Radiation Protection

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Monitoring and Data Management Strategies for Nuclear Emergencies

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

– to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
– to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
– to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of 27 OECD Member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

– to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
– to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

FOREWORD

Since the accidents at Three Mile Island in 1979, and more especially Chernobyl in 1986, many countries have intensified their efforts in nuclear emergency planning, preparedness and management. The OECD Nuclear Energy Agency (NEA) has responded to this growing interest by organising research activities through its Committee on Radiation Exposure and Public Health (CRPPH).

The Nuclear Energy Agency started the International Nuclear Emergency Exercise (INEX) programme with the table-top exercise INEX 1, which allowed the 16 participating countries to examine how their response mechanisms addressed the international aspects of a large-scale nuclear emergency. Based on the experience from INEX 1, a series of more realistic exercises, INEX 2, was developed. These exercises were based on simulated exercises at existing nuclear power plants, and addressed internationally the real-time exchange of information; public information; and decision making based on limited information and uncertain plant conditions.

The experiences and lessons learned during four regional INEX 2 exercises, hosted by Switzerland, Finland, Hungary and Canada, led to major improvements in national and international nuclear emergency response management. Based on experience with the INEX 2 regional exercises, the Expert Group on Nuclear Emergency Matters established three working groups at the beginning of 1998:

- the Working Group on Key Emergency Data;
- the Working Group on Emergency Communication and Information Exchange;
- the Working Group on Emergency Monitoring Strategy.

In order to synthesise the findings of these three groups, a Workshop on Emergency Management Strategy was held in Paris on 2-3 December 1998. The outcome was the present report, which represents a significant step towards modernising and streamlining emergency notification and information activities.

The opinions expressed in this report do not necessarily reflect the position of Member countries, or international organisations. This report is published on the responsibility of the Secretary-General of the OECD.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Experience from the NEA's programme in the area of nuclear emergency management, notably that from the INEX 1 and INEX 2 exercises and their related workshops, has shown that there is a need to improve the international system of emergency data communication and management. A very coherent approach has been developed by focusing on the needs of the decision maker, particularly with respect to the different temporal and geographic phases of an accident. This also includes considerations of the nature of the information sender and receiver, as well as the nature of the data being transmitted.

In terms of characterising data and information exchanges for decision-making purposes, the following classifications are useful:

- Division of an accident situation into various decision-making phases and zones:
  - temporal phases (notification phase; pre-release phase; release and immediate post-release phase; intermediate phase; recovery phase);
  - geographic zones (urgent protective action planning zone; food and agricultural restriction area; area farther from the release site).
- Identification of types of data exchange:
  - domestic official exchanges;
  - bilateral local exchanges;
  - government-to-government exchanges;
  - government-to-international organisation exchanges;
  - government-to-media exchanges.
- Identification of the nature of data exchanged:
  - notification data;
  - dynamic, accident-related data;
  - static, background data;
  - public and media instructions and information.

Based on these characterisations, a strategy for better addressing the decision-maker's needs can be defined as follows:

- Achieve a better selection of the data which is being transmitted. This will improve the data's usefulness, and will help to optimise the resources necessary to collect, receive and analyse the data. This data can be referred to as KEY. The existing Convention Information System (CIS) provides a very extensive, numerically keyed listing of important emergency data. Using the CIS as a basis combined with the above-defined phases and zones, arranged into a simple matrix structure, data which is KEY can be identified for each matrix point as a function of sender and receiver considerations.

- Achieve better transmission and reception of data and information using modern communication methods. The use of modern network technology (e.g. World-Wide Web) to connect nuclear emergency response organisations will help to optimise the volume of data which is transmitted, as well as the data's quality. By actively sending notification and important, dynamic, accident-related information, and by making available other dynamic, accident-related information and static background information, national emergency response organisations will receive the information they need, and will have easy access to other information they would like. Such an electronic system will also facilitate transmission of measurement and modelling results, greatly improve the quality of graphical transmissions (and retransmissions), and will help to minimise the volume of redundant messages which circulate as well as the resources necessary to interpret them.

- Achieve a better definition of emergency monitoring and modelling needs to support decision making. The use of resources can be optimised by focusing on WHY emergency monitoring is performed (to address which needs), and in this context identifying WHAT measurements are made (physical quantities), WHEN measurements are made (with respect to the previously defined accident time phases), and WHERE measurements are made (with respect to the previously defined geographic zones).

Broadly, the objective of this strategy is to facilitate the decision-making process by delivering the available/necessary information, in the most appropriate format, to the decision maker, while at the same time optimising the resources necessary to send, receive and analyse data. Such a system, using flexible, commonly used and independently updated software, must be developed and tested based on international consensus. It is proposed that the implementational details and procedures necessary for such an approach should be developed, and that an international emergency exercise, INEX 2000, be designed to test the resulting approach. Such an approach should allow the fulfilment of all existing international and multi-lateral conventions and agreements in a much more useful and efficient fashion.

This publication provides a coherent strategy for the international aspects of data identification, communication and management. It is recognised, however, that many of the ideas expressed would be equally applicable at the national level. In terms of the types of facilities addressed, the focus was on nuclear power plants, although this strategy is also seen as being applicable to other types of incidents, such as transportation accidents, and to satellite re-entry incidents. Areas specifically not addressed by this report are emergency response and communications from the accident-site owner or operator, accidents involving nuclear devices, and terrorist incidents.

1. HISTORY OF NUCLEAR EMERGENCY MATTERS AT THE NEA

Since the accidents at Three Mile Island in 1979, and more especially Chernobyl in 1986, many countries have intensified their efforts in nuclear accident emergency planning, preparedness and management. As a result of this interest by its Member countries, the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) has been actively involved in this area.

The areas which have been studied by the NEA include the radiological impact of the Chernobyl accident in OECD countries (NEA87), emergency planning practices and criteria after the Chernobyl accident (NEA88a), radioactive material and emergencies at sea (NEA88b), radiation protection research and development activities after the Chernobyl accident (NEA89a), emergency planning in case of nuclear accident (NEA89b), the influence of seasonal conditions on the radiological consequences of a nuclear accident (NEA89c), intervention levels for protection of the public (NEA89d), emergency preparedness for nuclear-powered satellites (NEA90a), protection of the population in the event of a nuclear accident, a basis for intervention (NEA90b), the influence of seasonal and meteorological factors on nuclear emergency planning (NEA91a), and off-site nuclear emergency exercises (NEA91b).

Based on the above mentioned work and experience, interest grew among the NEA Member countries in the international aspects of nuclear accidents, which led the NEA to develop the first international nuclear emergency exercise, INEX 1. Planning meetings were held during 1991 and 1992, and the exercise was run in 1993. A total of 16 countries participated in this tabletop exercise, which focused on the international aspects of nuclear accidents (14 NEA Member countries: Austria, Canada, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Norway, Sweden, Switzerland, the United Kingdom, and the United States; and two non-NEA member countries: Romania, and the Ukraine). The objectives of INEX 1 were defined as follows:

- to examine the process for alerting and communicating with neighbouring countries and the international community in the case of a nuclear accident, taking into consideration bilateral/multilateral agreements and international obligations;
- to examine the process for reaching conclusions on the need for national interventions or protective measures;
- to examine actions proposed in relation to the export and import of contaminated food and feeding stuffs; and
- to examine the process for identifying the need for and requesting assistance to cope with a radiological emergency.

INEX 1 was unanimously viewed by participants as having been extremely useful and enlightening. Conclusions and recommendations from INEX 1, listed in detail in the final analysis report: *INEX 1, An International Nuclear Emergency Exercise* (NEA95b), were made in the areas of communications, radiation and contamination monitoring and data base management, assistance to or from the affected country, cross-border issues, short-term countermeasures, long-term countermeasures, agricultural issues, and decision making. Although too numerous to mention here in detail, some of the more important conclusions and recommendations of international significance are listed below:

- In the area of monitoring data and data analysis, it was recommended that neighbouring countries need to co-ordinate the exchange of data in advance if the data is to be useful and timely during an accident. Data sharing would be delayed if the types, quantities and nature of data collected, and the procedures and practices used for collection, are not predetermined and exchanged. The usability of a central database could become the key factor in sharing information during the intermediate phase of an emergency.

- In the area of assistance given or received in the case of an accident, it was noted that countries should be well prepared with the policies and procedures necessary for the easy passage of monitoring teams and equipment across borders.

- In the area of border control, it was seen as very important that national procedures should be developed to implement monitoring, and to specify monitoring techniques, for goods and food crossing borders. Specifically in the case of food, acceptance criteria should be clearly identified and understood. In this context, a certification procedure is also needed. The co-ordination of these procedures, techniques and acceptance criteria by neighbouring countries was seen as essential.

- The co-ordination of intervention levels, and of countermeasures prior to implementation was seen as essential. The implementation of different countermeasures in two contiguous areas separated only by a country border would lead to confusion and a loss of confidence in scientists and elected officials.

- The need for prompt intervention is generally not critical for long-term countermeasures. However, country reports on INEX 1 indicated that planning for the implementation of long-term countermeasures was somewhat underdeveloped, which would lead to very long decision-making processes and in such a case would likely cause the public to question the competence of the decision makers. Additional planning is warranted in the area of defining national criteria for long-term countermeasures and the amount of environmental monitoring that should be performed to provide sufficient information to make decisions on long-term countermeasures.

- Criteria for import or export of food and feed items should be consistent among all countries. It is strongly suggested that all countries use the Basic Safety Standards' criteria which has adopted the Codex Alimentarius values. It should also be noted that the European Union Member states are bound to comply with a set of European regulations known as "foodstuff regulations".

Following the successful completion of INEX 1, the value of having a standing group to investigate nuclear emergency related issues became clear to NEA Member countries. Particularly, involving eastern European and former Soviet Union countries in such activities was seen as extremely important. It was decided to extend the mandate of the group, which had planned and executed INEX 1 for the NEA to include all aspects of nuclear emergency matters. The group was expanded to include representatives from additional NEA countries. This new standing Expert Group on Nuclear Emergency Matters was thus charged with all INEX 1 related follow-up (workshops, additional exercises, exercise and workshop recommendations), with keeping the NEA informed of emerging issues, and with carrying out work seen as useful by the NEA Member countries. This

Expert Group thus developed a well-planned short and medium range programme, in close co operation with the IAEA and the EC (both of whom are represented on the Group), and involving strong participation from and co-ordination with North American and European countries. The first projects of this Expert Group were three INEX 1 follow-up workshops, and the initial planning of INEX 2.

Recommendations from INEX 1 resulted in a series of three workshops being held during 1994 and 1995 in order to study areas where further international understanding and/or consensus was identified as beneficial. These workshop areas included the Implementation of *Short-term Countermeasures after a Nuclear Accident* (Stockholm, June 1994, NEA95a), the *Agricultural Aspects of Nuclear and/or Radiological Emergency Situations* (Paris, June 1995, NEA97a), and *Nuclear Emergency Data Management* (Zürich, September 1995, NEA97b). Proceedings from all these Workshops have been published as OECD/NEA reports.

From the interesting papers and discussions of these workshops many conclusions and recommendations were drawn. Although too numerous to list all of these here, some of the more important conclusions and recommendations are as follows:

The *Implementation of Short-term Countermeasures after a Nuclear Accident* (Stockholm, June 1994):

- There are still significant differences among countries in the application of countermeasures, and further developments in the area of understanding these differences and countermeasure co-ordination should be pursued.

- It was recommended that the dosage recommendations of the World Health Organisation for stable iodine prophylaxis should be followed, and that further international discussion is necessary in the area of pre-distribution and its practical aspects.

- Greater consideration should be given, during the first phases of an accident, to the accident country as an initiator of countermeasures.

The *Agricultural Aspects of Nuclear and/or Radiological Emergency Situations* (Paris, June 1995):

- It was felt that a better understanding is needed of the differences which still exist between various national and/or regional intervention levels for food, and maximum permitted levels for food, such as CODEX, for international trade.

- It was noted that after nine years of post-Chernobyl study of agricultural countermeasures, practical problems with their implementation still exist. For example, there is need for further discussion of alternative methods for the treatment of agro-food products containing unacceptable levels of radioactivity. Work, it was felt, should continue in these areas.

- The social and cultural aspects of communications with the agricultural community are extremely important before, during and after any nuclear emergency. It was suggested that further study be performed in this area.

The Nuclear Emergency Data Management (Zurich, September 1995):

- It was felt that there are many different national approaches to "standard" environmental measurement, and that these differences should at the very least be better understood to allow the valid comparison of data from different sources.

- The "key" data, necessary for quick transmission at various points in an emergency situation, is not well defined at this point, according to the Workshop.

- Data presentation, for experts, decision makers and the public, is one of the key issues to adequate management of data in an emergency situation. Quality assurance in data management is also essential.

Based on the experience from INEX 1 and from the three follow-up workshops, the NEA is currently running INEX 2, which is a series of regional, command-post exercises with the simultaneous real-time participation of many countries. The structure of INEX 2, for each Regional Exercise, is based on an "Accident-Host" country which will superimpose the INEX 2 objectives and requirements on top of a previously-planned and scheduled national-level command-post exercise. Bordering countries will participate simultaneously, activating their own emergency command posts and utilising existing bilateral and multilateral notification and communication agreements to receive and transmit information. Countries not bordering the accident host ("Far-Field countries") will also participate simultaneously, either with full or partial command-post exercises, again using their existing bilateral and multilateral notification and communication agreements. Only the information gathered through these normal channels will be used as the basis of decision making (countermeasures, public information, data management, etc.). The exercise will last one day, and only the pre-release, release and immediate post-release phases will be addressed.

Four Regional INEX 2 Exercises have been performed; Switzerland (November 1996), Finland (April 1997), Hungary (November 1998), and Canada (April 1999). The INEX 2 Programme has received wide support both inside and outside the NEA, with 35 countries (11 non-NEA member countries, 24 NEA Member countries) participating in the INEX 2 Programme Committee, and 30 countries and three international organisations participated in the Swiss Regional INEX 2 Exercise, 28 countries and five international organisations participated in the Finnish Regional INEX 2 Exercise, 30 countries and three international organisations participating in the Hungarian Regional INEX 2 Exercise, and 30 countries and four international organisations participating in the Canadian Regional INEX 2 Exercise. Because INEX 2 has been repeated in several regions, countries could choose to participate in the exercise in more than one region, playing "Accident-Host country", "Border country", or "Far-Field country" given by the geographical situation. The objectives of these exercises are as follows:

- **The real time exchange of information**: in order to exercise under conditions as close as possible to those of an actual emergency situation, each participant's actual communications hardware, software and procedures will be used to send and receive information from other countries and international organisations, and this will be done in real time. This will involve the use of all standing early notification conventions, notably those of the IAEA and the EC, as well as all appropriate bilateral and multilateral agreements that participating countries may have with other participating countries. The advantage of such an exercise is that programmatic and procedural aspects requiring further development can be highlighted, and at the same time personnel can receive valuable training and experience.

- **Public information**: the many aspects of public information were not well exercised in INEX 1, and as such many participants felt that the exercise was not as realistic as it could have been. In view of this, INEX 2 included public information components, such as press releases, public briefings, media interactions and pressures, co-ordination of public information, etc.:

  – Providing information to the public on what action to take – or not to take – based on the recommendations of government officials.

  – Questioning of various public officials and utility representatives by the media, at least by telephone, regarding the situation, actions taken or expected to be taken, and the reasons for not taking certain actions.

  – Conducting one or more press briefings in which media representatives have the opportunity to ask questions of government officials and utility representatives.

  – Providing information feedback to the players in the form of production of simulated news or radio programs based on the information collected by the media simulators.

- **Decision making based on limited information and uncertain plant conditions**: in order to exercise the decision-making process in each participating country, the pre-release, release and immediate post-release phases of an accident has been simulated in INEX 2. The use of realistic data (in quantity, quality, and flow rate) would exercise participants' programmes and procedures for making decisions based on incomplete data, that is, preliminary and/or incomplete plant status and radionuclide release data, which is often limited in scope and certainly pre-dates any detailed information as to the scale, duration and effects of a release. In addition, the decision making process immediately post-release would be exercised, thus providing information as to a programmes ability to adjust to quickly evolving situations. Although rapid countermeasure decision making may be less essential for far-field countries, early decisions regarding travel, tourism and advice to embassies may well be necessary. In this same spirit, it is suggested that real weather conditions be utilised. The World Meteorological Organisation (WMO) participated, as appropriate, in providing real-time information as to local, regional and global weather trends during the exercise.

Although each exercise will be summarised, e.g. the final report for the Swiss regional INEX 2 exercise has been published by the Nuclear Energy Agency (NEA98), in general it can be said that much has been learned in terms of the type, quality, and volume of information that will be needed in such emergency situations, and in terms of what information will be available through currently existing channels. It has been noted by many exercise participants that more information than is currently available would be necessary, in the case of a real emergency, to assure that decisions and public communications are based on appropriately knowledge. In addition, the currently existing procedural and technological means for information and data transmission have been shown to be in need of improvement and modernisation.

To address these concerns, at the beginning of 1998 the Expert Group established three Working Groups: the Working Group on Key Emergency Data; the Working Group on Emergency Communication and Information Management; and the Working Group on Emergency Monitoring Strategy. The results of the work of these three Working Groups are presented here. Annexes 4 and 5 list the members of these three Working Groups, along with each Group's Terms of Reference.

