CONCEPT OF OPERATIONS

FOR

RADIOACTIVE MATERIAL INFORMATION SERVICES

IN SUPPORT OF

INTERNATIONAL AIR NAVIGATION
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1 INTRODUCTION

This Concept of Operations (ConOps) document discusses the information services provided for a release of radioactive material into the atmosphere for use by aviation decision makers in flight planning and operational decisions. This document only addresses those aspects of radioactive cloud information services that are relevant to aviation.

This ConOps only addresses the international aspects of the problem with respect to airborne radioactivity. The resulting measures will be based on international recommendations and harmonized with national arrangements. Individual States have full authority to define their own arrangements and procedures on how to deal with airborne radioactivity within their boundaries, including how to deal with the deposition of radioactivity at the surface or contamination of aircraft once it lands.

Throughout this ConOps the terms radioactive material and radioactive cloud are synonymous and interchangeable.

1.1 Purpose

The ConOps describes the provision and use of radioactive cloud information in support of international air navigation and defines the functional and performance requirements necessary for that information to satisfy the near-term and future operational needs of aviation decision-makers. This ConOps discusses the experiences with the current radioactive cloud information services and identifies improvements envisioned for the future. This document also describes the manner in which the information on radioactive material provided through improved services can be used in support of international air navigation.

This ConOps forms the foundation for the establishment of the functional and performance requirements for this service. From the ConOps, Standards and Recommended Practices (SARPs) evolve on the services to be provided. An implementation plan and procedures on how those services are provided will then follow.

This ConOps is a living document and will evolve as technology and operational requirements evolve. Therefore, the overall objective of this document is to provide a baseline ConOps to meet services for radioactive material released into the atmosphere (i.e., radioactive cloud) for the international aviation community while recognizing that improvements in these services will evolve.

1.2 Background

The impetus to address issues related to the provision and use of radioactive cloud information was the release of radioactive material resulting from the accident at the Chernobyl Nuclear Power Plant in the Ukraine in April 1986. At the request of the International Federation of Air Line Pilots Associations (IFALPA), the International Civil Aviation Organization (ICAO) agreed to develop guidance to ensure that the extent and movement of radioactive clouds would be provided to aircraft and aerodromes likely to be affected.

It was determined that from an operational standpoint, there are similarities between the provision and use of volcanic ash information and radioactive cloud information. Thus, ICAO assigned the task to the Volcanic Ash Warnings Study Group who introduced Radioactive Cloud (RDOACT CLD) as a phenomenon for the SIGMET information message in Amendment 74 to Annex 3 —
States, in appropriate into 9691), however, this guidance was intended as a temporary solution until the development of appropriate international agreements and procedures was completed. The ICAO Met-Panel and its working group on MET information and service delivery (MetP-MISD) is responsible for recommending the standards for radioactive cloud information services. Although extremely rare, the provision of radioactive cloud information is operationally similar to that for volcanic ash and, therefore, falls within the purview of the MISD working group of the Met-Panel.

The need for radioactive cloud information was reinforced in March 2011 following the massive earthquake and tsunami in Japan which caused the Fukushima nuclear accident at the Fukushima Daiichi Nuclear Power Plant (NPP). This accident produced the largest release of radioactive material into the atmosphere since the Chernobyl accident. In response to the radioactive cloud release, the Japan Meteorological Agency issued a series of SIGMETs. Subsequently, the international aviation community determined that additional guidance regarding the issuance, management, and termination of the SIGMET product is necessary to better support international air navigation.

1.3 Problem Statement

Radioactive clouds are different from any meteorological phenomena observed and forecast by meteorological offices and Meteorological Watch Offices (MWO). MWOs are not necessarily holding experts on radioactive clouds. This expertise lies usually outside the MWOs and can be found in some States, regional and world centres of expertise. Yet, MWOs are expected to issue SIGMET information messages on this hazard on a 4-dimensional scale for their respective Flight Information Regions (FIR).

The challenges in providing information on the location of radioactive clouds is that the cloud(s):

- is/are not visible;
- cannot be seen or reported by an aerodrome observer in the aerodrome meteorological report (in meteorological code form – METAR/SPECI); and
- cannot be detected remotely by radar, or viewed from meteorological satellites.

