

WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

**MEETING OF CBS COORDINATION GROUP
FOR NUCLEAR EMERGENCY RESPONSE ACTIVITIES
(NERA)**

BEIJING, CHINA, 24-28 MAY 2010



FINAL REPORT



*(Back row) M. Sakamoto, H. Glaab, J. McQueen, YH. Duan, P. Chen, H. Zhou, L. Wei, ZX Song
(Front row) L. Perron, A. Muscat, R. Servranckx, G. Winkler, G. Wotawa*

Executive Summary

The meeting of the Coordination Group on Nuclear Emergency Response Activities took place at the National Meteorological Centre of the China Meteorological Administration, Beijing, China, 24 – 28 May 2010, under the chairmanship of Mr René Servranckx (Canada).

The RSMCs with Activity Specialization in Atmospheric Transport Modelling, and RTH Offenbach, presented the status of their respective implementations in relation to the Regional and Global Arrangements, which have been maintained in collaboration with IAEA. In particular the meeting concluded that mirrored Web sites will be further developed, implemented and maintained, the quarterly exercises be maintained, the plan for migration from facsimile distribution of products to electronic means (e-mail and Web-based) developed at the meeting will be implemented, and work will continue on ensemble methods and the “plume time of arrival products”. The meeting reviewed sections of the outdated WMO TD.170 relevant to nuclear emergency response, and agreed that much of these are no longer correct or useful. The RSMCs and CTBTO noted the full functioning of the joint ATM-backtracking response system with CTBTO. As well CTBTO informed the meeting of its wish to modernize its ftp server to a new data uploading system and to change its technical requirements for backtracking (increased duration of backtracking, and increased spatial resolution). The meeting reviewed and agreed to its Terms of Reference with no change.

The meeting reviewed the supporting information provided by the representative of Austria for its nomination of NMC Vienna to be considered at CBS for designation as a RSMC – ATM-backtracking, and agreed that the nomination is meets the designation criteria.

The meeting developed a proposed amendment to the Manual on the GDPFS, including the addition of 24-hour and 48-hour surface deposition charts to the basic set of products, and the inclusion of RSMC Vienna as an RSMC – ATM-backtracking.

The Coordination Group’s List of Actions was updated.

1. OPENING OF THE MEETING

1.1 The Meeting of the CBS Coordination Group on Nuclear Emergency Response Activities (ERA) was opened by the group's chairperson; Mr René Servranckx (Canada), at 9:30 a.m. on Monday, 24 May 2010 at the National Meteorological Centre of the China Meteorological Administration (CMA), Beijing, China. Dr Duan Yihong, Director-General of the National Meteorological Centre CMA, Dr Zhou Heng of the International Cooperation Department, Dr Wei Li, Deputy Director of Forecasting and Information Department CMA, and Dr Song Zhenxin, Deputy Chief, Division of Operational Management and Research and member of the Coordination Group, welcomed the meeting. Remarks were made by Dr Zhou, and by the WMO Secretariat on behalf of the WMO Secretary-General.

1.2 In his welcome, Dr Zhou highlighted the current significant contributions to the activities of WMO, including that of RSMC Beijing within the ERA programme, and for example, its exhibition at the Shanghai Expo 2010, and in the current development of the Global Framework for Climate Services.

1.3 The Secretariat recalled the ERA programme is part of the Global Data-Processing and Forecasting System (GDPFS) whose main goal is to assist NMHSs, along with other relevant agencies of Member countries, and in close collaboration with relevant international organizations, assisting them all to respond effectively to environmental emergencies. The ERA programme contributes to the WMO's strategy for Disaster Risk Reduction.

1.4 The 15th World Meteorological Congress (May 2007), and since then, Executive Council, and CBS have continued to recognize the importance of maintaining the operational capabilities of RSMCs that support emergency response in the case of nuclear accidents and radiological emergencies. The WMO recognizes that operational Atmospheric Transport Modelling, closely integrated with operational NWP systems, has an important function to play in "emergency" situations where people, property, and the environment could suddenly be placed in immediate risk. Over the last 10 years, while many more NMHSs have implemented atmospheric transport modelling within their operational NWP systems; the role that RSMCs play continues to be very relevant and important.

1.5 In nuclear environmental emergency response, WMO continues to work with its main international partners – IAEA, ICAO, CTBTO – to ensure that the established Operational Arrangements are well functioning and continue to meet the needs that have been identified by, and coordinated through the relevant International Organizations. The coordination should assist NMHSs to better deliver specialized services to meet their respective national requirements for nuclear emergency response.

1.6 Finally the Secretariat acknowledged the hard work and leadership of the Chairperson, Mr René Servranckx of RSMC Montréal, Canada.

2. ORGANIZATION OF THE MEETING

2.1 The Meeting approved the agenda, found in Annex 1.

2.2 The Meeting agreed on the details concerning the organization of its work including the working hours.

2.3 Documents submitted by the participants, have been posted on the WMO Web page, at:

<http://www.wmo.int/pages/prog/www/BAS/CBS-meetings.html>

linked to the banner for the meeting.

2.4 The Chairperson informed the meeting that there was no representative of RSMC Melbourne and RSMC Obninsk at this meeting. As well there was no representative present from CTBTO, ICAO, and WHO. However the representative of CTBTO joined the meeting by telephone conference for items related to cooperation with CTBTO. Documents have nevertheless been submitted by RSMC Melbourne, RSMC Obninsk, CTBTO, and ICAO.

2.5 The list of participants is found in Annex 2.

3. INTRODUCTION / REPORT OF THE CHAIRPERSON

3.1 The Secretariat provided background related to outcomes of the Fifteenth World Meteorological Congress (2007), and then particularly focused on Commission for Basic System (CBS.XIV (2009), Management Group (2010), and Executive Council, relevant to the ERA. It was noted that the next session of CBS will take place in November 2010.

3.2 The Chairperson reviewed the progress made relative to actions from its previous meeting. The meeting agreed to continue to maintain a record of progress and to carry forward this list of actions, including adding new actions that have been identified from this meeting. The updated actions (2010) for the Coordination Group are found in Annex 3.

3.3 The Chairperson reminded the meeting that its Terms of Reference, confirmed at CBS-XIV (2009) will be reviewed and the reviewed (revised) version is included in the report, and found in Annex 4.