2. STRATEGY FOR IMPROVEMENT

Within the historical context of emergency matters work at the NEA described in Chapter 1, experience from the INEX 2 programme, in addition to that from the Nuclear Emergency Data Management Workshop after the INEX 1 programme, has led to a consensus regarding how emergency notification and information programmes could evolve to better meet national and international emergency management needs.

Broadly, the objective of this strategy is to facilitate the decision-making process by delivering the available/necessary information, in the most appropriate format, to the decision maker, while at the same time minimising the resources necessary to send, receive and analyse data. This report describes this needs-based strategy. While not addressing the very broad area of emergency management, the essential aspects of data classification and management, information exchange and emergency monitoring strategy are discussed.

Elements of improvement

The INEX 2 exercises have shown that, in case of a serious nuclear accident with the potential for a great amount of radioactivity to be released off-site, there will be an urgent and significant need for the exchange of data and information to support countries' decision making processes. The amount of data exchanged during emergency situations is generally quite large, the sending and receiving of such data is time consuming and resource intensive, exchanged data and information does not generically fit the needs of the receiving country, and data misinterpretation is possible.

To improve the situation, the "quality" of data and information exchanged must be improved. In this context, "quality" means the applicability of data and information to the specific decision-making process of concern. It is important to prioritise data and information as a function of the needs of the decision-making process by identifying **key emergency data**.

Once the key data are identified, a structure to appropriately allow the exchange of such information is essential to this occurring successfully. This can be done by establishing a **strategy for efficient emergency communication**. It is felt that this can best be accomplished by the use of modern communication technology (e.g. "world-wide web"), which will help to optimise the exchange of information, and to minimise the amount of redundant information transmitted. The technical details of a reliable and secure system, based on active sending and passive retrieving of information, have been studied and are presented in this report. Such a communications strategy will serve as a basis for reducing the redundancy of efforts now codified in international notification conventions and bilateral agreements.

Finally, there is a need for a better understanding of the emergency monitoring aspects of nuclear emergency situations. Specifically, emergency environmental monitoring information should address the needs of the decision makers, and an **emergency monitoring strategy** should also be designed with this in mind. Although this includes the need to better understand the various country specific aspects of emergency monitoring data, such that valid comparisons and analyses could be made, these very technical aspects are extremely detailed for even just a single country. As such, it is recommended that local details should be understood locally, and for those sites near a national border this may include local response organisations in another country, however broader international understanding of these details is not necessary.

This report is divided into three sections, corresponding to the work of each of the three Working Groups; the identification of key emergency data, emergency communication and information management, and emergency monitoring strategy. Taken together, these chapters represent a holistic, generic strategy for the collection of emergency environmental monitoring information and for the management and communication of emergency data.

Assessors and decision-makers needs

As mentioned previously, the overall strategy discussed here is based on addressing the needs of assessors and decision makers over time and geographic location, and as a function of the type of decision being made. Subsequent discussions of each of the three elements of improvement previously presented are based on this premise. Relatively common "slices" of time, location and type of decision have been developed to facilitate strategy descriptions, and are presented here. It should be remembered that these have been somewhat arbitrarily defined, and as will be discussed in more detail, the boundaries between one slice and the next are intentionally "fuzzy" as to better apply to a wide variety of specific, national cases.

Time

In an accident situation, the nature of key emergency data, and requirements for efficient emergency communications and for emergency monitoring programmes will evolve with time. For the purposes of discussion of strategies, theoretical time phases can be defined. In most cases, it is not possible to exactly mark the "end" of one phase and the "beginning" of another, particularly because the phase of an accident will depend upon the physical location under consideration. For example, the plume passage phase will end for one area but will just begin for another area "downstream". For accidents with multiple releases it is difficult to characterise when the releases have finished. In the later phases of an accident, it is also quite difficult to generically classify countermeasures as "over" because some areas may be affected for very long periods.

However, while such time-phase designations are theoretical and artificial in nature, they are very useful for planning purposes and in guiding the identification of key data and in guiding the prioritisation of emergency monitoring actions to be taken. For this reason, the following emergency monitoring accident phases have been designated. These correspond largely to those defined in ICRP Publication 63, however it should be noted that some modifications, particularly in the release and immediate post-release phase and the intermediate phase have been necessary to better adapt these phases to the purposes of emergency monitoring. The phases used for this purpose are designated as "Notification", "Pre-release", "Release and Immediate post-release", "Intermediate", and "Recovery". For each of these phases, information needs for decision makers will vary.

The notification phase

This “phase” of an accident is somewhat unique. In the context of the identification of key data, this “phase” really means the identification of that data and information which should be included in the first notification of an accident situation to trigger actions by response organisations.

The pre-release phase

The Pre-release phase is characterised as the time following the recognition of the existence of a problem (such as an emergency situation at a nuclear power station, a notification of a serious transportation accident, the recognition that a nuclear satellite will re-enter the earth’s atmosphere in an uncontrolled fashion, etc.). This phase lasts until some environmental release has occurred or started. This phase can be physically very short, or can last for a long time. In this case, the designation of the beginning and the end of this phase is generally clear.

The release and immediate post-release phase

This phase is defined as being from the time at which a release begins until the time that the plume has passed. At the end of this phase, deposition has generally ended, but has not yet been fully characterised. Thus, for a moving plume, the actual time at which this phase will end will depend upon how the plume is travelling. For multiple releases over several days, this period will be defined as lasting until the last release has passed. In this sense, a more accurate description of this phase would be the “Plume Passage Phase”, however in order to be consistent with other international literature and conventions, the name, as specified here, is better known and generally in use. For a case such as a nuclear-powered satellite re-entry, this phase would terminate with the “end” of ground deposition. Obviously for releases or re-entries which result in significant radionuclide concentrations at higher altitudes, the designation of the end of this phase is very subjective.

The intermediate phase

This is the time period from the end of the plume passage, or the “end” of ground deposition, as described above, until the crisis management structure is dismantled and the situation management enters into what could be characterised as the new “routine” operation. For many situations, the results of an accident will alter, for perhaps very long periods, the way in which people live, and the way in which “normal” period monitoring is performed. A return to the pre-accident situation may not be possible, and it may not be entirely clear when the crisis management structure is dismantled, because parts of this structure may continue to function, at least in some areas. The designation of the end of this phase is obviously very flexible.

The recovery phase

This is the last phase of an accident, during which the longer-term effects of the accident are dealt with in some “final” fashion. The division between this phase and the intermediate phase is, for these purposes, more related to the management of the situation than to the type and frequency of measurements which would be made. As described above, the boundary between this phase and the intermediate phase is very flexible.

Geographic location

Keeping in mind the needs of the decision maker, three areas have been defined corresponding approximately to the zones in which different types of decisions will be necessary, and different monitoring data will be necessary to support these decisions. Such a simple division has been chosen because such spatial differentiation is very conceptual in nature and is for planning purposes only. Also, while the monitoring strategy for the area closest to an accident site would be different than that at a great distance (several hundred kilometres, for example) from the release site, much finer distinction than this is very artificial and is not useful in a planning context. These spatial zones are defined here.

Urgent protective action planning zone

In many national emergency response plans, particularly relating to accidents at fixed facilities, populations in an area immediately surrounding the facility are designated as being at elevated risk of significant stochastic effects in the event of a severe accident. For this area, often a circle of radius from about 2 to 15 km, urgent countermeasures (such as sheltering, evacuation and the use of iodine prophylaxis) are pre-planned.

Food and agricultural restriction area

Even beyond the above-mentioned pre-planning zone, it is likely that land contamination will occur, but the need to implement population protection countermeasures is less likely. However, in this area, contamination may result in the need to impose restrictions on the use of food and water, and agricultural countermeasures (sheltering of livestock for example) would most likely be implemented. In later phases of an accident, some populations in this zone may be temporarily evacuated or relocated.

Area farther from release site

Getting farther from the release site, although there may be some surface contamination, the need for the application of restrictions on the use of food or water, or the use of agricultural countermeasures is more unlikely. However, area characterisation and reassurance measures may be performed, and in some cases there will be a need to provide advice directed towards specific groups of the population which normally consume, to a great extend, locally grown or caught products, such as meat, berries or fishes. Such a characterisation of an impacted area can also be expected to be required in connection with export of food and feedingstuff originating from this area.

Types of data and information exchange

Another important strategy element is the nature of the parties exchanging information and data, which is tied to the use of the data and information being exchanged. Five types of exchanges have been identified as useful in this context:

Domestic official exchanges

These exchanges will be of data on many different levels of detail, between national agencies, ministries and other official organisations.

Bilateral "local" exchanges

For hazardous sites, such as nuclear power plants, located near national borders, data and information will need to be exchanged very quickly in order that populations on both sides of the border are appropriately protected. In this context, bilateral "local" exchanges are intended to refer to those situations where local authorities from two or more countries are physically close but are separated by a national border. Here, exchanges will most likely be of very detailed information referring to the local implementation of countermeasures, and to local monitoring. These exchanges are often automatic in nature, and are most importantly aimed at the harmonisation of urgent countermeasures and providing a common understanding of the basis for these countermeasures.

Government-to-government exchanges

These exchanges will be of data on many different levels of detail, between central governmental agencies, and will be in fulfilment of bilateral or multilateral agreements. This information and data will, as such, be verified and official in nature, although it is also expected that collaborative discussions between experts will also take place across borders, and between governmental organisations.

Government-to-international organisation exchanges

Government to international organisation exchanges refer to those between governments and international organisations as per international convention requirements. These, like inter-governmental exchanges, will be verified and official in nature.

Government-to-media exchanges

The last type of communication considered here is that from national authorities with their populations and the media. This generally includes such things as instructions to affected or potentially affected populations, information concerning the status of the accident and of measures taken by national authorities.

Data nature

In addition to varying over time, space and as a function of sender and receiver, accident-related data are also different in nature. Some data will change over the course of an accident, such as source terms, countermeasure implementation, etc. These data are "dynamic" in nature. Another type of data is static, and background in nature as opposed to dynamic. A subset of static and dynamic data will be used for the initial notification of the accident. Finally, another derivative of dynamic and static data is that information which will be provided to the public by national authorities and decision makers. This information will generally be instructive and/or informative. Identifying these three types of data will be useful for their formulation in the context of this strategy.

Dynamic data

Dynamic data are all types of data and information (numerical, graphical or textual) relating to an emergency situation which become available only during an emergency situation. This data and information should generally be "digested" by competent authorities prior to diffusion to the public and the media. In general, such data is essential to experts and decision makers in order to allow them to understand the emergency situation and to appropriately protect their affected populations by making decisions in the most efficient way.

Static data

Static data will not change over the course of an accident, such as plant technical details, national emergency response structures, demographics of the area surrounding the site, local and off-site emergency plans, national environmental monitoring structures, etc. Data of this type can and should be exchanged in advance of any emergency situation. Such data will be very useful to national authorities and international organisations in terms of helping them to better understand the overall situation.

Notification

Notification is a specific type of data, comprising a minimum of essential information, static and dynamic, announcing the existence of a situation which has or may result in some significant, off-site radiological effects.

Public and media data

The last type of information considered here is that from national authorities to their populations and to the media. This generally includes such things as instructions to affected or potentially affected populations, information concerning the status of the accident and of measures taken by national authorities

3. IDENTIFICATION OF KEY EMERGENCY DATA

As introduced earlier, emergency communication can be made more effective by improving the "quality" of data and information exchanged. In this context, quality is defined in terms of applicability of data and information to the specific decision-making process for which the data will be used. Because decision-making processes vary as described in Chapter 2, it is important to prioritise data and information as a function of these decision-making variables. The objective of this chapter is to identify that data which is "key" for the various needs of the decision-making process.

Current status and practice

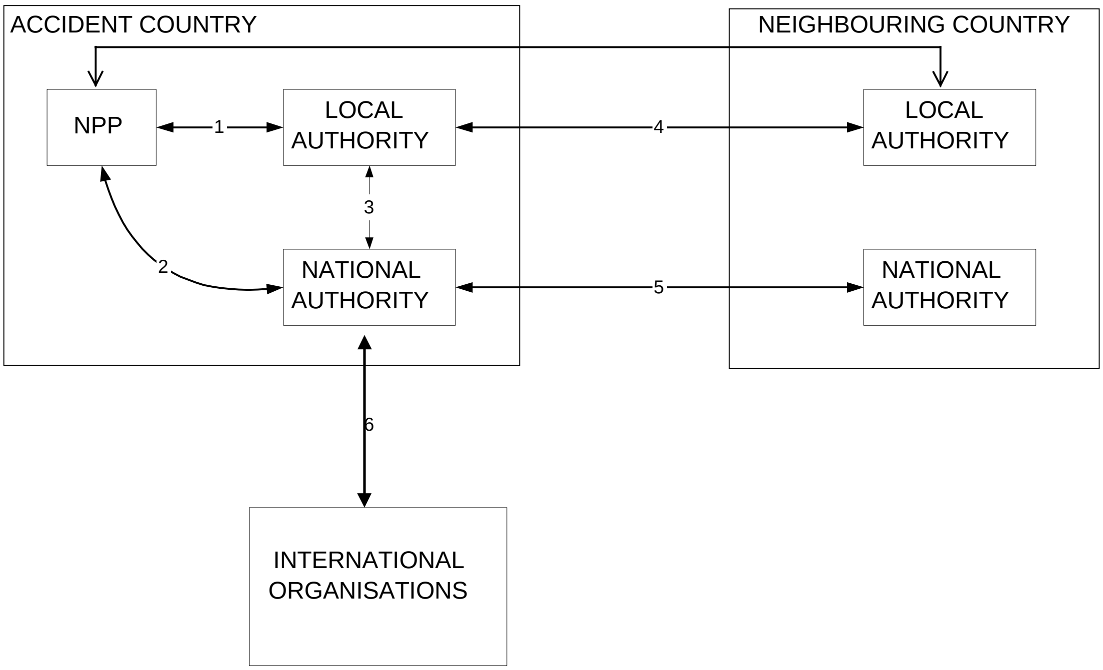
The following description of the current status and practices remains very general, and does not necessarily represent the details of any existing emergency response organisation in any particular country. It does however identify the key organisations and elements required for local, national, bilateral and multilateral notification and data exchange in such situations. Figure 3.1 is a schematic review of that key organisations involved in the response to an emergency situation namely:

- the nuclear power plant;
- local authorities;
- national authorities;
- local and national authorities in neighbouring countries;
- national authorities in non- neighbouring countries; and
- international organisations.

Within this general framework, various schemes have been planned or implemented to facilitate these information flows. For example, the IAEA has established an "early notification convention" encompassing approximately 80 of its member states. The European Commission has also issued a directive to its member states in this area. Systems and procedures have been established to implement the IAEA and EC approaches.

In addition at a European level, a pilot project, EURDEP (European Union Radioactivity Data Exchange Platform), was started in 1994 to test the technical feasibility of exchanging automatic monitoring data between 15 EU member states, Norway, Switzerland and JRC Ispra. At the present time some 20 countries participate in this data exchange exercise, which is based on daily values of gamma dose rate and air concentration. It is foreseen to use this technical platform in emergency situations with data updates every 2 hours. This technical data exchange platform is being extended to Eastern Europe (EUR96).

Figure 3.1 **Flow of emergency data and information**



Again at the European level, an integrated and comprehensive "Real-time On-line Decision Support system" (RODOS) for off-site emergency management of nuclear accidents is being developed. The RODOS system will be applicable from the very early stages of an accident to many years after the release and from the vicinity of a site to far distant areas. Decision support will be provided at various levels ranging from the largely descriptive, with information on the present and future radiological situation, to an evaluation of the benefits and disadvantages of different countermeasures options (ROD98). Products provided by these international projects should be included within a key-data exchange philosophy.

These initiatives somewhat address the problems posed in the introduction, however do not directly address the most important issues surrounding the questions of key data. A strategy for the identification of key data is thus necessary. Although there will always be a two way communication between the various organisations identified in Figure 3.1, the present work concentrates on the description of the data flow from the local/national authority to the authorities in the neighbouring country and to international organisations.

Key data identification strategy

Based on a review of current practices, and on experience gained from international exercises, it is felt that the specific needs of experts and decision makers of various emergency organisations, and of the public could be better addressed by the identification of key data and information exchanges. This, in turn, would help to improve the efficiency and effectiveness of data and information exchanges.

As presented very briefly, the proposed strategy for the identification of key data is based on addressing the needs of the decision-making process. These needs are characterised by dividing an accident into several phases in time, each having more or less unique data requirements, and by identifying the nature of the sending and receiving organisations (see Chapter 2). The matrix relationship of these two types of divisions is shown in Table 3.1

Table 3.1 **Matrix structure used for the identification of key data**

	Notification	Pre-release phase	Release and immediate post-release phase	Inter-mediate phase	Recovery phase
Domestic official exchanges					
Bilateral “local” exchanges					
Government-to-government exchanges					
Government-to-international organisation exchanges					
Government-to-media exchange					

The intention of Table 3.1 is to show a clear strategy of how the nature of “key” data and information will change depending upon the function of the sender and the receiver, and depending upon the phase of the accident. It is agreed that there are sub-categories of communication, and the types of “products” necessary for effective communication will vary. Specifically, communications between decision makers, or communications between experts and decision makers require a level of detail and presentation format suitable for making decisions. Communications between technical experts requires a level of detail and presentation format which is sufficiently complete to ensure full technical understanding by all parties. Finally, communications from governments to the population requires a third level of detail and presentation format to appropriately instruct populations and provide necessary information.