Currently, no detailed guidance exists for the provision and use of radioactive cloud information in support of international air navigation services. Discussions on possible ways to address this are under way (Working Paper 17, IAVWPSG/6). As previously noted, Annex 3 includes provisions for the SIGMET information message issued by MWOs. However, specific guidance when to issue, update, and cancel the SIGMET is lacking.

It should also be noted that no guidance currently exists on decision making principles to apply in support of a response to the release of radioactive material into the atmosphere. Experiences with volcanic ash related events have clearly demonstrated the need to define basic decision making principles to ensure the safety and cost effectiveness of flight operations. This ConOps does not address decision making principles as they are beyond the scope of this current version.

Therefore the development of this ConOps is to assess the:

(1) Availability of guidance material to MWOs to fulfill their current role in issuing radiation SIGMETs. This is a short-term problem requiring immediate attention.
(2) Availability of existing guidelines for aviation defining what constitutes an unacceptable level of radiation hazard (i.e., what thresholds are appropriate for specifying the threat area associated with a radiation release). This is a medium-term issue, since this has already been under examination by several groups for a number of years while it is still not resolved, nor is it likely to be so in a short-term timeframe.

(3) Capability of MWOs to provide information on the location of radioactive cloud given that for highly-specialized nature of radiation, and the inability to detect radioactive clouds through meteorological observing systems. Typically MWOs do not have skilled personnel to provide this information. This is a medium-term issue.

1.4 Information Identification

This ConOps document is expected to be included as either a standalone document, or an appendix to ICAO Document 9691 Manual on Volcanic Ash, Radioactive Material, and Toxic Chemical Clouds. As MET/14-IP/5 CAeM-15/INF. 5 Appendix A-7 such it is intended to set out the contemporary thinking with regard to the problem of radioactive cloud information generation, dissemination and use in international civil aviation.

The current product for disseminating radioactive cloud information, the SIGMET information message, is documented in Annex 3 and the Manual of Aeronautical Meteorological Practice (Doc 8896). The inclusion of a radioactivity symbol on the World Area Forecast System’s (WAFS) Significant Weather (SIGWX) forecasts is documented in Annex 3 and the Doc 8896.

The nuclear emergency message is an aeronautical fixed telecommunication network (AFTN) message issued by the volcanic ash advisory centre (VAAC) London. The regional specialized meteorological centre (RSMC) Exeter, which is co-located with VAAC London, receives information from the International Atomic Energy Agency (IAEA) and passes it to VAAC London who then prepares the nuclear emergency message which is transmitted to area control centres (ACC) concerned. The VAAC London Provider State accepted the responsibility to be the focal point for forwarding the direct notification received from the IAEA to area control centres (ACC) concerned related to the release of radioactive material into the atmosphere (see section 2). Formal documentation on the nuclear emergency message is currently not available.

The arrangements between IAEA and WMO are defined in WMO’s manual on the GDPFS (global data processing and forecasting system; WMO - No. 485, Volume I, 2010 edition).

It should be noted that, in the future, the provision of radioactive cloud information may be addressed in a new ICAO Procedures for Air Navigation Services (PANS) document that is specific to the provision of meteorological information in support of global air navigation, particularly the performance-based navigation (PBN) concept.

1.5 Radioactive material information service concept overview

For the near-term, consideration should be given to alternative provisions for radioactive cloud information currently provided by MWOs with the SIGMET information message. Perhaps regional or world centres can provide the equivalent of the SIGMET information message, in traditional alphanumeric code as well as a graphical image, similar to the advisory products issued by the VAACs for volcanic ash clouds. Furtheron the communication structure has to be aware that the information
may be available by other sources than IAEA. A special confirmation procedure by the responsible center has then to be taken into account.

For the long-term, the concept is to move from a product centric environment to an information centric environment to meet the operational needs of aviation decision makers. The information regarding the release of radioactive material is expected to be provided by the relevant State and/or international agencies, with responsibility for providing such information, with the information simultaneously disseminated, by the relevant State and/or international agency, to meteorological providers, affected area control centers (ACC), civil aviation authorities, and other users. The radioactive cloud information would be in digital format and ingested directly into decision support tools (DST) used by aviation decision makers (e.g. airline operations centres, air traffic management, air traffic control).

