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EMERGENCY PREPAREDNESS
AND RESPONSE

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency

Updating IAEA-TECDOC-953

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EPR-METHOD (2003) Emergency Preparedness And Response

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METHOD FOR DEVELOPING ARRANGEMENTS FOR RESPONSE TO A NUCLEAR OR RADIOLOGICAL EMERGENCY

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FOREWORD

The aim of this publication is to provide a practical resource for emergency planning, and to fulfil in part functions assigned to the IAEA in the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency ('Assistance Convention'). If used effectively, it will help users to develop a capability to adequately respond to a nuclear or radiological (radiation) emergency.

Under Article 5.a(ii) of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency ('Assistance Convention'), one function of the IAEA is to collect and disseminate to States Parties and Member States information concerning methodologies, techniques and available results of research relating to such emergencies.

The IAEA first published this material as Method for Development of Emergency Response Preparedness for Nuclear or Radiological Accidents in 1997, IAEA-TECDOC-953, which has been used extensively by the IAEA for training and for evaluation of emergency response programmes. In November 1999 a Technical Committee meeting with representatives of over 20 States reviewed and provided feedback on the TECDOC.

This TECDOC, published as part of the IAEA Emergency Preparedness and Response Series, replaces and builds on IAEA-TECDOC-953, incorporating revisions to address the lessons learned from using IAEA-TECDOC-953, previous emergencies and research, while ensuring consistency with the safety requirements "Preparedness and Response for a Nuclear or Radiological Emergency" GSR-2 published in 2002.

It is intended to keep the publication current and relevant by revising it on a regular basis.

Some of the expanded features in this publication include:

(1) information on response to the full range of foreseeable emergencies including those involving detection of medical symptoms of radiation exposure, lost or stolen dangerous sources, operations of a dangerous mobile source, public contamination, transport, or serious overexposure;

(2) expanded information for facilities in threat category II (e.g. research reactors) and threat category III (e.g. irradiation facilities);

(3) information on the categorization of and response to terrorist acts and threats;

(4) information on emergency organizations and facilities;

(5) extensive outlines of national, local, facility or operator plans and procedures;

(6) information on determining if a quantity of radioactive material should be considered a dangerous source; and

(7) information on management of the medical response and in mitigating the non-radiological consequences.

The IAEA officer responsible for this publication was T. Mc Kenna of the Division of Radiation and Waste Safety.

EDITORIAL NOTE

The use of particular designations of countries or territories does not imply any judgement by the publisher, the IAEA, as to the legal status of such countries or territories, of their authorities and institutions or of the delimitation of their boundaries.

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1. INTRODUCTION

1.1. BACKGROUND

In 1997 the IAEA compiled, consolidated and organized existing information, and published the TECDOC Method for Development of Emergency Response Preparedness for Nuclear or Radiological Accidents, IAEA-TECDOC-953 [1]. Subsequently this publication was used extensively by the IAEA for training and for evaluation of emergency response programmes. In November 1999 a technical committee meeting (TCM) with representatives of over 20 States reviewed and provided feedback on IAEA-TECDOC-953.

In March 2002, the IAEA's Board of Governors approved a Safety Requirements publication [2], "Preparedness and Response for a Nuclear or Radiological Emergency", jointly sponsored by seven international organizations, which establishes the requirements for an adequate level of preparedness and response for a nuclear or radiological emergency in any State. The IAEA General Conference in resolution GC(46)/RES/9 encouraged Member States "to implement, if necessary, instruments for improving their own preparedness and response capabilities for nuclear and radiological incidents and accidents, including their arrangements for responding to acts involving the malicious use of nuclear or radioactive material and to threats of such acts" and has further encouraged them to "implement the Safety Requirements for Preparedness and Response to a Nuclear or Radiological Emergency".

The obligations, responsibilities and requirements for preparedness and response for radiation emergencies are set out in the safety standards, in particular the 1996 "International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources" [3]. Consensus information on relevant radiation protection criteria was established in 1994 and published in "Intervention Criteria in a Nuclear or Radiation Emergency" [4]. Several other guides and publications in the area of emergency preparedness and response had previously been issued.

The present publication now being issued in the Emergency Preparedness and Response (EPR) series is an update to IAEA-TECDOC-953. It aims to: 1) fulfil in part the IAEA's function under article 5.a(ii) of the Assistance Convention, and 2) to provide a compendium of best practice for planners aiming both to comply with the Requirements [2] and to improve their own capabilities for responding to radiation emergencies, while the Secretariat facilitates consensus on formal guidance for meeting the Safety Requirements.

The publication incorporates material from existing IAEA emergency preparedness Safety Guides [5–10] updating it to be consistent with the Requirements [2], to incorporate best practice, the results of research and the latest lessons identified in past emergencies, and to reflect relevant issues of international law. It provides a practical source of information relevant to the development of an integrated national, local and operator capability for emergency response based on the potential nature and magnitude of the risk.

In order to apply the method described in this publication, emergency planners should have a good understanding of the basic principles for response to a nuclear or radiological emergency. They should review the relevant international guidance [2, 3, 4] beforehand.

1.2. OBJECTIVE

This publication provides information concerning methodologies, techniques and available results of research relating to response to nuclear or radiological emergencies. It also provides a practical, step-by-step method for developing integrated operator, local and national capabilities for emergency response. It does not provide IAEA endorsed guidance or recommendations because this material has not undergone the process of peer reviews needed to become part of the IAEA Safety Standards Series.

1.3. SCOPE

This publication concerns preparations for radiation emergencies[2]. The range of potential radiation emergencies of concern is enormous, extending from a major reactor emergency to emergencies involving lost or stolen radioactive material. This method covers planning for the entire range.

The method recognizes that a minimum level of preparedness is appropriate in every State, even in those without any known practices using nuclear or radioactive material, because any State could be affected by an emergency involving transport, lost or stolen sources, or transboundary contamination.

Clearly, the method cannot take all site specific or emergency specific factors into account. Moreover, this publication does not represent a set of obligations. Planners should remain flexible in its use and adapt the method to local socio-political, economic, and other factors.

Emergency preparedness must be carried out at two major levels. First, the operator must be prepared to mitigate the potential consequences of the emergency at the source and notify off-site officials. Second, the off-site officials must be prepared to manage and reduce the impact on the public and the environment. This publication addresses development of a response capability at both levels.

This publication does not address the preparations needed for an adequate tactical or investigative response to terrorist or other criminal acts. It does address the co-ordination of such a response with the response dealing with the actual or potential radiological consequences.

1.4. STRUCTURE

The remainder of the publication is divided into three sections.

Section 2 reviews basic concepts and describes the overall steps to follow in order to establish an adequate emergency response capability. It also explains how to select the appropriate threat category (see Section 2.1.2) applicable to practices in any given State. Section 3 contains a worksheet for the identification and assignment of critical emergency preparedness and response functions. Section 4 contains descriptions of severe emergencies, descriptions of the ideal response (concept of operations) to these emergencies and detailed checklists of items that should be considered by emergency planners in developing and maintaining the capability to respond to radiation emergencies. Readers need to refer only to the items that are applicable to their threat categories.

The publication also contains a number of appendices, which provide further elaboration or clarification.

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[2] The term “radiation emergency”, as used in this publication, is a common term for nuclear and/or radiological emergency.

2. ESTABLISHING AN EMERGENCY RESPONSE CAPABILITY

2.1. BASIC CONCEPTS

The IAEA has conducted an examination of past radiation emergencies to identify lessons that should be considered in the future. Answering the following two questions concerning severe accidents can provide the most important lessons:

(1) Why, as a result of the Chernobyl release, did 1000 or more children suffer from thyroid cancer that could have been easily avoided?

(2) Why were actions of the operators partly the cause of the melting of the core during the accident at Three Mile Island?

The answer to the first question is that the authorities under-reacted because of lack of preparedness. The answer to the second question is that the operators were not trained for the conditions they faced. In both cases, the basic cause was that no one thought it was worth preparing in advance for such low probability emergencies.

This publication was developed after considering such questions.

Preparing for radiation emergencies has often been done in isolation without the full involvement of the national or local organizations responsible for responding to conventional emergencies such as fires, floods, or storms. However, these organizations play a crucial role during a radiation emergency. Moreover, an emergency may involve criminal activity such as terrorism or theft, in which case emergency response must be co-ordinated with criminal investigation and possible tactical response. Many emergency plans do not consider this possibility. This lack of prior planning in co-operation with law enforcement agencies and other response organizations has caused confusion and reduced the effectiveness of response. Consequently, radiological and non-radiological planning should be fully integrated.

In the past, responses to emergencies have often been directed by many different organizations and individuals (at the same time) located throughout the State. Obviously, this resulted in confusion, conflicting information and instructions, and ultimately in ineffective response and loss of public trust. Consequently, each State should develop an integrated response system with responsibilities and authorities clearly assigned and co-ordinated. The response should be directed from a central location near the scene as soon as possible.

All radiation emergencies perceived as dangerous receive an immense amount of media, public and political attention. In general, it is not the actual risk that attracts this attention but the perceived risk. Slow, non-informative and unco-ordinated response by officials and operators to this media and public attention has resulted in confusion during the response, and in psychological, economic, and political damage. Since the media are often the primary source of public information during an emergency, provisions should be in place to respond to public and the media concerns effectively during an actual radiation emergency or if an event is perceived by the public or media as a radiation emergency.

The response to a radiation emergency is basically the same as the response to any emergency involving hazardous material. The major difference is that in many hazardous material emergencies, the hazard can be smelled, seen or felt. This is not the case with radiation emergencies. In addition, in most cases responders will have no experience with radiation emergencies (which are very rare), very small amounts of radioactive material and radiation (unlike many chemicals) can be immediately detected with simple, commonly available instruments, and the medical symptoms of radiation exposure (except in extreme cases) will

not appear for days, weeks or even years. Finally, many misconceptions prevail concerning the risks from radiation exposure and radiation emergencies, which can lead to decision making and public actions that do more harm than good. Therefore, preplanning on the basis of established principles of radiation protection and safety is essential.

This section provides a brief review of some terms and concepts that must be understood before planning can begin, followed by a discussion of the major steps to take in developing a capability to respond to radiation emergencies.

2.1.1. GOALS OF EMERGENCY PLANNING AND RESPONSE

In the context of a radiation emergency, the *practical goals of emergency response* [2] are:

(1) to regain control of the situation;
(2) prevent or mitigate consequences at the scene;
(3) to prevent the occurrence of deterministic health effects in workers and the public;
(4) to render first aid and manage the treatment of radiation injuries;
(5) to prevent, to the extent practicable, the occurrence of stochastic health effects in the population;
(6) to prevent, to the extent practicable, the occurrence of adverse non-radiological effects on individuals and among the population;
(7) to protect, to the extent practicable, the environment and property; and
(8) to prepare, to the extent practicable, for the resumption of normal social and economic activity.

The first and second goals are the responsibility of the operator of the practice or facility. It involves preventing or reducing the release of radioactive material and exposure of workers and the public. The remaining objectives are the *combined* responsibility of operators and off-site organizations.

The third goal is accomplished by taking urgent protective actions to keep the dose below the threshold for deterministic health effects (see Appendix 2). In many cases, this is best accomplished by taking protective actions before a release when severe conditions are detected in the facility.

The fourth goal is initially accomplished by having the first to arrive at the scene qualified to immediately provide first aid for life threatening injuries. It also can involve very specialized treatment of radiation-induced injuries that can only be prescribed or provided by specialists. Lack of preparation to provide the correct medical treatment of severe overexposure has resulted in several cases of inappropriate treatment and unnecessary suffering. Medical personnel, without training on radiological response, have been reluctant to treat potentially contaminated victims due to fear.

The fifth goal is met by taking protective actions to avert doses consistent with those indicated in international guidance. International guidance [3, 4] specifies “generic intervention levels” (GILs), at which urgent and longer term protective actions should be taken by the public, and “generic action levels” (GALs), at which controls should be placed on food. These levels were selected so that the protective action would do more good than harm: that is, the benefits of averting a dose will be greater than the penalty incurred by applying the protective action. Notably, this also means that taking protective action at considerably lower or higher values could increase the overall detriment to the public or workers. This information is summarized in Appendices 1, 2 and 3. However, this international guidance (GILs and GALs) is not designed to be used during an emergency; the

levels cannot be promptly measured in the field and do not address facility conditions. They should be used to develop, in advance, operational intervention levels (OILs) and other criteria, e.g. emergency action levels (EALs), which can easily be measured during an emergency (e.g. expressed as dose rate), and with which the need for protective action can be rapidly ascertained. The Chernobyl accident showed that developing OILs during an emergency that are consistent with international guidance is very difficult due to political pressure and public mistrust. In addition, not having internationally harmonized OILs in place before an emergency would result in different protective actions being taken by States for the same measured levels. This is what happened worldwide following the Chernobyl accident when establishing controls on contaminated food and was difficult to explain to the public. Therefore, OILs should be developed in advance as part of the planning process.

The sixth goal addresses what many feel is the most important consequence of many radiation emergencies. In these emergencies the psychological, sociological and economic consequences were far greater than the radiological consequences. Many of these non-radiological effects were caused by inappropriate actions taken to address radiological concerns. These in turn resulted from unrealistic fears of radiation due to a lack of information early in the emergency followed by conflicting and non-informative information from official sources and the technical community.

The seventh goal is addressed by limiting the spread of contamination and ensuring that any remedial actions taken to reduce the environmental impact (e.g. decontamination) do more good than harm. In the past, efforts made to decontaminate areas have increased the damage to the environment for little benefit radiologically.

The eighth goal is very closely tied to the sixth. Resumption of normal life is essential to eliminating many of the adverse non-radiological consequences. However, concern about inconsequential contamination and misconception about risks often delay or prevent people returning to normal where it would be possible. Before people can live normally they want to know that they and their loved ones are safe and their interests (e.g. property, livelihood) are not at risk.

2.1.2. THREAT CATEGORIES

Before any planning can begin, the practices and activities for which emergency response planning is necessary must be identified. Emergency planning could be different for each practice. However, this can be simplified by grouping practices into five threat categories, defined in Table I, each presenting common features in terms of the magnitude and timing of the hazard.

Information in the remainder of this publication is organized according to these “threat categories”. Threat categories I through III represent decreasing levels of threats at facilities and therefore decreasing emergency preparedness and response requirements. Threat category IV applies to threats and practices that can exist virtually anywhere and thus is the minimum level of threat assumed to exist everywhere. Threat category IV *always applies* to all jurisdictions, possibly along with other categories. Threat category V applies to the off-site areas where emergency preparations are warranted to address contamination resulting from a release from a facility in threat category I or II. These threat categories apply both to facilities or uses and to governmental jurisdictions for which various levels of preparedness are warranted. Section 2.2.5 provides help in determining the threat categories and Appendix 4 gives examples of the threat categories for different practices.

TABLE I. FIVE CATEGORIES OF NUCLEAR AND RADIATION RELATED THREATS FOR THE PURPOSES OF APPLYING THE METHOD [2]

Threat category	Description
I	Facilities, such as nuclear power plants, for which on-site events[3] (including very low probability events) are postulated that could give rise to severe deterministic health effects[4] off the site, or for which such events have occurred in similar facilities.
II	Facilities, such as some types of research reactors, for which on-site events[3] are postulated that could give rise to doses to people off the site that warrant urgent protective actions in accordance with international standards[5], or for which such events have occurred in similar facilities. Threat category II (as opposed to threat category I) does not include facilities for which on-site events (including very low probability events) are postulated that could give rise to severe deterministic health effects off the site, or for which such events have occurred in similar facilities.
III	Facilities, such as industrial irradiation facilities, for which on-site events are postulated that could give rise to doses that warrant or contamination that warrants urgent protective actions on the site, or for which such events have occurred in similar facilities. Threat category III (as opposed to threat category II) does not include facilities for which events are postulated that could warrant urgent protective action off the site, or for which such events have occurred in similar facilities
IV	Activities that could give rise to a nuclear or radiological emergency that could warrant urgent protective actions in an unforeseeable location. These include non-authorized activities such as activities relating to dangerous sources obtained illicitly. They also include transport and authorized activities involving dangerous mobile sources such as industrial radiography sources, radiothermal generators or nuclear powered satellites. Threat category IV represents the minimum level of threat, which is assumed to apply for all States and jurisdictions.
V	Activities not normally involving sources of ionizing radiation, but which yield products with a significant likelihood[6] of becoming contaminated as a result of events at facilities in threat categories I or II, including such facilities in other States, to levels necessitating prompt restrictions on products in accordance with international standards.

[3] Involving an atmospheric or aquatic release of radioactive material or external exposure (such as due to a loss of shielding or a criticality event) that originates from a location on the site.
[4] Doses in excess of those for which intervention is expected to be undertaken under any circumstances; see Schedule IV of Ref. [3], reproduced in Appendix 2. See Glossary under definition of deterministic health effects.
[5] Schedule V of Ref. [3], reproduced in Appendix 1.
[6] Conditional on the occurrence of a significant release of radioactive material from a facility in threat category I or II.

Table II summaries the emergency preparedness arrangements that should be in place for each threat category.

TABLE II SUMMARY OF THE EMERGENCY PREPAREDNESS ARRANGEMENTS BY THREAT CATEGORY

Threat Category I and II	
Operator	**Off-site officials for the emergency zones**
Arrangements to promptly: classify an emergency; mitigate the emergency; notify and recommend protective actions off the site consistent with international guidance; protect those on site; obtain off-site assistance; conduct environmental monitoring near the facility; and assist off-site officials in keeping the public informed.	Arrangements to promptly: implement urgent protective actions within the emergency zones; control consumption of contaminated food within the food restriction planning radius; provide emergency services to the facility; provide medical treatment to contaminated or overexposed victims; tell the public and media in plain language of the risk, and of the action they should take; and monitor and respond to inappropriate public reactions.
Threat Category III	
Operator	**Off-site officials – near the facility**
Arrangements to promptly: classify emergency; protect those on site; inform off-site officials; obtain off-site assistance; conduct environmental monitoring near the facility to ensure that there are no off-site risks; and assist off-site officials in keeping the public informed.	Arrangements to promptly provide emergency services; give medical treatment to contaminated or overexposed victims; confirm there are no off-site impacts; tell the public and media in plain language of the risk and of the action they should take; and monitor and respond to inappropriate public reactions.
Threat Category IV	
Operator (Dangerous mobile source)	**Off-site officials (National level)**
Arrangements to promptly: recognize an emergency, take action to protect the people nearby, mitigate the emergency, inform off-site officials of the risk; and provide technical assistance to off-site officials if needed.	Arrangements to: inform (in advance) medical practitioners, scrap metal dealers and border crossings on the recognition and response to a radiological emergency; promptly make decisions on protective actions consistent with international guidance, assess and respond to a limited radiological emergency, tell the public and media in plain language of the risk, and of the actions they should take; report transnational emergencies to the IAEA; respond to IAEA notifications; and request IAEA assistance when needed.
Threat Category V	
Farmers and food producers in food restriction planning radius	**Off-site officials (Food restriction planning radius)**
Arrangements to promptly respond to official instructions to protect the food/water supply and control potentially contaminated food/water.	Arrangements to issue instructions to protect the food/water supply and control potentially contaminated food/water, consistent with international standards.

2.1.3. AREAS AND ZONES

For most emergency types, response takes place over two distinct areas.

ON-SITE AREA

This is the area surrounding the facility within the security perimeter, fence or other designated property marker. It can also be the controlled area around a radiography source or contaminated area. It is the area under the immediate control of the facility or operator. For transport emergencies or emergencies involving uncontrolled sources or localized contamination there may not be an on-site area defined at the onset of the emergency. However, during the initial response to these events the first responders or operator establish a security perimeter containing the inner- and outer-cordoned areas as shown in Figure 1 [11], thereby defining the on-site area, which is under their control. Appendix 5 provides suggested sizes for the inner-cordoned area for various radiological emergencies.

OFF-SITE AREA

This is the area beyond that under the control of the facility operator or first responders. For facilities with the potential for emergencies resulting in major off-site releases or exposures (threat categories I and II), the level of planning will vary depending on the distance from the facility. For these facilities, planning can be discussed for two emergency planning zones, as illustrated in Figure 2, and as described below and discussed further in Appendix 5.

Precautionary action zone (PAZ)

This is a predesignated area around a facility in threat category I is where urgent protective action has been preplanned and will be implemented immediately upon declaration of a general emergency (see Section 2.1.5). The goal is to substantially reduce the risk of severe deterministic health effects by taking protective action within this zone *before* or shortly after a release.

Urgent protective action planning zone (UPZ)

This is a predesignated area around a facility in threat category I or II is where preparations are made to promptly implement urgent protective action based on environmental monitoring data and assessment of facility conditions, the goal being to avert doses specified in international standards [3], as reproduced in Appendix 1.

These zones should be roughly circular areas around the facility, their boundaries defined by local landmarks (e.g. roads or rivers) to allow easy identification during a response as shown in Figure 2. It is important to note that the zones do not stop at national borders. The size of the zones can be determined by an analysis of the potential consequences. Previous studies [12, 13] also provide a basis for generic zone sizes, as summarized in Appendix 5.

2.1.4. PLANNING LEVELS AND RESPONSIBILITIES

Effective emergency response requires mutually supportive and integrated emergency planning at three levels: operator, off-site, and international.

OPERATOR LEVEL

The operator can be facility staff, or personnel using or transporting nuclear/radioactive material at the time of the emergency. They are responsible for:

(1) taking immediate action to mitigate the emergency;

(2) protecting people on site;

(3) notifying off-site officials and providing them with recommendations on protective actions and technical assistance; and

(4) providing initial radiological monitoring.

For transport emergencies, the operator includes the carrier, the shipper, the owner of the source and the transporter.