4. STATUS OF IMPLEMENTATION / ACTIVITIES RSMCs / RTH OFFENBACH / IAEA

4.1 Representatives of the all RSMCs, RTH Offenbach, and IAEA provided their respective reports of the status of their operations in relation to the WMO Regional and Global Arrangements and in relation to the joint backtracking response system for CTBTO, including RSMC products, dissemination, coordination of their respective responsibilities, emergency incidents, routine exercises, etc.

4.2 All parts of the operational Regional and Global Arrangements have been well maintained by the RSMCs, RTH Offenbach, and IAEA, through ongoing work, improved NWP systems, exercises, and the experiences from a few real incidents, for example common Web pages, quarterly tests.

4.3 While all RSMCs participated in the planned quarterly exercises, it is desirable that they exercise the operational procedures within their respective Regions of responsibility on a monthly basis, as it is done by RSMCs in RA IV and RA V. Some RSMCs have joined the monthly tests that are led by RSMCs in RA IV and RA V.

4.4 The meeting noted that for some Regions, that process of composing a Joint Statement in English presents a special problem in communication, and could be a source of long delays in its completion.

4.5 The meeting noted that the success rate of RSMC fax transmissions to operational NMHS contact points continues to be generally very low. It also noted that the number of WMO Members that have provided official contact points could be increased, even as plans for transition to email distribution of products move forward. As well, the IAEA could advise on which Members have National Contact Points under the two International Conventions (Early Notification, and Assistance) on nuclear emergencies.

4.6 The annual status reports of the RSMCs and RTH are one method of assuring the maintenance of the Nuclear ERA system, and the performance of each of the components of the Regional and Global Arrangements. The report will be posted on the WMO ERA programme Web pages.

4.7 The meeting noted that the operational availability of radiological monitoring data for use in RSMC operational environment (CBS-XIV, term of reference (d) for nuclear ERA) is very difficult to attain. These data may be available to some NMHSs, depending on the national arrangements with their radiological monitoring authorities. However, these are generally not passed on to or available at RSMCs. The meeting noted that NMHS should be encouraged to strengthen their contacts with radiological monitoring authorities and explore the possibility of making radiological data available to the RSMCs during an incident.

IAEA Report

4.8 IAEA reported on the results of the ConvEx-3 (2008) exercise, and the remedial actions that have taken place at the IEC to improve on the performance of established procedures.

4.9 IAEA proposed the following quarterly exercise calendar for the remainder of 2010, 2011 and 2012:

Quarterly exercises with RSMCs (always on the 3rd Thursday of the month)

2010

August	Exeter, Toulouse
November	Beijing, Obninsk, Tokyo (18 th Nov., also date of ConvEx-2C)

2011

February	Melbourne
May	Exeter and Toulouse
August	Beijing, Obninsk and Tokyo
November	Washington and Montreal

2012

February	Exeter and Toulouse
May	Beijing, Obninsk and Tokyo
August	Washington and Montreal
November	Melbourne

4.10 The meeting noted that some significant offsets exist between the coordinates of the NPPs shown in the PRIS database compared to Google Earth for example. The IAEA will evaluate the possibility of providing an updated database with more detailed coordinates to the RSMCs.

4.11 The Secretariat confirmed that the new form for IAEA request for RSMC products, which were recommended at the last meeting of the Coordination Group have been approved for inclusion in the Manual on the GDPFS (update 2010), and is now in effect. IAEA is requested to distribute this new form to all RSMCs for immediate implementation.

5. IMPROVED PRODUCT DISTRIBUTION / ACCESS METHODS

5.1 The meeting reviewed the status of the implementation of the RSMC mirrored Web sites and concluded that good progress has been made in the posting of RSMCs' outputs on existing mirrored Web sites. Current sites include those of RSMCs Montreal, Washington, and Melbourne. RSMC Beijing's mirrored Web site is temporarily closed for upgrades. In

addition to the above, RSMCs Tokyo, Obninsk, and Toulouse have in the past posted their products on the mirrored sites during scheduled exercises.

5.2 The meeting re-confirmed that all RSMCs should, where local policy permits, a) implement the mirrored Web site, and b) FTP their RSMC products to all existing mirrored Web sites. Established standard methods should be used.

5.3 IAEA would eventually be ready to receive RSMC products, when its new Web site is ready. IAEA will let RSMCs know when it is ready, and provide technical details for the FTP transfer, at the same time as FTP transfers take place to mirrored Web sites.

5.4 Since the last meeting, the mirrored Web sites has seen the addition of a link to “meta-data” for each RSMC via a “All Products” button. The concept was to create a clickable link that would take the user to a listing of additional RSMC model products that could include, as examples, higher resolution images, Google Earth output, and GRIB products. This concept would allow the RSMCs to post additional products that would not fit in the standard mirrored Web pages. The contents of the meta-data link are dynamic such that a directory listing link is created for each event. Each RSMC would add additional products to the directory as needed and create new directories for prolonged events or situations that require many products that are updated frequently. Each RSMC would post the additional products to their own mirrored Web site, and the link on the mirrored Web site points to that RSMC’s server for the additional products.

5.5 The meeting agreed that there needs to be a mechanism to “clear” the standard products posted on the mirrored Web sites, such as blank images when the posted products are no longer needed or too old.

5.6 The RSMCs agreed to test FTP transfers of their products to all existing mirrored Web pages as soon as possible.

5.7 The meeting expressed its appreciation to Mr Glenn Rolph (RSMC Washington) for his long-standing support in the development and implementation of the RSMC mirrored Web sites.

6. RSMC PRODUCTS AND SERVICES FOR NUCLEAR EMERGENCIES

6.1 The meeting reviewed the status of the maintenance of contact information, various relevant Web pages, notification/communication, and participation and planning of exercises relevant to the RSMC Arrangements, and concluded that many aspects are in general functioning acceptably. All RSMCs are encouraged to continue regular exercises of operational procedures, including participating in planned exercises.

6.2 The meeting noted that CBS-XIV (2009, paragraph 6.3.39) had recommended to migrate from fax distribution of RSMC products to using e-mail/Internet distribution, through a clear implementation plan. Members will be asked to agree to e-mail distribution as the operational method, with fax as back-up. Members could decide to continue with fax by exception.