2 CURRENT OPERATIONS AND CAPABILITIES

In today’s environment aviation decision makers receive radioactive cloud information from three products: SIGMET information message, Notice to Airmen (NOTAM), and WAFS SIGWX forecast. In addition, ACCs and MWOs receive the nuclear emergency message. The provision of these products is based on information received from the IAEA, State authorities and/or regional specialized meteorological centres (RSMC). Static data on potential radioactive cloud hazards may also be included in a State’s aeronautical information publications (AIPs).

2.1 Description of current operations

Figure 1 shows the current structure of information flow for a radioactive cloud released into the atmosphere, from the initial notification by the IAEA to the delivery of end products to flight crews.
The arrangements between IAEA and WMO are defined in WMO’s manual on the GDPFS (Global data processing and forecasting system; WMO - No. 485, Volume I, 2010 edition).

Key points are:

1. The WMO community receives information about a nuclear emergency via GTS simultaneously to the national warning center. The WMO RSMCs receive information and a request for modeling from the IAEA concerning the release of radioactive material (dotted box in Figure 1). The RSMCs are responsible for running atmospheric transport and dispersion models, which results in products depicting the radioactive cloud in time and space. Always two RSMCs will provide the harmonized meteorological information.

2. The WMO RSMC products are designed specifically for IAEA and its Member States and are basically focused on the surface / near surface. They have not been designed for aviation.

3. WMO RSMCs products can only be sent to the IAEA and one contact point, i.e. national meteorological and hydrologic service (NMHS), in each State in accordance with existing protocol.

4. The transmission of some information to world area forecast centres (WAFC) and ACCs/FIRs is specified in Annex 3. The London VAAC receives the information from RSMC Exeter (they are co-located) and issues the nuclear emergency message which identifies the FIR affected by the nuclear accident/incident and adjacent FIRs.

   The contact points for the States that host the WAFCs pass on the information and the radioactivity symbol and other details are added on the SIGWX forecasts.

5. The IAEA has its own procedures to inform its Member States of a nuclear accident/incident. This is done outside of the IAEA/WMO arrangements. It is therefore possible that a WMO or ACC could be informed within its State before WMO RSMC products are received by the NMS contact point. This could also be the case in the State where the nuclear accident / incident happens. Add information flow of IAEA/WMO to show that the information about a release of radioactive material will be distributed by WMO/DWD.

6. Given that each State is sovereign and decides on what / how information will flow within its borders, the ConOps addresses only the international aspects of the problem and not local / national aspects.

The WMO RSMCs information is received by the NMHS contact point in each State (right side of Figure 1). It is however the responsibility of each State to decide and make arrange on how and where that information will be distributed (to respect the authority of each State as discussed in the previous section). The information about a contaminated aerodrome should forwarded immediately via the national authority to the MWO. If and when a MWO is notified of an event they have the responsibility under Annex 3 to produce the SIGMET which is disseminated to ACCs / FICs / AISS/AOCs.
The issuance of the SIGMET, particular one that is static in nature, may prompt the issuance of prohibited, restricted, danger areas, or other\(^1\) airspace designations, published by the State AIS provider and available to pilots and aircraft dispatchers.

**Example of a nuclear emergency message from the London VAAC:**

NUCLEAR EMERGENCY  
DTG: 20110315/0300UTC  
ORIGIN: VAAC LONDON  
INFO SOURCE: IAEA  
STATUS: EMERGENCY  
SITE: FUKUSHIMA  
LOCATION: N0037E0141  
START OF RELEASE: 20110315/0300 UTC  
END OF RELEASE: ONGOING  
FIR NAMES: FUKUOKA, MANILA, TAIBEI, SHANGHAI, INCHEON, PYONGYANG, VLADIVOSTOK, KHABAROVSK, YUZHNO-SAKHALINSK, ANCHORAGE.  
FIR CODES: RPHIZRZX, RCAAZQZX, ZSSSYMYX, RKRRZQZX, UHWWZRZX, UHHHZRZX, UHSSZRZX, PAZAZQZX

**Example of a SIGMET**

WSJP331 RJTD 171150  
RJII SIGMET 7 VAALID 1711500/171550 RJII-  
RJII FUKUOKA FFIR RDOACT CLD FCST WI N3714 E14047 - N3709 E14102 - N3714 E14116 - N3725 E14122 - N3737 E14116 - N3742 E14102 - N3737 E14047 - N3725 E14041 - N3714 E14047 STNR INTST UNKNOWN.