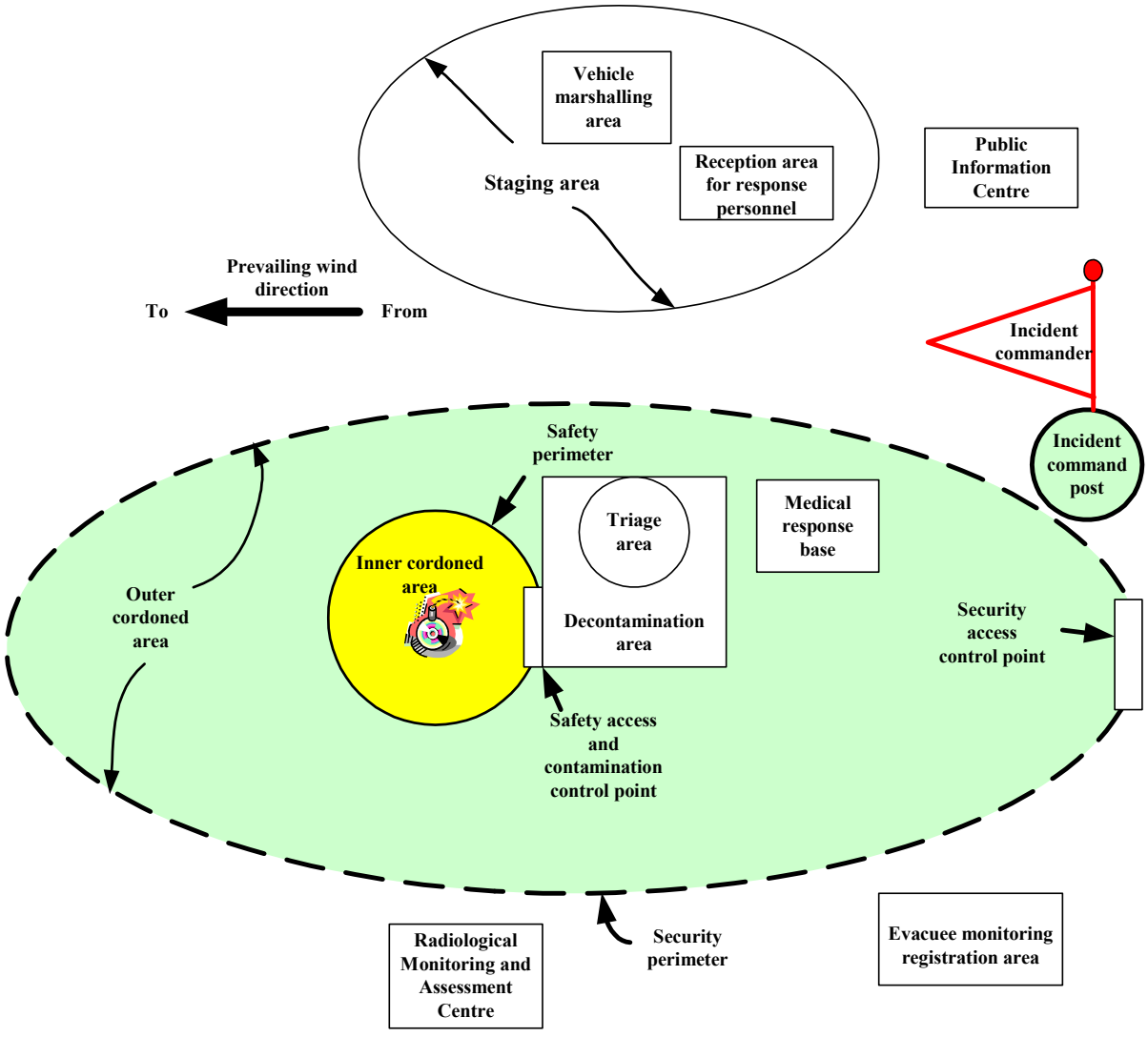

FIG. 1. Areas established by first responders.

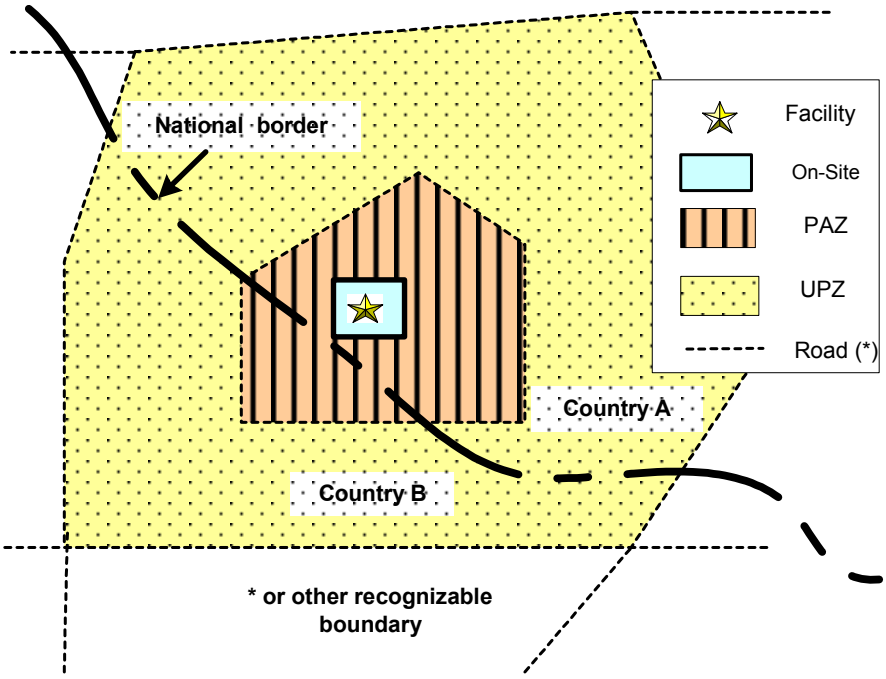

FIG. 2. Concept of emergency zones.

OFF-SITE LEVEL

This level consists of organizations that will perform the response actions carried out off site, and includes:

(1) Local officials: the government and support agencies responsible for providing immediate support to the operator and prompt protection of the public in the vicinity. This includes the police, fire fighting and civil emergency services or medical personnel, who may be the first to learn of an accident. It may include officials from different States if the facility is near a border.

(2) National and regional (province or state) officials: the governmental agencies responsible for planning and response on the national (or regional) level. These agencies are typically responsible for tasks that usually do not need to be implemented urgently to be effective. They include:

   (a) longer term protective actions; and

   (b) support of local officials in the event that their capabilities are exceeded.

(3) Non-governmental organizations (NGOs)

INTERNATIONAL LEVEL

This level consists of organizations responsible for providing international assistance as described in the "Joint Radiation Emergency Management Plan of the International Organizations" [14]. It includes:

(1) IAEA implementation of the "Convention on Early Notification of a Nuclear Accident", the "Convention on Assistance in the Case of a Nuclear or Radiological Emergency" [15] and para. 4.15 of the Safety Requirements (GS-R-2) [2]. The parties to the Notification Convention commit to inform forthwith those States that may be affected

by a significant transboundary release and the IAEA. In addition to meet the Safety Requirement [2] States adopting them must inform those that may be affected by a transnational emergency and the IAEA. These notifications can be made directly or through the IAEA. However, areas in States where urgent protective action should be taken should be notified directly and not through the IAEA. Under the Assistance Convention, States have committed to facilitate prompt assistance in the event of an accident. The IAEA, under the Assistance Convention, has provided or with the help of Member States and other international organizations, has provided assistance during emergencies, including: environmental monitoring, aerial surveys, medical consultation and treatment, assistance with source recovery and assistance in media relations.

(2) Organizations, such as the United Nations Office of the Co-ordination of Humanitarian Affairs (OCHA), the World Health Organization (WHO), or the Food and Agriculture Organization of the United Nations (FAO), that can provide technical, humanitarian or medical assistance in the event of an emergency.

2.1.5. EMERGENCY CLASSES, CONDITIONS AND IMMEDIATE ACTIONS

The response to an emergency should begin without delay and be fully co-ordinated from the start. To facilitate this, a common emergency classification system should be adopted by all response organizations. The requirements [2] suggest the following classes for facility emergencies (items 1–4) and for radiological emergencies (item 5):

(1) *General emergencies* at facilities[7] in threat category I or II involving an actual, or substantial risk of, release of radioactive material or radiation exposure[8] that warrants taking urgent protective action off the site. Upon declaration of this class of emergency, action shall be promptly taken to mitigate the consequences of the event and to protect people on the site and within the PAZ and the UPZ as appropriate.

(2) *Site area emergencies* at facilities[7] in threat category I or II involving a major decrease in the level of protection for those on the site and near the facility. Upon declaration of this class of emergency, action shall be promptly taken to mitigate the consequences of the event, to protect people on the site and to make preparations to take protective action off the site if this becomes necessary.

(3) *Facility emergencies* are at facilities[7] in threat category I, II or III involving a major decrease in the level of protection for people on the site. Upon declaration of this class of emergency, action shall be promptly taken to mitigate the consequences of the event and to protect people on the site. Emergencies in this class can never give rise to an off-site threat (e.g. site area or general emergency).

(4) *Alerts* at facilities[7] in threat category I, II or III involving an uncertain or significant decrease in the level of protection for the public or for people on the site. Upon declaration of this class of emergency, action shall be promptly taken to assess and mitigate the consequences of the event and to increase the readiness of the on-site and off-site response organizations as appropriate. Alerts include events that could evolve into facility, site area or general emergencies.

(5) *Other emergencies such as uncontrolled source emergencies* involving loss, theft or loss of control of dangerous sources, including terrorist threats involving radioactive material and re-entry of a satellite containing such a source. Appendix 7 provides safety guides that outline the response to a range of potential radiological emergencies.

[7] Includes fixed and mobile (e.g. ships) facilities.
[8] This could be due to loss of shielding or a criticality.

Typically, the operator declares a class of emergency on the basis of predetermined emergency action levels (EALs).

The on- and off-site action to be taken for each class should be co-ordinated in advance and be initiated upon declaration of the emergency. For areas in threat category V, the immediate action to be taken should also be preplanned; however, this may be accomplished without the use of a classification system. The classes and immediate action that should be taken for each class and other types of emergencies are summarized in Appendices 6 and 7. The emergency classification should not be confused with the International Nuclear Events Scale (INES). INES is designed to indicate how serious an event was *after it is understood* and is not the basis for the response. Determining the INES rating is impossible early in an emergency, so it does not form part of the initial response and should not delay any response action.

2.1.6. FUNCTIONS AND INFRASTRUCTURE

Information is provided for each threat category and is grouped into functional and infrastructural planning elements as follows.

FUNCTIONS

- Establishing emergency management and operations (A1 elements)
- Identifying, notifying and activating (A2 elements)
- Taking mitigatory action (A3 elements)
- Taking urgent protective action (A4 elements)
- Providing information and issuing instructions and warnings to the public (A5 elements)
- Protecting emergency workers (A6 elements)
- Assessing the initial phase (A7 elements)
- Managing the medical response (A8 elements)
- Keeping the public informed (A9 elements)
- Taking agricultural countermeasures, countermeasures against ingestion and longer term protective action (A10 elements)
- Mitigating the non-radiological consequences of the emergency response (A11 elements)
- Conducting recovery operations (A12 elements)

INFRASTRUCTURE ELEMENTS

- Authority (B1 elements)
- Organization (B2 elements)
- Co-ordination of emergency response (B3 elements)
- Plans, procedures and technical tools (B4 elements)
- Logistical support and facilities (B5 elements)
- Training, drills and exercises (B6 elements)
- Quality assurance programme (B7 elements)

The infrastructure elements must be in place to ensure that the functional elements of a response can be performed when needed (see Figure 3).

2.1.7. INTEGRATED PLANNING CONCEPTS

A radiation emergency may be caused by or may involve different types of hazards, including natural (e.g. storms), technological (e.g. nuclear power plant emergency), or criminal or malicious activity (e.g. theft, sabotage, terrorist attacks). The response to each of these hazards probably involves different response organizations with their own response terminology, cultures and plans. Consequently, the plans and procedures for response to all hazards should be structured into a coherent and interlocking system (see Fig. 4). At the top level should be a national emergency plan for an integrated response to any combination of hazards. The national radiation emergency plan (NREP) will be a part of this "all hazards" plan. If there is no national "all hazards" plan, the NREP must address in detail the integration with the response of other organizations during emergencies involving a combination of actual or perceived hazards.

The NREP is a general description of the roles and responsibilities of all the responding organizations and their relationships. In particular the NREP should provide sufficient detail to ensure the functional areas that are performed by personnel drawn from many different ministries or organizations can function effectively. This could be accomplished by attaching to the NREP detailed functional plans for functions such as incident command, radiological monitoring and assessment, medical response and public affairs. It is a summary of more detailed plans and ensures that all the other planning is integrated and compatible. At the next level, there are the plans developed by individual agencies, governmental jurisdictions, and facilities or operators. The final level represents the procedures (e.g. implementing instructions and operational procedures) and resources that will be used during an emergency to carry out the plans. Appendix 12 provides outlines of the various levels of plans and procedures.

In order to optimize the use of resources and the response effectiveness, it is recommended that response plans be highly co-ordinated and consolidated. Planning should not be done by one organization or agency without consultation of the others. For this purpose, information is presented in Section 4.2 for the operator, local officials and national officials. Responsibilities should be assigned jointly with the participation of all concerned parties.

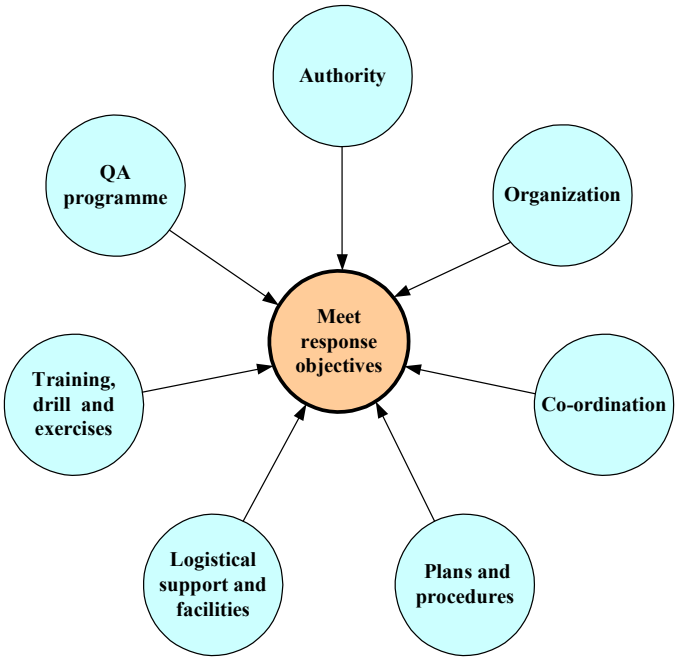

FIG. 3. Infrastructure needed to perform the functions.

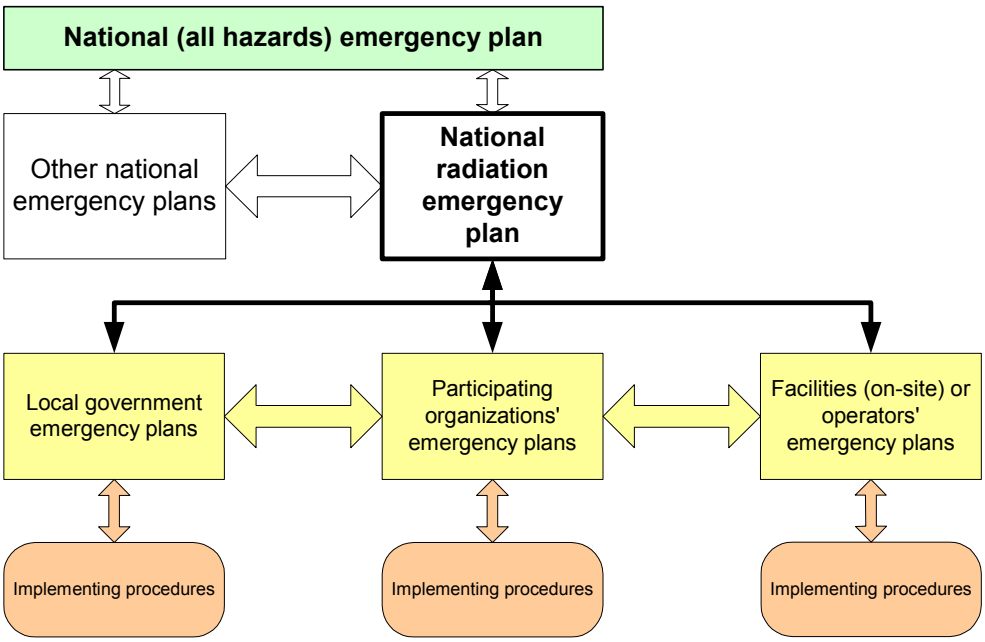

FIG. 4. Integrated planning concept.

2.2. STEP-BY-STEP APPROACH

2.2.1. OVERVIEW

This section describes a step-by-step approach for developing and maintaining a capability to effectively respond to radiation emergencies. The method assumes that only limited response arrangements are in place. If there are substantial emergency arrangements in place, rather than follow the each step in the method, it may be advisable to use the remainder of the publication, in particular Section 3 and 4, to audit you programme.

The main features of the proposed methodology are:

(1) it is modular, i.e. the overall methodology is divided into self-contained tasks that can be planned, developed and executed independently;

(2) it requires extensive consultation with all relevant organizations (*plans that have been developed in isolation have been consistently shown to be ineffective*); and

(3) it is dynamic, i.e. plans and procedures may need to be revised throughout the process.

2.2.2. TASKS

There are ten tasks to perform in order to develop and implement an adequate emergency response capability (see Fig. 5):

Task 1. Review national policy
Task 2. Perform threat assessment
Task 3. Develop planning basis
Task 4. Develop concept of operations and allocate responsibilities
Task 5. Develop *interim* capability

Task 6. Write national radiation emergency plan (NREP)

Task 7. Present NREP

Task 8. Implement detailed plans

Task 9. Test the capability

Task 10. Establish ongoing quality assurance (QA) and maintenance.

The tasks are listed in the order in which they would logically be started. Furthermore, as shown in Figure 5, many of the tasks will be performed in parallel. The development process can be roughly divided into two phases. Phase 1 covers tasks 1–5. One of the aims of this phase is to identify serious deficiencies in the capability to respond to emergencies and immediately develop an interim capability that addresses these deficiencies. During phase 2, which covers tasks 6–10, all the tasks are completed, resulting in a fully developed and formalized emergency response capability.

2.2.3. GETTING STARTED

Identify a national coordinator

Before development of an integrated response capability can begin, an organization should be identified to act as a national co-ordinating authority [2]. The functions of this authority include ensuring that responsibilities are assigned, resolving differences and precluding incompatible arrangements between the various parties. The national co-ordinating authority could be an existing ministry or a standing committee with representatives of all the national level organizations with a major role in the response to a radiation emergency. This authority should have the ability to co-ordinate the response preparations for all the national level organizations with roles in preparation for, or response to, radiation emergencies, conventional emergencies or criminal activities (e.g. terrorist attacks or threats.). Within the national co-ordinating body, before planning can begin, a single overall national radiation emergency planning co-ordinator should be designated to:

(1) ensure that the functions and responsibilities of operators and other response organizations are clearly assigned and understood by all concerned;

(2) ensure that the responsibilities for preparedness and response to a radiation emergency are clearly allocated;

(3) resolve differences and incompatible arrangements between the various participating parties;

(4) co-ordinate the assessment of the threats within the State (see Section 2.2.5);

(5) develop an integrated national radiation emergency plan (NREP);

(6) co-ordinate the development of plans and procedures within and between each level (national, local and operator);

(7) guide the planning process outlined in the following sections;

(8) ensure that a review is conducted periodically in order to identify any new practice or event that could necessitate an emergency response;

(9) foster the implementation by other States of measures designed to fulfil the relevant international obligations in accordance with the Safety Requirements [2]; and

(10) act as the focal point for international co-operation including projects undertaken under the Notification and Assistance Conventions [15] and IAEA assistance projects.

The co-ordinator should have in-depth technical and operational knowledge of emergency preparedness and response issues and should have sufficient decisional authority to ensure an effective co-ordination process. The co-ordinator should be provided with sufficient staff and long term resources to develop and maintain the response capability once it has been established. This should include a multi-year budget.

The co-ordinator should involve all parties with an interest in the development and implementation of the emergency plan(s) in the planning process at the early stage. Attempting to co-ordinate "after the fact" may actually be counterproductive by creating opposition to obligations being imposed on those who had no part in assigning them.

Develop an outline of the integrated plans

The process in developing a response capability is complex. It is helpful, before planning begins, to have an outline of the content of the final set of integrated emergency plans for the national, facility and local levels. This will add structure, promote integration and provide a skeleton on which to build. The emergency plan outline in Appendix 12 can be used for this process.

Tasks		Example Implementation Time Line
Designate national planning co-ordinator		
1	Review national policy	
2	Perform threat assessment	
3	Develop planning basis	
4	Develop concept of operations and allocate responsibilities	
5	Develop *interim* capability	
6	Write NREP	
7	Present NREP	
8	Implement detailed plans	
9	Test capability	
10	Establish ongoing QA programme	

▲ Preliminary result used to develop the interim capability (Task 5).

FIG .5. Overview of the development of an emergency response capability.

2.2.4. TASK 1 – REVIEW NATIONAL POLICY

Review and document the legal infrastructure and policies to ensure that there is agreement on planning responsibilities at the national level. This is a crucial step, and without such agreement it will be impossible to produce effective plans.

Include the outcome of the review in the NREP and ensure that all the major ministries that may have a role in response to an emergency endorse it. The NREP (see Appendix 12) should include:

(1) a list of the national laws or acts which define who is responsible for planning, decisions and actions for conventional or radiation emergencies or response to criminal activities;

(2) a brief description of the roles, responsibilities and capabilities of the major national ministries;

(3) a brief description of the responsibilities of local government and operators;

(4) a brief description of how response to radiation emergencies is integrated into the planning for other types of emergencies; and

(5) a brief description of the arrangements for emergency management (command and control) of the overall response under different conditions.

Ensure that responsibility for overall co-ordination for all types of potential radiation emergencies is addressed, including those involving licensed uses, military uses, unlicensed sources, transboundary releases, transportation incidents or terrorist acts. Ensure that the roles of police, military and other non-technical agencies are clearly defined and agreed upon. Clarify how responsibilities and authorities could change as the emergency progresses. It is also important to identify those organizations that believe they have a role during the response but do *not*. They must then be informed and agree that they do not have a role.

The planning may identify necessary revisions to the legal infrastructure. It may also identify necessary revisions to roles and responsibilities in emergency response. However, if the legal and regulatory infrastructure is not complete or is conflicting, *it is not necessary* to enact new laws before the emergency planning process can start. In fact, doing so would most likely delay the implementation of an effective emergency response capability by several years. A preliminary report (indicated by a ▲ in Figure 5) based on readily available information should be quickly developed for use as input in the development of an interim capability. If needed, government policy statements or agreements between response organizations can be used in the interim to resolve or reduce the conflicts.

2.2.5. TASK 2 – PERFORM THREAT ASSESSMENT

Conduct a national threat assessment to identify practices and facilities that may necessitate emergency interventions within the State to define the level of preparedness required by determining which threat categories (Section 2.1.2) apply. This assessment could include facilities outside the State.

The threat assessment should identify facilities, sources, practices, on-site areas, off-site areas or locations for which radiation emergencies could warrant:

(1) precautionary[9] urgent protective action to prevent severe deterministic health effects by keeping doses below those for which intervention would be expected to be undertaken under any circumstances[10,11];

(2) urgent protective action to prevent stochastic health effects by averting doses, in accordance with international standards[12];

(3) agricultural countermeasures, countermeasures for ingestion and longer term protective measures, in accordance with international standards[12]; or

(4) protection for the workers responding (undertaking an intervention), in accordance with international standards[13].