Key data tables

Based upon the above-mentioned strategy, key data for each level of information exchange can be identified. In order to be most efficient, however, key data should be identified as much as possible based upon existing structures and protocols. For historical reasons, using this approach it is most convenient to divide key data into that which is used for emergency notification, and that which is used for all other accident phases.

Notification

For some time, both the IAEA and the EC have been using various, standardised formats to send notification of emergency situations. Recently, the two agencies have finalised an emergency notification format, which is included here as Annex 1. This format has been developed based on the historical approaches of the two organisations, as well as on experience from the INEX 2 series of international exercises.

In order to make recommendations which are as efficient and effective as possible, it is strongly suggested that this joint notification format be used as the standard for all notifications at all levels. This will avoid the need to develop notification messages for different purposes and destinations, and will save time and resources during the initial, critical phase of an accident. The information contained on the joint notification format appropriately fits within the strategy outlined by this report.

Other accident phases

Within the context of emergency data and information exchanges which are currently in use, it is appropriate and efficient to base the identification of key data, as outlined in this strategy, on existing approaches. In order to implement the IAEA Early Notification Convention (IAE86) and the European Union Council Decision on Early Notification, the Convention Notification and Information Structure (CIS) (IAE92) has been adopted. This structure identifies useful data and information in many categories, which are broadly presented here in Table 3.2.

Table 3.2 **Convention Notification and Information Structure (CIS)**

Contents	***Line – Number***
General information about the message	001-004
Notification data	010-053
General characteristics of actual release	100-143
General characteristics for future release	200-217
Site meteorological and dispersion conditions	300-323
Projected dose information	400-409
Environmental off-site monitoring results	500-547
Off-site protective measures	600-654
Free text messages	900-902
Indication of confidential data	980-981
Distribution list	999

Because this structure already exists, it was logical to base any new identification of data and information on the CIS. However, the CIS does not provide any prioritisation of the large amount of data and information which are identified. As such, the matrix structure identified in Table 3.1 have been used as the basis for selecting key data. For each type of data exchange and in each accident phase, the data identified as key are provided in the tables in Annex 2.

Additional key data

Although the CIS presents a very complete list of types of data, experience has shown that a few modifications and additions to this list will improve its applicability. For example, recent approaches to emergency management, particularly in the Notification and Pre-release phases, have focused on emergency classification and plant conditions as indicators and triggers to actions. This approach is not reflected in the current CIS, but clearly represents data which is key in early accident phases. Also, the use of the INES accident severity rating scale should be addressed. Finally, it is recommended that a few relatively minor refinements of the CIS list would significantly improve its value. These issues are presented here.

Plant conditions

For those accident situations which are slowly or somewhat slowly developing prior to any release of radioactive material, many countries are now basing at least partially their decisions concerning urgent countermeasures on indicators of plant status. Indicators concerning the status of emergency core cooling systems, and concerning the integrity of various boundaries to the release of radioactive materials (in the case of nuclear reactors, these include the fuel cladding, the primary circuit, the reactor containment) are seen as the most significant. Many countries also use a system of plant status classification.

Recognising the importance of these considerations, the IAEA has developed an emergency classification scheme, IAEA-TECDOC-955 “Generic assessment procedures for determining protective actions during a reactor accident” (IAE97), and jointly with the EC has developed a short checklist to indicate plant status. Currently within the CIS, line 24 asks whether the situation at the plant is improving, unchanged, deteriorating or unknown. The two organisations have proposed that this line be replaced by a checklist, the draft of which is included here as Annex 3. The use of this checklist will significantly improve the CIS treatment of plant status. This information is seen as being key data for all types of communication in the Notification, Pre-release, Release and Immediate Post-Release phases of an accident.

Use of the INES scale

The International Nuclear Events Scale, INES, was developed by the NEA and further enhanced and implemented by the IAEA. Originally, this scale had been intended to serve as a sort of “Richter scale”, to be used as a communication tool to indicate to the public the severity of nuclear accidents. With time, however, the scale has instead developed into a tool used by the nuclear safety community for accident characterisation.

In current practice, the scale thus has two uses. First, significantly after the “end” of an event, the official INES rating is assigned by responsible authorities based on a relatively thorough understanding of all event circumstances. Second, very early in an accident and as the accident develops, authorities often determine a provisional INES rating to give an order-of-magnitude to the situation when discussing the situation within the emergency response framework or with the public and the media. Both applications of the INES scale are viewed as useful, however in the context of key data, it is noted that the second application is important in government-to-government communications, government-to-international organisation communications, and government to public and media communications. A third, incorrect, use has been as a partial basis for decisions regarding countermeasures.

However, it is essential that all communicating parties have an agreed-upon understanding of the INES rating. First, it is emphasised that the INES rating is a useful tool for communications, but that the INES rating has nothing to do with the basis for making decisions concerning countermeasures. With this in mind, early, provisional assignment of an INES rating can be useful as a communication tool. In any case, it is recommended that authorities should specify whether their assigned rating is based on the current situation and knowledge (an exact assessment), or whether it is based on their assumption of how the accident will progress (more of an upper limit of consequences). This advice is consistent with experience from INEX exercises. To accommodate this recommendation, the CIS should be modified.

Data applicability

Because data is often retransmitted, sometimes long after it is received, it is essential to know when the data is applicable. That is, it should be stated in the message that “the following information is valid as of (date) and (time)”. This will assure that anyone receiving the information will be able to compare it to other information and to appropriately situate the information in time. Also, in order to help receivers of information to better assess its nature, the identification of the data originator should be clearly marked.

Other recommended modifications

In addition to the above-mentioned changes, the following small modifications to the CIS are recommended to improve its usefulness and applicability:

- In section 30, “Countermeasures”, it is important to list all possible countermeasures. An example of a missing countermeasure would be “Travel restrictions” recommended for the affected area.

- Date and time of report status represent key data. This information should be indicated for each individual chapter given in the report.

- In block 100 to 143 the starting date and time of an actual release is missing. Although this information is given in line 25 this data is part of the “general characteristic of actual release”.

- Add a line 144: If the release has stopped, is there a possibility of an additional release?

- In section 200, the chemical form or nature of the release should be requested, if known.

- Line 302 lists weather conditions, following a list which was developed by WMO. It is recommended that the list should be more complete, and should include extreme weather conditions such as ice storm, tornado, hurricane, typhoon, and flood.

- A new section 330 should be introduced allowing results from model calculations to be included in terms of concentration fields. This includes air concentrations (in Bq/m^3) and deposition (in Bq/m^2). Results should be available both in graphical and numerical form for further processing.

- A new point 516 should be introduced describing results of deposition measurements (in Bq/m^2) for relevant radionuclides. These results should be available both in graphical and numerical form.

- In 540-547 monitoring of people should be included.

- In section 540, Other measurements, the water source, whether “raw” water or “processed” water ready for drinking, should be specified.

Data communication and presentation formats

An essential aspect of data and information communication is the format of presentation and the format of communication. These two have to be considered together and not separatly. The transmission of “raw” data allows the receiver to present the data in different formats, whereas the transmission of graphical information restricts the flexibility and leaves the receiver no possibility to change the graphical presentation significantly. Thereby the sender of information decides on the format and layout of the product the end user receives. As briefly mentioned earlier, the end use of the data is a key factor.

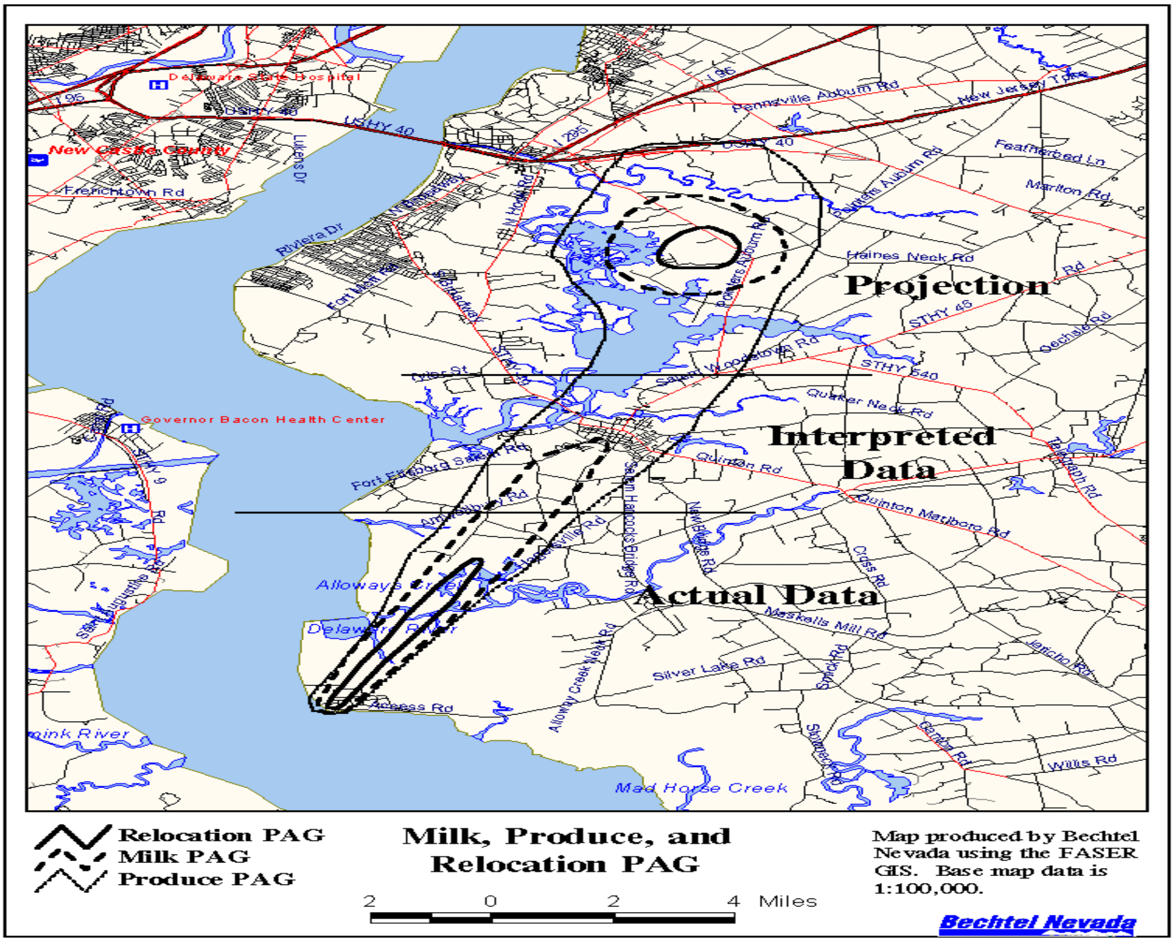
For example, experts communicating among themselves will require data to be presented in sufficient detail to allow subsequent manipulations and calculations based on their own national approaches, computer programmes, and assumptions. This implies the need to have electronic transmission of graphical information, tabular data, as well as textual material. The formats used should allow, in these cases, that the data can be manipulated by the receiving organisation. This will require that specific formats are pre-established. This also enables each expert to prepare his own presentations so that he has not to rely upon presentations made by others.

For decision makers, however, a much more synthesised view of the situation is necessary. The data and information presented to decision makers should be clear, concise, and as uncomplicated as possible to best highlight the possible choices which can be made. Here, simple tables, graphs and graphics may be the most appropriate, and their format must allow clear retransmission. This type of information should be easily cut from the incoming document and pasted into other documents for retransmission or other uses. The content of such information, however, should generally not be manipulated. For example, meteorological information from the WMO represents internationally recognised expert judgement, and should not be manipulated or altered. For communications with the public, particularly in terms of recommendations of particular countermeasures, instructions and information must be very clear. In this context, different data formats are necessary, including, for example, pictures, graphs, maps and tables.

Early in a radiological emergency situation, decision makers must make decisions for the safety and well-being of the public based upon very little, if any, radiological monitoring data. It is the responsibility of the experts to present an estimate of the off-site radiological situation to the decision makers in as clear and unambiguous terms as possible. One technique for communicating the off-site situation to the decision makers is the use of Geographical Information System (GIS) technology. The ability to integrate the path of plume passage, extent of deposition, and contours representing various intervention levels with aerial photography and maps containing local population distribution, infrastructure, land use, rivers, bodies of water, and other geo-referenced data is a very robust communications tool. It is nevertheless essential that a clear indication be made that the display data is either actual, interpreted, projected or a combination of some or all of these possibilities.

The following GIS map, Figure 3.2, is an example of what could be a typical data product produced several days after deposition from a nuclear power plant-based release scenario. Overlaid on the map is the Protective Action Guide (PAG), as used in the United States, intervention level contour for the relocation of the public and the PAG contours for the ingestion of milk and produce. The contours incorporate field monitoring data and model projections. Although this data product is in colour, the contour lines are sufficiently distinct so that the data product can be reproduced in black and white or faxed. This data product presentation provides the decision makers with a clear and easily understandable presentation of the off-site situation and relevant intervention levels.

Figure 3.2. **GIS map produced several days after deposition from a nuclear power plant-based release scenario**



Language considerations

The language used in transmitted messages is particularly important. Messages received in a language other than the native language of the receiver are often time consuming to translate. Messages written in a language other than the native language of the sender are also time consuming to translate, and may not be as accurate or as complete as a message written in the sender's native language, particularly in situations which are complex and difficult to describe.

The use of the CIS for information transfer has facilitated the use of various languages. The structure itself has already been translated into several languages. Thus, transmitting simply the line number from the CIS, the receiving organisation can "read" the information being transmitted in any language into which the CIS has been translated. Automatic computer systems to read the transmitted line numbers and to convert them into text in a desired language are already in use.

Free text messages, however, still present the language problems described above. The European Commission, for example, is required to accept and retransmit messages received in any European language. The IAEA Notification Convention requires messages to be in one of six official IAEA languages.

To address these difficulties, many countries try to send free text messages in English. Because of accuracy and timeliness considerations, this is not always the best solution. An approach which has been considered would use the international agencies (the IAEA and the EC principally), to translate received messages into English for retransmission. The ultimate solution to this problem, although not major, must be discussed and agreed upon, tested and implemented internationally.

4. STRATEGY FOR EFFICIENT EMERGENCY COMMUNICATIONS

International communication and exchange of information requires international consensus on necessary strategies and technologies. It is therefore necessary to identify the requirements for information exchange, and to consider the technical possibilities that are available in order to implement optimum solutions.

In addition to the need to improve the technical means currently used for information transfer, it is also apparent that a more rational strategy for emergency communication is needed. Specifically, optimisation of communications will probably involve some information being actively sent, while other information is made available for retrieval. The form and content of these exchanges need to be compatible with the technical means used for their transmission, and redundant "retransmission" of messages, information and data should be minimised. Such an approach will help to minimise the duties of the accident-affected country in terms of communication requirements, and will facilitate the gathering and assessing of information by other interested countries.

This chapter is an attempt to outline a proposed strategy for emergency communications, and to identify possible technical means to implement this strategy. Advice to improve some of the organisational aspects of communications is also given. The chapter is limited to information exchange between governmental bodies and international agencies, as well as with the media and the public. Communications with the utility or response personnel are not addressed.

Current status and practice

At present, emergency communications make use of dedicated and normal phone connections, teletype nets such as used by police for first alarms, data exchange connections such as the European Commission's ECURIE system, and fax machines such as are used by the IAEA's EMERCON system as well as by ECURIE. These means of communications have been rather reliable, but can not easily be adapted to the modern needs of data exchange. Current systems are either somewhat time consuming to manipulate for other than simple textual information, or the quality of transmitted information is poor or deteriorates with successive retransmission, as is the case for faxes. For transmission of data to be further processed, they are not suitable at all.

Various tests to improve the effectiveness of emergency communications using modern means of communications have taken place, particularly in the context of the INEX 2 series of exercises. Such systems as the Internet or e-mail have not yet, however, been able to meet all emergency communication requirements, particularly in terms of their lack of reliability and security. Such tests have, however, shown that modern means can be easier to use than current techniques, and are capable of higher quality data and information transmission than currently utilised means, including the capability to effectively transmit photographs, graphics, and figures.

Independently of the improvements which are suggested later in this report, various improvements of emergency notification and information exchange strategies and systems are underway.

For example, some standardisation of the fax format used for notification and follow up messages within the EU and world wide for IAEA Member States is being investigated. The Nordic countries already use such a fax format which is currently being used for "below early notification threshold", but which can be used as an example for other countries or the agencies.

The ECURIE system is currently under improvement. Besides other aspects, it is foreseen that the speed and reliability of the message transfer will be improved, and that the transfer of graphical radiation protection and emergency management information via such systems as, for example, VISEC (Visualising ECURIE information) will be allowed. The European Commission is developing a technical improvement of the ECURIE network for the transfer of emergency monitoring data. This system, called EURDEP (European Union Radioactivity Data Exchange Platform), uses ISDN lines and SMTP protocol, and is now being implemented for future use. The prototype database and visualisation system of EURDEP works with central server based on world-wide-web technology, and provides restricted access via the Internet.

For further increasing the usefulness of the EURDEP system, an interface has been made to the RODOS system, a real-time, on-line decision support system for general applicability in Europe (ROD97). The RODOS system is being developed and installed for operational use by a consortium of about 40 contractors in East and West Europe. The intention is to interconnect the distributed RODOS systems in various countries within the framework of an international network for radiological data exchange. The already existing RODOS/VISEC interface, and the corresponding data transmission will be tested during the next INEX exercises.