An example of radioactivity symbol on SIGWX forecasts is shown in figure 2. Note the symbol and name in the upper right corner of the SIGWX chart. Also note the legend box in the lower left corner of the SIGWX chart which states “CHECK NOTAM FOR RADIATION LEAK”.

In accordance with Annex 15 — Aeronautical Information Services, a NOTAM is issued when a:  
“release into the atmosphere of radioactive materials or toxic chemicals following a nuclear or chemical incident, the location, date and time of the incident, the flight levels and routes or portions thereof which could be affected and the direction of the movement”

The following is an example of a NOTAM:

RJSS SENDAI ()  
B1080/11 - IN ACCORDANCE WITH THE ARTICLE 80 OF CIVIL AERONAUTICS LAW,

---

\(^1\) Annex 15 provides for the use of three of airspace classifications, which are prohibited area, restricted area, or danger area. Some States use additional classifications for airspace, such as “Conditional” and “Temporary Flight Restriction (TFR)”.
FLT PROHIBITED AREA IS ESTABLISHED AS FLW, IDENTIFICATION: RJP1
AREA: WI A RADIUS OF 30KM FM 372529N1410158E
(THE TOKYO ELECTRIC POWER CO.INC. FUKUSHIMA NO.1, OKUMA-FUTABA-CHO FUTABA-GUN IN FUKUSHIMA)
RMK/SEE AIP ENR 5.3-29. SFC - UNL, 15 MAR 02:59 2011 UNTIL PERM.
CREATED: 15 MAR 03:03 2011

Figure 2. Example of the SIGWX forecast.
A radioactivity symbol is placed at the location of the release along with the name of the site.
The SIGWX legend box states to check NOTAM for radiation leak.
2.2 Current supporting infrastructure

The entities that comprise the current supporting infrastructure for the provision of radioactive cloud information are identified in Table 1.

**Table 1:** Current supporting infrastructure entities

<table>
<thead>
<tr>
<th>Entity</th>
<th>Responsibility</th>
</tr>
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<tbody>
<tr>
<td>National nuclear or emergency authorities</td>
<td>Depending on national arrangements (varies from State to State), provides information on releases directly to ACCs and/or MWOs.</td>
</tr>
<tr>
<td>International Atomic Energy Agency</td>
<td>Establishes procedures for notification of nuclear accidents/incidents and requests services from the RSMCs</td>
</tr>
<tr>
<td>World Meteorological Organization’s Regional Specialized Meteorological Center</td>
<td>Produces and disseminates trajectory / integrated air concentrations/deposition forecasts for radioactive materials released into the atmosphere</td>
</tr>
<tr>
<td>Meteorological Watch Office</td>
<td>Issues RDOACT CLD SIGMET product based on trajectory forecasts produced by RSMCs or other sources as available</td>
</tr>
<tr>
<td>World Area Forecast Center</td>
<td>Produces and disseminates SIGWX forecasts with radioactivity symbol for name and location of the incident. Alerts air crew to check NOTAMs.</td>
</tr>
<tr>
<td>Area Control Center</td>
<td>Disseminates RDOACT CLD SIGMET product to flight crews</td>
</tr>
<tr>
<td>NOTAM Office</td>
<td>Issues NOTAM for radioactive cloud for aircraft flight planners and flight crews</td>
</tr>
<tr>
<td>London Volcanic Ash Advisory Center</td>
<td>Issues Nuclear Emergency Message to ACCs and MWOs</td>
</tr>
</tbody>
</table>
2.3 Gap analysis

Table 2 is a high-level analysis of the radioactive cloud information needed versus the information provided.