A minimal threat assessment could be accomplished by identifying:

(1) the threat category of facilities within the State, based on Table III and Appendix 4;

(2) any national territory that is within the emergency zones or food restriction planning radius (see Appendix 5) of the threat category I and II facilities within or outside the State

(3) the threat category of the jurisdictions within the State, based on Table IV; and

(4) the operators of dangerous mobile sources (threat category IV in Table I) that can result in emergencies anywhere in the State.

This threat assessment for facilities can be based on the results of generic accident studies [12, 13] as summarized in Tables III and IV. This is generally sufficient for the emergency planning process. If a detailed analysis is to be performed, it should consider a range of potential emergencies and not be limited to "design basis" accidents.

The threat assessment should also identify significant non-radiological threats (e.g. UF_6 or other hazardous chemical releases) to the people on and off site associated with the facility.

A minimum level of threat (threat category IV in Table I) should be assumed to exist for all jurisdictions. Therefore States should assess their vulnerability to emergencies that can occur anywhere. This should include:

(1) what types of radioactive material shipments have passed through the State, and the main routes and focal points (e.g. distribution centres). The system used to identify such shipments and the current level of training provided to carriers and first responders should also be characterized [16];

(2) uses of dangerous mobile sources (e.g. for medical or industrial uses). This should include the system to ensure their control and proper disposal; and

(3) the locations at which there is a significant probability of encountering a dangerous source that has been lost, abandoned, stolen or illicitly transported. This should include large scrap metal processing facilities and national border crossings.

[9] Initiated on the basis of conditions at the facility before environmental monitoring is carried out.
[10] Schedule IV of Ref. [3], reproduced in Appendix 2.
[11] Including events with a very low estimated probability of occurrence.
[12] Schedule V of Ref. [3], reproduced in Appendix 1.
[13] Appendix V, paras V.27–V.32 of Ref. [3], summarized in Appendix 3.

Threat category V applies to farmers and food processor in food restriction planning radius. In this case emergency arrangements would be in place for them to be promptly warned of a contaminating event at a Category I or III facility to take action to protect the food supply.

The most complex part of this process may be determining the threat category that should be assumed for off-site jurisdictions. The threat category of off-site jurisdictions is determined by their responsibilities as shown in Table IV. Figure 6 illustrates the application of threat categories to off-site jurisdictions. Several different categories may be applicable for a governmental jurisdiction (local or national), while only one category can apply to a facility and on-site area. All jurisdictions, as a minimum, fall within threat category IV. In general, the information in this publication for threat category IV is intended for national officials, those responsible for transport of radioactive material and the operators of dangerous mobile sources such as for radiography or satellites.

The results of this analysis should be documented and included in the NREP with a list and a map that show threat categories of the facilities and local jurisdictions. The results of the threat analysis will be used to implement a graded approach to emergency preparedness arrangements commensurate with the potential magnitude and nature of the hazard.

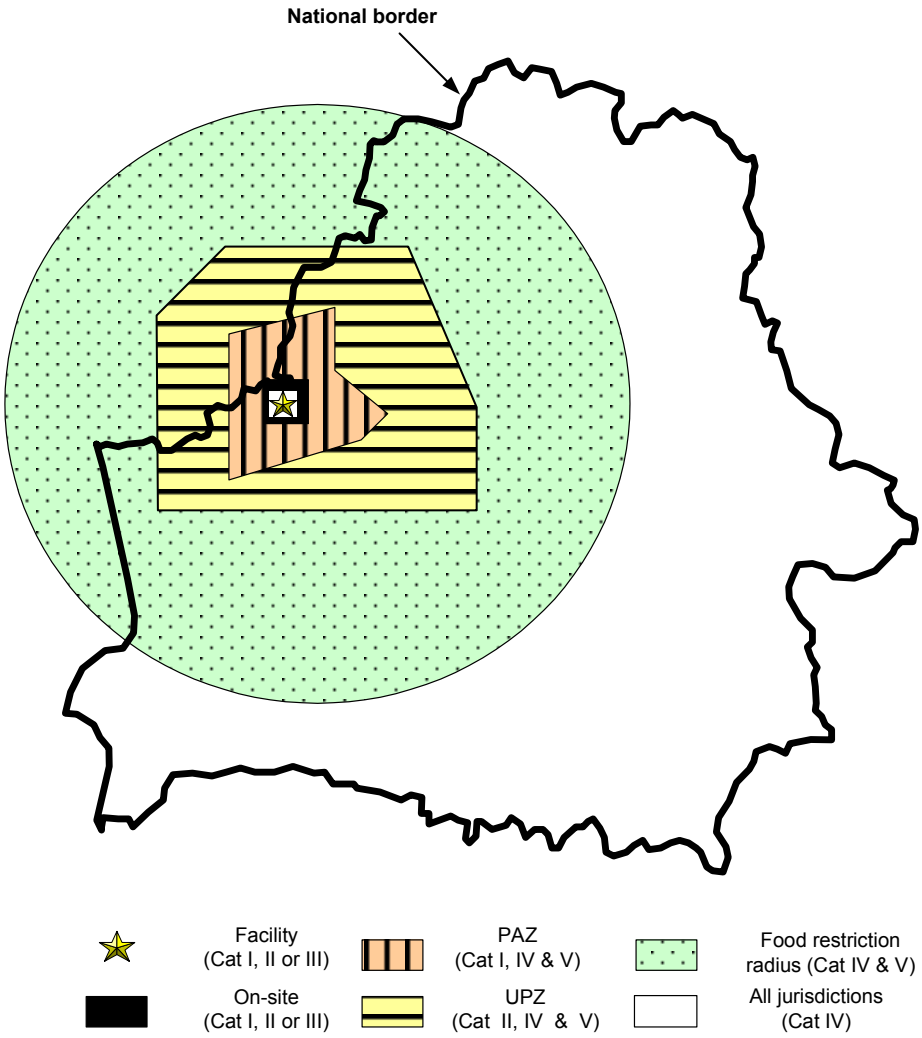

FIG. 6. Emergency zones and radius and application of threat categories to jurisdiction.

2.2.6. TASK 3 — DEVELOP PLANNING BASIS

Once the threat categories of the facilities and jurisdictions have been established, it is necessary to gather and document information about the possible emergencies and local conditions (e.g. typical weather conditions) that must be considered before plans can be developed. Appendix 9 summarizes the types of information needed. This information should be documented and briefly described in the NREP. It should include a general description of the nature of the possible emergencies addressed by the plan. Section 4.1 provides, for each threat category, a general description of the emergencies that fall within that category. This could be used as a model for the information in the plan concerning the nature of the threat. Appendix 10 provides information on the time objectives that should form part of the planning basis. A preliminary report (indicated by a ▲ in Figure 5) based on readily available information should be quickly developed for use as input in the development of an interim capability.

2.2.7. TASK 4 — DEVELOP CONCEPT OF OPERATIONS AND ALLOCATE RESPONSIBILITIES

Develop a basic concept of operations describing the response process. Section 4.1 provides, for severe emergencies within each threat category, a general concept of operations.

On the basis of the concept of operations, determine and assign the roles and responsibilities of each group, organization or individual involved in emergency preparedness and response. A list of critical responsibilities to be assigned is contained in Section 3.

Co-ordinators should be designated for each operator (facility), group, organization, department and ministry that may have a role to play in emergency response.

Allocation of responsibilities is an interactive process and should be carried out in consultation with each pertinent group, according to the realistic capabilities of that group. The individual groups to which roles and responsibilities are assigned should agree to the assignments and make a commitment to develop the necessary response capability.

A preliminary report (indicated by a ▲ in Figure 5) based on an assessment of the principal response agencies should be quickly developed for use as input in the development of an interim capability. This should include the concept of operations.

TABLE III. SUGGESTED EMERGENCY THREAT CATEGORIES FOR FACILITIES AND PRACTICES

Threat category	**Criteria**[14]
I	Emergencies have been postulated that could result in severe deterministic health effects off site, to including: • reactors with power levels greater than 100 MW(th)[15] (power, nuclear ship and research reactors[16]); • spent fuel pools that may contain some recently discharged fuel and a total of more than about 0.1 EBq of Cs-137[17] (equivalent to the inventory in a 3000 MW(th) reactor core); • facilities with inventories of dispersible radioactive material sufficient to result in severe deterministic effects offsite[18].

[14] Site-specific analysis can be performed to determine if the suggested threat category is appropriate.

[15] Calculations [17] performed assuming core melt and early containment failure in a reactor with power levels less than 100 MW(th) under average meteorological conditions show that doses from 12 hours of exposure off-site (e.g.>250 m) do not result in early deaths (acute bone marrow dose greater than 2 Gy).

[16] Assumes the reactor has been operating at this power level sufficiently long to build up the I-131 inventory close to 10 PBq/MW(th) [17,18]. For research reactors, due to the great variety in their design and operation, a facility specific analysis

Threat category	Criteria[14]
II	Emergencies have been postulated that could result in doses warranting taking urgent protective action off site, to including: • reactors with power levels greater than 2 MW(th) [19] and less than 100 MW(th) (power reactors, nuclear ship and research reactors[16]); • spent fuel pools containing fuel requiring active cooling[20]; • facilities with potential for an uncontrolled criticality within 0.5 km of the off-site boundary[21]; • facilities with inventories of dispersible radioactive sufficient to result in doses warranting taking urgent protective action off site[22];
III	Emergencies have been postulated that could result in doses warranting taking urgent protective action on site, including: • facilities with potential, if shielding is lost, of direct external (shine) dose rates of more than 100 mGy/h at 1 m; • facilities with potential for an uncontrolled criticality more than 0.5 km from the off-site boundary; • reactors with power levels of less than or equal to 2 MW(th); • facilities with inventories of radioactive sufficient to result in doses warranting taking urgent protective action on the site[23].
IV	Operators of mobile dangerous sources, including: • a mobile source with: i) potential, if shielding is lost, of direct external (shine) dose rates of more than 10 mGy/h at 1 m or ii) those with inventories in accordance with Appendix 8; • satellites with dangerous sources in accordance with Appendix 8; • transport of quantities of radioactive material that would be dangerous if not controlled. Facilities/locations with a significant probability of encountering an uncontrolled dangerous source such as: • large scrap metal processing facilities; • national border crossings; • facilities with fixed gauges with dangerous sources in accordance with Appendix 8.

should be performed to determine if there could be sufficient inventory and energy to result in a significant airborne release off-site. The methods described in Ref. [18] could be used.

[17] Calculations [17, 18, 19] indicate that severe deterministic health effects may occur off site from a release resulting from a zircaloy fire (exothermic $Zr+H_2O$ reaction) in a large amount of spent reactor fuel. This reaction is only possible in densely stored fuel that has been discharged from a core within the previous few months [20]. Zircaloy fires are unlikely unless the fuel pool is totally uncovered.

[18] 10000 times the A/D_2 value calculated in Appendix 8 provides an estimate of this inventory if 10% of the inventory is assumed to be released to the atmosphere.

[19] Severe core damage and therefore a major off-site release is not considered credible below 2 MW(th).

[20] Calculations [17, 18] indicate that doses warranting urgent intervention off site may be possible if a large amount of spent reactor fuel reaches temperatures >1000 °C resulting in failure of the fuel cladding. These temperatures are possible only if fuel being actively cooled in a pool is totally uncovered [20].

[21] Calculations [17, 21] show that a criticality further than about 500 m from the site boundary should not cause shine doses (gamma plus neutron) off site that exceed the recommended GILs for urgent protective actions (10 mSv [3]). These calculations assume no shielding and a criticality resulting in 1E+18 fissions initially resulting in an effective dose from shine (neutron and gamma) of 1 mSv/h at 0.3 km. It is also assumed that the criticality will continue until there are about 1E+19 fissions resulting in a total off-site dose of 10 mSv (shelter GIL [3]). A criticality cannot produce sufficient fission products to result in a significant airborne release. However, the thermal energy (heat) from a criticality may be sufficient to result in a release of radioactive or other hazardous material already existing in the vicinity of the criticality (e.g. in the process stream).

[22] 10 times the A/D_2 value calculated in Appendix 8 provides an estimate of this inventory if 10% of the inventory is assumed to be released to the atmosphere.

[23] 0.01 times the A/D_2 value calculated in Appendix 8 provides an estimate of this inventory if 10% of the inventory is assumed to be released into room and the people are evacuated within a few minutes.

TABLE IV. EMERGENCY THREAT CATEGORY FOR GOVERNMENT JURISDICTIONS

Threat category	Local planning is warranted for jurisdictions	National planning is warranted for States
I	Responsible for urgent protective actions within the PAZ[24] and UPZ of a threat category I facility.	With territory within the PAZ, UPZ or food restriction planning radius of threat category I facilities.
II	Responsible for urgent protective actions within the UPZ of a threat category II facility.	With territory within the UPZ or food restriction planning radius of a threat category II facility.
III	Responsible for providing emergency services to a threat category III facility, including fire fighting, police and medical.	Containing a threat category III facility.
IV	All	All
V	With farming or food processing facilities and/or responsible for taking local actions for agricultural and ingestion control within food restriction planning[24] radius for a threat category I or II facility.	With territory within food restriction planning[24] radius for a threat category I or II facility to include those located in other States. .

2.2.8. TASK 5 – DEVELOP INTERIM CAPABILITY

The full implementation of the NREP can be a long process, which involves writing procedures, training staff and holding drills and exercises. In order to ensure that a response capability is in place before the NREP can be fully implemented, an *interim* emergency response capability should be established. The purpose is to provide an improved response to emergencies until the full plan can be implemented. This interim capability does not need to be optimal. This means that, in the interest of quickly developing this interim capability, it will probably be necessary to make do with available means and resources, and with only minimal additional arrangements (e.g. training).

Concentrate on using existing capabilities effectively and efficiently. This involves ensuring that decisions can be made quickly and that existing capabilities (e.g. communication systems, monitoring personnel, and public information offices) are identified and provisions are made (e.g. central contact point) for quickly accessing them. An interim means for co-ordination of a large response involving several ministries and or jurisdictions should also be established (e.g. a response work group).

This should include starting the process of correcting any critical flaws that can be addressed quickly for facilities within threat category I and II and ensuring that decisions can be made quickly. In addition, developing a national capability for dealing with category IV threats should be started and should include: establishing a notification point where potential radiation emergencies can be reported and assistance obtained (see Section 4.2, Element A2.1); providing first responders (e.g. fire brigades and police) with guidance concerning recognition and immediate response to a radiation emergency[25] (see Section 4.2, Element A2.3); and providing physicians and hospitals with information on recognizing and reporting radiation induced injuries. Finally, a warning point for receipt of IAEA notifications should be established (see Section 4.2, Element A2.14).

[24] See Appendix 5 for information on emergency zone size and food restriction planning radius.
[25] This guidance should address radiological emergencies (See Appendix 7).

A serious emergency can occur at any time and the efforts invested in developing interim organization and capability will provide significant savings during the implementation of the full emergency response capability and provide a capability to respond before all the response arrangements are in place.

2.2.9. TASK 6 — WRITE NATIONAL RADIATION EMERGENCY PLAN

Develop an NREP as described in Section 2.1.7. and in Appendix 12. The NREP should be a *general* description of the possible emergencies and concept of operations for responding to each type of emergency as illustrated in Section 4.1. The NREP is a summary of the more detailed plans and ensures that all the other planning is integrated and compatible. All states, jurisdictions, ministries and organizations addressed in the NREP should be given an opportunity to review the plan. Appendix 12 contains a suggested outline for the plan.

The NREP should address all the facilities and jurisdictions identified in Task 2. The planning should consider the information provided in Section 4 for the threat categories of these facilities and jurisdictions. In developing the plan, consider the data gathered in Tasks 1, 2, 3 and 4.

2.2.10. TASK 7 — PRESENT NATIONAL RADIATION EMERGENCY PLAN

Once the NREP has been developed and approved, give formal presentations, directly or indirectly, to the organizations that may be involved in the maintenance and implementation of the plan. This will enable them to gain a common understanding of the response concepts and principles and will allow unforeseen issues to be raised and resolved before they become real difficulties. It will also facilitate the implementation of the NREP by maximizing staff participation and common ownership.

This process should begin with workshops on the plan and its basis. Meetings should also be held for the public near threat category I, II and III facilities to explain the risks and response plans and to elicit public comments.

2.2.11. TASK 8 — IMPLEMENT DETAILED PLANS

Develop the functional and infrastructural arrangements needed to implement the NREP for each facility and jurisdiction identified in Task 2. Capabilities should be developed to address the elements contained in Section 4.2 appropriate for the threat category of the practice or facility and jurisdiction. These arrangements include plans, procedures, staff, organization, facilities, equipment and training. Remember that, when using the information in Section 4.2, more than one threat category may apply to a jurisdiction. For example, the jurisdiction containing a nuclear power plant will fall within threat categories I and IV. Threat category IV is applicable because it applies to ***all*** jurisdictions (see Fig. 6).

A work group should be assigned the responsibility of assisting and helping in this effort. The national planning co-ordinator may chair the group. This co-ordinating group will:

(1) prepare a schedule and requirements for the development of individual facility, group, department, ministry (etc.) plans and procedures;

(2) provide assistance to individual groups in the development of plans and procedures to ensure compatibility and completeness of the planning process;

(3) organize periodic meetings between key representatives to encourage co-ordination; and

(4) ensure compliance with the schedule.

2.2.12. TASK 9 — TEST CAPABILITY

Once a response capability has been developed, drills and exercises should be conducted. The drills will provide training and the exercises will test and verify the adequacy of the entire system, including the plans, procedures, facilities, equipment and training. After the exercises have been conducted, deficiencies should be identified, prioritized and corrected. The drills and exercises should be conducted in a sequence starting with the smallest organizational elements (e.g. monitoring teams) and culminate in a national level exercise. The performance during exercises for threat categories I, II and III should be evaluated against the time objectives suggested for the response functions in Appendix 10.

2.2.13. TASK 10— ESTABLISH ONGOING QUALITY ASSURANCE (QA) AND MAINTENANCE

As a final task, all groups should develop the means to maintain, update, and validate the emergency response programme as described in Section 4.2, including:

1. a review of plans and procedures;
2. a review of training programmes;
3. an exercise programme; and
4. a feedback process for lessons learned during exercises and real emergencies.

Long term staff and budget must be provided to ensure that the capability is maintained.

2.2.14. ULTIMATELY

Ultimately, the State should adopt legislation to clearly allocate responsibilities for preparedness and response for a radiation emergency. This should ensure that the functions and responsibilities of operators and response organizations are clearly assigned and understood by all concerned. In addition, a regulatory body should require that emergency plans be prepared for the on-site area for any practice or source that could necessitate an emergency response [2]. For facilities within threat category I, II or III “appropriate emergency arrangements shall be established from the time that nuclear fuel [or significant amounts of radioactive or fissile material] is brought to the site, and complete emergency preparedness as described here shall be ensured before the commencement of operation” (Ref. [22], para. 2.36). The regulatory body should ensure that these plans are integrated with those of other response organizations as appropriate before the commencement of operation. The regulatory body should also ensure that these plans provide a reasonable assurance of effective response in accordance with this publication in the event of a radiation emergency [2].

3. CRITICAL TASKS

3.1. GENERAL REQUIREMENT

"It is presumed that the State …[shall] determine in advance the allocation of responsibilities for the management of interventions in emergency exposure situations between the regulatory …[body], national and … [response organizations] and … [operators]" (Ref. [3], Appendix V, Para. V.1).

Jurisdictions of the various orders and levels of government vary substantially between States, as do the legal authorities of the various organizations that could be involved in emergency response. Hence, this publication adopts a generic approach to the management of a radiation emergency. The State should adopt legislation to clearly allocate responsibilities for preparedness and response for a radiation emergency. This includes establishing or identifying an existing governmental body (as discussed in Section 2.2.3) to act as the national co-ordinating authority. This authority has to ensure that functions and responsibilities of operators and response organizations are clearly assigned and understood by all concerned and that mechanisms are in place for enforcing compliance therewith.

3.2. IDENTIFICATION AND ASSIGNMENT OF CRITICAL TASKS

The following worksheet is a list of tasks that are critical to a successful response. One copy of this worksheet should be distributed to each organization that may have a role in off-site response to conventional or radiation emergencies or to criminal activities. These organizations could be:

(1) national ministries and agencies;

(2) regional ministries and agencies;

(3) governments within the UPZ (for fixed facilities);

(4) operators;

(5) support organizations (medical, police, fire fighting services), including private companies (if applicable); or

(6) others, as required (e.g. non-governmental organizations that provide support).

Each organization should be asked to complete the portions of the worksheet (on the following pages) that it believes apply to it, indicating if it is responsible for the task. In some cases, organizations may recognize their role while admitting their lack of resources and capabilities; in such cases, the role should be recorded on the worksheet, and a comment regarding resources and capabilities should be added.

All completed worksheets should then be assessed at the national and local levels to identify gaps, overlaps and conflicts. Discussions should then be held between all co-ordinators responsible for emergency response to resolve these issues.

The worksheet cites the element from Section 4.2 that provides related information.

IDENTIFICATION AND ASSIGNMENT OF CRITICAL TASKS

Worksheet

Instructions: *The following is a list of tasks that are critical to a successful response in a nuclear or radiological emergency. Complete the portions of the worksheet that you believe apply to your organization. Where there is a lack of resources or capabilities, please comment.*

<table>
<tr><td colspan="4">Facility name or governmental jurisdiction:</td><td colspan="5">Threat categories applicable to the facility or jurisdiction:</td></tr>
<tr><td colspan="4">Organization name:</td><td colspan="5">Abbreviation:</td></tr>
<tr><td colspan="9">Full postal address: _____</td></tr>
<tr><td colspan="4" rowspan="3">Name of responsible or contact person(s):</td><td colspan="5">Tel:</td></tr>
<tr><td colspan="5">Fax:</td></tr>
<tr><td colspan="5">E-mail:</td></tr>
<tr><td colspan="4">Facilities only:
List and indicate governmental jurisdictions that:

1) provide emergency services
2) are within PAZ
3) are within UPZ</td><td colspan="5">Governmental jurisdictions only:
List threat category I, II and III facilities for which your jurisdiction:
1) provides emergency services
2) is within its PAZ
3) is within its UAZ
4) is within its food restriction planning radius</td></tr>
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Date of completion: _____ _____

(Signature of responsible person)

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
General						
✓	✓	✓	✓	✓	Co-ordinate national planning (national co-ordinating authority) (B3).	
✓	✓	✓	✓	✓	Co-ordinate local planning (B3).	
✓	✓	✓			Co-ordinate operator planning (B3).	
✓	✓	✓	✓		Regulate (regulatory body) (B1, B3).	
Emergency management operations (A1)						
✓	✓	✓	✓	✓	Direct overall response (A1.4).	
✓	✓	✓			Direct on-site radiation response (A1.1, A1.2, A1.3 A1.5).	
✓	✓	✓			Direct on-site security response (A1.3).	
✓	✓	✓		✓	Direct local radiation protection[26] (A1.1, A1.2, A1.3, A1.5).	
✓	✓	✓			Direct local conventional response (A1.4).	
✓	✓	✓			Direct local law enforcement response (A1.3).	
✓	✓	✓	✓	✓	Direct national radiological response (A1.1, A1.2, A1.3, A1.5).	
✓	✓	✓	✓	✓	Direct national response to conventional emergencies (A1.4).	