6.3 The meeting agreed in the following steps:

1. WMO, via circular letter from Secretary-General, to request all Permanent Representatives to provide confirmation or nomination of contacts for its Delegated Authority, and for its Operational NMHS Contact Point, including name, title, telephone and fax number, and only one operational e-mail address (deadline of 3 months); WMO to provide RSMCs with all replies;

2. RSMCs will commence testing e-mail distribution within their respective Regions of responsibility, and contact those Members that have not replied to the circular letter (deadline of 2 months); RSMCs to provide updated lists to WMO;
3. WMO and RSMCs, in consultation with IAEA decide additional measures to obtain additional replies from Members (deadline of 1 month); WMO to provide updated lists to RSMCs and to update all contact information on the WMO ERA Web pages.

6.4 The meeting agreed that it is highly desirable to only admit official NMHSs' operational e-mail addresses, however at the same time noted that many NMHSs only have less secure commercial or freeware, and personal Web mail accounts. The meeting recognized this problem however the meeting did not feel a suitable solution is available.

7. REVIEW OF REQUIREMENTS FOR RSMC PRODUCTS / SERVICES

7.1 The IAEA Secretariat briefed the meeting on the outcomes and relevant follow-up from the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies (2004-2009). The final Action Plan report, which is a high level strategy, was submitted to the Deputy Director General (DDG) of the Department of Nuclear Safety and Security for review, and will also be reported to the Board of Governors of the IAEA. The IEC considers implementing of any of the relevant outcomes of the Action Plan's technical findings and recommendations in relation to RSMC products, i.e. Action Plan's Working Group "B.5".

IEC's review of user requirements

7.2 Considering an emergency at a nuclear power plant, the most important new RSMC product to be evaluated would be one that displays the plume arrival time at a given location. The reference level for the airborne concentration of a radionuclide will be determined by IEC. The meeting agreed to continue to explore with different parameters and formats for such charts, including for the forecast time-range of the standard products, and for longer time ranges up to 10 days. See additional considerations and conclusions below under the subtitle "Plume Time of Arrival Products".

7.3 The recent exercise has shown that the introduction of a cut off limit in the chart for time-integrated air concentrations and also for deposition concentrations would be a benefit the presentation of the information for certain scenarios.

7.4 The meeting agreed to a lower cut off limit for integrated air concentrations of 10-20 Bq.s/m³, and for total deposition 10-20 Bq/m². This specification is proposed as an amendment to the Manual on the GDPFS, and is included in section 9 of this report.

7.5 The display of the time-integrated air concentrations and total deposition should be improved by using, for a particular set of maps, the same colour for a specific contour interval. Therefore additional colours will be used on consecutive maps (e.g. t+48 hours and t+72 hours) as different concentration or deposition values become applicable.

7.6 The meeting noted that while the present requirement for RSMC products only includes one total deposition chart at t+72 hours, many RSMCs are already producing and making available total deposition charts for t+24 hours and for t+48 hours. The meeting agreed to propose an amendment to the Manual on the GDPFS to include the two additional charts in the standard products (see section 9 below). All RSMCs are requested to confirm their agreement to this proposed amendment by the end of June 2010.

7.7 IAEA would welcome products in a geo-referenced format, preferably shape files, KML, or other file formats (with suitable viewer). These could be posted in the "All Products" pages of the mirrored Web sites.

7.8 As one of the users of RSMC products, IAEA/IEC has noted an improvement in the recent exercises concerning the content of the Joint Statement. Most liked was when a description of the meteorological situation in general terms was included as this helps the understanding of the situation. Differences in the models' results should be noted and clarified by statements about the model performance on a particular atmospheric processes (e.g., washout). The statements should be kept concise, to permit its earliest availability.

Perspective of NMC Vienna

7.9 Dr Gerhard Wotawa presented the emergency response process of the NMC Vienna in the case of a radiological emergency, to provide the context for understanding its requirements for RSMC products. He also noted a very close working relationship with the well functioning Austrian Department for Radiation Protection.

7.10 NMC Vienna would find it useful if:

1. RSMC products could include ensemble products to account for uncertainties;
2. RSMC ATM outputs be made available and exchanged in digital form;
3. Deposition calculations could be improved.

7.11 In an initiative to update emergency procedures of NMC Vienna, a major new element will be the operational provision of predicted Source-Receptor-Sensitivity Fields (ATM – backtracking) for 10 key locations corresponding to radiation measurement sites.

Perspective of NMC Offenbach

7.12 Mr Hubert Glaab noted that the situation in Germany is much the same as in Austria. He noted that plume arrival times, uncertainty of dispersion calculations, inclusion of precipitation data and analyses into deposition calculations, and near-field modelling would all be useful additions to RSMC products.

“Plume Time of Arrival” Products

7.13 The following considerations were made to explore Time of Arrival products.

7.14 It is important to use a threshold criteria, which means that the plume has actually arrived. From one observator's point of view, the “plume arrival” should be measured as clearly different from the background concentration variations. Therefore runs need to use a reasonable source term and a reasonable threshold criteria.

7.15 A “time of arrival” product should;

1. forecast arrival times out to +72 hours (or more, a range of 72 to 120 hours can be explored with the current RSMCs deterministic dispersion models)
2. could use time integrated air concentrations averaged between 0-500 m, whoever, the integration period is not yet determined. The integration period will be determined with the calculation of the threshold value. Another possibility is to use air concentration.
3. show a contour line for every 12-hour interval.

7.16 The IAEA will determine the threshold value. The value will be determined based on adequate measurements methods for the determination of plume arrival. However, the IAEA will provide a value in the appropriate units for time-integrated air concentrations or in terms of air concentrations.

7.17 Longer term products should be further explored but should reflect the uncertainty of longer forecast range. A possibility for this is the use of ensemble products of all RSMCs or other ensemble dispersion modeling.

7.18 RSMCs which will run time of arrival products are requested to provide the following information:

1. Air layers used for averaging
2. Source term used
3. Threshold criteria used
4. Time average value of the parameter

8. COOPERATION WITH CTBTO, ICAO

CTBTO

8.1 The meeting expressed its appreciation to the representative of the Provisional Technical Secretariat of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Dr Monica Krista, who was able to join the meeting by teleconference to present and discuss its papers under this agenda item only. Dr Krista provided a comprehensive background on the collaboration with WMO on the ATM-Backtracking (Level 5 response system), including a history of tests and exercises.

8.2 The meeting was informed that the CTBTO radionuclide analysis software shall be replaced in 2010. No significant change to the frequency of Level 5 detections is expected.