<table>
<thead>
<tr>
<th>Information needed</th>
<th>Information provided via</th>
<th>SIGMET</th>
<th>NOTAM</th>
<th>SIGWX</th>
<th>Nuclear emergency message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification of a release</td>
<td></td>
<td>No. Issued following receipt of the Nuclear Emergency Message or other notification of a release.</td>
<td>No. Issued following the receipt of the SIGMET.</td>
<td>No. Radioactivity symbol added to the next issuance of a SIGWX forecast (issued 4 times a day) following receipt of the Nuclear Emergency Message, SIGMET or other notification.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Current location and extent of the radioactive cloud</td>
<td></td>
<td>Yes, but is combined with forecast location and does not allow for complex shapes or layers. Existing RMSC products only provide limited or no information on vertical extent.</td>
<td>Provides same information as the SIGMET. May only provide limited or very broad information on vertical extent, e.g., “SFC-UNL” (from the surface to unlimited, e.g., top of the airspace, 60,000 feet)</td>
<td>No. Provide location of the release site but not the extent of the cloud.</td>
<td>No. Provides the location of the release and identifies the FIR and adjacent FIRs.</td>
</tr>
<tr>
<td>Future location and extent of the radioactive cloud</td>
<td></td>
<td>Provides a 4 hour forecast. Does not allow for complex shapes or layers. May only provide limited or no information on vertical extent.</td>
<td>Same as SIGMET.</td>
<td>No.</td>
<td>No</td>
</tr>
<tr>
<td>Notification that the release has ended</td>
<td></td>
<td>No.</td>
<td>No.</td>
<td>No.</td>
<td>No</td>
</tr>
<tr>
<td>Notification that the cloud has dissipated or is not a hazard to aviation.</td>
<td></td>
<td>Yes. SIGMET is cancelled.</td>
<td>Yes. NOTAM cancelled.</td>
<td>Radioactivity symbol removed only when SIGMET is cancelled.</td>
<td>No</td>
</tr>
<tr>
<td>Notification that the aerodrome/airspace affected by the release is safe to operate in or through</td>
<td></td>
<td>Yes. SIGMET is cancelled.</td>
<td>Yes. NOTAM cancelled.</td>
<td>Radioactivity symbol removed only when SIGMET is cancelled.</td>
<td>No</td>
</tr>
</tbody>
</table>
3 DESCRIPTION OF CHANGES

There are two key changes proposed for the provision of the service. First is the information source chain and the second is how the information is to be provided. Instead of the MWOs being the producer of an information product (i.e. SIGMET), all relevant information on the radioactive cloud should reside on a common information sharing platform, produced and populated by regional or world centre(s), and integrated into decision support systems. In other words, text-based products should be replaced by an information management environment in support of decision support system.

3.1 Short-term changes

MWOs face many challenges in providing SIGMETs as the current Annex 3 requires. To date little, or conflicting, guidance is available to assist in the decision to issue a SIGMET as well as how to determine the area of the SIGMET. If the MWOs are to continue with the responsibility to provide the SIGMET for a radioactive cloud, they must be provided with adequate and clear guidance for issuance of that SIGMET, as well as when the SIGMET is to be cancelled. Section 6.2 of this ConOps provides an example of the possible guidance.

3.2 Long-term changes

Long-term changes are described in section 4. Apart from this, it is mandatory to prepare a contingency plan similar to volcanic ash in the airspace. This contingency plan however always has to take into consideration state emergency plans.

4 PROPOSED RADIOACTIVE CLOUD INFORMATION SERVICE CONCEPT

The proposed mid to longer term concept is to produce and disseminate accurate and timely radioactive cloud information for all affected aviation decision makers during all phases of a release of radioactive material event in a format that best supports international air navigation. A release of radioactive material event includes the following phases:

1. Initial release of radioactive material into the atmosphere.
2. Transport of the radioactive material away from the source.
3. Dissipation of the radioactive cloud.
4. Return to a safe or acceptable level of radioactive material efflux at source

The radioactive cloud information that should be provided under the proposed service will most probably be based on:

- The activity concentrations, the total effective dose rate from cloudshine and inhalation in the atmosphere calculated by atmospheric transport and dispersion modeling using actual
or realistic default (if actual are unavailable) source term values (the total effective dose may then be calculated or related to measures on the ground)

- and identification of the area, in three dimensions (latitude, longitude, and altitude) and in time, where the activity concentration or if given the total effective dose rate exceeds a yet to be determined threshold value. Discussions are under way to define that threshold value.