The European Commission has funded a project aiming at the installation of an operational prototype network for the on-line data exchange of radiological information. After its completion, it will be possible to distribute data quickly and reliably among the interconnected countries, not only basic accident information (source term data, measurements) but also processed information on the current and future radiological situation and on emergency actions and countermeasures. Two regional centres will be established in Russia and Hungary, with the former linked to national centres in Belarus, Russia and Ukraine and the latter to a national centre in Hungary. In addition, data will be exchanged with a regional centre (EURDEP) in Western Europe.

Intention of a new strategy

In general, existing communication systems, with over 13 years of experience after the Chernobyl accident, function well. However, based on this experience, a renewed look at the functions which such systems are designed to fulfil is useful.

In order to appropriately design a coherent emergency communication and information exchange strategy, it is important to understand what such a strategy is intended to achieve. In general, such a strategy should assure that notification of an accident is appropriately transmitted and received, that follow-up accident-related information describing the status of the accident and of emergency response actions is appropriately made available to all concerned parties, and that other relevant background information is made appropriately available to all concerned parties. This must be done in a reliable and secure fashion, and should be performed in a way which optimises the appropriate assessment of data by its end users. More detailed description of these needs are provided below.

Classification of stages

Generally in an emergency situation, government agencies (at various levels) and international organisations will need to communicate internally, with other governments and international organisations, and with the public. For the purpose of optimising emergency communication and information exchange, it is useful to divide the type of information into the categories described in Chapter 2:

- notification, or first alert;
- co-ordination of dynamic, accident-related information with other institutions or agencies; and
- dissemination of static, background information;
- public and media information.

In this context, notification or first alert refers to the first OFFICIAL information received by an emergency response organisation. Notification must include a certain minimum level of information, as specified by various international conventions and bilateral agreements. The definition and identification of this "key data" is addressed in Chapter 3 of this report. Communications must be secure, very rapid and extremely reliable.

The alert or notification must include a "wake-up" instrument in order to assure that the unusual event is recognised by the addressee. The volume of information transmitted for these alerts is limited, since generally in the beginning of an event the amount of information available is still scarce. From there on, one may assume that incoming messages are watched such that further wake-up is not generically needed. Clearly, the first notification must be actively sent, or "pushed", to responding organisations.

With many different, sometimes only partially affected agencies working and more information being gathered, the number of exchange partners as well as the volume of dynamic information will rapidly increase. This information will include such things as post-notification plant status follow-up information, countermeasure implementation (or non-implementation) decisions, environmental monitoring data, official press releases/statements, etc. Because of the volume of such information, a rational communication strategy is necessary. The information/data needs of the various governmental agencies and international organisations involved will not be the same. Some of these messages must be pushed, and in some cases accompanied by a wake-up signal to assure that their importance is recognised. Some other messages may not be so urgent, and could be delivered via a more passive system. This would allow for a mixed push- or pull-system.

Finally, there will be a need to exchange static information, particularly concerning the physical characteristics of the plant, maps of various affected areas, national and regional emergency response structures and procedures, etc. This information will most likely be largely public, but will need to be reliably accessed by governmental agencies and international organisations in times of emergencies. The need to exchange large amounts of such data during an emergency situation may be reduced by the prior exchange of static data, such as information on plants and surroundings in the planning phase. This would allow, for instance, the overlay of dynamic data, such as deposition levels, on static, pre-exchanged maps.

Another aspect of the responsibilities of government agencies and international organisations involves communication with the public and the media. In terms of public and media information, it was agreed that these types of communication would mostly be recommendations as to countermeasure implementation, and official press releases. Public feedback could also serve as a valuable source of information for governmental agencies and international organisations as to what type of information they are not adequately supplying.

Technical requirements on the system

A system for communications in nuclear emergencies must be secure and absolutely reliable. It must be able to transmit large amounts of data, even under heavy load on (public) lines. From the experience of other disasters, it is clear that public telephone lines may break down due to overloading. Physically independent lines should be used, but these have to be well maintained and tested periodically if not used regularly, e.g. by police. These lines should be designed such that demands by emergency personnel during accidents will not lead to problems. A high degree of redundancy should be ensured.

The connections must be secure, i.e. secured against intruders that might change or misinterpret the information, but more importantly would overload communication channels. Information must therefore not be accessible by unauthorised parties.

As stated earlier, a wake-up feature for alert and, partially, for co-ordinated information exchange is essential. Moreover, the possibility for positive confirmation of receipt is important, and it is noted that this is currently not well addressed by conventional e-mail systems.

Finally, for all these types of information exchanges, format requirements should be as flexible as possible, but agreements on standard formats should be reached, as necessary, to ease the exchange of data and documents. These should be available as standards for accepted file formats for word processing, data handling, or graphical codes. The formats should be open to updated versions, but still be able to read earlier versions. The speed of introducing new standards may vary from country to country.

Organisational aspects

In general, the amount of redundant, and thus sometimes confusing, information which circulates during emergencies should be minimised to reduce confusion and congestion of communication lines. One aspect of this should be addressed by looking at the information exchange requirements of international and bilateral agreements. The doubling or even tripling of messages must be avoided, and only relevant information must be exchanged. Since the question of relevance is relative to the user of information, some type of passive system of making information available for retrieval is a possible solution which would allow users to tailor information to best fit their needs. Only first notifications, and some information concerning significant changes or for co-ordination purposes, should be actively sent, or pushed.

One last organisational issue concerns the speed of information transfer and digestion in order to meet public information needs. The modern media is extremely well equipped to rapidly gathering information from remote sites and to make this information widely available to the public. To assure that emergency response agencies are appropriately informed of emergency situations in a timely fashion, internal procedures should assure that information, particularly notification information, is rapidly processed and internally distributed to all relevant organisations and individuals.

The above discussions should not be interpreted as indicating that emergency notification and information needs are not currently addressed by existing structures and mechanisms. However, this review does lead well into the description of a new strategy to more effectively address these required functions.

Communication strategy

Based on these discussions of the types of communication and exchanges that governmental agencies and international organisations will need to perform, it appears that the best approach to help to improve the situation is to attempt to characterise an appropriate strategy in these areas, and then to propose technical means to achieve the implementation of that strategy.

In general then, in order to establish an international information communication system in accordance with ideas described above, a single communication system should be established and should be capable of handling all kinds of information related to a nuclear accident, and should have sufficient capacity for this exchange. The same system should be operated for international and domestic communication of information in all countries.

The system needs to be implementable in all parts of the world, supporting different levels of sophistication with respect to the various levels of technical development and national implementation found in industrialised and developing countries. The system should furthermore provide solutions having maximum flexibility with respect to future technical development and covering the needs foreseen for approximately the next 10 years.

The system should be designed in such a way that the quantity of data and number of messages transmitted are minimised, while at the same time maximising the useful content of messages. Different countries will focus on different problems in different phases of an accident, depending on such aspects as the distance to the site of the accident and the weather conditions. Since it is very difficult to treat all international communication partners individually, it is very important to assure that each user has access to the information he needs, and that information that he is not interested in is not automatically transferred, congesting transmission pathways and diverting valuable data-analysis resources. It is also important to establish systems that prohibit duplication (and triplication) of messages. In order to achieve this, data transfer should be conducted in two different modes:

- **Push mode**: Information considered important and urgent should be actively sent from the sender to the receiver. The sender should be responsible for the transmission.

- **Pull mode:** Information considered to be of interest for others, but not urgent, should be made available to potential receivers. The receiver should be responsible for fetching the information needed, and should be responsible for the transmission.

The communication system should be easy to use, minimising the manpower required for operation. International communication should not introduce substantial additional requirements with respect to resources. Automatic testing of the system, including address-list tests and overload tests, should be implemented, and appropriate backup systems should be planned, tested and made available.

The communication system should be based on standard commercially available components and tools which do not require any development of proprietary “gadgets”. In order to establish the system all over the world, the lower limit of cost for establishing the system should be low (a few thousand US$). The communication system should also offer maximum redundancy with respect to failure.

The strategy for the communication of the preliminary accident notification, dynamic, accident related information, static, background information, and public and media information should be based on the following new system using both push and pull approaches.

Accident notification and urgent, new developments (such as unexpected releases, sudden status degradation, or the implementation of significant countermeasures) should be actively sent, or pushed, by the accident country's authorities, and should have a "wake-up" function to assure that they are recognised as being important by receiving organisations. First notification messages to all required recipients should be identical, of "standardised format", and easily identifiable as being a notification of an emergency situation. Any information requirements from international conventions and bi-lateral or multilateral agreements should also be pushed, as appropriate. Messages should also be easily sent, and should be verified by "message received" and "message read" signals back to the sender.

For all other accident-related information, a data server approach should be used. This would make information available for interested and authorised parties to come and retrieve. Because each agency and organisation will have different needs during the various phases of an emergency situation, information servers should be flexible enough to address all these needs at the same time. To accomplish this, the following general structure is proposed:

- At the national level: each country and international organisation involved in an emergency situation should establish a communication node system, based on world-wide web technology, to which it will supply information in English concerning dynamic, accident-related data. These sites should be appropriately secure.

- Site linkage: all international sites should be "hot-linked" together in a secure structure, relying on a key-management system run by an international organisation also linked to the system. This model, of linked sites to which all involved organisations input data, could also be used on a national level to link various national authorities and institutes.

- System structure: the secure system should be based on "dedicated" lines, which would have as a backup the standard Internet/world-wide web system. The structure of these Web-pages should be somewhat "standardised" to allow users quick and easy access to the data they need for their decision-making process.

An international organisation such as the International Atomic Energy Agency (IAEA) or the European Commission (EC) could act as the co-ordinating organisation in this network of national and international websites. This international organisation could also assure the indispensable security of the network by running a key management system. The reliability of the network is warranted by the network itself, where many routes to transmit data are available and automatically chosen within the network.

Each country or international organisation, willing to participate, will have a key to enter the secure network. The link to the network will assure that the user will receive all important and urgent information (in **push-mode**). This information will be sent either by the country, in which this information occurs, or by the co-ordinating international organisation, if the informing country is not linked to the network. Countries, who are not participating in the network, will receive the same important and urgent information via conventional media, such as telex, fax, phone, etc. as up to now.

All important and urgent information sent in **push-mode** via the computer network will – at least in the beginning of the operation of the network – be sent also via conventional media, such as telex, fax, phone, etc., as backup. The first notification messages should be actively sent by perhaps several means simultaneously. By using a computer-based system and a database of recipient "addresses" (e-mail, fax, telex, etc.), an automatic mailing system can send the first notification message using the means (perhaps more than one) which is appropriate for each recipient. A back-up system must be available. The database of these addresses must, of course, be established before any emergency situation and must be maintained in an up-to-date condition.

- Update frequency: new information should be made available on Web-pages as soon as it becomes "official". If no new information has developed for a few hours (or several hours in later stages of the accident) a message to the effect of "no new information is available as of XX:XX UTC" should be posted.
- Backup system: it is obligatory to include a backup system for the transmission of such information. The commercial Internet lines should be used, with appropriate message encryption, as the primary backup, with fax or other more conventional systems as a secondary backup.

Because some types of information will not change during the course of an emergency situation, these can be placed at the disposition of interested and authorised agencies and organisations using the same type of server approach described above. In times of an emergency, governmental agencies and international organisations will need free access to such information, thus should be guaranteed priority entry into such databases. In many instances, this same information will be of value and interest to the public and the media, however separate or mirror systems will have to be established for the media and the public to assure that governmental agencies and international organisations are not forced to compete for access time.

Similarly to the electronic systems described above, it is proposed that web technology should be used to establish a second server system which would be accessible to the public and the press. Such a system should be run from a server separate from the server running the authority's information exchange process to avoid overloads and security problems, however mirroring of officially released data should be possible from the authority site to the public site. The use of such an electronic approach will not replace the need for other means of public notification (recommendations to implement urgent countermeasures for example) and press communications (press conferences and interviews). Current status and background information, however, can very effectively be transmitted by such means. Sufficient capacity should be provided.

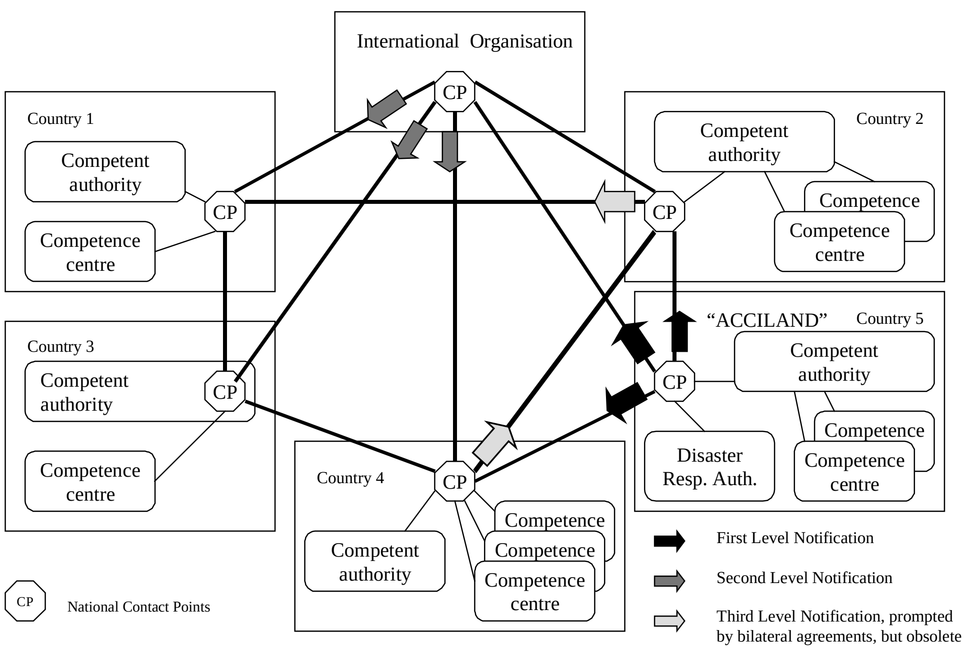
Technical means for strategy implementation

Although there are many methods which could be used to implement this strategy, based on the current and projected status of modern communications technology, the use of a secure network based on World Wide Web technology is the most likely to completely address the needs of the strategy, and to be flexible enough to evolve as technologies improve. The configuration of such a network should be like that shown in Figure 4.1.

In this configuration, contact points in participating countries and international organisations are all linked through a secure, reliable network. Although access to these sites is controlled, all participants can send messages within the network, and have at least read-only access to all other network sites. For such a system to work most efficiently, it is optimum for each country and international organisation to have only one contact point. National ties to this contact, for providing and receiving information, should be nationally co-ordinated, and may use a national-level network structure similar to the international network structure. National data made available to the international network could thus be all read from this contact point location, or the contact point location could act as a guide and link to other national network points. National configurations will obviously depend upon national structures and priorities.

The security of this network should allow three levels of access. First, a password system should be used to verify the identity of official participants and grant them access to the first level of information. Such a key encryption system should include a digital signature and restricted access. Commonly used Web browser have already implemented such features based on public/private key encryption techniques. Such access to the first level should be read only in nature. Additional passwords can be used within each site to allow access to more specific and/or confidential information. Such a distinction would allow, for example, access to the press and the public at one level, and access to participating governmental organisations at a second level. Again, however, access at the second level should also be read only. The third level of access would be reserved for the organisation maintaining the web site and supplying information.

Figure 4.1 **International communication links for emergency notification and information**



The network should be based on a world-wide carrier, or system of world-wide carriers, through which national participants can connect via their own national access providers and systems. These are commercially available but have to be checked for reliability. Therefore, the contract with the provider has to encompass a priority boost.

For test and back-up purposes, the public Internet can be used and should be accessible by the contact points. The public Internet may, in some cases, be the only pathway available for some national competent authorities, and will most likely serve, at least initially, as the primary backbone of the network.

5. EMERGENCY MONITORING STRATEGY

The experience from the INEX 1 and INEX 2 exercises has shown that there is a need for a better understanding of the emergency monitoring aspects of emergency planning, preparedness and management. The strategy for emergency monitoring, as it is described in this chapter, should be seen as part of an improved strategy for data and information acquisition. One initial aspect of this work concerned the understanding of the various detailed, country specific aspects of emergency monitoring. It was thought that this would allow decision makers in different countries to perform valid comparisons and analyses of communicated data and information. However, it was observed that these very technical aspects could become extremely detailed for even just a single country, and that for practical purposes this level of understanding is not completely necessary.

The overall emergency monitoring strategy includes two different modes of information acquisition, as there are physical measurements of relevant data on one hand and modelling of situations as a tool for interpolation and extrapolation in time and space where measurement data are sparse on the other hand. It should be kept in mind that these two different modes are complementary and should not be separated. The distinction between what is measured and what is modelled depends again on the scenario, the time phase of the accident and the resources available.

The focus of this chapter is on the identification of an overall emergency monitoring strategy, based upon which monitoring priorities can be established, good practice can be identified, and guidance can be drawn. The situations discussed include mostly the “off-site” collection of “raw data”, once radioactivity has been released from the nuclear installation. On-site data collection, such as stack monitoring or personnel dosimetry, as well as modelling techniques to obtain information relevant for decision making, are not included in this report.