Meteorology and the infrasound detection technology

8.3 Detection of infrasound constitutes one of the four pillars of the CTBTO verification regime. Detecting capacities are strongly affected by the spatial and temporal evolution of the atmospheric specifications such as wind and temperature. For the needs of developing and assessing these capacities, the CTBTO has introduced the semi-empirical G2S-ECMWF model which merges ECMWF wind and temperature profiles with high altitude (up to about 170km – 1.7432 10⁻⁶ hPa) HWM07 [Drob, 2008] and NRLMSISE-00 [Picone, 2003] empirical models. The CTBTO is currently pursuing research on infrasound wave propagation taking into account the atmospheric complexity, and working on integrating near real-time atmospheric specifications in operational daily analysis.

Modification of the current technical solutions at CTBTO

8.4 CTBTO is currently modernizing its ftp server. In order to meet strict security requirements CTBTO will be using a content management system (Alfresco). All the cooperating RSMCs will be invited to install and test a new upload mechanism. A successful accomplishment of those tests followed by a unanimous technical approval by all the participants will be required before the switch to the new mechanism shall take place. Further details and documentation will be communicated by CTBTO in due course.

8.5 CTBTO intends to take better advantage of the resolution of the meteorological fields provided by the ECMWF, i.e. to replace the current resolution of 1°x1° with 0.5°x0.5°. At present it is investigating hardware solutions enabling operational computation and storage of the SRS fields with the enhanced resolution.

Actions proposed by CTBTO

8.6 CTBTO intends to test the modifications to the current upload mechanism. It will thus require from the RSMCs installation of its new upload scripts and subsequent testing. It is hoped that RSMCs could accomplish the entire process in 2011. Based on this information, the meeting noted that no amendment is required for the Manual on the GDPFS at this time.

8.7 The CTBTO would like to assess the feasibility of submitting notifications for Level 5 support in a period of four weeks after the end of the sampling time and also assess the feasibility of requesting the SRS fields three weeks backwards in time counting from the end of the sampling time. In these rare cases (at most once or twice a year) the meteorological

centres would be expected to have 7 weeks of meteorological data available. The meeting informally responded that any expanded ATM-backtracking requirement that exceeds the current requirements, as included in the Manual on the GDPFS, could only be performed on a more relaxed turn-around time, such as 3 or 4 days. The RSMCs are requested to confirm the feasibility of undertaking the expanded requirements and respond to CTBTO (copied to the Chair and Secretariat), by end of June 2010.

8.8 All RSMCs are requested to investigate the feasibility of the RSMCs performing computations of the SRS fields with the enhanced resolution of $0.5^{\circ} \times 0.5^{\circ}$. CTBTO will make a formal request to RSMCs for this information.

Transmission of CTBTO International Monitoring System Radionuclide stations' meteorological data on the WMO GTS/WIS

8.9 In 2002, the CTBTO PTS began e-mail transmission of meteorological data from its International Monitoring System (IMS) radionuclide stations to the Canadian Meteorological Centre (CMC)/RSMC Montreal, to foster cooperation between CTBTO / WMO by making the data available to WMO Members. The participation of CMC established a "proof of concept" of this cooperation and in practical terms, set up transmission of the CTBTO meteorological data on the WMO GTS (which is evolving into the WMO Information System, WIS).

8.10 At the time, the data transfer included the encoding of CTBTO data to WMO MOBIL SYNOP format, done by CMC, and transmissions to the GTS began on 6 June 2002 using headers SNCN19 CWAO. At that time, data from 10 stations were being transmitted. Data from over 50 IMS/RN stations are now being transmitted.

8.11 In the past 2 years WMO Members have shown a great interest in using these data in real-time for their objective analysis and numerical weather prediction systems. Some National Meteorological and Hydrological Services (NMHS), including NOAA's National Weather Service and the UK Met Office, have asked for more information, including the precise station elevations, an important parameter for NWP data assimilation.

8.12 CTBTO noted the increase in interest by WMO to use the meteorological data from IMS/RN stations, and is willing to work on developing new data transfer solution. Dr Gerhard Wotawa (NMC Vienna) agreed to investigate the possibility with CTBTO and RSMC Montreal to develop a new data transfer process that would result in a robust real-time fully supported 24/7 system to ensure timely delivery and quick resolution of problems, such as those cited by RSMC Montreal. A plan will be developed thereafter, coordinated by the Chair.

Proposal for designation of NMC Vienna as RSMC for Atmospheric Transport Modelling – Backtracking

8.13 The Secretary-General of WMO received correspondence from Austria wherein it was indicated that Austria is prepared to seek a WMO designation of its NMC Vienna to become an RSMC in Activity Specialization in Atmospheric Transport Modelling / backtracking.

8.14 The meeting was informed of the status of NMC Vienna's implementation of the necessary systems to conduct and participate in the joint CTBTO-WMO Backtracking response system, and agreed to fully support the proposal for the designation of NMC Vienna as RSMC Vienna for this Activity Specialization. NMC Vienna agreed to prepare the necessary documentation for CBS-Ext.(10) to support this proposal.

8.15 The NMC Vienna agreed to prepare its first Annual Status Report for 2009, and up to the present, for posting on the WMO ERA Web site.

8.16 A proposal for an amendment to the Manual on the GDPFS in this regard is included in Section 9 of this report.

ICAO

8.17 The International Civil Aviation Organization (ICAO) informed the meeting about the enhancement of procedures that will be applicable as of 15 November 2010. After an IAEA notification concerning the release of radioactive material to the atmosphere, information will be transferred to Area Control Centres (ACCs) in accordance to Annex 3 — Meteorological Service for International Air Navigation. As of the above noted date, London Volcanic Ash Advisory Centre (VAAC), via RSMC Exeter, will provide direct notification to ACCs.

8.18 The Meeting was informed that a procedure has been developed for this at RSMC Exeter – VAAC London, and that the only time the direct notification to ACCs would take place is when the IAEA checks the following box on the request form (Annex II-7, WMO-No. 485): “ALL RSMCs: GENERATE PRODUCTS AND DISTRIBUTE WITHIN THEIR REGION(S)”.

9. REVIEW OF RELEVANT SECTIONS OF THE MANUAL ON THE GDPFS FOR PROPOSED AMENDMENT

9.1 The meeting proposed draft text for an amendment of the Manual on the GDPFS relevant to the ERA programme, in the following aspects (with reference to the relevant section of the manual):

1. Lower cut off limit for time-integrated air concentration and total deposition charts as well as other display parameters (Vol. I, Part II, Appendix II-7);
2. Addition of 24-hour and 48-hour surface total deposition charts (Vol. I, Part II, Appendix II-7);
3. Designation of RSMC Vienna (Vol. I, Part I, Appendix I-1).