The information should be appropriate for integration into flight planning systems, flight management systems (FMS), and other decision support tools, such as those used for air traffic flow management. The information should be updated periodically (e.g., every 6 hours) based on updated information regarding the release site (e.g., nuclear power plant), changes in atmospheric transport and dispersion modeling output, and Numerical Weather Prediction forecasts. Until text and graphical products are no longer required, the corresponding graphical and text products that depict and describe the latitude, longitude, base, and top of the radioactive cloud with a clearly indicated valid time should be produced. These graphic and text products should replace the current SIGMET and provide the basis for the NOTAM that informs on the airspace affected by the radioactive cloud.

4.1 Assumptions and Constraints

The proposed service for the provision of radioactive cloud information is based on the following assumptions:

- Information about the release of radioactive material is received by IAEA and passed on to appropriate agencies.
- Information about the source term is received by IAEA and passed on to RSMCs via the GTS/WIS of WMO to be used for dispersion calculations.
- The availability of aircraft based measurements of radioactivity in relevant flight levels would be very welcome for the provision of radioactive cloud information and for verification of dispersion modelling. Measurements are however not likely to be available in a timely manner. It should however be noted that measurements at the surface would not provide information on the level of radioactivity in the atmosphere for aircrafts en route.
- Text and graphic based forecasts should serve as an immediate interim solution for the end-users until digital information can be used by appropriate decision support tools and be made available. For this intermediate period:
  - The SIGMET could be replaced by appropriate and authoritative graphical and text products that better meet the operational needs of aviation decision-makers.
  - These products could be produced by a regional centre (WMO/RSMCs and other capable centres e.g. of CTBTO) and would provide the information on a contaminated area without constraints on State and regional borders and boundaries.
  - The following constraints may impede the implementation of the proposed concept:
    - Lack of agreement on threshold levels for total effective dose rate;
    - Lack of agreement on threshold levels for activity concentrations of radionuclides;
    - Lack of agreement on entity to produce and disseminate radioactive cloud information;
    - Lack of capability to provide digital radioactive cloud information in a format that can be ingested by DSTs;
    - Lack of capability to use digital radioactive cloud information in DSTs;
4.2 Operational Environment

Radioactive cloud information should reside on a common information sharing platform, produced and populated by regional or world centre(s), to be integrated into decision support systems.

4.3 Operations

Tables 3, 4 and 5 describe the decisions made by users of radioactive cloud information. It should be noted that even though these tables list decisions made by aerodrome operators, this ConOps only addresses the international aspects of the problem with respect to airborne radioactivity. Individual States have full authority to define their own arrangements and procedures on how to deal with airborne radioactivity within their boundaries, including how to deal with the deposition of radioactivity at the surface or contamination of aircraft once it lands.

4.4 Operational Requirements

- Need prompt notification of a release.
- Need to know if release and any associated cloud are a hazard to international air navigation.
- Need to know what aerodromes and airspace are affected by the release and associated cloud.
- Need to know when the release has ended and that the cloud has dissipated.
- Need to know when the aerodrome/airspace affected by the release is safe to operate in or through.

Need to know information about the three-dimensional extent of the radioactive Cloud

Need to know measurement results of the activity concentration and/or gamma dose rate in the atmosphere and on the ground.
4.5 Supporting Infrastructure

In the near-term, the information on radioactive materials will still be product centric and be produced by humans in traditional alphanumeric text along with a graphical image. Production of these products are would migrate from the MWO to a regional or global centre(s).

These are only examples of possible actions. Decisions will vary from State to State as they are a national responsibility.

In the long-term, all relevant information on the radioactive materials will reside on a common information sharing platform, produced and populated by regional or world centre(s).

4.6 Benefits to be realized

Short-term benefits can be realized by developing guidance material for radioactive cloud SIGMET, specifically when to issue, when to cancel, how large or small should the volume be, and when to increase or decrease the SIGMET area.

Long-term benefits will be realized when information on radioactive material is digitized and integrated into decision support systems. Moving from a product centric environment to an information centric environment will meet the future operational needs of aviation decision-makers.