Current status of emergency monitoring and the need for changes

At this time, over thirteen years after the Chernobyl accident, emergency monitoring programmes in NEA Member countries are well developed to address national concerns, and reflect various national approaches and priorities to internal and external threats of radiological accidents. However, for various reasons, such as historical background, advances in modern hardware and software, regulatory requirements, etc., national emergency monitoring programmes include very country-specific characteristics. This has lead to differences, both in approach and in technical details, which can cause confusion and misunderstanding when interpreting data coming from another country. However, through regulatory reforms and reassessment of resource allocations, many national programmes are being, or will be in the near-term future, reviewed and appropriately modified to meet evolving national needs. The possible qualitative and quantitative uses of monitoring data, in connection with international exchanges and comparisons, are important to consider in this regard.

In a qualitative sense, monitoring data from other countries is important, for example, to identify trends (increases or decreases) in radiation levels or in radionuclide deposition levels. This level of information can help in plume tracking, and in giving an “order-of-magnitude” understanding of the results of an accident, which in turn helps in the understanding of countermeasure requirements. This would particularly apply to countermeasures concerning foreign nationals within or travelling through the country whose data is being interpreted, or concerning the control of individuals or merchandise coming from the affected country. For the purposes of this type of decision making, a simple qualitative understanding of levels and trends is often sufficient.

In a quantitative sense, monitoring data from other countries is important, for example, to performing source-term estimations, or to help identify the source of a release if its origin is unknown. For releases which occur very near a national border, detailed quantitative data will be very important in both affected countries for the preparation and evolution of protective countermeasures. Here also, particularly in the early stages following a release, detailed quantitative monitoring data will be very useful for the validation and/or refinement of the model predictions on which some countermeasures have been or will be based. In general, these quantitative uses of monitoring data will be very case and location specific.

For these types of uses, a thorough understanding of sampling and monitoring conditions is necessary to avoid misinterpretation. The sorts of condition include:

- the geographic location of the measurement (Global Positioning System – GPS – is useful in this regard);
- the date and time (in Universal Time Co-ordinated – UTC – or defined time-zone at which the measurements was made);
- the duration of sampling;
- whether the results were decay corrected to the time of sampling;
- the height above ground of the measurement (1 m, 1.5 m, roof-top, etc.);
- in some cases, the physical surroundings of the detector (in a forest, in a field, in a city, etc.) can be important;
- what is the level of “normal background”;
- a clear understanding of physical quantity being measured (ambient equivalent dose rate or air kerma rate); and
- a clear understanding of the measurement assumptions, including whether the sample results are reported as wet or dry weight for specific activity measurements (it is impossible to tell from simply Bq/kg), how dose-rate instruments have been calibrated, and, in general, what measurement procedures have been used.

From these considerations of the uses of qualitative and quantitative data, and based on the known existence of differences in approach and details, sometimes significant, among the monitoring programmes in various countries, extensive listing of detailed differences seems to be unnecessary. Those specific cases where the need for such details are already identified, such as for nuclear power plants located near national borders, local arrangements are generally already in place for appropriate data sharing. For those specific cases where accident characteristics result in a need for additional understanding of monitoring details, existing bilateral or multilateral arrangements (agreements, contacts, etc.) will be necessary. These however are best performed on a case-by-case basis due to their specific nature.

However, as input to the evolution of national programmes, to the understanding of qualitative data needs, and to the prioritisation of those quantitative details which need to be communicated, a generic emergency monitoring strategy would be very useful. In general, this will guide the identification of monitoring priorities, and the subsequent national programme implementation necessary to address these priorities. The following sections provide a unique approach, based on the needs of decision makers and those officials providing information to the public and media, to identifying an appropriate emergency monitoring strategy, and provide some general information concerning strategy implementation.

Emergency monitoring strategy

In the development of a national emergency monitoring strategy, national and international aspects must be considered, the reasons for performing emergency monitoring must be the basis of the strategy, and the intended uses of the resultant information should guide the choice of monitoring priorities and the technical details of what monitoring is performed. With this in mind, one approach to developing a strategy is to view the priorities in terms of the decision maker's needs. Specifically, "WHY" (for what purpose) should emergency monitoring be performed, "WHAT" (in terms of physical quantities to be measured) parameters should be monitored, "WHEN" (with respect to the time-phases of an accident) should each parameter be monitored, and "WHERE" (with respect to the accident site) should specific parameters be measured. These four questions form a structured "matrix" which can be used to define emergency monitoring needs and priorities.

This section describes the specific elements of this matrix structure. Practically speaking, this structure is displayed here as a series of two dimensional tables. For each of four monitoring periods defined (WHEN – see Chapter 2), a table of reasons to perform monitoring (WHY) versus the type of monitoring to perform (WHAT) have been developed. Each box of this table represents a monitoring parameter to be measured, and for each of these parameters, the location (WHERE – see Chapter 2) is also specified. Note that the WHERE and the WHEN definitions for these tables has been previously defined and will not be repeated here.

Why

The first key element of the emergency monitoring strategy matrix addresses the reasons WHY emergency monitoring is performed. In order to effectively prioritise emergency monitoring efforts, it is useful to address these reasons in terms of the needs of the decision maker. For the purposes of this report, seven areas where emergency monitoring data, information, and assessments will be important input to the decision-making process have been identified.

For government and public information

In any accident situation, a national government will need to be informed of the status of the situation at all times for decision-making purposes, as specified previously, but also for internal co-ordination and for public/media information reasons. This includes information and data necessary for the co-ordination of decisions among various national offices or agencies, among different governments, or with international organisations, and also the information and data necessary to inform the public and the media of the situation.

The implementation of urgent population protection countermeasures

In this context, urgent population countermeasures include sheltering, evacuation and the use of stable iodine prophylaxis. How, when and where to implement these will be among the most important early decisions made, and although these decisions may be based on plant conditions, various data, information and assessments from the emergency monitoring programme will also be important.

Predicting and tracking plume trajectory, and detecting any release

Emergency monitoring data is essential for the prediction of plume trajectories and for validating and updating those predictions with actual measurements. In terms of providing an early warning of releases, whether expected based on a known emergency situation or unexpected from an unknown source, detecting radioactive releases is also essential input to an emergency monitoring programme and for subsequent decision making.

For the protection of emergency and recovery workers

Finally, throughout an emergency situation, various types of emergency and recovery workers will be exposed to radiation. These workers will include police, fire and military personnel, but will also, in the broad sense, include workers at water treatment plants, food processing plants, or normal building maintenance workers involved in post-accident service and decontamination operations (the cleaning of roofs, the changing of ventilation filters, etc.). For the protection of this population, decision makers will need various data, information and assessments concerning worker total doses (retrospectively), as well as of contamination levels for appropriate dose management.

The implementation of agricultural countermeasures and food restrictions

In many radiological release situations, the need to implement agricultural countermeasures (such as the sheltering or evacuation of livestock, the use of clean feed for livestock, the closing of greenhouse ventilation, etc.) and the imposition of restrictions on food consumption (such as the interdiction of eating local vegetables, the need to thoroughly wash vegetables prior to consumption, or the interdiction of drinking local milk) will also be very important decisions. These will generally affect areas much larger than those where urgent population protection countermeasures are necessary.

The implementation of intermediate- and recovery-phase countermeasures

In the context of this report, these refer to population protection countermeasures as well as decontamination countermeasures. Population protection countermeasures might include the evacuation of populations from areas found to be contaminated during detailed characterisations, or the decision to relocate evacuated populations, temporarily or permanently, to "clean" areas following dose assessments concerning the evacuated areas. Decontamination countermeasures might include large-scale decontamination opera tions on soils, streets, and buildings. Detailed emergency monitoring data, information and assessments will be fundamental to decisions in these areas.

Contamination control

Following the wide-spread contamination of land due to a large release of radionuclides into the atmosphere, measurement of contamination levels on merchandise and vehicles leaving or coming from the affected area (or the affected country) will be necessary for many reasons, including the control of the spread of contamination (early phases), the verification/certification that food and goods meet national/international specific activity norms, and for population reassurance. These types of monitoring data will be necessary for the decision maker in order to appropriately manage this contamination control process.

What

The second axis of the emergency monitoring strategy matrix concerns the actual measurements to be made, WHAT. For the purposes of strategy development, these have been kept very general in this section. However, the next section discusses in more detail the types of instruments necessary to perform these measurements, as well as several advantages, disadvantages and possible misunderstandings associated with each.

Meteorological data

This data is essential to predict and track the dispersion of any release of radioactivity, and generally includes wind speed, wind direction, atmospheric stability, release air flow rate/speed, temperature, and precipitation. These can be gathered in greater or lesser detail, depending on the needs of the dispersion prediction and tracking models being used.

Ambient dose rate and dose

This involves the measurement of ambient dose rate, in Sv/h or the equivalent (microSv/h or milliSv/h etc.), using any of various dose-rate instruments, and the measurement of total integrated doses in Sv or the equivalent. In some countries there are requirements specifying that kerma in air shall be the quantity used for the exposure measurements, expressed in Gy/h or the equivalent. In practice, in an emergency situation, external gamma dose rate measurements reported in Gy or in Sv may be used interchangeably to a first approximation.

Airborne radionuclide concentration

This refers to the measurement of the specific activity found in the air, in Bq/m^3 or the equivalent ($\mu Bq/m^3$, mBq/m^3, etc.). These are generally radionuclide specific, but may also be in terms of gross-beta activity.

Environmental deposition

This measurement refers to the amount of radioactive material which has been deposited on surfaces, as measured in Bq/m^2. This may also refer to the specific activity of soil, water, or plants, which is measured in Bq/kg or Bq/l, and requires material sampling (such as rain, run-off water, soil, grass, crops, etc.). Because of the nature of how these measurements are performed, as described in the next section of this report, they are generally given in terms of total surface activity (Bq/m^2), but may also be nuclide specific (for example, Bq of Cs-137/m^2).

Food, water and environmental contamination

These measurements, generally reported as specific activities, require sampling, and in many cases will involve sample preparation. The units of these measurements will generally be Bq/kg, Bq/l or the equivalent, and they may be total activity or they may be radionuclide specific.

Individual dose

Individual dose is either measured directly or is assessed retrospectively. For example, personnel involved in accident management and recovery operations usually wear personal dosimeters, and their individual doses are measured and recorded. Here, the measured effective doses are in Sievert (Sv). Doses to members of the exposed public, however, are not measured directly and must be assessed. Biological dosimetry, such as blood analyses, can be a tool to assess whole body absorbed doses in some individual cases when high exposures can not be excluded. In this case, the model used for the assessment gives the result in Gray (Gy). For lower doses, which generally represent the vast majority, such biological dosimetry techniques are not sufficiently sensitive, thus doses resulting from external or internal contamination must be assessed via whole-body counting and excretion analyses. Assessment of committed dose following intake by inhalation or ingestion requires considerable interpretation involving additional information such as the duration and time of intake, the age and physiological parameters of the individual, and the biokinetic behaviour of the radionuclides which have been ingested or inhaled. In these cases, the assessed committed, effective doses are in Sievert (Sv). Organ dose equivalents (thyroid, skin) are measured in Sv using specific counting techniques.

Object surface contamination

During any release of radioactive materials, surfaces of objects may become contaminated. Measurements of this contamination are generally expressed in Bq/m^2 or the equivalent, but can also be assessed based on dose-rate measurements made in Gy/h or Sv/h.

Emergency monitoring strategy tables

In the following tables, each parameter measured (WHAT) is tied to a justifying reason (WHY), a phase in the accident when the parameter is likely to be useful (WHEN), and finally to a location where the parameter should be measured (WHERE).

Table 5.1 **Matrix structure for monitoring strategy in support of decision making during the pre-release phase**

Why **What**	**Government and public information**	**Urgent population protection countermeasures**	**Plume trajectory and detection of release**	**Protection of emergency and recovery workers**	**Agricultural countermeasures and food restrictions**	**Intermediate and recovery-phase countermeasures**	**Contamination control**
Meteorological data	Relevant Zone = U,F	Relevant Zone = U	Relevant Zone = U,F		Relevant Zone = U,F		
Ambient dose rate and dose	Relevant Zone = U	Relevant Zone = U	Relevant Zone = U				
Airborne radionuclide concentration	Relevant Zone = U	Relevant Zone = U	Relevant Zone = U				
Environmental deposition							
Food, water and environmental contamination		Relevant Zone = U*					
Individual dose							
Object surface contamination							

Zone of application: U = Urgent Protective Action Planning Zone
F = Food and Agricultural Restriction Area
A = Area farther from release

* Drinking water

Table 5.2 **Matrix structure for monitoring strategy in support of decision making during the release and immediate post-release phase**

Why **What**	**Government and public information**	**Urgent population protection countermeasures**	**Plume trajectory and detection of release**	**Protection of emergency and recovery workers**	**Agricultural countermeasures and food restrictions**	**Intermediate and recovery-phase countermeasures**	**Contamination control**
Meteorological data	Relevant Zone = U,FA	Relevant Zone = U	Relevant Zone = U,F,A	Relevant Zone = U	Relevant Zone = U,F,A		Relevant Zone = U
Ambient dose rate and dose	Relevant Zone = U,F,A	Relevant Zone = U	Relevant Zone = U,F,A	Relevant Zone = U	Relevant Zone = U,F,A		
Airborne radionuclide concentration	Relevant Zone = U,F,A	Relevant Zone = U	Relevant Zone = U,F,A	Relevant Zone = U	Relevant Zone = U,F,A		
Environmental deposition	Relevant Zone = U,F,A	Relevant Zone = U		Relevant Zone = U	Relevant Zone = U,F,A		
Food, water and environmental contamination		Relevant Zone = U			Relevant Zone = U,F,A		
Individual dose	Relevant Zone = U	Relevant Zone = U		Relevant Zone = U			Relevant Zone = U,F
Object surface contamination				Relevant Zone = U			Relevant Zone = U,F

Zone of application:
- U = Urgent Protective Action Planning Zone
- F = Food and Agricultural Restriction Area
- A = Area farther from release

Table 5.3 **Matrix structure for monitoring strategy in support of decision making during the Intermediate Phase**

Why **What**	**Government and public information**	**Urgent population protection countermeasures**	**Plume trajectory and detection of release**	**Protection of emergency and recovery workers**	**Agricultural countermeasures and food restrictions**	**Intermediate and recovery-phase countermeasures**	**Contamination control**
Meteorological data							
Ambient dose rate and dose	Relevant Zone = U,F,A	Relevant Zone = U, F		Relevant Zone = U	Relevant Zone = U,F,A	Relevant Zone = U,F,A	
Airborne radionuclide concentration	Relevant Zone = U,F,A					Relevant Zone = U	
Environmental deposition	Relevant Zone = U, F,A	Relevant Zone = U, F			Relevant Zone = U,F,A	Relevant Zone = U,F,A	
Food, water and environmental contamination	Relevant Zone = U,F,A				Relevant Zone = U,F,A	Relevant Zone = U,F,A	Relevant Zone = U,F,A
Individual dose	Relevant Zone = U,F,A	Relevant Zone = U,F		Relevant Zone = U		Relevant Zone = U,F	Relevant Zone = U,F,A
Object surface contamination	Relevant Zone = U,F,A			Relevant Zone = U		Relevant Zone = U,F	Relevant Zone = U,F,A

Zone of application: U = Urgent Protective Action Planning Zone
F = Food and Agricultural Restriction Area
A = Area farther from release

Table 5.4 **Matrix structure for monitoring strategy in support of decision making during the recovery phase**

Why **What**	**Government and public information**	**Urgent population protection countermeasures**	**Plume trajectory and detection of release**	**Protection of emergency and recovery workers**	**Agricultural countermeasures and food restrictions**	**Intermediate and recovery-phase countermeasures**	**Contamination control**
Meteorological data							
Ambient dose rate and dose	Relevant Zone = U,F,A			Relevant Zone = U	Relevant Zone = U,F,A	Relevant Zone = U,F,A	
Airborne radionuclide concentration	Relevant Zone = U,F,A					Relevant Zone = U	
Environmental deposition	Relevant Zone = U,F,A				Relevant Zone = U,F,A	Relevant Zone = U,F,A	
Food, water and environmental contamination	Relevant Zone = U,F,A				Relevant Zone = U,F,A	Relevant Zone = U,F,A	Relevant Zone = U,F,A
Individual dose	Relevant Zone = U,F,A			Relevant Zone = U		Relevant Zone = U,F,A	Relevant Zone = U,F,A
Object surface contamination	Relevant Zone = U,F,A			Relevant Zone = U		Relevant Zone = U,F,A	Relevant Zone = U,F,A

Zone of application: U = Urgent Protective Action Planning Zone
F = Food and Agricultural Restriction Area
A = Area farther from release

Emergency monitoring elements

Although the techniques for performing emergency monitoring measurements are generally well known, and are described in detail in, for example, documents developed by the International Atomic Energy Agency, such as IAEA-TECDOC-1092 on "Generic procedures for monitoring in a nuclear or radiological emergency" (IEA99), this report presents a very brief summary of the types of instruments and techniques which could be used to implement the monitoring strategy described above. Using the same matrix approach, for each type of measurement (WHAT) several different types of monitoring techniques (HOW) can be used. For each HOW, various significant parameters which can assist in the implementation of a monitoring strategy are listed. Thus, for each WHAT, various HOWs are listed together with several other important parameters as follows:

The physical quantity being measured or type of measurement being made

To obtain the data or information required, different type of measurements can be performed, and different physical quantities can be measured. For example, gamma dose rate can be measured as ambient equivalent dose rate, or as air kerma rate. Specific activity can be measured as the number of Bq per kilogram of either dry or wet material. This parameter is used as the basis for providing details of the various physical techniques which can be used to measure the quantity, and their advantages and disadvantages.