[26] For all jurisdictions within emergency zones, including those in other States.

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓	✓	✓	✓	Direct national law enforcement response (A1.3).	
Identifying, notifying and activating (A2)						
			✓		Develop national information for first responders (A2.3, A4.3, A6.4).	
✓	✓	✓	✓		Develop national information on classification and emergency reporting (A2.4, A2.5, A2.6, A2.10,).	
			✓		Develop national information for operators using dangerous sources (A3.3, A3.4).	
			✓	✓	Receive and initiate the response to notifications and requests from IAEA (warning point) (A2.14).	
✓	✓				Notify those responsible for control of air, rail and water borne traffic (A4.6).	
✓	✓		✓		Notify IAEA and other States of transnational emergencies (A2.15).	
✓	✓	✓	✓	✓	Receive reports of a radiation emergency and initiate response (A2.1).	
✓	✓				Receive notification from facility and initiate the response within the emergency zones (A2.7).	

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓	✓	✓		Inform local officials of potential hazards (A2.2).	
✓	✓				Classify and notify off-site officials[27] of an emergency and provide a recommendation on protective actions (A2.4, A2.8, A2.12, A2.16, A4.4).	
Taking mitigatory action (A3)						
			✓		Provide advice by phone to first responders (A3.1).	
			✓		Provide a team of radiation specialists (A3.1, A7.4).	
			✓		Provide public warnings of lost dangerous sources or unanticipated radiological hazards (A3.4).	
			✓		Conduct search and recovery of lost dangerous sources (A3.4).	
✓	✓	✓			Provide emergency services to facility (A3.6).	
✓	✓	✓			Provide technical support to operators (A3.6).	
✓	✓	✓			Perform on-site damage control, fire fighting and radiation surveys (A3.5, A3.6).	
✓	✓	✓			Request off-site emergency service support and ensure that they receive prompt access and adequate support (A3.6).	
Taking urgent protective action (A4)						

[27] Including those jurisdictions that may be in another State.

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓	✓	✓		Develop national guidance (OILs) for taking urgent protective actions (A4.1, A4.4, A7.3, A10.1, A11.1).	
✓	✓				Make urgent protective action decisions for the emergency zones (A4.5, A4.6).	
✓	✓				Conduct evacuations (A4.6).	
✓	✓				Monitor and decontaminate evacuees (A4.6).	
✓	✓				Control traffic and access (A4.6).	
✓	✓				Restrict local rail, water or air traffic (A4.6).	
✓	✓				Provide social support for evacuees (A4.6).	
✓	✓	✓	✓		Protect on-site personnel and administer first aid (A4.7).	
✓	✓	✓			Monitor and decontaminate on-site personnel (A4.7).	
Providing information and issuing instructions to the public (A5)						
✓	✓		✓	✓	Provide nationwide warnings (A.5)	
✓	✓				Provide guidance, warnings and instructions within the emergency zones (A5.1, A5.2).	
Protecting emergency workers (A6)						

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓	✓	✓		Develop national guidance on designation of emergency workers (A6.1, A6.3).	
✓	✓	✓	✓		Develop national guidance for controlling dose to emergency workers (A6.5, A6.8).	
✓	✓	✓	✓		Protect emergency workers and manage doses (A6.7, A6.10).	
✓	✓	✓	✓		Identify possible hazardous on-site response conditions (A6.6).	
Assessing the initial phase (A7)						
			✓		Assess conditions involving a dangerous source, protect people nearby and advise decision maker (A7.1).	
✓	✓	✓			Assess conditions at facility, project doses and advise decision maker (A7.2, A7.3).	
✓	✓		✓	✓	Assess all environmental monitoring data (A7.3).	
✓	✓	✓			Conduct prompt environmental monitoring on and near the site (A7.3).	
✓	✓				Conduct prompt environmental monitoring within the UPZ (A7.3).	
Managing the medical response and mitigating the non-radiological consequences (A8)						
✓	✓	✓	✓		Develop national guidance for medical practitioners on recognition and treatment of radiation exposure or contamination (A8.1, A8.4).	
✓	✓	✓	✓		Direct the medical response (A8).	

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓	✓	✓		Provide initial treatment of contaminated or exposed individuals (A8.4).	
✓	✓	✓	✓		Provide extended treatment of severe overexposures (A8.2).	
✓	✓	✓	✓		Provide long term medical monitoring of exposed people (A8.5).	
✓	✓	✓	✓	✓	Assess and explain the risk to the public and workers (A6.9, A10.6).	
✓	✓	✓	✓	✓	Reduce inappropriate public reactions (A11.2).	
Keeping the public informed (A9)						
✓	✓	✓	✓	✓	Co-ordinate provision of public and media information and act as the single official spokesperson (A9.1, A9.2).	
✓	✓	✓	✓	✓	Direct public information effort of the response organization and provide information to the official spokesperson (A9.1, A9.2).	
Taking agriculture countermeasures, countermeasures against ingestion and long term protective measures (A10)						
✓	✓	✓	✓	✓	Develop national guidance (OILs) on control of contaminated food and agricultural products (A10.1, A10.2).	
✓	✓			✓	Provide information to the agricultural community (A10.2).	
✓	✓			✓	Enforce agricultural countermeasures (A10.2).	
✓	✓			✓	Develop national guidance (OILs) on relocation (A10.1, A10.2).	
✓	✓			✓	Implement relocation and provide social support (A10.3).	

APPLICABLE THREAT CATEGORY					CRITICAL TASKS (References to the associated elements in Section 4.2 are provided)	Comments
I	II	III	IV	V		
✓	✓			✓	Conduct sampling and monitoring in support of agricultural controls and long term protective actions (A10.2)	
				✓	Monitor and certify exports and imports (A10.2).	
✓	✓	✓	✓	✓	Develop national guidance (OILs) for control of contaminated waste (A10.4, A10.5).	
✓	✓		✓	✓	Conduct monitoring in support of waste and contamination control (A10.4, A10.5).	
✓	✓		✓	✓	Control contamination and radioactive waste (A10.4, A10.5).	
✓	✓			✓	Develop national guidance on longer-term compensation and restoration (A10.2).	
Conducting recovery operations (A11)						
✓	✓	✓	✓	✓	Develop national guidance for the termination of restrictions and other arrangements imposed in response (A10.3).	
✓	✓	✓	✓	✓	Direct recovery planning and transition from response to recovery phase (A12.1).	

4. EMERGENCY PREPAREDNESS CONSIDERATIONS

4.1. THREAT DESCRIPTIONS AND CONCEPTS OF OPERATIONS

This section provides a brief description of severe emergencies that fall within each threat category. The ideal response to these emergencies is also described in the concepts of operations for these emergencies.

There are two operational concepts that apply when responding to all emergencies. First, the response should operate under an integrated incident command system (ICS) as described in Appendix 13. The most important characteristic of the ICS is that there should be a single incident commander responsible for directing the response of all the organizations responding to the radiological, conventional, and law enforcement aspects of the emergency. This responsibility would typically be assigned to an individual in the organization with the primary role during each phase of the response. As the emergency progresses, this would typically pass from the operator or first responders to a local official and finally to a national official or to a command group (composed of representatives of the facility and other principal responders) for events involving several jurisdictions or ministries. The incident commander should direct the response from an incident command post located near the emergency.

The second general operational concept is that provisions should be made to promptly provide useful and co-ordinated information to the public through the media. This is best done from a single location (PIC, see Appendix 14). Attempting to provide information from several locations or being slow, contradictory or secretive when providing information to the media has resulted in loss of trust by the public. This, in turn, has resulted in considerable economic and psychological harm. The public needs a plain language explanation of the risks, of action they can take to reduce their risk and of action being taken to ensure that they and their loved ones are safe and to protect their interests. It is important to realize that this applies to any event perceived as a serious emergency by the public or the media.

4.1.1. THREAT CATEGORY I AND II FACILITY EMERGENCIES

THREAT DESCRIPTION

For reactors and facilities with large amounts of spent fuel or dispersible radioactive material, the primary risk comes from atmospheric releases. For the most severe releases (general emergencies — see Appendix 6) postulated at threat category I facilities, the risk of severe deterministic health effects can only be substantially reduced by taking urgent protective action in the precautionary action zone (PAZ) before or shortly after a release (see Appendix 5). For these emergencies and other general emergencies at threat category I and II facilities, immediately instruct the public not to consume food that could be directly contaminated and promptly initiate monitoring to determine if urgent protective action is warranted in the urgent protective action planning zone (UPZ) to avert doses consistent with international guidance (see Appendix 1). Deposition from severe releases warranting relocation or restrictions on food consumption may occur at a considerable distance.

For facilities with the potential for uncontrolled criticalities, the direct external dose (shine) from gamma and neutron radiation from a criticality dominates the hazard; airborne releases are not significant. In the event of a criticality, prompt monitoring is necessary to determine if urgent protective action is warranted in the UPZ.

In all these facilities, the off-site releases or doses from criticalities are not predictable with any accuracy and the release could result in very complex dose patterns and contamination off

site. However, in most cases, emergency action levels (EALs) indicating serious conditions can be identified in time to classify the emergency and initiate a response before a significant release or exposure occurs.

In all these facilities, the on-site dose rates during an emergency may be very high (e.g. >10 Gy/h) and there is a risk of beta emitter contamination and other hazardous conditions (e.g. steam) in areas where staff action may be needed to mitigate the emergency.

The actions carried out to respond to the long term consequences of these emergencies can have a serious detrimental psychological and economic impact on the public, as demonstrated by the Chernobyl accident response, if they are not based on internationally accepted criteria considering their long term sociological, psychological and economic impact.

CONCEPT OF OPERATIONS

Before or shortly after a release or criticality, the operator (facility staff) declares a general emergency on the basis of predetermined EALs. Upon declaration of the emergency, the facility staff notifies the notification point for jurisdictions within the PAZ, UPZ, and food restriction planning radius (including jurisdictions within other States) and national authorities. Within about 15 minutes of declaration, the facility staff recommends to off-site officials that they perform the protective actions specified in Appendix 11. In addition, the facility staff takes all possible actions to prevent or reduce the release or exposure and perform all other immediate actions specified in Appendix 6. Local officials provide police, fire fighting and medical assistance to the site, if requested, and decide on the protective actions to recommend to the public. They warn the PAZ and UPZ population (for example, with sirens) and inform them (e.g. via a radio message) within one hour of being notified of the general emergency. The public, being instructed in advance, promptly take the action recommended. National officials notify the IAEA and all States where food restrictions are warranted. Until relieved by off-site officials, the facility staff rapidly monitor the PAZ and UPZ to determine if additional protective actions are needed. Following a release or criticality, default OILs are used by officials to immediately assess environmental data and determine if additional protective actions are warranted. The facility operator ensures that the people on site (including those responding from off site) are protected from all possible hazards. People from the site who are contaminated or exposed above predetermined criteria are transported to local hospitals and treated in accordance with procedures. Physicians treating exposed individuals consult doctors with experience in dealing with severe overexposures. National officials support local officials and assist in obtaining specialized treatment of exposed persons through the IAEA if necessary. Triage centres are established within 24 hours outside the evacuated area to screen casualties and determine the level of treatment for any overexposed public and on-site personnel. People who are contaminated or exposed above predetermined criteria are assigned to predetermined and prepared hospitals located outside the affected area. National officials support local officials, conduct monitoring away from the site and co-ordinate longer term protective actions. Soon after the public is warned (e.g. by sirens), the media are briefed by a single government spokesperson. Joint press briefings are given (at a joint public information centre) periodically with participation by the operator, and local and national officials.

The personal data of people in a population with exposures due to the emergency sufficient to result in detectable excess cancer incidence among the exposed population will be placed on a registry. Those on the registry will receive information on their individual risk and long term medical screening to detect and effectively treat any excess cancers should they occur.

Programmes to deal with the longer term impact are carefully developed according to internationally accepted criteria, considering sociological, psychological and economic

factors. Methods for compensation are carefully considered and targeted at the tangible consequences of the emergency.

4.1.2. THREAT CATEGORY III FACILITY EMERGENCIES

THREAT DESCRIPTION

This threat category has no credible emergencies postulated for which urgent off-site protective actions are warranted. These emergencies may, however, cause considerable concern among the population and off-site officials. In addition, there may be the risk of contaminated persons, products, articles or equipment leaving the site. Emergencies can have a significant adverse psychological and economic impact if the public or off site officials are not aware that these facilities do not pose an off-site risk.

Emergencies at these facilities may occur with little warning and could result only in significant exposure on site. However, for most emergencies, the facility can develop EALs for classifying emergencies (see Appendix 6) that ensure prompt, effective on-site response.

On site there may be high dose rates, beta emitter contamination or other hazardous conditions in areas requiring action by the staff to mitigate the emergency. Therefore, people responding on site must be provided with appropriate protective equipment and training.

CONCEPT OF OPERATIONS

The response concentrates on implementing immediate actions on site, obtaining prompt off-site fire fighting, police and medical support, and informing the public. The facility staff declares a facility emergency (see Appendix 6), on the basis of predetermined EALs, and notifies local off-site officials. These officials provide police, fire fighting and medical assistance to the site if requested. The operator ensures that all the people on site (including those responding from off site) are provided with appropriate protection. If there are serious overexposures, the facility staff gathers information concerning the circumstances and other information helpful for reconstructing the dose. Highly contaminated or severely overexposed persons identified based on predetermined criteria, are transported to local hospitals and treated there in accordance with advanced training and procedures. Physicians treating exposed individuals consult doctors with experience in dealing with severe overexposures. National officials support local officials and assist in obtaining specialized treatment of exposed persons through the IAEA if necessary. The facility staff conducts environmental monitoring promptly to confirm, on the basis of default OILs, that no protective action is needed off site and that all persons and objects leaving the facility are not unacceptably contaminated. Local and national officials promptly inform the public and the media of the emergency. Soon after the public is notified, the media are briefed by a single government spokesperson. Joint press briefings are given (at a joint public information centre) periodically with participation by the operator, and local and national officials.

4.1.3. THREAT CATEGORY IV RADIOLOGICAL EMERGENCIES

Appendix 7 provides emergency guides that summarize the hazards and delineate response actions for selected radiological emergencies.

THREAT DESCRIPTION

Threat category IV planning applies everywhere and represents the minimum level of preparedness appropriate for all States. In general, this applies to emergencies involving:

(1) sources;

(2) transport;

(3) severe overexposure; and

(4) terrorist threats or criminal activities.

Source emergency

In this publication, this term applies to emergencies involving:

(1) detection of medical symptoms of radiation exposure;

(2) lost or stolen dangerous sources;

(3) dangerous mobile sources;

(4) fixed sealed sources;

(5) public exposure/contamination;

(6) nuclear weapons; and

(7) re-entry of radioactive satellites.

Physicians recognizing radiation-induced injuries have been the first to alert response officials of many, if not most, emergencies involving lost or stolen sources. As such emergencies are very rare, local physicians are inexperienced in the diagnosis of these injuries. There have been several emergencies during which people suffering from radiation induced injuries made several visits to medical professionals before accidental radiation exposure was suspected. In each of these cases, other information prompted the doctors to consider radiation exposure as the cause of the symptoms. If the first physician visited had diagnosed possible radiation exposure and promptly alerted officials, action could have been taken to prevent further injuries or deaths.

Numerous dangerous sources are lost or stolen every year. There are typically several fatalities among the public each year resulting from someone, unaware of the hazard, handling a lost or stolen dangerous source. There have been several cases in which prompt public announcements, alerting the public of a hazard, following the loss or theft of dangerous sources resulted in the prompt recovery of the source and thus the prevention of serious consequences.

Among the most common types of dangerous mobile sources are radiography cameras. Emergencies involving these sources are generally handled by the operator with no or limited assistance. However, there have been emergencies resulting in serious exposure of operators, other workers and the public due to inadequate response by the operators.

Fixed sealed source emergencies involve the rupture of sources or the dispersal of radioactive material that are under control of the operator. In most cases, contamination results from industrial emergencies where sources are damaged at construction or drilling sites; in manufacturing facilities; or during spills, explosions, or fires at research or educational facilities. The most important features of these emergencies are that they should be detected promptly by the operator, they should be limited to an area under some level of administrative control, the source of the contamination and potentially contaminated persons and items should be promptly identified, and the cause and scope of the emergency should be promptly determined.

Public exposure/contamination emergencies may involve the spread of contamination for a long period before detection. There have been cases where the contamination was not detected for several years. These emergencies can result from the rupture or dispersal of uncontrolled (lost/stolen) radioactive material in the public domain. In several cases, a member of the public has unknowingly ruptured a sealed source, followed by other members of the public unknowingly spreading the material. These emergencies can be very serious. For example, the Goiânia accident resulted in several deaths and about 370 truckloads of waste. Public contamination emergencies can also be the result of the undetected dispersal of controlled material. The undetected melting of gauges into metal products is an example. The most important feature of these emergencies is that the source and scope are unknown at the time of detection. These emergencies are often detected through the diagnosis of radiation exposure injuries by physicians or the inadvertent detection of contamination on people, vehicles, packages or products. In some cases, the contamination has been detected in imports, making them transnational emergencies. By the time the contamination is detected, the area contaminated and number of people exposed can be very large. These emergencies, understandably, often receive intense public and media attention.

A nuclear weapon accident would probably involve a vehicle or aircraft crash and a conventional explosion or fire. The primary risk comes from and inhalation of toxic materials such as plutonium, enriched uranium, or beryllium. The most important feature of these emergencies is that commonly available monitoring instruments and teams may not be able to identify dangerous levels of contamination. Specially trained and equipped teams are required to adequately respond to such an emergency. The owner of the weapon should provide these teams. Consequently, first responders should be made aware of the potential hazard and of the precautions to take until specialized assistance arrives.

Several satellites carrying dangerous sources have re-entered the atmosphere. In most cases the State responsible for the satellite provides, often through the IAEA or other UN agency, an estimated time and location for the re-entry. However, these estimations have often been inaccurate. Typically, the radioactive components are less than one cubic metre in volume and shatter upon re-entry and impact in an area of 100 000 km^2 or more. Thus, in most cases it would be virtually impossible to identify the area of impact with sufficient accuracy to allow reasonable precautionary protective action to be taken in advance. For these emergencies, the risk is very low and consists principally in someone finding and handling radioactive debris. None of the re-entries, to date, have resulted in a known case of significant exposure or food/water contamination. Nevertheless, these emergencies often receive intense attention from the international media.

Transport emergency

A transport emergency could result in the release of radioactive material, loss of shielding or loss of criticality control. In the event of an emergency, fire fighters are generally well equipped with standard protective clothing and respiratory protection equipment. This equipment should provide good protection against radioactive contamination and inhalation of airborne radioactive material. Historically, there have been no reported transport emergencies involving radioactive material that have had serious radiological consequences [16].

Severe overexposure emergency

Severe overexposures can result from controlled sources such as radiotherapy devices. In some cases, equipment, software or human factors (e.g. confusing procedures from the manufacturer) were contributing causes. Therefore, it is important to promptly alert other users (national and international) of similar devices of the circumstances involved. However, there have been cases during which the investigation of the cause of the overexposure was delayed resulting in the loss of important information and in substantial delays (months) in warning other users of the devices.

Once diagnosed, several overexposures have been inadequately treated due to the inexperience of medical staff, resulting in considerable unnecessary suffering. However, there are several medical centres throughout the world with the experience needed to develop treatment strategies for radiation injuries. Advice from these centres and other assistance can be obtained through the IAEA or WHO under the Assistance Convention [15].

Terrorist threat or criminal activities

These may involve bomb threats, bombings, sabotage, attacks, kidnapping, hostage taking, theft of radioactive or fissionable material, or other criminal acts potentially resulting in an actual or perceived radiation emergency. The objective of the perpetrators may be to create "terror" among the public with the resulting psychological and economic impact. Experience shows that the public's *perception* of the risk posed by the threat may be more important than the actual risk. Consequently, an important part of the response will be providing the public, ideally in advance, with timely, informative (understandable) and consistent information on the true risk.

The response to these emergencies may involve a tactical response and almost certainly an investigation, and possibly also, by law enforcement officials. Experience shows that, in order for a response involving law enforcement and radiological response elements to be successful, arrangements are needed to establish a clear chain of command and assignment of responsibilities, and a single source of official information; and to ensure that law enforcement activities do not cause safety concerns, that law enforcement responders are provided with adequate protection as emergency workers, and that the radiological response does not interfere with law enforcement (e.g. unnecessary interference with collection or preservation of evidence).

The response to limit the consequences of exposure or spread of contamination should be essentially the same as for other radiation emergencies.

CONCEPT OF OPERATIONS

For these emergencies, planning at the local level is limited to being able to recognize a potential radiological emergency (e.g. recognizing radioactive labels and clinical symptoms of radiation exposure), being familiar with basic precautions and knowing who should be called to provide further assistance. Local officials will most likely need assistance in dealing with the radiological aspects of the emergency from the national level. If there is public or media interest, the media should be promptly briefed by a single official spokesperson. National level preparedness should involve adopting international criteria and having the capability to promptly advise (e.g. over the phone) and support local officials if needed in controlling a limited radiation emergency, with provisions to ask for international assistance if this capability is overwhelmed.

If additional radiological assistance is needed, national officials should request it through the IAEA under the Assistance Convention. The IAEA should arrange for additional radiological support under the ERNET programme (see Appendix 15) and consultation by physicians experienced in treating severe exposure.

Source emergency

Even if radiation contamination is suspected, the first responders or physicians should promptly implement life saving action (i.e. rescue the person from fire) and provide first aid for serious injuries without delay or waiting for radiological monitoring. They should then isolate the possible source of exposure and thereafter notify local officials. If an emergency involves a source that is under the control of the operator, the operator implements the immediate actions shown in Appendix 7, including measures to control the source of potential

exposure, protect the people nearby and report any uncontrolled sources. They would also notify and provide technical assistance to off-site officials. When local officials are notified of a potential hazard, they take immediate precautions to confine the radioactive material and protect people in the vicinity. National officials provide advice to local officials and dispatch personnel/teams to assist with monitoring, decontamination, media relations and medical treatment. National support teams/personnel are mobilized using pre-identified experienced personnel from throughout the State. Off-site officials brief the local media jointly shortly after monitoring or protective actions have been initiated.