9.2 The proposed amendment to the Manual on the GDPFS is found in Annex 5.

9.3 The Secretariat agreed to notify members of the decision on the above proposed amendment to the Manual, following the sixteenth World Meteorological Congress (May 2011), including the final amendment and the effective date of implementation.

10. OTHER BUSINESS

10.1 Review of WMO ERA Web pages

10.1.1 The meeting agreed that the WMO ERA Web pages at:

<http://www.wmo.int/pages/prog/www/DPFSERA/EmergencyResp.html>

are a very useful reference to the ERA programme, and should be maintained, to show Members and cooperating organizations of how ATM technology could be used for scientific assessments and operational emergency response. Members are encouraged to provide example of cases where ATMs have been applied to environmental problems.

10.1.2 The meeting agreed that the information on the Web pages should be updated at a minimum once a year, and encouraged all members to ensure new information is provided to the Secretariat in a timely fashion. The next update should include information on the collaboration with CTBTO.

10.2 Ensemble atmospheric transport modelling

10.2.1 The meeting reviewed the conclusions and actions on this subject from previous meetings (Vienna, 2006; Melbourne, 2008), and agreed to maintain the agreed actions. Dr Wotawa (NMC Vienna) agreed to contact Dr S. Galmarini (JRC, Ispra) to coordinate the necessary steps that will lead to the ENSEMBLE platform for undertaking a “private” RSMC ERA session.

10.2.2 A majority of RSMCs present agreed to participate in the “private” RSMC session to take place in 2010, re-confirming the understanding that this project is intended as a way of comparing outputs from various RSMCs and to generate ensemble products, which are not intended for operational distribution. Mr Winkler (IAEA) agreed to provide a suitable release scenario for the experiment.

10.3 The meeting was informed on the status of development in the provision of guidance to Meteorological Watch Offices (MWO) writing the required SIGMET (i.e. information concerning en-route phenomena which may affect the safety of aircraft operations) for an accidental release of radioactive material in the atmosphere. The ICAO is undertaking a project through its International Airways Volcano Watch Operations Group to develop a guide to be used by MWOs for preparing the SIGMET, based on using the 3-level trajectory chart (one of the RSMC basic product). The Coordination Group could consider including this guidance material in the TD-No. 778 associated with the 3-level trajectory charts.

10.4 Review of relevant sections of the WMO-TN 170 on “Meteorological and Hydrological Aspects of Siting and Operations of Nuclear Power Plants”

10.4.1 The meeting reviewed the document “Meteorological and Hydrological Aspects of Siting and Operations of Nuclear Power Plants” (WMO TN-No. 170) and concluded that this document was out of date in many aspects. The meeting recommended that Sections 2.2.4 and 2.2.5 of the document be thoroughly reviewed in order to facilitate a document that was of greater relevance to users.

10.4.2 The revised document should leverage recently updated documents such as US Nuclear Regulatory Commission (NRC) documents related to the recommended meteorological monitoring and dispersion modelling practices (NRC regulation documents 1.23, 1.145, 1.76, 1.195 and 1.97). In addition, vertical profiles of winds and temperatures from nearby commercial aircraft (ACARS), SODARS, RASS, wind profilers and LIDARS should be used for the purposes of site planning and emergency response.

10.5 Any other business arising.

ERA programme in relation to WIS

10.5.1 The meeting discussed the possible implications of the development of the WMO Information System (WIS) as the future evolved state of the GTS. It recalled that the RSMC products (ERA) are very sensitive and should be protected for the exclusive use by meteorological and radiation protection specialists. It noted that presently only the “WNXX IAEA” messages circulate on the GTS; all RSMC products are exchanged by fax or through password protected Web pages.

10.5.2 The meeting requested the Secretariat to ask WIS programme experts as to how WIS could be used to distribute or exchange very sensitive information, such as noted above. If WIS could be used, then clarification would be needed as to how this would be achieved, including the preparing of metadata for the ERA messages and products. Once the information is provided to the RSMCs, it will be shared with the others.

Review of the Terms of Reference for the Coordination Group

10.6 The meeting agreed to maintain its Terms of Reference as adopted at CBS-XIV (2009), and is found in Annex 4.

11. CLOSURE OF THE MEETING

The meeting is anticipated to close at 18:00 on Friday, 28 May 2010.

AGENDA

- 1. OPENING OF THE MEETING**
 - 2. ORGANIZATION OF THE MEETING**
 - 2.1 Adoption of the agenda
 - 2.2 Working arrangements
 - 3. INTRODUCTION / REPORT OF THE CHAIR**
 - 4. STATUS OF OPERATIONAL IMPLEMENTATION / ACTIVITIES OF RSMCs / RTH OFFENBACH / IAEA**
 - 5. IMPROVED PRODUCT DISTRIBUTION / ACCESS METHODS**
 - 6. RSMC PRODUCTS AND SERVICES FOR NUCLEAR EMERGENCIES**
 - 7. REVIEW OF USERS REQUIREMENTS FOR RSMC PRODUCTS / SERVICES**
 - 8. COOPERATION WITH CTBTO, ICAO, WHO**
 - 9. REVIEW OF RELEVANT SECTIONS OF THE MANUAL ON THE GDPFS FOR PROPOSED AMENDMENT**
 - 10. OTHER BUSINESS**
 - 10.1 Ensemble atmospheric transport modelling
 - 10.2 Review of relevant sections of the WMO-TD 170 on “Meteorological and Hydrological Aspects of Siting and Operations of Nuclear Power Plants”
 - 11. CLOSURE OF THE MEETING**
-

