation industry except as an indication of where there might be some non-zero amount pollutant.	Australia has limited ways to determine the height and area covered by radioactive cloud, other than using guidance from the atmospheric dispersion model and satellite analysis.	ICAO, in conjunction with WMO and IAEA, could provide more detailed guidance in Doc9691 – Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds to assist a) the RSMCs in issuing EER advice relevant to aviation and b) the Meteorological Watch Offices (MWOs) in issuing SIGMET. Better access to more timely and accurate source quantity, height, areal extent. Educational material for both the MWO and the aviation industry.	Meteorological Authority, Australian Bureau of Meteorology	Mrs Sue O'Rourke	Section Head, Meteorological Authority	metauthority@bom.gov.au	+61 3 9669 4662 Mob: +61 4 1823 4138
10	BANGLADESH	Yes	No. There are procedure given in the hand book to receive messages (if any) from RSMC's via AFTN, SADIS, GTS & other means.	Yes	Yes	RSMC message	If the RSMC message includes present/forecast position & it is within FIR boundary	RSMC message	Standard criteria and thresholds for issue of SIGMETs are needed	BANGLADESH METEOROLOGICAL DEPARTMENT	SYED ABUL HASANAT	METEOROLOGIST	hasanat2001@yahoo.com, info@bmd.gov.bd	+880 29135742, +880 1714202486
11	ROK	Yes	Yes	Yes	Yes	Pilot report, NOTAM, SIGMETs and RSMCs	When radioactive cloud observed or expected within Incheon FIR	Pilot report, NOTAM, SIGMETs and RSMCs	International standard criteria and thresholds for issuing SIGMET	Korea Aviation Meteorology Agency of Korea Meteorological Administration	Lee Hoyong	Assistant Director	Lhy2502@korea.kr	+82 32 740 2820