In the case of a lost or stolen dangerous sources, the operator reports the loss to the appropriate officials, providing a description of the device and of the threat to the public. If theft is suspected, the operator protects the scene and any records that may be important to an investigation, and any additional action is co-ordinated with law enforcement. The operator also conducts a search and provides technical support to off-site officials. Off-site officials promptly make a public announcement describing the source and stressing the hazard. If a dangerous source may have originated from another State or may have been taken across a border, the potentially affected States and the IAEA are notified. Officials conduct an investigation to determine why the source was not properly controlled and if additional sources may have been lost or stolen.

In an emergency involving a radiography camera (a dangerous mobile source) under the control of an operator, the operator carries out a radiation survey, sets up barricades, as required, verifies the location, seeks advice from the radiation protection officer (radiological assessor) and notifies local authorities. A recovery plan is developed to minimize the dose to the workers. The recovery operation is carried out using suitable tools. During the recovery operation, the location of the source and dose to the workers are continually monitored and controlled. The recovered source is stored in a properly shielded and secure facility.

In the event of an emergency involving contamination from a fixed sealed source that is the responsibility of an operator (e.g. a gauge in a facility), the operator – following the facility's emergency procedures – immediately takes any necessary life saving action, sounds the alarm, and evacuates and secures the potentially contaminated area. The radiation protection officer (radiological assessor) is notified and arrives to direct operations. Potentially contaminated individuals are monitored and, if necessary, decontaminated. If they need hospitalization, they are accompanied by somebody who can provide monitoring and advice on radiation to the hospital. If this is not possible, the hospital is given technical information on control of contamination by the operator or radiation protection officer (radiological assessor). Access to the potentially contaminated area is restricted until authorized by the radiation protection officer (radiological assessor). Access is allowed in order to conduct monitoring and decontamination. If there is a potential for contamination or contaminated individuals or products leaving the facility or area, off-site officials are promptly notified and advised on the action to be taken. Monitoring and technical assistance is provided to off-site officials if needed. The facility and off-site officials brief the local media jointly shortly after monitoring or protective actions have been initiated.

In the event of an emergency involving public contamination, local officials notify national officials and isolate, on the basis of preliminary information, potentially contaminated areas and people. A consolidated incident command post is established in the vicinity. Monitoring and interviews are conducted to identify the source and isolate significant contamination. The local media are briefed before or shortly after monitoring or protective actions are initiated in public areas. Medical facilities that can treat contaminated patients are identified, and their staff briefed on the treatment of these patients and possible risk to the staff. An experienced radiation specialist is assigned to the hospital. The public is evacuated from significantly

contaminated areas and kept informed of their status, the health risk and the state of their relatives and property. Field centres are established in the vicinity for screening, decontamination, and triage of potentially contaminated people and/or disposal of contaminated items. The affected population is monitored according to predetermined criteria, decontaminated and admitted to hospital if appropriate. If needed, additional expertise and equipment are promptly requested through the IAEA under the Assistance Convention [15, 23]. A system is established to ensure that products and people leaving the area are not contaminated above predetermined criteria. Before recovery efforts begin, a long term plan is developed that has objectives and criteria consistent with international guidance. Decontamination and other restoration methods are tested before long term application. Methods for compensation are carefully considered and targeted at the consequences of the emergency.

For emergencies involving contaminated products, monitoring and interviews are conducted to identify and isolate the source of contamination. If the contaminated products may have originated from another State or may have been taken across a border, the potentially affected States and the IAEA are notified in accordance with the requirements [2] and consistent with IAEA recommended procedures [23]. An analysis is performed to determine the risk and the criteria – on the basis of international guidance – for clearance. The national media are briefed before or shortly after monitoring or protective actions are initiated in public areas. A system is established to ensure that products leaving/entering the areas are not contaminated above predetermined criteria.

In response to a nuclear weapons accident, the first responders take initial life saving actions, isolate the area and notify national officials. Specially trained and equipped personnel provided by the State responsible for the weapon conduct monitoring and other follow-up actions.

In response to the re-entry of satellites with significant amounts of radioactive material, the State responsible for the satellite notifies the IAEA of the estimated time and location of re-entry and provides an analysis of the risks. The IAEA informs the potentially affected States. These States inform the public of the limited nature of the hazard. If — following re-entry — the area of concern can be bounded (e.g. through sightings), the public is instructed to avoid and report possible debris and monitoring is conducted to locate radioactive debris. Ground based monitoring is used to investigate reported possible debris or areas first identified by airborne monitoring. Airborne monitoring is initiated, possibly through the IAEA, if a limited area of concern has been identified.

Transport emergency

The carrier immediately takes initial life saving and first aid action without concern for the risk associated with the presence of radioactive material. The carrier isolates the source and notifies local emergency response services. First responders take the initial actions appropriate for the UN number, labels and placards [16]. Typically, this involves isolating the accident scene, getting the names of people who may have been in the area (for possible follow-up) and requesting radiological assistance from regional or national officials. National officials send a team to conduct monitoring and cleanup if needed.

Serious overexposure emergency

The operator should conduct an investigation to determine the cause of the overexposure, take action to prevent further overexposures, and protect information that may be important in investigation of the cause. National officials should promptly identify causes of the overexposures

that could contribute to similar overexposures in other States and report them to the IAEA. The IAEA should inform other States of the facts that warrant their attention.

In a case of serious overexposure, interviews are conducted, pictures are taken and other information needed to estimate the dose is gathered at the scene. Medical examinations and blood tests are promptly performed to assist in estimating the dose. The IAEA may be contacted to arrange for consultation with physicians with expertise in treating severe overexposures. A course of treatment, based on the estimated dose received, is established in consultation with the experts. The decision on treatment takes both the physical and psychological suffering of the patient into consideration.

Terrorist threats or criminal activities

In a case of a terrorist or criminal threat, the party receiving the threat immediately notifies local law enforcement, which contacts the national ministry responsible for assessing such threats. The threat is assessed consistently with Appendix 17.

For a credible threat, an integrated response involving law enforcement and radiological response elements will be implemented to prevent the act or to reduce its radiological, psychological and economic impact. The response is implemented using the incident command system (ICS) under the direction of an incident commander. In many cases teams with both law enforcement and radiological response expertise will perform operational functions. In any case, the law enforcement elements will be briefed on radiological and safety concerns and the radiological elements will be briefed on law enforcement concerns (e.g. collection of evidence for nuclear and classical forensics). The appropriate elements of the response needed to address law enforcement; radiological, psychological and economic concerns will be activated/deployed. The response to radiological concerns should be similar to that for public contamination emergencies.

For credible threats, local and national officials will promptly inform the public and media of the realistic risks posed and the action they should take. Joint press briefings are given (at a joint public information centre) periodically with participation by the law enforcement and radiological response organizations in order to address the public's concerns.

Threat category V

THREAT DESCRIPTION

Threat category V preparedness is for the area within the food restrictions planning radius[28]. The Chernobyl accident resulted in contamination exceeding the international guidance on food restriction at more than 1000 km from the plant site.

The staff of the affected (threat category I or II) facility should have declared a general emergency (see Appendix 6) and notified the IAEA or the affected States before the plume containing radioactive material arrives. However, the first indication of the emergency may be the detection of airborne contamination. For some States the entire territory could be contaminated at levels warranting restrictions on food and agricultural products. The pattern and levels of contamination will be very complex, varying both temporally and spatially. OILs for gross gamma dose rates from ground deposition can be used to identify areas where locally produced food would likely be contamination in excess of the GAL (see Appendix 1).

[28] The distance that could be affected by emergencies at a threat category I or II facility resulting in levels of ground deposition necessitating food restrictions consistent with international standards (see Appendix 5).

However, laboratory analysis of food samples will be needed to confirm concentrations warranting restriction.

CONCEPT OF OPERATIONS

The State where the emergency has occurred notifies the potentially affected States and the IAEA of a potential transboundary release (general emergency). The IAEA, in accordance with the Notification Convention [15, 23] also transmits the notification to potentially affected States. Upon receiving notification of an emergency potentially affecting their State, national officials provide instructions to the public and to farmers on measures to take to protect the food supply. They also conduct monitoring and sampling to determine what food control action is required. Decisions on restrictions are based on OILs determined in advance, taking local conditions such as a limited food supply into consideration. The criteria used should be consistent with international guidance and co-ordinated with neighbouring States. OILs for gross gamma dose rates from ground deposition are used to identify areas that should be restricted until laboratory analysis of food samples is conducted. Programmes developed to deal with the longer term impact are carefully developed, according to internationally accepted criteria, and should consider the long term sociological, psychological and economic impact.

If a State detects significant contamination that is suspected to have originated from another State, the national officials promptly alert the IAEA of the possibility of a transnational emergency.

4.2. EMERGENCY PREPAREDNESS AND RESPONSE ELEMENTS

This section provides information elements that should be considered in the development of an adequate response capability. The threat category for which a given element is applicable is indicated along with a suggestion for the organizations responsible for the element. Responsibilities are indicated for:

(1) operator (O);

(2) local officials (L); and

(3) national officials (N).

For threat category IV, the operator refers to the person directly responsible for operation of a dangerous mobile source (e.g. radiography) in the field. For transport, the operator includes the carrier (e.g. driver), the shipper, and the transporter.

The elements are assigned to those who appear to have a major role in implementation. The assignments are based on judgement and must be revised to reflect the conditions under which the information will be applied. In a consolidated approach, the element may be addressed by the operator, the local authorities or the national authorities, or by a combination thereof, **so long as the arrangements are well co-ordinated**. Weaknesses at one level should be compensated at another. However, the responsibilities should be consistent with those identified in Section 3.

The response objectives in this section correspond to the response requirements in the requirements publication [2] and the individual elements to the functional and preparedness requirements in the same publication. The elements are often paraphrased versions of parts of the requirements and the corresponding paragraphs in the requirements are shown in parenthesis. In many cases, additional information is provided *in italics*.

4.2.1. Establishing emergency management and operations (A1 elements)

Response objectives:

(1) To execute on-site emergency response promptly without impairing performance of the normal operational safety functions (4.2.).
(2) To manage off-site emergency response in co-ordination with the on-site response (4.3).
(3) To co-ordinate emergency response between all responding organizations (4.4).
(4) To appraise necessary information on the allocation of resources throughout the emergency (4.5).
(5) To co-ordinate emergency response between all jurisdictions, response organizations, and other States that fall within the precautionary action zone or the urgent protective action planning zone so as to provide mutual support (4.6).

A1 - ESTABLISHING EMERGENCY MANAGEMENT AND OPERATIONS	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A1.1 Arrange the transition from normal to emergency operations without jeopardizing safety. Designate responsibilities of persons on site during an emergency as part of the transition. Ensure that transition to emergency response does not impair the ability of operational staff (such as control room staff) to follow procedures for mitigatory actions by the operator (4.7).	✓	✓	✓			✓		
Avoid expanding the functions of the control room during an emergency to include those not directly related to plant control. Establish a technical support centre (TSC) and an operational support centre (OSC) (see Element A3.6), as described in Appendix 14, outside the control room from which on-site aspects of the response are undertaken and managed as soon as possible. Upon declaration of an emergency, restrict entrance into the control room and ensure it is clear who is responsible for directing control room operations, in-plant actions, and analysis of the events.	✓	✓				✓		
A1.2 Arrange to co-ordinate the emergency responses of all off-site response organizations with the on-site response (4.8).	✓	✓				✓	✓	✓
Establish an emergency operations facility (EOF), as described in Appendix 13 to serve as the incident command post (ICP) from which the on and off-site response is co-ordinated. Representatives from the facility and local response organizations having the authority to represent and make commitments on behalf of their organizations should be at the EOF and act as part of the incident command group (see Appendix 13). Arrangements should be made for co-ordinating the on- and off-site response before the EOF is fully operational.	✓	✓				✓	✓	✓

A1 - ESTABLISHING EMERGENCY MANAGEMENT AND OPERATIONS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Co-ordinate, in advance, the response by off-site law enforcement organizations to criminal activity. This would include both tactical response and criminal investigations. Law enforcement organizations should, for all emergencies, be represented on the incident command group (see Appendix 13) and should be given training in on-site response.	✓	✓				✓	✓	✓
A1.3 Integrate planning for a radiation emergency with planning at the national and local levels for conventional emergencies (4.9).	✓	✓	✓	✓	✓	✓[29]	✓	✓
A1.4 Arrange for implementation of a command and control system for response to a radiation emergency. The system should be responsible for co-ordinating activities, developing strategies and resolving disputes between the response organizations concerning functions, responsibilities, authorities, allocation of resources and priorities. Arrange for obtaining and assessing information necessary to allocate resources for all response organizations (4.10).	✓	✓	✓	✓	✓	✓	✓	✓
Designate an incident commander or incident command group as described in Appendix 13, with ultimate responsibility for the overall response and for promptly directing activities and resolving disputes among all response organizations. The incident commander should be located in the ICP or EOF near the scene of the emergency (see Element B1.3).	✓	✓	✓	✓	✓	✓	✓	✓
Ensure that the responsibility for activation and co-ordination of the response at the national level is clearly assigned for emergencies with different origins (e.g. licensed material, natural material, international, military, unknown) and whenever there is simultaneous involvement of other emergency plans or hazards (e.g. major natural disasters or criminal activity).	✓	✓	✓	✓	✓	✓[29]	✓	✓
Ensure that all national, regional and local response organizations and also organizations that believe they have a role during the response have agreed (in writing) to the command system.	✓	✓	✓	✓	✓	✓[29]	✓	✓
The ICP/EOF should have access to information needed to co-ordinate the on- and off-site response.	✓	✓				✓	✓	✓

[29] Does not apply to operators of dangerous mobile sources.

A1 - ESTABLISHING EMERGENCY MANAGEMENT AND OPERATIONS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A1.5 Arrange co-ordination of response to a radiation emergency between response organizations, jurisdictions, and other States that fall within the emergency zones (see Element A4.4) (4.11).	✓	✓				✓	✓	✓
Ensure that all major response organizations responding within the emergency zones, including those from other States, are represented on the incident command group (see Appendix 13) or provided with the means for ongoing co-ordination with the group.	✓	✓				✓	✓	✓
Co-ordinate with other States within the emergency zones to provide mutual support; exchange information on the basis for decisions on protective actions; exchange information on assessment and monitoring; expedite access across borders, as appropriate, for providing assistance or implementation of protective actions; and co-ordinate public information.	✓	✓				✓	✓	✓

4.2.2. Identifying, notifying and activating (A2 elements)

Response Objectives:

(1) To ensure that operators promptly determine the appropriate emergency class or the level of the response, initiate on-site actions, and notify and provide updated information to the off-site notification point (see Element A2.4) (4.12).

(2) To promptly notify — through the off-site notification point — all appropriate off-site response organizations, which will initiate the preplanned and co-ordinated response appropriate to the emergency class or the level of emergency (4.13).

(3) To initiate appropriate emergency response actions upon receipt of notification by another State or the IAEA of an actual or potential transnational emergency (4.14).

(4) To ensure that — in the event of a transnational emergency — the notifying State forthwith informs directly or through the IAEA those States that may be affected and the IAEA, and that the notifying State responds to requests from other States and from the IAEA for information concerning the emergency (4.15).

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A2.1 Arrange for notification points responsible for receiving notification of an actual or potential radiation emergency that are continuously available to receive any notification or request for assistance and to initiate an off-site response (4.16).	✓	✓	✓	✓	✓	✓	✓	✓
This should be at a facility used to receive and initiate the off-site response to any type of emergency (conventional or radiation).	✓	✓	✓	✓	✓	✓	✓	✓
Provide emergency services (fire, law enforcement, ambulance, medical) with instructions/procedures on how to handle the report of the potential radiation emergency.	✓	✓	✓	✓			✓	✓
A2.2 In jurisdictions in which there is a significant probability of a dangerous source being lost, abandoned, illicitly removed or transported, arrange that the on-site managers of operations and local officials responsible for response are aware of the indicators of a potential radiation emergency and aware of the appropriate notifications and other immediate actions warranted if a radiation emergency is suspected (4.17).				✓			✓	✓
Include scrap metal processors and border crossings.				✓			✓	✓

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A2.3 Ensure that first responders are aware of the indicators of the presence of radiation or radioactive material, such as the trefoil symbol, the class 7 labels on packages and class 7 placards on vehicles [16, 24] and the significance of these indicators; the symptoms that would indicate a need to conduct an assessment to determine whether there may be a radiological emergency; and the appropriate notification and other immediate actions warranted if a radiological emergency is suspected (4.18).				✓			✓	✓
This can be accomplished by a poster showing the trefoil symbol and information that would indicate a potential radiological emergency such as the medical symptoms of radiation exposure and descriptions of technical dangerous mobile sources along with the immediate actions to be taken if a radiation emergency is suspected. Provide this information to all local and national emergency service (fire, law-enforcement, medical) organizations.				✓			✓	
A2.4 Arrange for the identification of a radiation emergency and determine the appropriate level of response. Include a system for classifying all potential radiation emergencies that warrant an emergency intervention to protect workers and the public, in accordance with international standards. Address the following emergency types: general emergencies, site area emergencies, facility emergencies, alerts, and uncontrolled source emergencies (4.19).	✓	✓	✓	✓	✓	✓	✓	✓
The classification system should be consistent with the information in Appendices 6 and 7.	✓	✓	✓	✓		✓[29]	✓	✓
Arrange to assess threats of terrorist or other criminal acts[30] involving radioactive or fissionable material and to initiate an appropriate response including: 1) identification of the national level ministry responsible for prompt assessment of such threats; 2) informing local and national law enforcement organizations of their immediate action upon receipt of a threat; 3) a system for characterizing the credibility of a threat that will initiate a response consistent with Appendix 17; and 4) provisions to co-ordinate the response to criminal activity and to deal with the associated radiological, psychological and economic impact of a radiological emergency, 5) notifying facilities in threat categories I, II or III of potently threats and 6) provision at these facilities to enhance their level of protection commensurate with the threat. This should also include a	✓	✓	✓		✓	✓[29]	✓	✓

[30] These include bomb threats, bombings, sabotage, attacks, kidnapping, hostage taking, theft of dangerous amounts (See Appendix 8) of radioactive or fissionable material, or other criminal acts potentially resulting in an actual or perceived radiation emergency.

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
classification system for communicating the likelihood and potential severity of a security or terrorist threat to the facility. *The plans for radiation emergencies (see Appendix 12) should address initiation and co-ordination, with law enforcement, of the response to events involving terrorist threats and other criminal acts. The response should include provision to ensure that the actual risk from the terrorist act is realistically described and provision to monitor and address psychological and economic consequences.*								
A2.5 Address all postulated radiation emergencies within the emergency classification system. Establish emergency action levels (EALs) for the classification of emergencies. The EALs should be for abnormal conditions involving operations or a condition with the facility or practice, security related events, radiological releases, environmental measurements and other observable indications. Establish the classification system with the aim of initiating a response quickly enough to allow for effective management and implementation of emergency operations, including mitigation by the operator, urgent protective actions and protection of workers. Rating the event on the IAEA/NEA International Nuclear Event Scale (INES) should not delay other actions (see Element A7.2) (4.20).	✓	✓	✓	✓		✓	✓	
The EALs should be consistent with the approach in Ref. [18]. Consider the expected response of facility or other instrumentation or systems during abnormal operations and conditions in developing the EALs. The classification system should assess: the status of facility safety systems needed to prevent accidental criticality, to protect release barriers, damage to release barriers, radiation levels in the facility or near a practice, release rates from normal discharge points, fires, security events (e.g. warning, threats, intruders, attacks, sabotage, bombs), reduced levels of safety or security, severe natural conditions, and off-site radiation measurements. Provide assistance in classification of an emergency for the operators while they are implementing procedures to diagnose, control or mitigate the emergency. This could include notes concerning classification in other response procedures. Different classification system criteria may be needed for different operating modes (e.g. refuelling) when the number of safety systems, number of barriers and threat (e.g. decay heat) are altered.	✓	✓	✓			✓	✓	

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Establish arrangements to detect and initiate the appropriate response to radiological emergencies consistent with Appendix 7. This should include provisions to 1) promptly detect loss or theft of dangerous amounts of material (e.g. frequent inventory checks, intrusion detection devices [45], checks upon completion of jobs, receipt of packages or return of devices), 2) detect radioactive scrap or 3) detect radioactive material crossing national borders. As appropriate this should include criteria (e.g. radiation dose rate- OILs) at which response action will be taken				✓		✓	✓	
Establish arrangements to change emergency classification, indicating who is responsible and the criteria to be used. The criteria should consider both facility conditions and off-site radiological conditions.	✓	✓	✓			✓	✓	
Demonstrate through drills and exercises that classification, notification, activation and initial response can be performed fast enough to meet the response time objectives established by the threat assessment or as specified in Appendix 10.	✓	✓	✓			✓	✓	
A2.6 Arrange that each emergency class represents circumstances that pose approximately the same level of risk and prompt approximately the same level of response to be initiated when declared at different facilities in the State (4.21).	✓	✓	✓			✓	✓	
The regulatory body should develop guidance for a nation wide classification system consistent with Appendices 6 and 7.	✓	✓	✓					✓
The organizations responsible for implementation of response actions following the declaration of emergency should understand and agree to the classification system to ensure their prompt response, at the appropriate level, upon declaration of an emergency. Normally, the facility is responsible for providing training to off-site response organizations on the classification system and its basis as it relates to their facility.	✓	✓	✓			✓	✓	
A2.7 Arrange that each State with territory within the emergency zones has an off-site notification point responsible for receiving emergency notification of an actual or potential radiation emergency. This point shall be continuously available to receive notification or requests for assistance and to initiate the	✓	✓				✓	✓	

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
appropriate preplanned off-site response (4.22).								
To reduce the burden on the facility staff, only one call to a single off-site notification point within each State should be sufficient for off-site notifications and activation in an emergency situation. The off-site notification point should be staffed 24 hours a day, 7 days a week by personnel with the authority or means to promptly activate the off-site response.	✓	✓				✓	✓	
Establish a capability to immediately and directly notify the notification points of other States within the PAZ, UPZ and food restriction planning radius upon the declaration of an emergency. This should be co-ordinated in advance and provide sufficient information for them to implement an effective response.	✓	✓				✓	✓	
A2.8 Arrange to have a person on site at all times that has the authority and responsibility to classify a radiation emergency and then promptly, without consultation, to initiate an appropriate on-site response; to notify the appropriate off-site notification point and to provide sufficient information for an effective off-site response. Provide this person with a suitable means of alerting on-site response personnel and notifying the off-site notification point (4.23).	✓	✓	✓			✓		
A job description should clearly designate the position on site (at all times) empowered and responsible to declare an emergency, activate the on-site response and notify public authorities immediately without consultation.	✓	✓	✓			✓		
Provide and regularly test primary and backup communication links that are reliable under emergency conditions between the facility and the notification points (see Element B5.1).	✓	✓				✓	✓	
Develop the initial notification message format and confirmation/authentication procedures. The notification message should contain the location of the emergency, class, immediate hazard, actions taken, urgent protective actions recommended for response personnel and the public, and authentication methods.	✓	✓	✓			✓	✓	✓
For a general emergency, include recommendations for off-site protective actions in the initial off-site notification (see Element A4.4).	✓					✓		