ANNEX 2**Final List of Participants**

Mr René SERVRANCKX (Chair) Canadian Meteorological Centre (CMC) Meteorological Service of Canada Environment Canada 2121 Trans-Canada Highway DORVAL, Quebec H9P 1J3 Canada	Tel: Fax: Email:	+(1 514) 421 4704 +(1 514) 421 4679 rene.servranckx@ec.gc.ca
Dr Gerhard WOTAWA ZAMG Hohe Warte 38 Postfach 342 A-1191 VIENNA Austria	Tel: Fax: Email:	+(43 1) 36026 2007 +(43 1) 369 12 33 gerhard.wotawa@zamg.ac.at
Dr Zhenxin SONG China Meteorological Administration National Meteorological Centre 46 Zhongguancun Nandajie Haidian District BEIJING 100081 China	Tel: Fax: Email:	+(86 10) 6840 0477 +(86 10) 6840 8454 songzx@cma.gov.cn
Mr Laurent PERRON Météo-France 42, avenue Gaspard Coriolis 31057 TOULOUSE, Cédex 1 France	Tel: Fax: Email:	+(33 5) 6107 8210 +(33 5) 6107 8209 laurent.perron@meteo.fr
Dr Hubert GLAAB Deutscher Wetterdienst P.O. Box 100465 63004 OFFENBACH Germany	Tel: Fax: Email:	+(49 69) 8062 2747 +(49 69) 8062 3721 Hubert.glaab@dwd.de
Mr Masami SAKAMOTO Japan Meteorological Agency Numerical Prediction Division 1-3-4 Otemachi, Chiyoda-ku TOKYO 100-8122 Japan	Tel: Fax: Email:	(81 3) 3211 8408 (81 3) 3211 8407 masami.sakamoto-a@met.kishou.go.jp

<p>Mr Anton MUSCAT Met Office Fitzroy Road Devon EX13PB EXETER United Kingdom</p>	<p>Tel: Fax: Email:</p>	<p>(+44 1392) 886 033 (+44 1392) 884 549 anton.muscat@metoffice.gov.uk</p>
<p>Mr Jeffery Mc QUEEN Environmental Modeling Center NOAA – National Centers for Environmental Prediction World Weather Building CAMP SPRINGS, Maryland (MD) 20746-4325 United States of America</p>	<p>Tel: Fax: Email:</p>	<p>+(1 301) 763 8000 ext 7226 +(1 301) 763 8545 Jeff.mcqueen@noaa.gov</p>
(by telephone conference)		
<p>Ms Monika KRYSTA CTBTO Preparatory Commission P.O. Box 1200 A-1400 VIENNA Austria</p>	<p>Tel: Fax: Email:</p>	<p>+(43 1) 26030 6405 +(43 1) 260 30 5932 Monika.Krysta@ctbto.org</p>
<p>Mr Guenther WINKLER International Atomic Energy Agency (IAEA) Wagramerstr. 5 UNO City POB 100 1400 VIENNA Austria</p>	<p>Tel: Fax: Mobile: Email:</p>	<p>+(43 1) 2600 22745 +(43 1) 26007 22745 +(43) 699 165 22745 g.l.winkler@iaea.org</p>
<p>WMO Secretariat 7 bis avenue de la Paix Case postale 2300 1211 GENEVE 2 Switzerland</p>	<p style="text-align: center;">WWW website www.wmo.int/web/www/www.html</p>	
<p>Mr Peter CHEN</p>	<p>Tel: Fax: Email:</p>	<p>+(41 22) 730 8231 +(41 22) 730 8128 pchen@wmo.int</p>

ACTIONS FROM THE BEIJING 2010 nERA-CG Meeting

ACTION 1: ALL RSMCs, RTH Offenbach and WMO Secretariat

DUE DATE: 1 JULY 2010

Updating of Annex 4, WMO TD-No. 778

All RSMCs will maintain the information regarding their respective Centres up-to-date in their mandatory annexes in the WMO Technical Note 778 on Environmental Emergency Response. All RSMCs and RTH / RSMC Offenbach will provide an updated version to WMO Secretariat by 1 July 2010. The WMO Secretariat will then update <http://www.wmo.int/pages/prog/www/DPS/WMOTDNO778/Annex4.html>

ACTION 2: WMO Secretariat and ALL RSMCs

Implementation plan to migrate from fax distribution of products to email/internet distribution of products

DUE DATE: 1 SEPTEMBER 2010

1. WMO, via circular letter from Secretary-General, to request all Permanent Representatives to provide confirmation or nomination of contacts for its Delegated Authority, and for its Operational NMHS Contact Point, including name, title, telephone and fax number, and only one operational e-mail address; WMO to provide RSMCs with all replies;

DUE DATE: 1 NOVEMBER 2010

2. RSMCs will commence testing e-mail distribution within their respective Regions of responsibility, and contact those Members that have not replied to the circular letter; RSMCs to provide updated lists to WMO;

DUE DATE: 1 DECEMBER 2010

3. WMO and RSMCs, in consultation with IAEA decide additional measures to obtain additional replies from Members; WMO to provide updated lists to RSMCs and to update all contact information on the WMO ERA Web pages.

ACTION 3: ALL RSMCs

DUE DATE: 1 NOVEMBER 2010

Mirrored web-pages

1. All RSMCs will send (FTP) their basic products (graphical) to be uploaded to the mirrored Web-sites.
2. All RSMCs, where local policy permits, to install the mirrored Web-site to accommodate the posting of the basic products from all 8 RSMCs
3. All RSMCs, where local policy permits, to include an "all products" web link on mirrored-web page where an archive of modelling results will be maintained
4. All RSMCs to test that the transmission of their products to the other sites is working correctly
5. A meta-data Web page and directory will be used to post non-standard / initial response products and files, post non-standard / initial response products and files, including GRIB-2 files
6. Work on producing basic products in GRIB, GRIB-2, BUFR and post on meta-data web page
7. Work on producing basic products in geo-referenced format, preferably shape files, KML or other file formats (with suitable viewer)
8. RSMC Washington to provide to the other RSMCs a script to clean the main mirrored-web page of "old" images and information; provide information on KML products generation

ACTION 4: WMO SECRETARIAT

DUE DATE: 30 September 2010

File naming convention

It is necessary to define appropriate file naming conventions consistent with WMO recommended practices or standards to facilitate the exchange, accessibility and management of products. The Secretariat has investigated existing standards and will report new information as needed.

ACTION 5 (NEW): ALL RSMCs

(old action 5 has been merged with action 3)

DUE DATE: 30 JUNE 2010

Total deposition maps for 24 and 48 hours

All RSMCs are requested to confirm their agreement to the proposal to amend the Manual on the GDPFS to include total deposition maps at 24 and 48 hours

ACTION 6: IAEA and RTH OFFENBACH

ONGOING

IAEA Incident and Emergency Centre to investigate with RTH Offenbach regarding data format for the GTS messages. This way we could eliminate the time delay that the message comes to RTH Offenbach.

ACTION 7: ALL RSMCs AND CHAIRPERSON

DUE DATE: 30 JUNE 2010

Operational email confirmation

All RSMCs to confirm / update 24/7 operational e-mail addresses information to Chairperson who will send results to IAEA IEC.