The technique used to measure the physical quantity

In general, several techniques can be used to measure a given physical quantity. For example, surface contamination levels can be measured in-situ, or by sampling as gross beta activity, or as radionuclide specific activity depending upon the counting equipment used, and several different types of counting equipment can be used for the same measurement. The most commonly used techniques are listed.

Advantages of the technique

For each technique, advantages are listed, such as its accuracy, portability, flexibility of utilisation, speed of measurement, degree of sample preparation.

Disadvantages of the technique

For each technique, disadvantages are listed such as large uncertainties, size and/or cost of equipment, long sampling periods, complex sample preparation and/or system calibration procedures, etc.

Misunderstandings or misinterpretations

For each technique, various misinterpretations could arise in transferring this type of information from one country to another, or to an international organisation. For example, measurements could have been performed under different boundary conditions, such as dose-rate measurements at ground level or at 1 m height. Some common areas which might cause misinterpretations are listed.

Emergency monitoring elements tables

For each of the “WHAT” measurements specified earlier, a table is presented here to briefly outline some important measurement aspects. It should be noted that in general measurements will have interrelated applications. For example, aerial surface activity measurements are used for characterisation of deposition, but rely upon knowledge of the radionuclide composition from soil and/or surface samples for detailed calculations. Count-rate measurements can be converted into dose-rate measurements, and inversely, again given radionuclide composition information. These tables should not, thus, be taken as showing all these interrelated uses, but as providing representative descriptions of some of the more important applications and measurement techniques.

Meteorological data

As these types of measurement are very common, it is not necessary to provide details as to how these should be measured. However, it should be noted that the level of detail of data collection should match the intended predictive and modelling purposes. Specifically, some more advanced dispersion models include very detailed, short-range topographical information, and thus require very detailed meteorological data in the immediate vicinity of the source facility (wind fields, temperature profiles, etc.).

Ambient dose rate and dose: Table 5.5

Dose and dose-rate measurements are generally used as input for plume tracking operations, as part of an early warning system, to support decisions concerning the implementation of various countermeasures, and as background for information of the general public. These measurements could be performed using several different types of detectors, from fixed stations, by monitoring teams with portable instruments, and by aerial measurements. In general, the physical quantity being measured is ambient equivalent dose or ambient equivalent dose rate, measured in Sv or Sv/h.

Airborne radionuclide concentration: Table 5.6

Measurements of airborne aerosols and gases are generally made to provide early warning of releases from unmonitored or as-yet unreported sources, and to provide data for deposition predictions/profiles and plume profiles. Such measurements are also used for emergency response purposes. In cases where urgent population-protection countermeasures are based on predictions and plant conditions, decision makers will not generally wait for actual measurement data, thus making such data less useful for this purpose. The physical quantity measured in this case is generally activity concentration, in Bq/m^3 of radionuclide specific or gross beta activity. These measurements are generally more sensitive than dose-rate measurements.

Environmental deposition: Table 5.7

Measurements of environmental deposition are generally performed to characterise deposition, to determine the physical extent and profile of deposition, to support dose calculations and intervention decisions, and for public information purposes. Because of the spatial nature of these measurements and to facilitate the creation of detailed contamination maps, many times they are associated with a GPS (global positioning system) location. The physical quantity which is generally measured here is radionuclide specific surface activity, as in Bq of Cs-137 per m^2.

Food, water and environmental contamination: Table 5.8

These measurements are made to support population protection countermeasure decisions, as well as for public reassurance. In general, these measurements require a certain level of sample preparation and are therefore performed in fixed laboratories, although some measurements could be performed in mobile laboratories. A common misunderstanding which can occur when measuring the specific activity of solids concerns the weight to which the measurement refers which can be dry weight or wet weight. The quantity measured is activity concentration, expressed in Bq/kg or Bq/l. This can be gross activity (α, β, or γ), or can be radionuclide specific.

Individual dose: Table 5.9

Individual dose may arise from external irradiation or from intakes of radionuclides, primarily by ingestion or inhalation. In general, doses to individuals cannot be measured directly. Rather some combination of measurement and assessment is required. If the dose is relatively low, effective dose or dose equivalent to an individual tissue (measured in Sv) are useful as measures of the risk of stochastic effects. At higher doses and dose rates, deterministic effects may be of concern, in which case the absorbed dose in tissues (measured in Gy) would be the relevant quantities to assess. External dose rate measurements – made for example by thermoluminescent dosimeter or a dose rate monitor – will provide a good indication of the doses absorbed by the whole body from penetrating gamma radiation. For intakes, some other means of assessing body or organ radionuclide content is required. This may be an *in-vivo* technique, such as whole body gamma spectrometry, or excreta analysis. In either case, the measurement must be used with biokinetic knowledge to determine the committed dose arising from the intake. For high doses and dose rates, biological dosimetry such as chromosome aberration analysis can be used to gauge the absorbed dose (Gy) of penetrating radiation across the body as a whole. Other indirect assessment of individual dose can be made utilising air concentration, ground deposition and food or environmental concentration measurements.

Object surface contamination: Table 5.10

These and other measurements are made on objects and material leaving or coming from what is suspected to be a contaminated area. The intention of these measurements is to allow the selection of those objects, which should be decontaminated, disposed of as waste, or treated, in some other controlled fashion. The physical quantity, which is generally measured, is surface activity, such as gross beta activity measured in Bq/m^2, although this may also be radionuclide specific. In some cases where high levels of contamination have accumulated, such as air filters from building ventilation units, contamination levels are assessed based on dose-rate measurements (in Sv/h) and on knowledge of the radionuclide mix found on the filter.

Table 5.5 **Elements of ambient dose rate and dose measurements**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
Stationary, automatic gamma monitoring system (Sv/h)	• Energy-compensated GM-counters and proportional counters • Ion-chambers • NaI (Tl)-detectors	• Automatic alarm can be provided • Rapid overview over wide areas		• Height above ground is an important parameter • Representative siting is critical
Portable or mobile measurements (Sv/h)	• Energy-compensated GM-counters and proportional counters • Ion-chambers • NaI (Tl)-detectors	• Allows locally detailed surveys	• Doses to personnel in case of high dose rates	• Height above ground is an important parameter • Differences in calibration may lead to non-comparable results
Aerial measurement of gamma dose rate from ground deposition (Sv/h)	• NaI detectors • Proportional counters	Covers large areas	• Complex calibration procedure • Costly	• Height above ground is an important parameter • Differences in calibration may lead to non-comparable results
Integrated dose measurement (Sv)	• TLD	• Cheap • Easy to use, transport • Flexible use	• No alarm • No dose rate profile • Require processing	• Representative siting is critical.

Note: The quantity being measured here is ambient dose equivalent: $H^{*}(10)$

Table 5.6 **Elements of airborne radionuclide concentration measurements**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
Stationary filter stations equipped for on-line measurement (Bq/m^3)	• On-line gamma spectroscopy measurement (or gamma-energy groups) of moving filter	• Alarm function • Spectroscopy methods have higher sensitivity than gamma dose-rate measurements • Time trends can be followed	• Expensive	• Aerosol filters sample only the particulate portion of iodine, missing the gaseous portion
	• On-line gross β measurements of moving filter	• Cheap • Alarm function • Time trends can be followed	• No information regarding radionuclides	• Aerosol filters sample only the particulate portion of Iodine
Stationary filter stations requiring filter collection for measurement (Bq/m^3)	• Gamma spectroscopy analysis of the filter in laboratory	• Provides very detailed spectroscopic results	• Sample collection, transportation, preparation and measurement is time consuming	
Stationary filter stations equipped with advanced sampling devices (Bq/m^3)	• On-line iodine monitors	• Time trends can be followed		
Stationary filter stations requiring filter collection for measurement (Bq/m^3)	• Iodine sampling (elementary and organic) with impregnated charcoal and aerosol filters	• Provides very detailed spectroscopic results	• Sample collection, transportation, preparation and measurement is time consuming	
Mobile air-sampling stations (Bq/m^3)	• On-line gross β • Gamma spectroscopy analysis of a filter sample	• Spatially flexible	• Do not run continuously for early warning purposes	
Aerial sampling at high altitudes (Bq/m^3)	• Gamma spectrometry in laboratory	• Concentrations at various elevations could be measured	• Contamination of air craft • Very expensive	

Table 5.7 **Elements of emergency environmental deposition measurements**

Type of measurement and physical quantity	**Technique**	**Advantage**	**Disadvantage**	**Misunderstandings or misinterpretations**
In-situ measurement of surface activity on the ground (Bq/m^2)	• In-situ gamma-ray spectrometry (HPGe-Detectors)	• Can give reliable data on radionuclide deposition • Can give fast estimation of nuclide composition	• Demanding calibration procedure • Risk of contamination of equipment • Limited to gamma emitting radionuclides	• Calibration must match the depth distribution of radionuclides in the soil
Aerial measurements of surface activity on the ground (Bq/m^2)	• NaI -detectors	• Detailed information on spatial inhomogeneities • Rapid	• Costly • Limited nuclide identification • Ground reference calibration needed • Limited to gamma emitting nuclides	
	• HPGe detectors	• Detailed information on spatial inhomogeneities • Rapid	• Costly • Ground reference calibration needed • Limited to gamma emitting nuclides	
Environmental samples (Bq/kg or Bq/l) • **soil** • **vegetation (grass, crops, etc.) water (rain, surface runoff, river, etc.)**	• Laboratory analysis (HPGe-detectors)	• Can give fast estimates of radionuclide compositions	• Rain samplers must be pre-installed • Requires sample preparation	• Need to specify dry or wet sample weight
Indirect modelling of deposition from dose rate measurements (Bq/m^2)	• Establish a numeric relationship between dose rate and deposition for a given radionuclide mixture	• Timely results • Can cover large areas	• Significant dependence on radionuclide mixture	• Airborne radioactivity (noble gases) and the measurement of non-representative sites may lead to a bias.

Table 5.8 **Elements of food, water and environmental contamination measurements**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
γ-Spectrometry (Bq/kg or Bq/l)	• HPGe detector • NaI detector	• Excellent nuclide identification • Simple operation, high sensitivity	• Normally liquid N_2 required • Limited nuclide identification for complex spectra	
ß Spectrometry (Bq/kg or Bq/l)	• Liquid scintillation (This technique can also be used for α measurements)	• Large scale automatic measurements, • Method for low energy ß-emitters	• Limited nuclide identification capability	
Gross ß (Bq/kg or Bq/l) • **without radiochemical separation** • **with radiochemical separation**	• Proportional counter	• High intensity • Nuclide specific	• Not nuclide specific • Labour intensive	• Separation of natural background
Gross α (Bq/kg or Bq/l)	• Proportional counter	• Short counting time • Screening possible	• No spectral information	• Separation of natural radionuclides
α-Spectrometry (Bq/kg or Bq/l)	• Semi-conductor counter (Si diode)	• Spectral information	• Labour intensive • Significant sample preparation necessary • Long count times necessary.	

Table 5.9 **Elements of individual dose measurement**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
External exposure (Sv or Gy)	• TLD • Electronic dosimeters	• Cheap • Direct display • Alarm function	• Processing required • Costly	
External contamination (Bq/m^2)	• Alpha monitoring Scintillation or proportional counters • Beta monitoring • GM-, proportional or scintillation counters	• Inexpensive • Rapid • Immediate result	• No radionuclide information • Booth systems only in nuclear sites elsewhere hand-held. • Alpha monitoring is very sensitive to distance from surface to monitor • Alpha monitors are fragile • Requires trained personnel • Not very accurate	
Internal contamination screening (Bq)	• Contamination monitors or dose rate instruments (including thyroid monitoring)	• Quick and very portable. • Equipment inexpensive and can be used for other purposes • Results available immediately. • Large throughput possible • Quite sensitive	• No radionuclide information available • No automatic storage of information	

Table 5.9 (continued) **Elements of individual dose measurement**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
Internal contamination measurements (Bq)	• Gammaspectrometry (Ge-based or NaI(Tl)) (whole body, thyroid or chest measurements)	• Gamma spectrometry gives radionuclide resolution, can be whole body or specific organs • Information usually retained on computer. • Very sensitive • Quite short measurement time (5-10 mins in emergency) • Equipment is quite robust	• Fairly expensive equipment • Equipment requires maintenance • Portable units have location requirements (power, space…) • Lower throughput than hand-held methods. • Possible need for shielding to ensure sensitivity. • Interpretation of mixed nuclide spectra quite difficult if using NaI detectors. • Cooling required for Ge devices.	
Excretion measurements (Bq) • **Nose blow** • **Urine** • **Faeces**	• Laboratory analysis	• Analysis (e.g. gamma spectrometry or radiochemical separation) will identify radionuclides • Samples can be transported to distant laboratories • Provides sensitivity not achievable by any other methods (e.g. detecting alphas)	• Samples require special handling • Long delay (possibly days/weeks) for results • Considerable expertise required for some analyses • Problems with sample contamination • Samples may be biological hazard. • Transport of samples requires careful planning. • Analysis is often expensive	
Individual accumulated dose	• Biological dosimetry (Cytogenetic analysis)	• Applicable in connection with evaluation of accidental exposures	• Limited sensitivity (doses above 100 mSv)	

Table 5.10 **Object surface contamination measurements**

Type of measurement and physical quantity	Technique	Advantage	Disadvantage	Misunderstandings or misinterpretations
External contamination (Bq/m^2)	• Alpha monitoring with scintillation or proportional counters • Beta monitoring with GM-, proportional or scintillation counter	• Inexpensive • Rapid • Immediate results	• No radionuclide information • Alpha monitoring is very sensitive to distance from surface of the detector • Alpha detectors are fragile • Requires trained personal for the evaluation • Not very accurate	

Note: Bulk activity can be measured using similar procedures as for food.

6. CONCLUSIONS AND RECOMMENDATIONS

The objective of this strategy is to facilitate the decision-making process in case of a nuclear emergency situation by providing an improved strategy for emergency monitoring, key data management and information exchange. By using this strategy, the decision maker will receive and analyse available and necessary information in the most appropriate format, optimising the resources necessary for the communication of this information. This improved strategy for emergency monitoring, key data management, and information exchange will allow emergency response organisations to:

- Better select the data which is being transmitted by using the established list of key data during the different accident time phases as a function of the defined sender and receiver classifications. The simple matrix developed is based on the existing Convention Information System (CIS) which provides a very extensive, numerically keyed listing of important emergency data. This will improve the data's usefulness, and will help to optimise the resources necessary to collect, receive and analyse the data.

- Better transmit and receive data and information by developing, establishing and using modern communication methods. The use of network technology (e.g. World-Wide Web) to develop a secure network for nuclear emergency response organisations will help to optimise the volume of data which is transmitted, as well as the data's quality. By actively sending notification and important, dynamic, accident-related information, and by making other dynamic, accident-related information and static background information available, national emergency response organisations will receive the information they need, and will have easy access to other information they would like. Such an electronic system will also facilitate transmission of measurement and modelling results, greatly improve the quality of graphical transmissions (and retransmissions), and will help to minimise the volume of redundant messages which circulate as well as the resources necessary to interpret them.

- Better define the emergency monitoring and modelling needs to support decision making, by using the established tables on WHY emergency monitoring is performed (to address which needs), identifying WHAT measurements are made (physical quantities), WHEN measurements are made (with respect to the previously defined accident time phases), and WHERE measurements are made (with respect to the previously defined geographic zones). Doing so, the use of resources can be optimised.

It is recommended that such a system be further refined and tested based on international consensus. Details for the implementation of such a system, and procedures necessary for such an approach, should be developed. An international emergency exercise, INEX 2000, should be designed and used to test the resulting approach.

This improved strategy should allow the fulfilment of all existing international and multilateral conventions and agreements in a much more useful and efficient fashion.

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Annex 1

IAEA / EC JOINT NOTIFICATION FORMAT

To: **International Atomic Energy Agency,** Emergency Response Centre
Fax: +43-1-2600729000 Tel: +43-1-2632000 or +43-1-2632012

After sending, telephone the above number(s) to confirm receipt

EMERCON EMERCON EMERCON EMERCON

See over for instructions on how to complete this form

Reported by (Organisation):____	
Country:_______________________________	Tel: +________________________
Name of Reporter_______________________	Fax: +________________________

INITIAL NOTIFICATION of a Nuclear Accident or Radiological Emergency

1	Accident STATE	
2	Name(s) of STATE(S) NOTIFIED	
3	LOCATION/FACILITY name	
	(Latitude = Deg Deg/ Min Min)	(Lat): ___ ___° / ___ ___' N ☐ S ☐
	(Longitude = Deg Deg Deg /Min Min)	(Long): ___ ___ ___° / ___ ___' E ☐ W ☐
4	DATE of Event	Year-Month-Day (UTC/GMT) __ __ __ __ /__ __ / __ __ Year-Month-Day (Local) __ __ __ __ /__ __ / __ __
	TIME of Event	UTC/GMT (24 Hour Clock) hh:mm ___ ___ : ___ ___ Local Time (24 Hour Clock) hh:mm ___ ___ : ___ ___
5	NATURE of Event	N.P.P. accident ☐ Other (Specify):
6	RADIOACTIVE RELEASE	None until now ☐ Ongoing ☐ Terminated ☐ Possibility of Future Release? Yes ☐ No ☐ Unknown ☐
7	OFF-SITE PROTECTIVE MEASURES	Sheltering ☐ Stable iodine ☐ Evacuation ☐ Others (specify) ☐ None ☐
8	Other relevant information	
9	Date/Time of Report (local) Signature of Reporter	yyyy/mm/dd __ __ __ __/ __ __ / __ __ hh:mm __ __ : __ __ ……………………………………………………………………

INSTRUCTIONS FOR COMPLETING THE INITIAL NOTIFICATION FORM

(IAEA-ERC/NF01 Ver 1.13 (1998))

Note: This form should be sent ***forthwith*** to notify the IAEA to go on standby. This form provides basic information for alert purposes.