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A2.9 Arrange for identifying an event that warrants emergency response, generating adequate information and communicating it to the responsible authorities, for: 1) early prediction or assessment of the extent and significance of any discharge of radioactive substances to the environment or exposures; 2) rapid and continuous assessment of the radiation emergency as it proceeds; and 3) determining the need for protective actions for the public and workers (4.24).	✓	✓	✓	✓		✓		
Make arrangements for flow of relevant information from the facility to the competent authorities, other State sand the IAEA consistent with ENATOM [23].	✓	✓				✓	✓	✓
A2.10 Arrange for declaration of an emergency class that will initiate the appropriate level of co-ordinated and preplanned emergency response on and off the site. Define the responsibilities and initial response actions of all response organizations for each class of emergency (4.25).	✓	✓	✓	✓		✓	✓	✓
All the responding organizations should understand the basis for the classification system and should prepare initial response for each class consistent with Appendices 6 and 7. These arrangements should include procedures for immediate actions of personnel as they arrive at their duty stations. The leaders of each response organization should have a procedure listing their organization's response actions upon declaration of each class of emergency.	✓	✓	✓			✓	✓	✓
A2.11 Demonstrate through the threat assessment that, for the range of postulated emergencies, identification, notification, activation and implementation of other initial response actions can be performed in time to meet the practical goals of emergency response (see Section 2.1.1) (4.26).	✓	✓				✓	✓	✓
Include time goals consistent with those in Appendix 10.	✓	✓				✓	✓	✓
A2.12 Arrange for the response organizations to obtain sufficient personnel to perform their assigned initial response actions (4.27).	✓	✓	✓	✓	✓	✓	✓	

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Include means (e.g. beepers) to reach critical persons 24 hours a day at the organizations whose actions are critical for emergency management, notification, activation, mitigatory actions, initial phase assessment and urgent protective actions implementation. The time for their activation should be consistent with the response time objective in Appendix 10.	✓	✓	✓	✓[31]		✓	✓	✓
A2.13 Arrange to provide a response to radiation emergencies for which detailed plans could not be formulated in advance (4.28).				✓			✓	✓
Designate the organization responsible for direction of the response to emergencies not covered by the plans and explain how this response will be co-ordinated (see Element A1.4).				✓			✓	✓
A2.14 Arrange to provide the IAEA and other States, directly or through the IAEA, with a single warning point of contact responsible for receiving emergency notifications and information from the IAEA. This warning point shall be continuously available to receive any notification, request for assistance or request for verification from the IAEA and to promptly initiate a response or verification of an information request. The State should inform the IAEA and, directly or through the IAEA, other concerned States of any changes that may occur in respect of the point of contact (4.29).	✓	✓	✓	✓	✓			✓
The warning point should be prepared to receive and initiate an appropriate response, on a 24-hour basis, upon notification of a wide range of potential radiation emergencies including but not restricted to satellite re-entry, potential transnational emergencies involving shipment of dangerous sources and potential transboundary atmospheric releases. The warning point should have prompt access to English speakers. The means used at the warning point to receive notification and information from the IAEA should be continuously operational and monitored on a frequent basis. The procedures for notification of the IAEA should be consistent with Ref. [23].	✓	✓	✓	✓	✓			✓
A2.15 Arrange to promptly notify, directly or through the IAEA, those States that may be affected by a transnational emergency. Arrange to promptly respond to requests from other States or from the IAEA for	✓	✓		✓				✓

[31] Radiological assessor

A2 - IDENTIFYING, NOTIFYING AND ACTIVATING	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
available information on a transnational emergency, in particular with regard to response to any transnational effects (4.30).								
The competent authority should be prepared to promptly provide information to the IAEA concerning rumours, media stories and information regarding the impact on other States, protection of foreign nationals, and influence on international travel and trade. (See Element A9.1).	✓	✓		✓				✓
A2.16 Arrange for direct notification of any State in which urgent protective actions should be taken, including States with territory within the emergency zones (4.31).	✓	✓				✓	✓	✓
See Element A2.7	✓	✓					✓	✓

4.2.3. Taking mitigatory action (A3 elements)

Response objectives:

(1) To ensure that first responders take all appropriate actions to minimize the consequences of a radiation emergency (4.32).
(2) To ensure that operators of a facility or practice take action to minimize the consequences of a radiation emergency involving a source or practice under the operator's responsibility (4.33).
(3) To make emergency services available to support the response at facilities (4.34).

A3 - TAKING MITIGATORY ACTION	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A3.1 Arrange to provide expertise and services in radiation protection to local officials and first responders. Include arrangements for on-call advice and for dispatching to the scene of the event an emergency team including radiation specialists who are capable of assessing threats involving radioactive or fissile material, assessing radiological conditions, mitigating the radiological consequences and managing the dose of responders. Arrange to determine when additional assistance is necessary for dealing with the radiological aspects of the event and how to obtain such assistance. Also, provide first responders with information that is in compliance with international standards on the immediate response to events concerning transport and suspected illicit trafficking involving radioactive material (4.35).				✓			✓	✓
This team can be effectively drawn from personnel who work with radiation. Provide it with procedures, training, equipment, and appropriate legal liability protection, medical and social benefits (e.g. medical treatment and disability benefits). Equip and prepare it to respond in remote locations, operate on difficult terrain (e.g. for transport accidents) or under adverse weather conditions. Recognize the need and provide for restricting public access to a potential emergency site, especially in heavily populated areas. Train team members in interacting with the media and public (see Element A9.1) and then integrate them into the response organization as part of the ICS. (See Appendix 13).				✓			✓	✓
Arrange to identify and obtain additional assistance if needed to cope with an emergency as discussed in Element B.5				✓			✓	✓

A3 - TAKING MITIGATORY ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Provide responders with information on the immediate response to transport and suspected illicit trafficking and other emergencies involving uncontrolled radioactive material consistent with Appendix 7 and Refs. [11, 16, 34].				✓			✓	✓
A3.2 Arrange for the operators of a practice to receive basic instruction for mitigating the potentia consequences of emergencies and protecting workers and the public in the vicinity (4.36).				✓		✓		
The instruction should be designed for use by operator, carrier and first responders and set out the immediat response actions. It should be based on the visual information that would be available at the emergency scene The operator or carrier should make all efforts, even if incapacitated, to ensure that the instruction reaches th first responders. It should be consistent with Appendix 7 and Refs. [11, 16].				✓		✓		
A3.3 Arrange for the operators of a practice using a dangerous source (such as practices in industria radiography or radiotherapy) to respond to emergencies involving the source so as to mitigate any consequences s. Ensure the response includes prompt access to a radiological assessor or radiation protection officer traine and qualified to assess radiological emergencies and to mitigate any consequences (4.37).				✓		✓		
Ensure access to shielding, tools and instruments needed during an emergency to return the source to a safe and stable condition. The radiological assessor or radiation protection officer should be trained and qualified to conduct radiological surveys, perform contamination control, assess doses, support emergency response actions and initiate retrieval or cleanup actions consistent with Appendix 7 and Refs. [11,16,25].				✓		✓		
A3.4 Arrange to initiate a search and issue a warning to the public in the event of a dangerous source being lost or illicitly removed (4.38).				✓			✓	✓
Arrange to warn the public (through the media), emergency medical facilities, and scrap dealers, describing the source, the threat and symptoms of radiation exposure. See Appendix 18 for a plain language statement of the threat from a source that is not under control.				✓			✓	✓

A3 - TAKING MITIGATORY ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A3.5 Arrange for the operator to take mitigatory action to prevent escalation of the threat, return the facility to a safe and stable state, reduce the potential for releases of radioactive material or exposures, and mitigate the consequences of any actual releases or exposures. In developing these arrangements take into account: the necessary operational actions; operational information needs; workload and conditions of the operational staff (such as in the control room); responder actions necessary in the facility; conditions in the facility where responder actions are necessary; and the response of personnel, instrumentation and systems of the facility under emergency conditions. Include emergency operating procedures and information for mitigatory action for severe conditions by the operator, for the full range of emergencies, including accidents beyond the design basis (4.39).	✓	✓	✓			✓		
This should be consistent with Ref. [26] and include emergency operating procedures and severe accident guidelines for operator response to severe emergencies. Through the procedures, monitor the symptoms that indicate success or failure of key functions (e.g. to protect fission product barriers) critical to the protection of workers, the public and the environment. The procedures should state the immediate action to be taken to restore the performance of the functions whenever a symptom indicates that these functions have been lost, degraded or threatened. They should be usable under emergency conditions (see Elements B4.9, B4.10)	✓	✓	✓			✓		
A3.6 Arrange to provide technical assistance to the operational staff. Make teams available for mitigating the consequences of an emergency (e.g. damage control, fire fighting) in the facility. Needed equipment should be placed at the most suitable location to ensure its ready availability at the time of need and to allow human access to it in the anticipated emergency or environmental conditions. Provide personnel directing mitigatory actions with an operating environment, information and technical assistance that allow them to take effective action to mitigate the consequences of the event. Ensure that support can be obtained promptly for police, medical and fire fighting services from off the site. Afford off-site support personnel access to the facility and inform them of on-site conditions and the necessary protective actions (4.40).	✓	✓	✓			✓		
Establish a technical assessment group outside the control room with a communications link to the operating staff. If on site, locate it in a technical support centre (TSC) capable of being staffed under emergency conditions (see Appendix 14). Make provisions to access key sources of technical support, including the designer or builder of the facility. Ensure that information crucial to the implementation of accident management procedures, technical assessment, classification and accident mitigation is available/displayed	✓					✓		

A3 - TAKING MITIGATORY ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
where the facility operations are controlled (e.g. control room) and technical assessment (e.g. TSC) and accident mitigation are co-ordinated (e.g. within the OSC). Display this information in a clear and integrated manner (e.g. on a separate SPDS) independent of normal operational information. The primary aim should be to aid the operators in determining the safety status of the plant and the appropriate corrective actions. Include information on the status of safety systems, release barriers, on-site radiological conditions and off-site releases (see Element B5.3).								
Co-ordinate in-plant teams from outside the control room in an operations support centre (OSC) (see Appendix 14).	✓					✓		
Provide on-site teams with the appropriate monitoring instruments, lighting, damage control supplies and communications.	✓	✓	✓			✓		
Establish communication links between the facility control room, sources of technical advice and in-plant teams that are secure and not vulnerable to overload, loss of power or other emergency conditions. This communication should be compatible with that used by off-site support organizations. Normal public landline and public mobile telephone systems are not suitable for critical emergency communications (see Element B.5.1).	✓	✓	✓			✓		
Give off-site emergency services prompt access to the facility and train and equip them for on-site response under anticipated hazardous conditions. Provide adequate information to off-site responders concerning on-site conditions when assistance is requested. Train the support services in radiation protection, their expected functions during an emergency, the facility layout and hazards, on-site response and access to the facility. They should drill and exercise with the on-site response, should be integrated into the ICS (see Appendix 13) and should be considered emergency workers and provided with protection for the anticipated hazards (see Element A6.7).	✓	✓	✓			✓	✓	

4.2.4. Taking urgent protective action (A4 elements)

Response objectives:

(1) To take all appropriate measures to save lives (4.41).
(2) To take urgent protective actions, in compliance with international standards, to avoid severe deterministic health effects and avert doses (4.42).
(3) To modify urgent protective actions, as appropriate, in the light of any new information relating to the emergency that becomes available (4.43).
(4) To discontinue a protective action when it is no longer justified (4.44).

A4 – TAKING URGENT PROTECTIVE ACTION	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A4.1 Establish optimized national intervention levels to take urgent protective actions in compliance with international standards, taking into account local and national conditions, such as: 1) the individual and collective doses to be averted by the intervention; and 2) the radiological and non-radiological health risks and the financial and social costs and benefits associated with the intervention (4.45).	✓	✓	✓	✓	✓			✓
Scientifically based recommendations for implementing countermeasures should be accompanied by an explanation that enables the public and decision makers to understand them, reasonably consider them and explain them to the other stakeholders. The explanation must make it clear to people that it ensures their "safety" and that of all other family members, including unborn children. Therefore, along with the criteria there should be a common language statement defining "safe". This explanation should be tested on representative members of the intended audience.	✓	✓	✓	✓	✓		✓	✓
The intervention levels should be consistent with the international standards contained in Refs. [2,3] reproduced here in Appendix 1. The existing generic intervention levels (GILs) for evacuation in the international standards [2,3] are for good travel conditions; however, evacuation or substantial shelter should always be implemented if the acute dose to an organ approaches or exceeds the dose levels in Appendix 2. The use of the inhalation committed effective dose factors from Refs. [2,3], which are for a lifetime (50–70 years), is inappropriate in calculating the acute dose.	✓	✓	✓	✓	✓			✓

A4 – TAKING URGENT PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A4.2 Adopt national guidelines in compliance with international standards for the termination of urgent protective actions (4.46).	✓	✓		✓				✓
A4.3 Ensure that first responders are aware that in the event that there is an immediate threat to the life of a person (e.g. threatened by a fire), they should not delay actions to save the person's life or to prevent serious injury even if there are signs or other indications of the possible presence of radioactive material. (4.47).				✓			✓	✓
A4.4 Arrange for making and effectively implementing decisions on urgent protective actions off the site. Make use of the existing public infrastructure to limit severe deterministic health effects and avert doses, in compliance with international standards, for the full range of potential emergencies at those facilities. Arrangements should include the following: 1) Specification of off-site emergency zones within which arrangements are made for implementation of urgent protective actions. Ensure zones are contiguous across national borders and include: a. A precautionary action zone (PAZ), for facilities in threat category I, for which arrangements should be made with the goal of taking precautionary urgent protective actions before a release occurs or shortly after a release begins, on the basis of conditions at the facility (such as the emergency classification) in order to substantially reduce the risk of severe deterministic health effects. b. An urgent protective action planning zone (UPZ), for facilities in threat category I or II, within which arrangements should be made for urgent protective actions to be taken promptly in order to avert doses off the site in compliance with international standards. 2) Criteria, based on event classification and on conditions at the facility and off the site, for the formulation of recommendations for urgent off-site protective actions, which are to be provided to off-site officials responsible for taking protective actions within the PAZ and UPZ. Arrange for the revision of these recommendations, with account taken of factors (such as conditions for travelling or sheltering) that may affect the implementation of protective actions and of environmental monitoring following a release or an exposure (see Element A7.3).	✓	✓				✓	✓	

A4 – TAKING URGENT PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
3) A single position, on the site at all times, with the authority and responsibility to recommend protective actions to officials off the site upon the declaration of a radiation emergency. 4) Arrangements for prompt notification of the off-site notification point with the authority and responsibility to take urgent protective actions within the PAZ and UPZ, including all the jurisdictions (including those in other States) within the emergency zones (4.48).								
The emergency zone sizes and boundaries should be consistent with Appendix 5.	✓	✓				✓	✓	
The classification system and corresponding response actions should be consistent with Appendix 7 and Ref. [18].	✓	✓				✓	✓	
The protective actions should be recommended immediately upon declaration that a specific class of emergency exists (before a release or environmental monitoring) (see Element 7.2) and revised on the basis of later monitoring (see Element A7.3) consistent with Appendix 11 and Ref. [18].	✓	✓				✓	✓	
A4.5 Arrange for officials off the site who are responsible for making decisions on protective actions for the population within the PAZ/UPZ to make such decisions promptly upon the notification of a radiation emergency (4.49).	✓	✓					✓	
This applies to all jurisdictions within the PAZ or UPZ irrespective of national boundaries. Other States within the emergency zones should establish bilateral or multilateral agreements that provide for rapid and direct notification by the facility.	✓	✓					✓	
The decision making should be the responsibility of an off-site official available 24 hours a day and should not require meetings or other time consuming activities. Off-site officials should arrange to promptly consider the recommendations issued by the facility (see Element A4.4) and determine and issue a warning signal and instructions on protective actions for the public within the PAZ and UPZ within the time objectives stated in Appendix 10.	✓	✓					✓	
Decision makers should be trained in the protective action strategy and should participate in exercises. Training should include the basis of the protective action recommendations and reasons why additional	✓	✓					✓	

A4 – TAKING URGENT PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
conservatism (for example evacuating larger areas than planned) or delays may decrease the effectiveness of the actions.								
A4.6 Arrange for the jurisdictions within the emergency zones to take appropriate urgent protective actions promptly upon the notification of a radiation emergency. Include appropriate actions for protecting emergency workers; alerting permanent, transient and special population groups or those responsible for them; taking urgent protective actions; protecting sources of food and water; imposing restrictions on immediate consumption of produce from farms or gardens and of locally produced milk; monitoring and decontaminating evacuees; caring for evacuees; arranging for special facilities; and controlling access to and restricting traffic by road, air, water and rail. Co-ordinate with all jurisdictions (including those beyond national borders) within any emergency zone (4.50).	✓	✓					✓	
The arrangements for implementing protective actions should concentrate on the most effective use of existing buildings, homes, transportation and communication.	✓	✓					✓	
A4.7 Arrange for the safety of all people on the site in the event of a radiation emergency. Include arrangements to notify them and for their taking appropriate immediate action upon notification; to account for those on the site; to locate those unaccounted for; to implement urgent protective actions (i.e. evacuation, shelter, immediate restriction of the consumption of potentially contaminated food, iodine prophylaxis); and to provide immediate first aid. Arrange suitable assembly points for all persons in the facility and provide a sufficient number of safe escape routes, clearly and durably marked, with reliable emergency lighting, ventilation and other building services essential to the safe use of these routes. Ensure escape routes meet relevant international requirements for radiation zoning and fire protection and relevant national requirements for industrial safety and security. Provide suitable alarm and communication systems so that all persons in the facility and on the site can be warned and instructed, even under emergency conditions (4.51).	✓	✓	✓			✓		
This applies to all people in areas controlled by the operator such as visitors or others (e.g. construction workers, fishermen). Routine security arrangements could be used to record the identities and location of people who are on site.	✓	✓	✓			✓		

A4 – TAKING URGENT PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Provide instructions to those on site on their response in an emergency or have knowledgeable staff escort them. Post the instructions on the response expected to a warning signal, evacuation routes, and assembly areas.	✓	✓	✓			✓		
Evacuate non-essential personnel or provide them with substantial shelter upon declaration of a facility, site area or general emergency. For nuclear power plants, provide on-site personnel with thyroid prophylaxis, which should not delay their evacuation or sheltering.	✓	✓	✓			✓		
Develop a procedure to monitor the dose in the on-site assembly areas or shelters and evacuate if necessary.	✓	✓	✓			✓		
Arrange to promptly provide conventional first aid, prepare for transport and transport to an appropriate off-site facility (see Element A8.2) for further treatment contaminated/injured individuals.	✓	✓	✓			✓		
Arrange to monitor and manage the contamination of evacuees from the site, estimate the dose (see Element A8.4) of those on site during the emergency and record sufficient information for their inclusion in a registry for medical follow-up if appropriate (see Element A8.5)	✓	✓	✓			✓		
A4.8 Arrange for the necessary communications for implementation of protective actions within the facility and in the area controlled by the operator and to communicate with off-site agencies with responsibility for taking protective actions within the PAZ and UPZ at all times, taking into account the design and the diversity of the methods of communication selected (4.52).	✓	✓	✓			✓	✓	
The communication system should be resistant to failure under emergency conditions (see Element B5.1).	✓	✓	✓			✓	✓	

4.2.5. Providing information, and issuing instructions and warnings to the public (A5 elements)

***Response objective**:* To warn the public promptly of an emergency and inform them of the immediate action that they should take (4.53).