ACTION 8 (NEW): IAEA

DUE DATE: 30 June (yearly)

List of IAEA Contact points

Provide a list of IAEA contact points to WMO Secretariat

ACTION 9: IAEA and RSMCs

DUE DATE: 30 JUNE 2010

Implementation of the new request form

1. IAEA will send new version of the Request Form to Members of the nERA-CG. This is the version that will be included 2010 update of Appendix II-7 of the Manual on GDPFS (WMO-No.485)
2. Each RSMC to inform its operational staff about the implementation of the new request form

ACTION 10: ALL RSMCs and IAEA

ONGOING

Real-time radionuclide data and real-time radiation monitoring data would be of great value for real-time responses, including modeling, but also for hindcast studies. It was agreed that each RSMC would investigate the possibility of accessing such monitoring data and report at the next meeting of this Group.

ACTION 11 (NEW): IAEA

DUE DATE: 30 OCTOBER 2010

NPP Coordinates and radionuclide database

1. Evaluate the possibility of providing an updated database with more detailed coordinates for NPP to the RSMCs
2. Evaluate the possibility of provide an radionuclide database to the RSMCs

ACTION 12: IAEA and WMO Secretariat

DUE DATE:

Continue work on coordination and liaison between NMHSs and the counterpart NCAs. One suggestion was to include in the next mailing of the IAEA technical operations manual information on the RSMC services and the role of the NMHS Operational Contact Point, and the list of Delegate Authorities for requesting specialized RSMC products (refer to WMO ERA and WMO TD-778 web pages).

ACTION 13 (NEW): WMO Secretariat

DUE DATE: May 2011

Amendments to the Manual on the GDPFS

Inform nERA-CG about status of amendments to the Manual on the GDPFS (WMO-No. 485) following WMO Cg-XVI

ACTION 14: ALL

Terms of reference of nERA-CG

The following Terms of Reference were adopted by CBS XIV (Dubrovnik, 25 March – 2 April 2009) for the Coordination Group on Nuclear Emergency Response Activities (ERA). The meeting recommends that they be maintained:

1. Test and improve the collective ability of all RSMCs, the IAEA, the RTH Offenbach and NMHSs in the ERA to fulfill the operational requirements specified in global and regional arrangements, according to adopted standards and procedures;
2. Implement and explore further improved distribution/access methods for specialized products to NMHSs, and the IAEA in collaboration with the IAEA and other relevant organizations;
3. Collate the individual capabilities of RSMCs to produce enhanced products in support of nuclear emergencies, including ensemble techniques;
4. Explore the operational availability of radiological monitoring data for use in the RSMC operational environment;
5. Develop concepts of operational arrangements for atmospheric transport modelling backtracking products;
6. Continue testing and evaluating the operational arrangements with CTBTO

ACTION 15: completed

ACTION 16: ALL RSMCs, RTH / RSMC OFFENBACH and WMO Secretariat

DUE DATE: REPORT FOR 2010 (2011) BY FEBRUARY 2011 (2012)

Annual Report

The meeting agreed that all RSMCs and RTH Offenbach will produce and share an

annual report to cover the calendar year. The report should be submitted to the Chairman of the Coordination Group by the end of February of the following year, for posting on the WMO Web-site for the ERA programme.

The contents of the Annual Report shall include, but not limited to:

- Introduction
- Operational contact information
- Responses and information on dissemination of products (fax, web-page access, which products were sent and time delay from point of notification)
- Exercises and routine tests
- Lessons learned from recent experiences
- Operational issues / challenges
- Summary / status of the operational atmospheric transport and dispersion model(s)
- Plans for the coming year

WMO Secretariat will post the 2009 reports on the ERA web pages and update when the 2010 reports are received

ACTION 17: IAEA

IAEA to provide WMO with pdf format file of NCA contacts by 20 June 2008.

~~ACTION 18: All RSMCs~~ . This action was merged with ACTION 3.

~~A meta-data Web page and directory will be used to post non-standard / initial response products and files, including GRIB-2 files.~~

~~ACTION 19: RSMC Washington~~

~~COMPLETED.~~ Provide updated web page that includes additional button to access meta-data directory.

ACTION 20: RSMCs Obninsk, Montréal, Toulouse, Washington and IAEA. Chair will coordinate.

DUE DATE: 1 DECEMBER 2010

"Time of Arrival" Product Tests

1. Conduct a test of the experimental "time of arrival of pollutant" product using the parameters defined at the meeting and evaluate results
2. Chair will consult with RSMCs about possible approaches for the "Time of Arrival" product beyond a few days
3. (IAEA with a few RSMCs) Conduct tests and evaluate new guidelines (colours, contouring, and threshold values) proposed in the amendment to Appendix II-7 of the Manual on the GDPFS (WMO-No. 485) and report back to the group

ACTION 21: WMO Secretariat and RSMCs

ONGOING

Radar and precipitation data

1. Identify sources of radar and precipitation data and investigate possibility of providing information to IAEA to help diagnose "hotspot" regions following a nuclear accident.
2. RSMCs are invited to provide examples and links to web pages

ACTION 22: NMC Austria in cooperation with RSMCs Obninsk, Toulouse, Exeter, Montreal, IAEA and other interested RSMCs

DUE DATE: 1 DECEMBER 2010

Tests with ensemble

1. Coordinate with S. Galmarini at JRC Ispra the setting up of a private session for the RSMCs.
2. Coordinate with the RSMCs to conduct a few tests to experiment with ensemble products and post on JRC Ispra web site
3. Provide a short analysis of the results

~~ACTION 23: RSMCs Obninsk, Toulouse, Exeter, Montréal, NMC Offenbach / DWD and CTBTO PTS (merged with action 22)~~

~~Conduct a few tests and post results on the EC-JRC web site.~~

ACTION 24: Chairperson in coordination / collaboration with RSMCs and WMO Secretariat

DUE DATE: 1 FEBRUARY 2011

Updates to WMO TD-778

Check, review and update the ERA web pages and WMO TD-778
Produce a pdf version of updated version of WMO TD-778

ACTION 25: RSMC Toulouse

DUE DATE: 1 DECEMBER 2010

Updates to WMO TD-778

RSMC Toulouse will request and lead a group of members to maintain, update and further develop the "WEB LINKS", "CASE STUDIES" and "WEBSITE LINKS to RSMCs and International Organizations".

~~ACTION 26: RSMC Montréal Merged with ACTION 24~~

~~Produce a pdf format version of WMO TD 778 from the new ERA web page.~~

ACTION 27: IAEA in coordination with WMO Secretariat

Users requirements meeting

Consider the possibility to organize a users meeting regarding requirements in December 2010.