> **Even if all the details in this form are not known do not delay sending it. Missing or unknown information can be sent later or when known**.
> **Further information should be transmitted promptly on separate forms [**IAEA-ERC/NF02 Ver 1.13 (1998)**].**
>
> If assistance is required please send a separate form with the details of the assistance needed. (EMERCON FORM2)

Each number below corresponds to its equivalent question number on the form overleaf.

1) ***Accident State***	Name of the sovereign State in contrast to a federal or protectorate state.
2) ***Name(s) of State(s) Notified***	States notified by the reporting State can either be written out in full or the ISO codes used for expediency e.g. AT = Austria. The ISO codes can be found in ENATOM Appendix II.
3) ***Location/Facility Name***	Name of the nearest major geographically identifiable town or city to the accident site. This need not be the same as the facility name.
Latitude and Longitude	Give the standard geographical co-ordinates of the facility location.
4) ***Date of Event***	In the format YYYY/MM/DD where Y = Year, M = Month and D = Day. UTC = Universal Time Co-ordinated and is the same time as GMT = Greenwich Mean Time.
Time of Event	Use a 24 hour clock format: HH/MM where H = Hour and M = Minutes. UTC = Universal Time Co-ordinated and is the same time as GMT = Greenwich Mean Time.
5) ***Nature of Event***	State if it is a Nuclear Power Plant (NPP) accident by marking the box. If not specify the nature of the event.
6) ***Radioactive Release***	Provide the status of any release or potential release, by marking the appropriate box(es).
7) ***Off-Site Protective Measures***	Indicate if any off-site protective measures are being taken by marking the appropriate box(es).
8) ***Other relevant information***	Give any other information on the situation which you feel is relevant. **Do not delay sending the form**.
9) ***Date and Time of Report***	Give the date and time in UTC/GMT that you completed this form. Follow formats as in question 4. Sign.

ADDITIONAL INFORMATION Nr: ....

After sending, telephone the dedicated line given you by the IAEA to confirm receipt

EMERCON EMERCON EMERCON EMERCON

See over for instructions on how to complete this form

Reported by (Organization):________________________________			
Country:________________________		Tel:+ ________________________	
Name of Reporter________________________		Fax:+ ________________________	
1a	RADIOACTIVE RELEASE	None until now ☐ Ongoing ☐ Terminated ☐ Possibility of Future Release? Yes ☐ No ☐ Unknown ☐	
b	If release has OCCURRED or FUTURE release is possible, assumed start time	UTC/GMT (24 Hour Clock) hh:mm ___ ___ : ___ ___ Year-Month-Day(UTC/GMT) ___ ___ ___ ___/___ ___/___ ___	
c	If TERMINATED, assumed end time?	UTC/GMT (24 Hour Clock) hh:mm ___ ___ : ___ ___ Year-Month-Day(UTC/GMT) ___ ___ ___ ___/___ ___/___ ___	
d	If, FUTURE release is possible	Controlled ☐ Uncontrolled ☐	
e	Assumed release pathway	Water ☐ Air ☐	
f	Assumed TOTAL AMOUNT of radionuclides released	___ E+___ ___ Bq ☐ Ci ☐	
g	Assumed effective HEIGHT of release	__ ___ ___ ___ m above ground.	
2	MOVEMENT of material from the site	Direction of Movement towards __ __ __ (degrees from North) Speed of movement: __ __ m/s If atmospheric release, precipitation? Yes ☐ None ☐	
3	Confirmed highest OFF-SITE gamma DOSE RATE measurements		

Results (Gy/h)	UTC/GMT Time (24 Hour Clock) hh:mm	Distance from plant	Direction (degrees from North)	In Plume Y/N
___ E–___ ___	___ ___ : ___ ___	___ km	__ __ __	☐ Yes ☐ No
___ E–___ ___	___ ___ : ___ ___	___ km	__ __ __	☐ Yes ☐ No
___ E–___ ___	___ ___ : ___ ___	___ km	__ __ __	☐ Yes ☐ No
___ E–___ ___	___ ___ : ___ ___	___ km	__ __ __	☐ Yes ☐ No

4	OFF-SITE PROTECTIVE MEASURES TAKEN/PROPOSED and DISTANCE?	Sheltering ☐ ....km Stable iodine ☐ ....km Evacuation ☐ ....km Others (specify) ☐ ....km None ☐
5	Other relevant information (i.e., was the release gaseous or particulate; is there a significant change in the main transport direction and/or speed (m/s) anticipated within the next 6 hours etc, what is the nature of the radionuclides?).	
6	PUBLIC INFORMATION	provisional INES rating ……………..
7	Date/Time of Report (local) Signature of Reporter	yyyy/mm/dd __ __ __ __/ __ __ / __ __ hh:mm __ __ : __ __ ……………………………………………………

INSTRUCTIONS FOR COMPLETING THE ADDITIONAL NOTIFICATION FORM

(IAEA-ERC/NF02 Ver 1.13 (1998))

Note: This form should be sent ***promptly*** to the IAEA.

This form is assumed to be used after the initial notification has been sent to the IAEA for the first few days of an accident. Before sending ensure that the initial notification was sent and that the receipt was confirmed. This form may be sent several times during an accident, so do not delay sending it. Resend this form when missing or unknown information is available.

Any information provided on the form will be used unrestricted. If there is confidential information it needs to be sent on an additional form.

Further information should be transmitted promptly on separate forms (it is recommended to use the worksheet provided in TECDOC-955 as templates for attachments**).**

If assistance is required please send a separate form with the details of the assistance needed. (EMERCON FORM2)

Each number below corresponds to its equivalent question number on the form overleaf.

1a) ***Radioactive Release***	Provide the status of any release or potential release, by marking the appropriate box(es). Use a 24 hour clock format.
b) ***assumed start time*** and	HH/MM where H = Hour and M = Minutes.
c) ***assumed end time***	UTC = Universal Time Co-ordinated and is the same time as GMT = Greenwich Mean Time.
f) ***assumed total amount***	give the best estimate of the assumed total amount of radionuclides released using the format given. Do not use prefixes to give the magnitude of the release. Indicate whether Becquerel (Bq) or Curie (Ci) are used as unit.
g) ***assumed effective height of the release***	The effective height of the release is the height above ground that the release is going to reach. Don't only take the release height into account. Consider also (e.g., depending on the temperature of the surrounding air and of the release) how high the plume may raise in the atmosphere.
2) ***Movement of material from the site***	State the direction of the plume that is known for the time when the form was sent. Give the speed of the moving plume based on your best estimate. This does not need to be consistent with the prevailing wind direction and speed. Tick the appropriate box if there is precipitation or not. If you know the intensity, state it in the field: other relevant information.
3) ***Off-site gamma dose rate measurement***	Use only confirmed measurement results that are characteristic for the given area by using distance and direction (clockwise from north) from the plant.
4) ***Protective Measures***	Indicate which of the stated protective measures were initiated or proposed, by marking the appropriate box(es). Give the actual or proposed distance up to which each protective measure is initiated or proposed. State if other protective actions e.g., access control are proposed or initiated.

5) ***Other relevant information***	Use this field to give more details on one of the fields given on the form or any other information that is useful, i.e., emergency classification; composition of the release; was the release gaseous, particulate or both; is there a change of movement direction or speed anticipated.
6) ***Public information***	Give an estimated of an provisional INES rating that can be used for public information purposes. This field is optional. Do not delay sending in case no provisional INES rating is available.
7) ***Date and Time of Report***	Give the date and time in UTC/GMT that you completed this form. Follow formats. Sign.

Annex 2

KEY DATA TABLES

CIS–No		Pre-release			Release			Intermediate			Recovery			Remarks
		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	

001–004 REPORT IDENTIFICATION

CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
001–004	***Report identification***													
1	reported by (State, Organisation)	+	+	+	+	+	+	+	+	+	+	+	+	fix header
2	Reporting date and time	+	+	+	+	+	+	+	+	+	+	+	+	fix header
3	Serial number of the report	+	+	+	+	+	+	+	+	+	+	+	+	header
4	Any additional information about the message	–	–	–	–	–	–	–	–	–	–	–	–	
5	Date of report status	+	+	+	+	+	+	+	+	+	+	+	+	new element (to be repeated for each individual item)
6	Time of report status	+	+	+	+	+	+	+	+	+	+	+	+	new element (to be repeated for each individual item)

010–053 NOTIFICATION DATA

CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
010–014	***Notification data***													
10	Date and time of accident	+	+	+	+	+	+	+	+	+	–	–	–	fix header
11	Country of accident	+	+	+	+	+	+	+	+	+	–	–	–	fix header
12	Name of place	+	+	+	+	+	+	+	+	+	–	–	–	fix header
13	High above sea level	+	+	+	+	+	+	+	+	+	–	–	–	fix header
14	Location <latitude, longitude>	+	+	+	+	+	+	+	+	+	–	–	–	fix header

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
020–027	***Nature of accident***													Item not sufficiently defined, new section: plant status
20	Activity or facility involved	+	+	+	+	+	+	+	+	+	–	–	–	
21	Specific characteristics of activity, facility or accident	+	+	+	+	+	+	+	+	+	–	–	–	
22	Anticipated severity of the accident – INES	+	+	+	+	+	+	+	+	+	–	–	–	
23	Does the Accident State understand what has happened?	–	–	–	–	–	–	–	–	–	–	–	–	
24	Development of situation	+	+	+	+	+	+	+	+	+	–	–	–	
25	Actual starting date and time of release	–	–	–	+	+	+	–	–	–	–	–	–	should be given in section 100–143
26	Expected starting date and time of release	+	+	+	–	–	–	–	–	–	–	–	–	
27	Type of release	–	–	–	+	+	+	–	–	–	–	–	–	
030–033	***Countermeasures***													
30	Are countermeasures being taken or are they imminent	+	+	+	+	+	+	+	+	+	–	–	–	
31	If yes, nature of countermeasures	+	+	+	+	+	+	+	+	+	–	–	–	
32	If countermeasures are being taken within 20km of the border with another country, give name of the country	+	+	+	+	+	+	+	+	+	–	–	–	
33	Nature of the countermeasure within 20 km of the country mentioned in line 032	+	+	+	+	+	+	+	+	+	–	–	–	

		Pre-release			**Release**			**Intermediate**			**Recovery**			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
040–042	***Other potentially affected countries***													
40	Are other countries likely to be radiologically affected?	–	–	+	–	–	+	–	–	–	–	–	–	
41	If yes, following countries	–	–	+	–	–	+	–	–	–	–	–	–	
42	Is the Agency requested to notify the countries which are or may be radiologically affected?	–	–	–	–	–	–	–	–	–	–	–	–	
050–053	***Further Reporting***													
50	Language for further information if other than English	–	–	–	–	–	–	–	–	–	–	–	–	Translation in E by IAEA?
51	Mode of further reporting in order of preference	–	–	–	–	–	–	–	–	–	–	–	–	has to be done in preparation
52	Give relevant communication address numbers	–	–	–	–	–	–	–	–	–	–	–	–	has to be done in preparation
53	Any further information about communication methods?	–	–	–	–	–	–	–	–	–	–	–	–	has to be done in preparation

CIS–No		Pre-release			Release			Intermediate			Recovery			Remarks
		LB	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**		**LB**	**GG**	**I**	**Remarks**

100–143 GENERAL CHARACTERISTICS OF ACTUAL RELEASE

100	Has actual release started?	+	+	+	+	+	+	–	–	–	–	–	–	
101	Are the general characteristics of the release given?	–	–	–	–	–	–	–	–	–	–	–	–	
110	The release was terminated at	–	–	–	+	+	+	+	+	+	–	–	–	
111	Type of release	–	–	–	+	+	+	+	+	+	–	–	–	measured or estimated
112	Qualitative composition of the release in descending order of importance of activity	–	–	–	+	+	+	+	+	+	–	–	–	measured or estimated
113	Quantified estimate(s) of amount of radio activity released in descending order of importance of activity	–	–	–	+	+	+	+	+	+	–	–	–	measured or estimated
114	Up to the date and time?	–	–	–	+	+	+	+	+	+	–	–	–	
115	Is there a possibility of significant chemical toxic health effects	–	–	–	+	+	+	+	+	+	–	–	–	
116	Is the release likely to reach the atmospheric mixing layer or to reach a height of about 1 000 m?	–	–	–	–	+	+	–	+	+	–	–	–	
117	Is the release accompanied by a significant emission of water vapour?	–	–	–	M	M	M	M	M	M	–	–	–	for modelling experts
118	or heat?	–	–	–	M	M	M	M	M	M	–	–	–	for modelling experts
119	Vapour emission rate?	–	–	–	M	M	M	M	M	M	–	–	–	for modelling experts
120	Heat emission rate	–	–	–	M	M	M	M	M	M	–	–	–	for modelling experts
121	Area of heat emission	–	–	–	M	M	M	M	M	M	–	–	–	for modelling experts

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
130–138	***For release to water***													
130	The release was terminated at?	–	–	–	+	+	+	+	+	+	–	–	–	Indication of start of release?
131	Qualitative composition of the release in descending order of importance of activity	–	–	–	+	+	+	+	+	+	–	–	–	
132	Quantified estimate(s) of amount of radioactivity released in descending order of importance of activity	–	–	–	+	+	+	+	+	+	–	–	–	
133	Up to the date and time?	–	–	–	+	+	+	+	+	+	–	–	–	
134	Is there a possibility of significant chemical toxic health effects?	–	–	–	+	+	+	+	+	+	–	–	–	
135	Name and type of water body into which release first occurs	–	–	–	+	–	–	+	–	–	–	–	–	
136	Approximate location of release into this water body	–	–	–	+	–	–	+	–	–	–	–	–	
137	Name of first major downstream recipient water body	–	–	–	+	+	+	+	+	+	–	–	–	
138	Approximate location of confluence with that major water body	–	–	–	+	+	+	+	+	+	–	–	–	
140–143	***Possible continuation of the release***													
140	Is the release still occurring?	–	–	–	+	+	+	+	+	+	–	–	–	
141	Expected behaviour during the next 6 hours?	–	–	–	+	+	+	–	–	–	–	–	–	
142	The release is likely to be terminated at?	–	–	–	+	+	+	–	–	–	–	–	–	
143	Is there a possibility that the general characteristics of the release will change?	–	–	–	–	–	–	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
200–217	**GENERAL CHARACTERISTICS FOR FUTURE RELEASE**													
200–204	***For future release to atmosphere***													
200	Type of the release is expected to be	+	+	+	–	–	–	–	–	–	–	–	–	
201	Anticipated qualitative composition of the release in descending order of importance of activity?	+	+	+	–	–	–	–	–	–	–	–	–	
202	Anticipated quantitative estimate(s) of amount of radioactivity to be released in descending order of importance of activity	+	+	+	–	–	–	–	–	–	–	–	–	
203	Will there be a possibility of any significant chemical toxic health effects?	+	+	+	–	–	–	–	–	–	–	–	–	
204	Is the release likely to breach the atmospheric mixing layer or to reach a height of about 1 000 m?	–	+	+	–	–	–	–	–	–	–	–	–	
210–217	***For future release to water***													
210	Anticipated qualitative composition of the release in descending order of importance of activity	+	+	+	–	–	–	–	–	–	–	–	–	
211	Anticipated quantitative estimate(s) of amount of radioactivity to be released in descending order of importance of activity	+	+	+	–	–	–	–	–	–	–	–	–	
212	Will there be a possibility of any significant chemical toxic health effects?	+	+	+	–	–	–	–	–	–	–	–	–	
213	Name and type of water body where release will first occur	+	–	–	–	–	–	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
214	Approximate location of release into this water body	+	–	–	–	–	–	–	–	–	–	–	–	
215	Name of first major downstream recipient water body	+	+	+	+	+	+	–	–	–	–	–	–	
216	Approximate location of confluence with that major water body	+	+	+	+	+	+	–	–	–	–	–	–	
217	Hydrological parameters for use in transport models	M	M	M	M	M	M	–	–	–	–	–	–	missing in block 130-133
300–323	***Site meteorological and dispersion conditions***													
300	Are site meteorological, dispersion or forecast conditions described?	–	–	–	–	–	–	–	–	–	–	–	–	
301	Date and time of reported meteorological conditions?	+	+	+	+	+	+	–	–	–	–	–	–	
302	Present weather code	+	+	+	+	+	+	–	–	–	–	–	–	
303	Wind direction and speed and measuring height above ground?	+	–	–	+	–	–	–	–	–	–	–	–	
304	Temperature?	+	–	–	+	–	–	–	–	–	–	–	–	
305	Cloud cover of total sky area and standard deviation of wind direction fluctuations	+	–	–	+	–	–	–	–	–	–	–	–	
306	Estimated mixing height?	+	+	+	+	+	+	–	–	–	–	–	–	
307	Precipitation during relevant period and duration of time of reference	+	–	–	+	–	–	–	–	–	–	–	–	
308	Pasquill-Gifford stability category	+	–	–	+	–	–	–	–	–	–	–	–	
309	Actual release height above ground level	+	–	–	+	–	–	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
310	Effective release height above ground level	+	–	–	+	–	–	–	–	–	–	–	–	
311	Main transport direction in degrees from north and mean transport speed?	+	–	–	+	–	–	–	–	–	–	–	–	
312	Is it likely that the plume will encounter rain in the Accident State?	+	+	+	+	+	+	–	–	–	–	–	–	
313	Is a significant change in the main wind direction and/or speed anticipated within 6 hours?	+	–	–	+	–	–	–	–	–	–	–	–	
314	If 313 = yes, the expected new transport direction and speed after about 6 hours are	+	–	–	+	–	–	–	–	–	–	–	–	
320–323	***Trajectory forecast***													Graphical form
320	Are trajectory forecasts available?	–	–	–	–	–	–	–	–	–	–	–	–	
321	Trajectory starting time and starting height above ground level or at pressure level	+	+	+	+	+	+	–	–	–	–	–	–	
322	Trajectory path	+	+	+	+	+	+	–	–	–	–	–	–	
323	Expected date and time of arrival?	+	+	+	+	+	+	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**