A5 - PROVIDING INFORMATION AND ISSUING INSTRUCTIONS AND WARNINGS TO THE PUBLIC	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A5.1 Ensure that before and during operations, information on the response to a radiation emergency is provided to the permanent, transient and special population groups or those responsible for them and to special facilities within the emergency zones. Include information on the nature of the hazard, how people will be warned or notified, and on the actions to be taken in a radiation emergency. Provide information in the main languages spoken and periodically assess the effectiveness of this public information programme (4.54).	✓	✓				✓	✓	
Provide information in a form available during an emergency. Assess availability and reissue the information on a regular basis. Include definitions of terms used during response; describe all reasonable and unreasonable actions to reduce individual risks (see Elements A10.6, 11.2 and A11.3) including information on how family members (e.g. children at school) will be protected. All response organizations should use the same terms and definitions in dealing with the public. Use graphics and pictures to make the information interesting and comprehensible and preparation should involve organizations perceived as trustworthy by the public. Test the instructional material before use to ensure that it is understandable and can be used during an emergency by the public and that translated information is understandable for non-native speakers.	✓	✓				✓	✓	
Establish an ongoing exchange of response information with the population and with trusted people within the community such as community leaders, the medical community, teachers, religious leaders, clubs, community action groups and local media.	✓	✓				✓	✓	
Periodically conduct audits to ensure that enough people know the meaning of warning signals and have received the instructional information provided in advance.	✓	✓				✓	✓	
A5.2 Arrange to provide a warning signal and instructions to the permanent, transient, and special population groups or those responsible for them and to special facilities within the emergency zones upon declaration of an emergency class. Include instructions in the main languages spoken in these zones on the	✓	✓				✓	✓	

A5 - PROVIDING INFORMATION AND ISSUING INSTRUCTIONS AND WARNINGS TO THE PUBLIC	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
immediate protective and other actions to be taken (4.55).								
The warning system used within the PAZ must be capable of providing a warning signal for the population within minutes of a decision to implement protective actions. Fixed sirens and centrally activated radios within homes are effective in providing these warning signals. The warning system used within the UPZ must be capable of providing a warning signal for the population within an hour or two of a decision to implement protective actions. Fixed sirens, centrally activated radios within homes, loudspeakers operated from police or fire fighting vehicles and door-to-door notification are effective in providing warning signals within these time frames. The components of the systems must be reliable, not vulnerable to normal power failures and routinely tested. Periodically assess the effectiveness of the system in alerting all segments of the public.	✓	✓				✓	✓	
Warning messages should be brief, pre-recorded, and refer to the more detailed instructional information issued in advance. Repeat the message often to increase effectiveness. After the initial message, provide additional information on the reasons why protection is necessary and how other members of the family (e.g. patients in hospitals or school children) will be protected.	✓	✓				✓	✓	
Co-ordinate, as part of planning, the instructions to be provided to the population in other States within the emergency zones.	✓	✓				✓	✓	
Scientifically based recommendations for implementing countermeasures should be accompanied by an explanation that enables the public and decision makers to understand them, reasonably consider them and explain them to the other stakeholders. The explanation must make it clear to people that it ensures their "safety" and that of all other family members, including unborn children. Therefore, along with the criteria there should be a common language statement defining "safe". This explanation should be tested on representative members of the intended audience.	✓	✓	✓	✓	✓	✓	✓	
Provide information to the areas outside the emergency zones following warnings and instructions to the population within the zones. Include the public and local officials in areas nearby in order to reduce unwarranted or disruptive actions such as other officials diverting needed resources (e.g. buses) or	✓	✓				✓	✓	

A5 - PROVIDING INFORMATION AND ISSUING INSTRUCTIONS AND WARNINGS TO THE PUBLIC	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
spontaneous evacuations ("evacuation shadow"), which could hamper the implementation of protective actions within the zones.								
A5.3 Provide information on the risk posed by a facility in threat category III to the public and officials near the facility and make provisions to inform local officials and the public in an emergency at the facility.			✓			✓	✓	
The aim is to reduce unwarranted reactions during an emergency since the off-site risk is small.			✓			✓	✓	
A5.4 In response to a heightened threat of a terrorist act resulting in a radiation emergency have provisions, at the nation level, to inform the public on of the nature of the threat, threat recognition and reporting, and appropriate and inappropriate action in response to the threat.						✓		
Make provision to promptly follow a public announce with provisions to answer media and public inquiries (see elements A9 — Keeping the public informed).						✓		

4.2.6. Protecting emergency workers (A6 elements)

***Response objective**:* To protect emergency workers, in compliance with international standards (4.56).

A6 – PROTECTING EMERGENCY WORKERS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A6.1 Designate as emergency workers those who may undertake an intervention in order to: 1) save lives or prevent serious injury to include doses that could cause severe deterministic health effects; 2) take action to avert a large collective dose; or 3) take action to prevent the development of catastrophic conditions (4.57).	✓	✓	✓	✓	✓	✓	✓	✓
Include personnel responding on site or within the emergency zones to perform any of the tasks listed in Appendix 3.	✓	✓	✓	✓	✓	✓	✓	✓
A6.2 Designate those called upon to respond at a facility or within the emergency zones as emergency workers. Include assisting personnel such as law enforcement, fire fighters, medical personnel and drivers, crews of evacuation vehicles (4.58).	✓	✓	✓			✓	✓	✓
Include personnel controlling traffic, those assigned to administer shelters or to care for special populations, and those assigned to maintain critical infrastructure elements (e.g. telephone systems) or special facilities.	✓	✓	✓			✓	✓	✓
A6.3 Designate as emergency workers radiation specialists (see Element A3.1), radiation protection officers and radiological assessors (see Element A3.3) who may respond to emergencies involving practices or other hazards (4.58). Have provisions to designate emergency specific specialists as emergency workers. This could include bomb disposal experts and criminal investigators.	✓	✓	✓	✓		✓	✓	✓
A6.4 Inform first responders of the risks of radiation exposure and the meanings of radiation signs and placards (see Element A2.3) (4.59).	✓	✓	✓	✓	✓	✓	✓	✓

A6 – PROTECTING EMERGENCY WORKERS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A6.5 Adopt national guidance that is in compliance with international standards for managing, controlling and recording doses received by emergency workers (see Appendix 3). Include operational levels of dose for emergency workers for different types of response activities, which are set in quantities that can be directly monitored during the performance of these activities (such as the integrated dose from external penetrating radiation). In setting the default operational levels of dose for emergency workers, consider the contributions to doses via all exposure pathways (4.60).	✓	✓	✓	✓	✓			✓
These operational levels should be developed using methods consistent with Ref. [18]. The anticipated dose from external exposure and inhalation and effectiveness of the protective equipment provided should be considered in the development of the operational levels.	✓	✓	✓	✓	✓			✓
Provide plain language description of the risk from exposure greater than 500 mSv that would allow emergency workers to make informed decisions concerning volunteering for tasks for which doses above 500 mSv are possible (see Element A10.6).	✓	✓	✓	✓				✓
A6.6 Identify the anticipated hazardous conditions in which emergency workers may be required to perform response functions on or off the site (4.61).	✓	✓	✓	✓		✓	✓	
Include areas where operators' actions such as manipulation of valves, sampling or maintenance are needed during the response to an emergency (see Element A3.6). Provide for safe operations (e.g. shielding in advance) if needed to allow safe operations in these areas following an emergency. Include consideration of potential hazards such as heat, steam, poor visibility, toxic gases, heights, and strenuous activities in addition to radiation exposure.	✓	✓	✓			✓		

A6 – PROTECTING EMERGENCY WORKERS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A6.7 Arrange to provide protection for emergency workers for the range of anticipated hazardous conditions (see Element A6.6) in which they may have to perform response functions on or off the site. Include arrangements to continually assess and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance in compliance with international standards; and arrangements for appropriate specialized protective equipment, procedures and training for emergency response in the anticipated hazardous conditions (4.62).	✓	✓	✓	✓	✓	✓	✓	✓
Define the precautions to be taken by emergency workers immediately upon declaration of an emergency.	✓	✓	✓	✓		✓	✓	
Provide protective equipment and clothing, respiratory protection, and self-reading dosimeters where needed in locations accessible during an emergency and in appropriate quantities for the range of anticipated hazardous conditions under which they may have to perform (see Element A6.6), consistent with Appendix 3 and 16. Ensure that there are adequate expendable supplies (e.g. air tanks, filters, and clothing).	✓	✓	✓	✓		✓	✓	✓
Workers train in the proper use of the equipment, and conduct drills during which assigned tasks are performed while wearing the equipment. Ensure that they are physically capable of performing their assigned tasks while using the protective equipment under anticipated hazardous conditions (e.g. high temperatures).	✓	✓	✓	✓		✓	✓	✓
Have provisions in place for approving doses in excess of the operational emergency worker levels; for continuously monitoring doses and continuous communications with workers in very hazardous areas. Tasks performed in high dose rate or other hazardous conditions should be planned in detail and rehearsed if possible. Develop a capability to continuously account for emergency workers.	✓	✓	✓	✓		✓	✓	✓
Have provisions to provide "just in time" training (see Element B6.1), at the time of an emergency, for a limited number emergency specific emergency workers (see Element A6.3).	✓	✓	✓	✓		✓	✓	✓

A6 – PROTECTING EMERGENCY WORKERS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Ensure that general plans are developed to provide radiological protection services to large numbers of personnel who may be needed to mitigate the consequences of an emergency. This plan should consider requesting additional assistance through the IAEA under the Assistance Convention [15] following the procedures in Ref. [23].	✓							✓
A6.8 Ensure that once the emergency phase of an intervention has ended, workers undertaking recovery operations (non-urgent actions or actions not related to safety) such as repairs to buildings, waste disposal and decontamination are subject to the full system of detailed requirements for occupational exposure prescribed in Appendix I of Ref. [3] (4.63).	✓	✓	✓	✓	✓	✓	✓	✓
A6.9 When the intervention has ended, provide information on doses received and consequent health risks to all workers involved (4.64).	✓	✓	✓	✓	✓	✓	✓	✓
See information for Element A10.6 on how to characterize risk.								
A6.10 In emergency plans and procedures, specify the person within each response organization responsible for compliance with the requirements for the protection of workers undertaking an intervention (4.65).	✓	✓	✓	✓	✓	✓	✓	✓
A6.11 Arrange to provide psychological support to workers involved in response to an emergency.	✓	✓	✓			✓	✓	✓

4.2.7. Assessing the initial phase (A7 elements)

Response objectives:

(1) To appraise the magnitude and development of hazardous conditions throughout the emergency in order to identify new hazards and refine the strategy for response (4.66).

(2) To carry out radiation monitoring and environmental sampling and assessment in order to identify new hazards and refine the strategy for response (4.67).

(3) To provide all relevant response organizations, throughout the period of the emergency, with information about emergency conditions, emergency assessments and protective actions recommended and undertaken (4.68).

A7 - ASSESSING THE INITIAL PHASE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A7.1 Arrange to characterize the extent and significance of any abnormal exposures or contamination, initiate mitigatory and protective actions on the site, identify members of the public potentially exposed, and communicate the recommended protective actions to the appropriate off-site response organizations (4.69).	✓	✓	✓	✓		✓		
A7.2 Arrange to assess abnormal facility conditions, exposures and releases; radiological conditions on and off the site and actual or potential exposures to the public. Use the assessments for mitigatory action by the operator (Element A3.6), emergency classification (Element A2.5), urgent protective actions on the site, protection of workers, and recommendations for urgent protective actions to be taken off the site (Element A4.4). Include access to instruments displaying those parameters that can be measured or observed in a radiation emergency and form the basis for the EALs used to classify events (see Element A2.5). Take into account the expected response of instrumentation or systems at the facility under abnormal conditions (4.70).	✓	✓	✓			✓		

A7 - ASSESSING THE INITIAL PHASE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
In the emergency classification procedures, provide the instrument readings to be used as EALs (see Element A2.5) in order to indicate the presence of the conditions stated in Appendix 6 warranting declaration of different classes of emergency. The EALs should be in the units displayed by instruments available in the control room. The procedures should not rely on a single indicator as the basis for an assessment and, as much as possible, measurements should be used that are direct indicators of the condition of interest (e.g. water level in the reactor vessel). The procedures and operator training should address response of instruments under abnormal conditions, and should include warnings when instrument readings may be misleading. They should also address the response of area and process radiation monitoring and of other instrumentation essential during a severe emergency and during emergency system operations (e.g. recirculation mode following core damage). For reactors, the EALs should be consistent with Ref. [18].	✓	✓	✓			✓		
A7.3 Arrange to assess, during an emergency, radioactive contamination, releases and doses in the emergency zones to determine or modify urgent protective actions following a release. Arrange for monitoring of the environment and of the contamination of people (e.g. evacuees) within the zones. Include designated trained teams and instrumentation and arrange to assess the monitoring results in order to determine, modify or initiate urgent protective actions to protect workers and the public, using operational intervention levels (OILs) and making arrangements to revise the OILs to accommodate the conditions present during the emergency (4.71).	✓	✓				✓	✓	
For the predictable environmental release routes (atmospheric and water), provide methods to assess releases by these routes under emergency conditions. For these release routes, develop EALs for classification (see Element A5.3, A7.2) that indicate potential off-site doses warranting declaration of an emergency consistent with Appendix 6. These EALs should be in units directly measured by instruments (e.g. Bq/s) available in the control room and be calculated in advance assuming realistic (e.g. average) dispersion conditions. Provisions should be put in place to estimate the radionuclide mixture of releases.	✓	✓				✓		
Develop methods to project off-site consequences implied by facility conditions (e.g. for unmonitored or future releases). This could be precalculated doses for different accident conditions as shown in Ref. [18] or computer models such as INTERAS [18].	✓	✓				✓	✓	

A7 - ASSESSING THE INITIAL PHASE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Those responsible for assessments and management should be aware that dose projections are very uncertain and that for severe emergencies making accurate projections of off-site doses may be impossible. They should expect differences in results from models run by different organizations and should not use these projections as the sole basis for protective actions.	✓	✓				✓	✓	
Arrange for monitoring and sampling by teams consistent with Appendix 15, response in times consistent with Appendix 10 and a strategy consistent with Refs. [18] and [27].	✓	✓				✓	✓	
Provide precalculated default OILs for assessing environmental data following a release, and techniques to revise OILs according to the actual radionuclide mix of the release consistent with Ref. [18]. Preclude frequent changes to OILs in order to maintain confidence and stability in the decision making process. Plans should identify responsibilities for deciding whether or not to revise OILs and the criteria to be used to decide on whether a change is required.	✓	✓				✓	✓	
Arrange to conduct monitoring of people within the emergency zones to determine if decontamination or medical follow-up is warranted. Include criteria for initiation of decontamination and medical follow-up. The criteria should be tied to potential health effects (e.g. doses approaching deterministic effect thresholds) and be consistent with other criteria (e.g. criteria for relocation). For facilities such as nuclear power plants with the potential for large radioiodine releases, establish a means of measuring thyroid radioiodine intake (e.g. by direct gamma measurement next to the thyroid).	✓	✓				✓	✓	
Arrange to analyse the environmental monitoring data and produce information useful for decision making (e.g. maps). Ensure that the results of different monitoring organizations are comparable, including those in other States. As soon as possible, all organizations (facility, local, national, and international) conducting environmental monitoring and analysis should consolidate their efforts and form a single organization co-located at a radiation monitoring and assessment centre- RMAC (see Appendix 14).	✓	✓				✓	✓	
The assessment staff should be aware of the great uncertainties in assessment early in an emergency and the need to make best estimate assessments, and of the problems that can arise from inappropriate pessimistic assumptions.	✓	✓				✓	✓	

A7 - ASSESSING THE INITIAL PHASE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A7.4 Arrange for teams of radiation specialists providing support to the first responders to identify gamma, beta and alpha emitters, and for delineating the areas in which urgent protective actions are warranted (Element A3.1) (4.72).				✓				✓
The team's capabilities should be consistent with those of the radiation monitoring team (RMT) described in Appendix 15 and be prepared to perform the radiological assessment functions outlined in Appendix 7. Team members could be effectively drawn from personnel experienced in dealing routinely with radiation, such as the staff from research reactors; however, team members should be provided with training for emergencies, means for rapid activation and legal medical and social protection for any consequences resulting from their service.				✓				✓
A7.5 Arrange for relevant information to be recorded and retained for use during the emergency, in post-emergency evaluations, and for long term health monitoring and follow-up of emergency workers and members of the public who may be affected (4.73).	✓	✓		✓			✓	✓
Record the full names, dates of birth, and general location and activities at the time of possible exposure of individuals who may have been exposed sufficiently to warrant long term medical monitoring (see Element A8.5).	✓	✓	✓	✓		✓	✓	✓

4.2.8. Managing the medical response (A8 elements)

Response objectives:

(1) To ensure that medical practitioners or other responsible parties make appropriate notification and implement response actions after the presentation (observation) of medical symptoms of radiation exposure or other effects indicating a possible radiological emergency (4.74).

(2) To provide appropriate specialized treatment to any person who receives a dose that could potentially result in severe deterministic health effects (4.75).

(3) To detect any increase in the incidence of cancer among emergency workers and the public resulting from radiation exposure during a radiation emergency and provide appropriate treatment (4.76).

A8 - MANAGING THE MEDICAL RESPONSE	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A8.1 Arrange to make medical personnel, both general practitioners and emergency staff, aware of the clinical symptoms of radiation exposure and of the appropriate notification procedures and other immediate actions warranted if a radiological emergency is suspected (4.77).				✓			✓	✓
This can be accomplished by distribution of information similar to the IAEA/WHO poster "How to recognize and initially respond to an accidental radiation injury".				✓			✓	✓
A8.2 Arrange for treatment of a limited number of contaminated or overexposed workers, including provisions for first aid, the estimation of doses, medical transport, and initial treatment of contaminated or highly exposed individuals in local medical facilities (4.78).	✓	✓	✓			✓	✓	
Arrange to gather information needed to reconstruct the dose promptly following a serious exposure in order to determine the course of treatment. This information should include: estimates of the dose received to the whole body or tissues; photograph/diagrams of the facility/practice and activities involved; a description of the source of exposure (e.g. activity, radionuclide, dose rate at 1 metre); a detailed description of circumstances of the exposure (e.g. location of person as a function of time); readings of all personal dosimeters (all staff members) or other monitoring devices; samples of items	✓	✓	✓	✓		✓	✓[32]	

[32] Medical facility

A8 - MANAGING THE MEDICAL RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
worn by the overexposed person; a full description and time of onset of any early clinical symptoms (e.g. vomiting); results of a general medical examination of all systems and organs, including the skin, visible mucosa; and total blood counts in order to detect the first occurrence of symptoms related to exposure (see Ref.[28]).								
Arrange for a local medical facility (the "designated hospital" – see Appendix 14) to be used for initial treatment (see Element A4.7). This facility should have the capability to: treat and decontaminate contaminated patients, identify radiation exposures needing specialized treatment, control the spread of contamination and prepare patients for transport to a facility (the "referral hospital" – see Appendix 14) that can treat severe overexposures consistent with Refs. [28, 29]. Train/inform the facility medical staff on control of their exposure (the staff should be considered emergency workers, see Element A6.2), the risks of treating contaminated and exposed patients, contamination control, and handling of contaminated waste or samples. One aim of this training is to overcome staff fears that may interfere with treatment. (See Element A10.6).	✓	✓	✓			✓	✓	
A8.3 Establish a medical management plan for emergency zones, which should include operational criteria for performing triage and assigning any highly exposed members of public to appropriate medical facilities (4.79).	✓						✓	
The triage and treatment system should be consistent with Refs. [28,29]. Identify facilities to treat overexposures of up to 5% of the population in the PAZ. The operational criteria (triage criteria) for determining which level of treatment people receive should be based on estimated exposure or onset of clinical symptoms consistent with Ref. [28, 29].	✓						✓	
A8.4 Arrange, at the national level, treatment for people who have been exposed or contaminated. Include guidelines for treatment; a list of medical practitioners trained in the early diagnosis and treatment of radiation injuries and the selection of approved institutions to be used for extended medical treatment or follow-up of persons subjected to radiation exposure or contamination. Include arrangements for consultation with medical practitioners experienced in dealing with such injuries on treatment for any exposure that could result in severe tissue damage or other severe deterministic health effects (4.80).				✓				✓
Inform agencies that may be notified of a radiation injury of these arrangements. Use existing medical facilities and brief the medical staff on the limited risk from treating contaminated and exposed patients				✓				✓

A8 - MANAGING THE MEDICAL RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
facilities and brief the medical staff on the limited risks from treating contaminated and exposed patients, precautions they should take, contamination control, and handling of contaminated waste or samples. See information for Element A10.6 on how to characterize risk. Ensure that medical staff will not let fear interfere with treatment of contaminated patients. Establish a procedure and system of organization and notification of appropriate medical staff and support personnel. Diagnosis and treatment guidelines should be consistent with Refs. [28,29]. Attempt to minimize psychological suffering (for example, by treating the patient near home if possible). Consult experienced physicians on the treatment of severe deterministic health effects through the IAEA or WHO using the procedures in Ref. [23]. See the first information item under Element A8.2 on the information to be gathered to estimate dose.								
Be prepared for three waves of people arriving at a hospital from a radiation emergency with mass-casualties: 1) Wave 1: worried-well, who are not injured but worried and get to the hospital on their own and fast. If the staff is not prepared for them, they can clog the hospital and interfere with the treatment of the truly injured that will arrive later. 2) Wave 2: the injured that are rescued by the public – bystanders. These arrive next and, while injured, they may not be the most severely injured and 3) Wave 3: the injured that are rescued by the emergency response personnel. These will be the last to arrive and will typically be the most severely injured. Note Wave 1 and 2 could contain people who have not been monitored or decontaminated.	✓	✓	✓	✓	✓		✓	✓
Have arrangements to dispatch an emergency medical response team to co-ordinate the medical response to a radiological emergency at any location. This team should be prepared to prepare and use local medical resources. (see Appendix 7 for typical responsibilities)				✓				✓
A8.5 Arrange for identification, tracking and long term medical follow-up and treatment of the health effects of people in those groups that are at risk of sustaining a detectable increased incidence of cancer from radiation exposure or in effects from prenatal exposure (e.g. mental retardation). The criteria for determining who should receive long term medical follow-up should have the aim of detection of radiation induced cancers or mental retardation at an early stage to allow more effective treatment (4.81).	✓	✓	✓					✓
A registry should be established of persons to be tracked and to receive long term medical follow-up. These arrangements should include identification of the responsible organization, criteria for inclusion in	✓	✓	✓	✓	✓			✓

A8 - MANAGING THE MEDICAL RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
the registry and information to be obtained that ensures that the correct identity of persons in the registry can be confirmed over time (see Element A7.5). Base inclusion in the registry on objective criteria that indicate a potential for an increase in the incidence of radiation induced cancer or mental retardation from prenatal exposures (e.g. 50 mSv to the thyroid, 200 mSv [41] whole body and 100 mSv foetus [40]). Include those who were children at the time of exposure and who may have received sufficient dose from radioiodine to result in a detectable increase in thyroid cancer (e.g. 50 mSv) risk. Inform people included in the register of their risk level and of the purpose of the register. (See Element A10.6.)								

4.2.9. Keeping the public informed (A9 elements)

***Response objective**:* To provide the public with useful, timely, truthful, consistent and appropriate information throughout a radiation emergency (4.82).

A9 - KEEPING THE PUBLIC INFORMED	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A9.1 Arrange to provide useful, timely, truthful, consistent and appropriate information to the public in a radiation emergency, responding to incorrect information and rumours, and to requests for information from the public and from news and information media (4.83).	✓	✓	✓	✓	✓	✓[29]	✓	✓
Upon declaration of an emergency or receipt of significant inquiries from the media concerning a possible emergency, arrange to immediately co-ordinate all information from sources viewed by the public as official (governmental agencies and the facility). This should include arrangements: 1) to issue a press release identifying the agency that will be the official source of information; 2) to establish as soon as possible, a single official source and 3) to remind other agencies to refer requests by the media for information to the designated agency. For significant events, a PIC (see Appendix 14) should be established near the location of the emergency that will be the only location disseminating official information. Security should be provided for the PIC along with a system for confirming the credentials of media personnel.	✓	✓	✓	✓	✓	✓[29]	✓	✓
Arrange to provide the public promptly with information on the risk and protective actions following warning of an emergency (see Element A5.2) and again following issuance of protective action recommendations. Identify sources of additional information in the instructions provided to the public (see Element A5.1). Arrange to provide information to the public outside the emergency zones (outside the area where protective actions are being recommended) on what actions they should or should not take and why (see Element A5.2).	✓	✓		✓		✓[29]	✓	✓
Arrange to monitor media information and to promptly respond to misleading, inaccurate or confusing information. Arrange to identify inappropriate reactions (see Element A11.2) by the public during an emergency and to provide information to the media to help alleviate the situation. Address incorrect or misleading information in the international media through the IAEA (see Element A2.15).	✓	✓	✓	✓		✓[29]	✓	✓

A9 - KEEPING THE PUBLIC INFORMED	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Prepare material in advance to be used to provide advice to the public and address likely questions and concerns during an emergency. Arrangements should be made to revise this material before release during an emergency. Ref. [37] provides examples of such material.	✓	✓	✓	✓	✓	✓[29]	✓	✓
Have arrangements to dispatch a public information officer/team to assist local officials responding to a radiological emergency. (see Appendix 7 for typical responsibilities)					✓			✓
Arrange, after the declaration of an emergency, to brief trusted members of the local community, including doctors, teachers, religious leaders and action groups.	✓	✓	✓	✓		✓[29]	✓	✓
Arrange, in advance, a location to serve as the PIC (see Appendix 14), where facility, local and national officials provide media briefings. The PIC should be near the facility but outside the UPZ.	✓					✓	✓	
Arrange to provide information to the members of the media at the scene on risks, restrictions, and precautions they should take for their protection. Members of the media could be considered emergency workers (because they are needed to provide trusted information to the public) and should be included in the arrangements for providing radiation protection and long term medical monitoring (see Element A8.5).	✓	✓		✓		✓[29]	✓	✓
Arrange to provide responders who will have direct contact with the public (e.g. monitoring teams) with instructions on how to interact with the public and media.	✓	✓		✓	✓	✓[29]	✓	✓
Arrange to promptly provide the public with the results of medical examinations, monitoring, sampling or other activities directly involving them, their homes, community or workplaces.	✓	✓		✓	✓	✓[29]	✓	✓
A9.2 Ensure that the operator, the response organizations, other States and the IAEA co-ordinate the provision of information to the public and to the news and information media in the event of a radiation emergency (4.84).	✓	✓	✓	✓	✓	✓	✓	✓
Arrange for all response organizations, States within the emergency zones and the IAEA to co-ordinate the information provided to the public and the news media.	✓	✓		✓		✓	✓	✓

4.2.10. Taking agricultural and longer term protective action (A10 elements)

Response objectives:

(1) To take agricultural countermeasures and longer-term protective actions in compliance with international standards (4.85).