5 REQUIREMENTS

5.1 Functional requirements

The following are an initial set of functions:

• Receive prompt notification of a radioactive material release.

• Determine if the radioactive cloud is a hazard to aviation (i.e. does it exceed acceptable threshold for effective dose rates?). (This takes time and requires information about the source term)

• Determine the current location and three-dimensional extent of the radioactive cloud.

• Forecast the future location and extent of the radioactive cloud.

• Determine aerodromes and/or airspace impacted by the release and radioactive cloud.

• Receive notification of when the release has ended.

• Determine when the cloud has dissipated.

• Receive notification that the aerodrome/airspace affected by the release is safe to
operate in or through.

5.2 Performance requirements

Development and agreement on up-to-date guidance material to set-up a global warning system and improve timeliness and accuracy of warnings via SIGMETs and chart information on contaminated regions

Guidance requires consideration of two phases in the course of the release of radioactive material into the airspace:

1. Reactive phase – Once notified of a release, a start of event SIGMET should be issued with a polygon describing the area as given in Memo/64.
2. Proactive Phase – Subsequent SIGMETs should rely on dispersion modeling coupled with any other information the forecaster receives. For an ongoing event the area outlined in the SIGMET could be both the circle centered on the release location and the downwind.

Guidance material generally requires

- Decision on content of warnings
- Decision on assumption regarding source term and related timely information via IAEA
- Decision on absolute and/or relative information on radioactive contamination
- Decision on activity and/or dose information

5.2.1 Existing performance requirements

Current performance requirements are contained in Annex 3. For the provision of the SIGMET information message and the inclusion of the radioactivity symbol on the SIGWX forecasts, the following metrics apply:

- SIGMETs issued every four hours and valid for four hours.
- SIGWX forecasts issued every six hours with a validity time of 24 hours.
- Chart information on contaminated regions without common agreement on related assumptions on the source term

5.2.2 New performance requirements

In the short-term, should a guidance product be developed such as is shown in section 6.2, it would likely need to issue every four hours to match the SIGMET issuance. Should such guidance product be issued on a six-hourly basis (to align with numerical weather prediction model cycles), consideration would need to be given to changing the validity time of the SIGMET to six hours.

Long-term performance metrics are yet to be developed. This step will require input from the decision makers, the science community as well as the information providers.
6 OPERATIONAL SCENARIOS

6.1 High-level example

The following is a high level example of how information on a radioactive material release into the atmosphere might be provided in the future. The scenario is provided in bullet form.

- Release occurs.
- IAEA notified of release by officials from State.
- IAEA notifies simultaneously all States, the Meteorological Institutions, and the RSMCs via DWD (GTS or WIS) and also the MWOs in order to avoid time delays for immediate warnings.
- State of NPP notifies ACC and/or MWO directly.
- Regional or world centre service provider runs atmospheric transport and dispersion models using information from IAEA. If Information about the source term is available, the expected dose may be estimated.
- Information on the release, current and forecast location of the cloud are populated on a common information sharing platform for decision support.
- Affected ACCs, national and regional ATM centres, aerodromes, AOCs are notified of the release and associated cloud and begin to use the information from the common information platform.
- Pilots are notified (by an automated system) of the release and cloud.
- Airline dispatchers and flight planners make appropriate changes to flights en-route and planned flights.
- Updated information continue to be populated on the common information sharing platform provided by the regional or world center until such time the release ceases and the cloud dissipates or reaches an acceptable level.
- Return to normal operations once affected aerodrome/airspace determined safe to operate in or through.

6.2 Guidance example

The following is an example of guidance information that could be provided to MWOs for the issuance of a SIGMET for a radioactive cloud. This example is modeled after the provision of information for volcanic ash in Annex 3. The volcanic ash advisory (VAA), in both text and graphic, is created by a volcanic ash advisory centre (VAAC). Similarly a designated national meteorological centre (perhaps the RSMCs), could produce an equivalent product for a radioactive cloud. This product could have the same format of the VAA and be known as a radioactive cloud advisory. The centre would produce a text and graphic version of the advisory. An example of an advisory is shown below:

FXX20 KWNO 042118
RDOACT ADVISORY
DTG: 20100804/2100Z
(Issuing Center, example): NCEP WASHINGTON
RDOACT RELEASE: PEARL HARBOR HI  
LOC: N2121 W15759  
AREA: HAWAIIAN ISLANDS  
RELEASE ELEV: UNKNOWN BUT ESTIMATED AT FROM NR SFC TO 500 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 +4HR: 05/0100Z SFC/080 N2122 W15755 - N2117 W15749 - N2058 W15815 - N2114 W15832 - N2122 W15755  
RMK: ESTIMATED OBS AND FCST POSITIONS BASED ON INCOMPLETE INITIAL RELEASE DETAILS AND HYSPLIT MODEL. NOTE THAT IT IS IMPOSSIBLE TO DETECT RADIOACTIVITY WITH SATELLITES IRRESPECTIVE OF CLOUD CONDITIONS  
NXT ADVISORY: 20100805/0100Z  
The MWOs receiving the advisory information could either prepare the RDOACT SIGMET using the coordinates from the advisory, or simply issue a SIGMET that says to refer to the advisory for information on the cloud.  
REFERENCES  
To be added as required.  
— END —  

7 Acronyms and Terminology  

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AFS</td>
<td>Aeronautical fixed service</td>
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<tr>
<td>AFTN</td>
<td>Aeronautical fixed telecommunication network</td>
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<tr>
<td>AIXM</td>
<td>Aeronautical Information Exchange Model</td>
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<tr>
<td>AMD</td>
<td>Amendment</td>
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<tr>
<td>AMHS</td>
<td>ATS Message Handling System</td>
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<tr>
<td>AMO</td>
<td>Aerodrome Meteorological Office</td>
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<tr>
<td>AoR</td>
<td>Area of responsibility</td>
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<tr>
<td>COM</td>
<td>Communication</td>
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<tr>
<td>CONOPS</td>
<td>Concept of operations</td>
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<tr>
<td>DB</td>
<td>Databank</td>
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<tr>
<td>FAQ</td>
<td>Frequently asked questions</td>
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<tr>
<td>FASID</td>
<td>Facilities and services implementation document</td>
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<tr>
<td>FIR</td>
<td>Flight information region</td>
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<td>FIXM</td>
<td>Flight Information exchange Model</td>
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<td>FTBP</td>
<td>File Transfer Body Parts</td>
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<tr>
<td>GML</td>
<td>Geography markup language</td>
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<td>I/R</td>
<td>Inter regional</td>
</tr>
<tr>
<td>IA-5</td>
<td>International Alphabet nr. 5</td>
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<tr>
<td>IAoR</td>
<td>Interregional area of responsibility</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<td>---------</td>
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<tr>
<td>ICAO</td>
<td>International Civil Aviation Authority</td>
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<td>ICD</td>
<td>Interface control document</td>
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<td>IROG</td>
<td>Interregional OPMET Gateway</td>
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<tr>
<td>IWXXM</td>
<td>ICAO Meteorological Information Exchange Model</td>
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<td>METAR</td>
<td>Meteorological Aerodrome Report</td>
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<td>MTA</td>
<td>Message transfer agent</td>
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<td>National OPMET Centre</td>
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<td>OGC</td>
<td>Open Geospatial Consortium</td>
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<td>OPMET</td>
<td>Operational Meteorological information</td>
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<td>Regional OPMET Centre</td>
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<td>RODB</td>
<td>Regional OPMET Databank</td>
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<td>RODEX</td>
<td>Regional OPMET Data Exchange model</td>
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<td>Meteorological databank request in TAC-format</td>
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<td>RQX</td>
<td>Meteorological databank request in IWXXM-format</td>
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<td>SIGMET</td>
<td>Significant Meteorological Information</td>
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<td>SPECI</td>
<td>Special meteorological report</td>
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<td>SWIM</td>
<td>System Wide Information Management</td>
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<td>TAC</td>
<td>Traditional Alphanumeric Code form</td>
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<td>TAF</td>
<td>Aerodrome forecast</td>
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<tr>
<td>TCA</td>
<td>Tropical Cyclone Advisory</td>
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<tr>
<td>VAA</td>
<td>Volcanic Ash Advisory</td>
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<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
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