400–409 PROJECTED DOSE INFORMATION

400–409	***Projected dose information***													
400	Are projected critical group dose(s) from accident in the main transport direction given?	–	–	–	–	–	–	–	–	–	–	–	–	
401	Do dose(s) take into account the effects of countermeasures	+	+	+	+	+	+	+	+	+	+	+	+	
402	Approximated period of time in which anticipated dose will be received	+/-	+/-	+/-	+	+	+	+	+	+	+	+	+	+/-: dependent on timely evolution of accident
403	Distance	+/-	+/-	+/-	+	+	+	–	–	–	–	–	–	
404	Thyroid dose	+/-	+/-	+/-	+	+	+	–	–	–	–	–	–	
405	Lung dose	–	–	–	–	–	–	–	–	–	–	–	–	
406	Bone dose	–	–	–	–	–	–	–	–	–	–	–	–	
407	Skin dose	+/-	–	–	+	–	–	–	–	–	–	–	–	+/-: dependent on timely evolution
408	Whole body dose	+	+	+	+	+	+	+	+	+	+	+	+	
409	Additional relevant information, nature of critical group, pathway, countermeasures taken into account	–	–	–	–	–	–	–	–	–	–	–	–	

500–547	***Environmental off-site monitoring result***												
500	Are environmental off-site monitoring results given?	–	–	–	–	–	–	–	–	–	–	–	–

		Pre-release			Release			Intermediate			Recovery			
CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
501–508	***Gamma results***													to be substituted by new solution, graphical form
501	Gamma dose or dose rate in air?	+	+	+	+	+	+	+	+	+	+	+	+	
502	Monitoring height above ground level	–	–	–	–	–	–	–	–	–	–	–	–	to be defined in advance, otherwise “key”
503	Central location of measurement area or point measurement	+	+	+	+	+	+	+	+	+	–	–	–	
504	Measurement area for which value(s) are representative	+	+	+	+	+	+	+	+	+	–	–	–	
505	Integrated dose period	–	–	–	+	+	+	+	+	+	+	+	+	to be defined in advance
506	Mean integrated dose, maximum integrated dose	–	–	–	+	+	+	+	+	+	+	+	+	Graphical form
507	Time of measurement of dose rate	+	+	+	+	+	+	+	+	+	+	+	+	
508	Dose rate measurement	+	+	+	+	+	+	+	+	+	+	+	+	
510–515	***Airborne concentration(s)***													to be substituted by new solution, graphical form
510	Air concentration data given?	–	–	–	–	–	–	–	–	–	–	–	–	
511	Height above ground level [m]	+	+	+	+	+	+	+	+	+	–	–	–	
512	Central location of sampling area or the location of the point sample	+	+	+	+	+	+	+	+	+	–	–	–	
513	Measurement area for which values are representative	–	–	–	–	–	–	–	–	–	–	–	–	
514	Sampling period	+	+	+	+	+	+	+	+	+				
515	Measuring results	+	+	+	+	+	+	+	+	+				

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
520–524	***Precipitation contamination***													to be substituted by new solution, graphical form
520	Data on concentration(s) in precipitation given?	–	–	–	–	–	–	–	–	–	–	–	–	
521	Location of precipitation	–	–	–	+	+	+	–	–	–	–	–	–	
522	Sampling period	–	–	–	+	+	+	–	–	–	–	–	–	
523	Amount of precipitation	–	–	–	+	+	+	–	–	–	–	–	–	
524	Measuring result	–	–	–	+	+	+	–	–	–	–	–	–	
530–535	***Food and/or feedingstuffs***													to be substituted by new solution, graphical form
530	Concentration(s) in food given?	–	–	–	–	–	–	–	–	–	–	–	–	
531	Type of food/feedingstuffs	–	–	–	–	–	–	+	+	+	+	+	+	
532	Central location of sampling area	–	–	–	–	–	–	+	+	+	+	+	+	
533	Measurement area for which value(s) are representative	–	–	–	–	–	–	+	+	+	+	+	+	
534	Period of sampling	–	–	–	–	–	–	+	+	+	+	+	+	
535	Measuring result(s)	–	–	–	–	–	–	+	+	+	+	+	+	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
540–547	***Other measurements***													to be substituted by new solution, graphical form
540	Data for other measurements given?	–	–	–	–	–	–	–	–	–	–	–	–	
541	Medium sampled, e.g. deposition, river water, drinking water	–	–	–	+	+	+	+	+	+	+	+	+	
542	Central location of sampling area	–	–	–	+	+	+	+	+	+	+	+	+	
543	Measurement area for which values are representative	–	–	–	+	+	+	+	+	+	+	+	+	
544	Sampling period				+	+	+	+	+	+	+	+	+	
545	Measuring result(s) other than deposition	–	–	–	–	–	–	–	–	–	–	–	–	
546	Deposition results	–	–	–	+	+	+	+	+	+	+	+	+	
547	Other relevant information	–	–	–	–	–	–	–	–	–	–	–	–	
600–655	***Off-site protective measures***													
600	Off-site protective measures given?	–	–	–	–	–	–	–	–	–	–	–	–	
601–605	***Access control***													
601	Access control?	+	+	+	+	+	+	+	+	+	–	–	–	
602	Size or name of area(s) affected	+	+	+	+	+	+	+	+	+	–	–	–	
603	Furthest access control distance	+	+	+	+	+	+	+	+	+	–	–	–	
604	Date and time of start	+	+	+	+	+	+	+	+	+	–	–	–	
605	Date and time of protective measure cancelled	+	+	+	+	+	+	+	+	+	–	–	–	
		Pre-release			**Release**			**Intermediate**			**Recovery**			

CIS–No		LB	GG	I	LB	GG	I	LB	GG	I	LB	GG	I	Remarks
610–614	***Sheltering***													
610	Sheltering?	+	+	+	+	+	+	–	–	–	–	–	–	
611	Size or name(s) of area(s) affected	+	+	+	+	+	+	–	–	–	–	–	–	
612	Furthest sheltering distance	+	+	+	+	+	+	–	–	–	–	–	–	
613	Date and time of start	+	+	+	+	+	+	–	–	–	–	–	–	
614	Date and time protective measure cancelled	+	+	+	+	+	+	+	+	+	–	–	–	
620–624	***Evacuation***													
620	Evacuation?	+	+	+	+	+	+	+	+	+	+	+	+	
621	Size or name(s) of area(s) affected	+	+	+	+	+	+	+	+	+	–	–	–	
622	Furthest evacuation distance	+	+	+	+	+	+	+	+	+	–	–	–	
623	Date and time of start	+	+	+	+	+	+	+	+	+	–	–	–	
624	Date and time protective measure cancelled	–	–	–	+	+	+	+	+	+	–	–	–	
630–633	***Iodine prophylaxis***													
630	Iodine prophylaxis	+	+	+	+	+	+	–	–	–	–	–	–	
631	Size or name(s) of area(s) affected	+	+	+	+	+	+	–	–	–	–	–	–	
632	Furthest distance for prophylaxis	+	+	+	+	+	+	–	–	–	–	–	–	
633	Date and time of start	+	+	+	+	+	+	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
640–647	***Restriction on use of foods / beverages / feedingstuffs***													
640	Restriction on use of foods/beverages/feedingstuffs?	–	–	–	+	–	–	+	+	+	+	+	+	to be substituted by new solution, graphical form
641	Type of restriction and medium involved	–	–	–	+	–	–	+	+	+	+	+	+	for Intermediate and Recovery
642	Restriction based on contamination by radionuclides	–	–	–	+	–	–	+	+	+	+	+	+	
643	Intervention level used	–	–	–	+	–	–	+	+	+	+	+	+	
644	Size or name(s) of area(s) affected	–	–	–	+	–	–	+	+	+	+	+	+	
645	Furthest distance away from accident location	–	–	–	+	–	–	–	–	–	–	–	–	
646	Date and time of start	–	–	–	+	–	–	+	+	+	+	+	+	
647	Date and time protective measure cancelled	–	–	–	+	–	–	+	+	+	+	+	+	
650–655	**Other protective measures**													
650	Other protective measures?	–	–	–	–	–	–	–	–	–	–	–	–	
651	Type of protective measure	–	–	–	–	–	–	–	–	–	–	–	–	
652	Size or names of area(s) affected	–	–	–	–	–	–	–	–	–	–	–	–	
653	Furthest distance of measure	–	–	–	–	–	–	–	–	–	–	–	–	
654	Date and time of start	–	–	–	–	–	–	–	–	–	–	–	–	
655	Date and time protective measure cancelled	–	–	–	–	–	–	–	–	–	–	–	–	

		Pre-release			Release			Intermediate			Recovery			
CIS–No		**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**LB**	**GG**	**I**	**Remarks**
900–999	***Free text messages***													
900	Free text messages referencing line number as appropriate	–	–	–	–	–	–	–	–	–	–	–	–	
901	<Reference line number(s)>	–	–	–	–	–	–	–	–	–	–	–	–	
902	Free text to lines above	–	–	–	–	–	–	–	–	–	–	–	–	
980	Confidential information	–	–	–	–	–	–	–	–	–	–	–	–	general agreement
981	Line #s containing confidential information	–	–	–	–	–	–	–	–	–	–	–	–	
999	Distribution List: countries and organisations receiving message directly from originator	–	–	–	–	–	–	–	–	–	–	–	–	

Annex 3

DRAFT PLANT STATUS CHECKLIST

Reporting Form on Technological Status of the Nuclear Power Plant

STATUS OF KEY SAFETY FUNCTIONS	Subcriticality	Under Control ☐ Out of Control ☐	challenged ☐ degraded ☐	improving ☐ worsening ☐
	Core Cooling	Under Control ☐ Out of Control ☐	challenged ☐ degraded ☐	improving ☐ worsening ☐
	Containing Radioactivity	Under Control ☐ Out of Control ☐	challenged ☐ degraded ☐	improving ☐ worsening ☐
	Status of barriers			
	Fuel Matrix	Unknown ☐ Intact ☐ Damaged ☐	within design ☐ beyond design ☐	
	Fuel Cladding	Unknown ☐ Intact ☐ Damaged ☐	within design ☐ beyond design ☐	
	Reactor Coolant System	Unknown ☐ Intact ☐ Damaged or opened ☐	within design ☐ beyond design ☐	
	Containment	Unknown ☐ Intact ☐ Damaged or opened ☐	within design ☐ beyond design ☐	

Annex 4

DOCUMENT PREPARATION GROUPS

Expert Group on Nuclear Emergency Matters

	Name	Organisation	Country
Chairman	Hans Brunner	Nationale Alarmzentrale	Switzerland
Members	Martin Baggenstos	Nuclear Safety Inspectorate	Switzerland
	Keith Binfield	DETR	United Kingdom
	Sabine Bittner	Federal Ministry for the Environment, Nature Conservation and Reactor Safety	Germany
	Jim Bond	Atomic Energy of Canada	Canada
	Craig Conklin	US Environmental Protection Agency	United States
	James Fairobent	US Department of Energy	United States
	George Frazer	European Commission	
	Riitta Hanninen	Radiation and Nuclear Safety Authority	Finland
	Rosemary T. Hogan	US Nuclear Regulatory Commission	United States
	Stig Husin	Swedish Radiation Protection Institute	Sweden
	Ivan Lux	Hungarian Atomic Energy Directorate	Hungary
	Dorothy Meyerhof	Health Canada	Canada
	Horst Miska	Ministry for the Interior and Sports of the Land Rheinland-Palatine	Germany
	Wim Molhoek	Ministry of Housing, Spatial Planning and the Environment	Netherlands
	Carlos Alberto Nogueira de Oliveira	International Atomic Energy Agency	
	Colin Patchett	Health and Safety Executive	United Kingdom
	Ake Persson	Swedish Radiation Protection Institute	Sweden
	Dominique Rauber	Nationale Alarmzentrale	Switzerland
	Denys Rousseau	Institut de protection et de sûreté nucléaire	France
	Jan-Olof Snihs	Swedish Radiation Protection Institute	Sweden
	Finn Ugletveit	Norwegian Radiation Protection Authority	Norway

Working Group on Emergency Communication and Information Exchange

	Name	Organisation	Country
Chairman	Horst Miska	Ministry for the Interior and Sports of the Land Rheinland-Palatine	Germany
Members	Martin Baggenstos	Nuclear Safety Inspectorate	Switzerland
	Sabine Bittner	Federal Ministry for the Environment, Nature Conservation and Reactor Safety	Germany
	Marc de Cort	European Commission	
	Fred Hardmeier	Nationale Alarmzentrale	Switzerland
	Carlos Alberto Nogueira de Oliveira	International Atomic Energy Agency	
	Finn Ugletveit	Norwegian Radiation Protection Authority	Norway

Working Group on Key Emergency Data

	Name	Organisation	Country
Chairman	Wolfgang Weiss	Federal Office for Radiation Protection	Germany
Members	Michel Jean	Environment Canada	Canada
	Olof Karlberg	Swedish Radiation Protection Institute	Sweden
	Carlos Alberto Nogueira de Oliveira	International Atomic Energy Agency	
	Colin Patchett	Health and Safety Executive	United Kingdom
	Dominique Rauber	Nationale Alarmzentrale	Switzerland
	Denys Rousseau	Institut de protection et de sûreté nucléaire	France
	Daryl Thome	Remote Sensing Laboratory	United States
	Serge Vade	European Commission	

Working Group on Emergency Monitoring Strategy

	Name	Organisation	Country
Chairman	Ake Persson	Swedish Radiation Protection Institute	Sweden
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	Matthias Zähringer	Federal Office for Radiation Protection	Germany

Secretariat:

	Ted Lazo	Nuclear Energy Agency	France
	Stefan Mundigl	Nuclear Energy Agency	France

Annex 5

TERMS OF REFERENCE OF THE WORKING GROUPS

Working Group on Emergency Communication and Information Exchange

The Terms of Reference for the Working Group on Emergency Communication and Information Exchange are as follows:

1. elaborate a strategy for international emergency communications and information management;

2. perform a survey to identify the relevant technical means for implementing this strategy, and to identify good practice;

3. co-ordinate with the Working Group on the Identification of Key Emergency Data, and the Working Group on Monitoring Strategies to assure that the work of all three Groups is complementary in nature;

4. elaborate concepts and proposals for operational applications of new technologies and methods, and for standardisation of products and procedures in view of their use for international emergency notification and emergency information exchange (IAEA, EC);

5. develop a summary report on these subjects for the Expert Group on Nuclear Emergency Management and for the CRPPH, and organise, if appropriate, a workshop to discuss these issues and move towards international consensus; and

6. report periodically to the Expert Group and to the CRPPH on the progress of the programme.

Working group on key emergency data

The Terms of Reference for the Working Group on Key Emergency Data are as follows:

1. Evaluate recent and on-going work in the area of the identification of key emergency data, particularly taking into account work performed by EURDEP and RODOS, and identify those areas where the NEA could usefully contribute.

2. Develop a report, using the above mentioned recent and on-going work as a basis, on the subject of key emergency data, including discussion of trigger levels for various information and data exchanges, of what data is the most important/useful/available at various stages of an emergency, co-ordination with other working groups on topics such as how such key data could be made available to other countries and international organisations (automatic transfer via fax, telex, teletext, etc., available for consultation on a data server on the internet or on a dedicated and more secure network, etc.), how key data should be displayed (graphics, tables, maps, etc.), how data should be quality controlled, and good practice in this area. The report should also include a survey of some current national practices in terms of what data are currently transmitted in emergency situations and by what means.

3. Report periodically on its progress to the Expert Group on Nuclear Emergency Matters, which in term will report to the CRPPH.

Working group on emergency monitoring strategy

The Terms of Reference for the Working Group on Emergency Monitoring Strategies are as follows:

1. evaluate recent and on-going work in the area of monitoring strategies and identify those areas where the NEA could usefully contribute;

2. develop a working paper, using the above mentioned recent and on-going work as a basis, on the subject of monitoring strategies, including discussion of the differences among existing national programmes and strategies, of current "good practice" in monitoring strategy, of current measurement techniques and technologies;

3. based on the working paper, develop a workshop programme to discuss all relevant issues, and will present this programme to the Expert Group on Nuclear Emergency Matters and the CRPPH for approval;

4. based on the workshop results, develop conclusions and recommendations for future work; and

5. report periodically on its progress to the Expert Group on Nuclear Emergency Matters, which in tern will report to the CRPPH.

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