ACTION 28: CTBTO PTS

ONGOING

Reference material on CTBTO Web page

Develop and maintain reference material on the Web page regarding the CTBTO – WMO response system.

~~ACTION 29: CTBTO PTS and WMO~~

~~Publish the results of the 2007 test.~~

ACTION 30: ALL (except CTBTO)

ONGOING

Quarterly tests:

Information on the planned tests will be published in the IAEA operational manual
GTS message will be sent with each quarterly test
Distribution of products will be done by Lead RSMCs to their region(s) of responsibility.

ACTION 31 (NEW): PARTICIPATING RSMCS

DUE DATE: 30 JUNE 2010

Expanded SRS fields for CTBTO

The RSMCs are requested to confirm the feasibility of undertaking the expanded requirements (possibility of producing SRS fields up to 7 weeks back with a more relaxed turn-around time, such as 3 to 4 days) and respond to CTBTO (copied to Chair and WMO Secretariat)

ACTION 32 (NEW): NMC VIENNA

DUE DATE: 30 JUNE 2010

Transmission of CTBTO meteorological data on WMO GTS

Investigate the possibility of NMC Vienna taking over from CMC the transmission of CTBTO meteorological data on the WMO GTS and inform the Chair and WMO Secretariat.

ACTION 33 (NEW): NMC VIENNA, CTBTO and RSMC Montreal

DUE DATE: May 2011

Transmission of CTBTO meteorological data on WMO GTS

Develop a plan to make the transmission of CTBTO meteorological data more robust and (if appropriate) for the transfer of this task from CMC to NMC Vienna

ACTION 34 (NEW): CTBTO and RSMCs

DUE DATE: ----

SRS fields for CTBTO

RSMCs to investigate the feasibility of performing computations of the SRS fields with the enhanced resolution of $0.5^\circ \times 0.5^\circ$. CTBTO will make a formal request to the RSMCs for this

CG-nERA TERMS OF REFERENCE (REVIEWED 2010)

- (a) Test and improve the collective ability of all RSMCs, the IAEA, the RTH Offenbach and NMHSs in the ERA to fulfil the operational requirements specified in global and regional arrangements, according to adopted standards and procedures;
- (b) Implement and explore further improved distribution/access methods for specialized products to NMHSs, and the IAEA in collaboration with the IAEA and other relevant organizations;
- (c) Collate the individual capabilities of RSMCs to produce enhanced products in support of nuclear emergencies, including ensemble techniques;
- (d) Explore the operational availability of radiological monitoring data for use in the RSMC operational environment;
- (e) Develop concepts of operational arrangements for atmospheric transport modelling backtracking products;
- (f) Continue testing and evaluating the operational arrangements with CTBTO.

PROPOSED AMENDMENTS TO THE MANUAL ON THE GDPFS

A. Volume I, Part I, Appendix I-1 (paragraph 3)

Propose to add “RSMC Vienna (backtracking only)” to list of RSMCs with Activity Specialization in Atmospheric Transport Modelling / backtracking, as follows:

3. The RSMCs with activity specialization are the following:

RSMC Nadi – Tropical Cyclone Centre

RSMC New Delhi – Tropical Cyclone Centre

RSMC Miami – Hurricane Centre

RSMC Tokyo – Typhoon Centre

RSMC La Réunion – Tropical Cyclone Centre

RSMC Honolulu – Hurricane Centre

RSMC European Centre for Medium-Range Weather Forecasts (RSMC ECMWF)

Provision of atmospheric transport modelling (for environmental emergency response and/or backtracking)

RSMC Beijing

RSMC Exeter

RSMC Melbourne

RSMC Montreal

RSMC Obninsk

RSMC Offenbach (backtracking only)

RSMC Tokyo

RSMC Toulouse

RSMC Vienna (backtracking only)

RSMC Washington

B. Volume I, Part I, Appendix II-7

(Modifications to Appendix II-7 are in shaded text and deleted parts are crossed out)

USERS’ INTERPRETATION GUIDE FOR ATMOSPHERIC TRANSPORT MODEL PRODUCTS PROVIDED BY RSMCs

[...]

2. Basic set of products

~~Five~~Seven maps consisting of:

- (a) Three-dimensional trajectories starting at 500, 1 500 and 3 000 m above the ground, with particle locations at six-hour intervals (main synoptic hours up to the end of the dispersion model forecast);
- (b) Time-integrated airborne concentrations within the layer 500 m above the ground, in Bq s m^{-3} for each of the three forecast periods;
- (c) Total deposition (wet + dry) in Bq m^{-2} from the release time to the end of **each of the three forecast periods** ~~the dispersion model forecast~~.

[...]

5. General rules for displaying results

In order to make the interpretation of the maps easier, the producing centres should adopt the following guidelines:

[...]

Specific guidelines for concentration and deposition maps:

(a) Adopt a maximum of four concentration/deposition contours corresponding to powers of 10 with minimum values not less than 10^{-20} Bq s m⁻³ for time-integrated airborne concentrations and not less than 10^{-20} Bq m⁻² for total deposition;

(b) For a particular set of time-integrated airborne concentrations maps, use the same colour for a specific contour interval. Therefore additional colours will be used on consecutive maps (e.g. t+48 hours and t+72 hours) as different concentration values become applicable;

(c) For a particular set of total deposition maps, use the same colour for a specific contour interval. Therefore additional colours will be used on consecutive maps (e.g. t+48 hours and t+72 hours) as different total deposition values become applicable;

(d) A legend should indicate that contours are identified as powers of 10 (i.e. $-12 = 10^{-12}$). If grey-shading is used between contours, then the individual contours must be clearly distinguishable after facsimile transmission and a legend provided on the chart;

(e) Use solid dark lines (darker than map background lines) for each contour;

(f) Indicate the following input characteristics: (i) source assumption (height, duration, isotope, amount released); (ii) the units of time integrated concentration (Bq s m⁻³) or deposition (Bq m⁻²). In addition, charts should specify: (i) "Time integrated surface to 500 m layer concentrations"; (ii) "Contour values may change from chart to chart", and if the default source is used; (iii) "Results based on default initial values";

(g) Indicate, if possible, the location of the maximum concentration/deposition with a symbol on the map and include a legend indicating the symbol used and the maximum numerical value;

(h) Indicate the time integration starting and ending date/time (UTC).