(2) To manage radioactive waste and contamination appropriately (4.86).

(3) To discontinue protective actions when assessments show that they are no longer justified (4.87).

A10 - TAKING AGRICULTURAL COUNTERMEASURES, COUNTERMEASURES AGAINST INGESTION AND LONGER TERM PROTECTIVE ACTION	**Threat category**					**Responsibility**		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A10.1 Establish national intervention levels and action levels for agricultural countermeasures, countermeasures against ingestion and long term protective actions that are in compliance with international standards, modified to take account of local and national conditions, such as: (1) the individual and collective dose to be averted by the intervention; and (2) the radiological and non-radiological health risks and the financial and social costs and benefits associated with the intervention (4.88).	✓	✓	✓	✓	✓			✓
Scientifically based recommendations for implementing countermeasures should be accompanied by an explanation that enables the public and decision makers to understand them, reasonably consider them and explain them to the other stakeholders. The explanation must make it clear to people that it ensures their "safety" and that of all other family members, including unborn children. Therefore, along with the criteria there should be a common language statement defining "safe". This explanation should be tested on representative members of the intended audience. This should include arrangements to respond, as outlined in Appendix 7, to radiological emergencies involving accidental or intentional contamination of the food, water or products.	✓	✓	✓	✓	✓		✓	
The international guidance (GILs and GALs) reproduced in Appendix 1 for relocation, resettlement and foodstuff restrictions is for a large release involving rural areas where alternative food supplies are available. Make provisions to adjust the criteria if alternative food is not available and to adopt higher relocation GILs for contamination of large metropolitan areas or other conditions where relocation may have a significant social or psychological impact.	✓	✓		✓	✓			✓

A10 - TAKING AGRICULTURAL COUNTERMEASURES, COUNTERMEASURES AGAINST INGESTION AND LONGER TERM PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Establish criteria and process to discontinue the agricultural countermeasures and relocation when assessments show that continuation of the actions is no longer justified. This could include consultation with international experts through the IAEA by following the procedures in Ref. [23].	✓	✓			✓			✓
A10.2 Arrange for effective agricultural countermeasures, including restriction of the consumption, distribution and sale of locally produced foods and agricultural produce following a release. Include default OILs for environmental measurements (such as deposition exposure rates and deposition densities) and food concentrations; means to revise the OILs; timely monitoring for ground contamination in the field; sampling and analysis of food and water; and the means to enforce agricultural countermeasures (4.89).					✓			✓
Establish relocation OILs for localized contamination from a gamma emitter (e.g. Cs- 137). These OILs should be shown to be valid for all reasonable exposure pathways (e.g. children playing on contaminated ground). These OILs should be developed using the methods outlined in Ref. [18].				✓				✓
Arrange, within the emergency zones and within the food restriction planning radius (see Appendix 5), for control of contaminated foodstuffs. Establish default OILs, consistent with Refs. [18] and [11] for implementation of agricultural countermeasures and food and agricultural product restrictions. This should include OILs for deposition exposure rates, deposition densities and food concentrations. Deposition OILs should be used to promptly identify areas where food may be of concern, to be further assessed by sample analysis. Provide a means to revise the agricultural OILs consistent with Refs. [18] and [11].	✓	✓			✓		✓	✓
Arrange for environmental monitoring strategy consistent with Refs. [11, 18 and 27] and teams consistent with Appendix 15 to identify areas where agricultural restrictions may be warranted following a release. Include OILs based on deposition, dose rate and sample analysis results. Take into account all organizations involved in food and agriculture production and distribution and significant components of the local diet (e.g. meat and dairy animals, local milk, kitchen gardens, open water, local fish, forest products, and cisterns). Identify and restrict potentially contaminated products related to terrestrial farming, animal husbandry, drinking water, personal gardens, forest products, seafood production and	✓	✓			✓		✓	✓

A10 - TAKING AGRICULTURAL COUNTERMEASURES, COUNTERMEASURES AGAINST INGESTION AND LONGER TERM PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
forestry. Co-ordinate monitoring and analysis for all affected areas from a single RMAC (see Appendix 14) and integrate into a single assessment.								
Arrange to provide instructions promptly to members of the public, government agencies, farmers and food production and distribution activities to take action to protect food (e.g. take animals off pasture), water supplies and cisterns; prevent immediate consumption of contaminated food (e.g. local milk or home grown garden vegetables); and protect the food and agricultural product system (e.g. prevent introduction of potentially contaminated food into the food processing/distribution system by restricting harvesting and marketing until monitoring has been implemented). Initiate actions upon declaration of a general emergency consistent with Appendix 6.	✓	✓			✓		✓	✓
Provide guidance, in advance, to farmers and the food and agricultural product industry on the actions to be taken during an emergency consistent with Ref. [30] that considers the laws, population characteristics, food distribution systems, farming practices and crops, and effectiveness of agriculture countermeasures. This should be as part of the information programme addressed by Element A5.1.	✓	✓			✓		✓	✓
Arrange to monitor and control the import food and products, and develop default OILs consistent with Table A1-III and to enforce agricultural countermeasures locally and at international borders.					✓		✓	✓
Arrange to sample of the population to validate intake pathway, diet and uptake assumptions and to revise protective actions as appropriate. Care must be taken to ensure this programme does more good than harm by not unduly inflating risk perceived by the public.	✓				✓		✓	✓
Outline a long- term plan for agricultural use of a contaminated area. This outline should include provision for detailed studies of the relationship of contamination, climate, soil type and agricultural practices to agriculture product contamination levels; and for gathering detailed climatic, agrochemical and radiological information using airborne-gamma-spectrometric and remote sensing land survey information. Include provisions for testing various agricultural practices, including non-traditional agricultural uses for the land and economic assistance and training in the production of more suitable agricultural products.	✓						✓	✓

A10 - TAKING AGRICULTURAL COUNTERMEASURES, COUNTERMEASURES AGAINST INGESTION AND LONGER TERM PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Arrange for local agents to work closely with the local farmers and foresters on methods to control the level of contamination in agricultural products. These agents should be trained in using those practices that appear, according to the latest studies, to be most effective in reducing contamination and those products that are most suitable for different contaminated areas.	✓				✓		✓	✓
A10.3 In the UPZ and beyond, make arrangements for temporary relocation. Include: OILs for deposition densities and exposure rates; means to revise the OILs; timely monitoring of ground contamination; means for accomplishing relocation; and arrangements for assisting those people who have been relocated (4.90).	✓	✓					✓	
Develop default OILs for temporary relocation and process for their revision on the basis of environmental and other data consistent with Refs. [18] and [27]. Arrange for timely monitoring of ground contamination to identify where the relocation OILs are exceeded using a strategy consistent with Ref. [18] that includes teams consistent with Appendix 15. Co-ordinate monitoring and analysis for all affected areas from a single RMAC (see Appendix 14) and integrate it into a single assessment.	✓	✓					✓	✓
Arrange to monitor the degree of public adherence to the protective action recommendations and the psychological impact. Have provisions to adjust the protective action accordingly to optimize its effectiveness (see Element A11.1)	✓	✓					✓	✓
A10.4 Within the emergency zones arrange for monitoring the contamination levels of vehicles, personnel and goods moving in and out of contaminated areas to control the spread of contamination. Set operational criteria for the monitoring results that indicate the need for decontamination or controls compliant with international standards (4.91).	✓	✓					✓	✓
Ensure that criteria used for monitoring people and vehicles are consistent with those for relocation, i.e. monitoring and decontamination should not be needed for people in areas not relocated. Arrange to monitor to locate, in areas not relocated, contamination concentrators (e.g. filters, roof drip zones) that may warrant limited decontamination. Ensure that the public understands that these decontamination	✓	✓					✓	✓

A10 - TAKING AGRICULTURAL COUNTERMEASURES, COUNTERMEASURES AGAINST INGESTION AND LONGER TERM PROTECTIVE ACTION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
efforts do not indicate that living in the area in unsafe.								
A10.5 Arrange for safe and effective management of radioactive waste in compliance with international standards. Include criteria for categorizing waste; criteria for monitoring and sampling to characterize the contamination and the waste; measurable criteria in terms of dose reduction for use in assessing the effectiveness of decontamination efforts; a method of testing decontamination methods before their general use; a method of minimizing the amount of material declared waste and avoiding unnecessary mixing of different waste types; criteria for determining appropriate methods of storage, pre-disposal management and disposal; and a plan for the long term management of waste (4.92).	✓	✓	✓	✓	✓		✓	✓
Establish a process for making decisions about decontamination measures and ensure they are justified and optimal. Arrange to test decontamination methods before widespread use. The data and experience gained performing decontamination following the Chernobyl accident should be considered. This advice can be obtained through IAEA using the procedures in Ref. [23].	✓	✓					✓	✓
A10.6 Arrange assessment of exposure incurred by members of the public as a consequence of a radiation emergency and make results publicly available. Base assessments on the best available information and update when information would produce substantially more accurate results. Maintain comprehensive records of assessments and their updates, and of monitoring results for workers, the public and the environment (4.93).	✓	✓	✓	✓	✓	✓[29]	✓	✓
Comprehensive records should be maintained of assessments and their updates, and of monitoring results for workers, the public and the environment. The " linear non threshold" assumption should not be used to characterize the risk of cancers from an emergency; however others will and preparations should be made to address such estimates. The risk should be in terms of expected observable health effects on the children (to include those receiving in vitro exposures) and adults living in different areas in order to reduce the non-radiological impacts and unwarranted reactions by the public (e.g. abortions for fear of deformities - see Element A8.4).	✓	✓		✓	✓	✓[28]	✓	✓

4.2.11. Mitigating the non-radiological consequences (A11 elements)

***Response objective**:* To consider the non-radiological consequences of the response in order to ensure that the response actions do more good than harm (4.94).

A11 - MITIGATING THE NON-RADIOLOGICAL CONSEQUENCES OF THE EMERGENCY AND RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A11.1 Arrange for justifying, optimizing and authorizing different intervention levels or action levels following an event for which agricultural countermeasures or longer-term protective actions are in place. Include arrangements for consulting the people affected. Consider, for the long term protective actions, anxiety or distress caused, effects on economic conditions, employment and long term needs for social welfare, and other non-radiological effects. This process should provide for exceptions from compliance with international standards where these are justified (4.95).	✓	✓		✓	✓			✓
Resist the public, political and media pressure to implement long term programmes based on the perceived radiological risk and before actual radiological risk reduction and the adverse social and psychological impact of the programmes can be evaluated. This can be accomplished by establishing in advance the process and criteria, based on international standards, for making long term decisions and by ensuring that all the parties involved in the decision making process, including the media and public, are aware of the actual radiation risks (see Element A10.6). Develop recommendations for implementing countermeasures to alleviate the radiological consequences according to on accepted radiation protection principles that do not anticipate other factors and that are based on realistic assumptions. Recommendations should be accompanied by a plain language explanation that enables the decision maker to understand them, reasonably consider them and explain them to the public. The explanation must make it clear to people that the actions recommended (taken) ensure their safety and that of all other family members, including unborn children. The decision maker should consider this in the broader decision making process that includes consideration of economic, social and other factors when determining the action levels to be used.	✓	✓		✓	✓			✓
Scientifically based recommendations for implementing countermeasures should be accompanied by an explanation that enables the decision maker to understand them, reasonably consider them and explain them to the other stakeholders. The explanation must make it clear to people that it ensures their "safety"	✓	✓		✓	✓			✓

A11 - MITIGATING THE NON-RADIOLOGICAL CONSEQUENCES OF THE EMERGENCY AND RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
and that of all other family members, including unborn children. Therefore, along with the criteria there should be a common language statement defining "safe". This explanation should be tested on representative members of the intended audience. Provision to address public concerns of a perceived terrorist threat should be considered such as increased security at locations perceived as concern.								
A11.2 Arrange to respond to public concern, anxiety and distress in an actual or perceived radiation emergency. Arrange to explain any health risks and appropriate and inappropriate personal actions for reducing risks; to monitor for and respond to any related health effects; to counter inappropriate actions on the part of workers and the public; to designate organization(s) with the responsibility for identifying the reasons for such actions (such as misinformation obtained from the media) and to make recommendations on countering them. Specify how these recommendations are to be incorporated into the national emergency response (4.96).	✓	✓	✓	✓	✓		✓	✓
Identify the organization(s) with the responsibility for identifying causes of these reactions (e.g. misinformation or unrealistic fears) and for making recommendations on their mitigation. Detail how these recommendations will be incorporated into the national response. Unwarranted reactions include shunning of potentially exposed people, spontaneous evacuations, hoarding, or unwarranted terminations of pregnancy.	✓	✓	✓	✓	✓		✓	✓
Establish the process used to develop the system of compensation for emergency workers and the public after an emergency (radiation, chemical or other) following careful consideration of the benefits and long term social, psychological and economic effects. The compensation system should be directly related to tangible losses or needs resulting from the emergency, such as implementation of protective actions (e.g. evacuation costs, or replacement of potentially contaminated food); compensation for demonstrated losses or costs directly related to the emergency (e.g. replacing lost incomes or contaminated property); and re-establishing a normal life (e.g. providing job training for those who lost jobs or providing assistance in finding housing for those displaced from contaminated areas). Compensation criteria that support public fears (e.g. based on contamination levels in areas where the population is allowed to remain) should be avoided. The system of compensation should address acts of terrorism.	✓	✓		✓	✓		✓	✓

4.2.12. Conducting recovery operations - (A12 elements)

Response objectives:

(1) To plan and implement the transition from the emergency phase to longer term recovery operations and the resumption of normal life in an orderly manner and in accordance with international standards and guidance (4.97).

(2) To fulfill all requirements for occupational exposure for workers undertaking recovery operations (4.98).

A12 - CONDUCTING RECOVERY OPERATIONS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
A12.1 Arrange for the transition from emergency phase operations to routine long term recovery operations. Include the definition of the roles and functions of organizations; and methods used to transfer information, of assessing radiological and non-radiological consequences, and of modifying action taken to mitigate the radiological and non-radiological consequences of the radiation emergency (4.99).	✓	✓				✓	✓	✓
The regulatory body should establish the principles and criteria for removal of restrictions and return to normal consistent with Ref. [31].	✓							✓
Prepare an outline of a recovery plan. Identify the differences in authority, management and co-ordination between the emergency and recovery responsibilities and how the transition would be made. Identify the objectives for recovery, the process used to determine the need for recovery measures, the means of securing resources, methods for making decisions and methods to involve the public and other relevant parties. Ensure that any longer term programmes to monitor the population (see Element A8.5) are incorporated into the planning.	✓					✓	✓	✓
Prepare arrangements to co-ordinate the radiological aspects of a recovery to a radiological emergency such as those outlined in Appendix 7. This should include provisions to co-ordinate with law enforcement (e.g. to preserver evidence) and other recovery workers (e.g. construction).				✓				✓
A12.2 Arrange a formal process in accordance with international guidance to cancel restrictions or other arrangements imposed in response to a radiation emergency. Ensure that the regulatory body provides necessary input to the intervention process, including advice to the government or regulatory control of intervention activities. Establish principles and criteria for intervention actions with advice from the	✓							✓

A12 - CONDUCTING RECOVERY OPERATIONS	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
regulatory body and consultation with the public. Provide for exceptions from compliance with national and international standards where justified (4.100).								
The goal should be to return to normal (see Element A12.1). The process should include consultation with the public and must ensure they understand the risk (see Element A10.6. The plan should minimize the likelihood of further measures being taken in areas that have been previously released for unrestricted use. Before long term monitoring or other activities are conducted in areas designed for unrestricted use after an emergency, ensure that the public understand that these activities do not indicate that they are at risk and that they know the reasons for the continuing activities (e.g. scientific investigations of behaviour of radioisotopes in the environment). See Element A11.1 for related guidance.	✓							✓
A12.4 Ensure that, at the end of the emergency phase, workers undertaking recovery operations, such as repairs to the plant and buildings, recovery of sources, waste disposal or decontamination of the site and surrounding area, are subject to the full system of detailed requirements for occupational exposure. Carefully plan all such work.	✓	✓	✓	✓	✓	✓	✓	✓
The full system of detailed requirements for occupational exposure is in Appendix I of Ref. [3] is to be followed for recovery operations. Recovery operations are typically those that are not directly related to implementation of urgent protective actions or longer-term protective, mitigatory actions to reduce further risk to the public, workers or the public.	✓	✓	✓	✓	✓	✓	✓	✓

4.2.13. Authority (B1 elements)

B1 - AUTHORITY	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B1.1 Establish the authority for developing, maintaining and regulating arrangements for preparedness and response for a radiation emergency by means of legislative acts, legal codes or statutes (5.2).	✓	✓	✓	✓	✓		✓	✓
As part of the review of national policy (see Sections 2.2.4) the national co-ordinating authority (see Element B3.1) should identify laws, regulations or plans that interfere with adequate emergency preparedness and response (e.g. lack of laws or laws specifying conflicting responsibilities) and work with the institutions involved to resolve the potential impediments to an adequate response.	✓	✓	✓	✓	✓		✓	✓
B1.2 Document roles, functions, authorities and responsibilities in an emergency response and agree on the authorities, roles and responsibilities of other response organizations. Typically this is documented as part of the appropriate national and local emergency response plans (see Appendix 12). Conflicting roles and responsibilities should be resolved as part of the planning process or by the national co-ordinating authority (see Elements B1.2 and B3.1) (5.3).	✓	✓	✓	✓	✓		✓	✓
The development of a workable concept of operations for emergency preparedness and response arrangements should not await resolution of deficiencies in the legal or regulatory basis, which could require years. Problems should be resolved, with the help of the national co-ordinating authority, by development of agreements (based on a practical concepts of operations, see Section 2.2.7, Section 4.1, and Element B2.1) between agencies on the practical aspect of a response (see Element B1.2).	✓	✓	✓	✓	✓	✓	✓	✓
B1.3 In the emergency arrangements, include clear allocation of responsibilities, authorities and arrangements for co-ordination in all phases of the response. For each response organization, establish a single position that has the authority and responsibility to direct its response actions. Clearly assign the responsibility for co-ordination of the entire response and for the resolution of conflicts between response organizations (5.4).	✓	✓	✓	✓	✓	✓	✓	✓

B1 - AUTHORITY	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Develop agreements (see Elements B1.1 and B1.2), signed by the organizations responsible for the performance of the tasks listed in Section 3.2 delineating their authority and responsibilities during a response. These agreements should be summarized in or attached to the emergency plans as shown in Appendix 12. Identify and develop agreements with organizations with functions that may need to be integrated with the response by non-radiological response organizations (e.g. law enforcement, military). To prevent unplanned response actions, all major organizations (ministries) should sign a general agreement of responsibilities and concept of operations, even those with no identified role during the response.	✓	✓	✓			✓	✓	✓
Delegate the authority and responsibility for initiating and implementing initial protective actions to local level of government.	✓	✓	✓	✓			✓	✓
Arrange for the incident command system, as described in Appendix 13, to be used to direct and co-ordinate the response. This would include an incident commander and incident command group with the responsibility for co-ordination of the entire response (on and off-site) as discussed in Element A1.4. Command of the response is best performed from near the scene by local officials. The incident commander is typically assigned to an individual in the organization with the primary role during each phase of the response. As the emergency progresses, responsibility would typically flow from the operator or first responders to a local official and finally to a national official or incident command group (composed of the representatives of the principal responders) for emergencies involving several jurisdictions or ministries. See Elements A1.2 and 1.3 for related guidance. *Address the co-ordination of the radiological response with the conversional response (e.g. fire fighting, rescue) and the law enforcement or military response.*	✓	✓	✓	✓			✓	✓
The single on-site position with the responsibility for directing the entire on-site response may be transferred to different positions as the on-site staff is augmented (see Elements A1.1). The position should become part of the incident command group (see Appendix 13) as the emergency progresses.	✓	✓	✓			✓		
B1.4 Arrange for delegation and/or transfer of authority in the relevant emergency plans, together with arrangements for notifying all appropriate parties of the transfer (5.5).	✓	✓	✓		✓	✓	✓	✓

4.2.14. Organization (B2 elements)

B2 - ORGANIZATION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B2.1 Establish organizational relationships and interfaces between all the major response organizations (5.6).	✓	✓	✓	✓	✓	✓	✓	✓
Develop a concept-of-operations (see Section 2.2.7), consistent with Section 4.1, and Appendix 6 and 7, for each organization that describes the response to emergencies and how it relates to other organizations. Ensure that organizations with potentially overlapping responsibilities understand their roles during an emergency. All response organizations should concur on the concept of operations (see Elements B1.1 - B1.3).	✓	✓	✓	✓	✓	✓	✓	✓
B2.2 In the emergency plans, assign positions responsible within each operating and response organization for performance of specified response functions (5.7).	✓	✓	✓	✓	✓	✓	✓	✓
In the response plans (see Appendix 12), include a block diagram of the organizational relationships and interfaces between all the major response organizations. Use the response organization structure shown in Appendix 13. The plans should be easily revisable to meet the needs during an emergency.	✓	✓	✓	✓	✓	✓	✓	✓
B2.3 Assign personnel to appropriate positions in all operating and response organizations to meet requirements for performing response functions (5.8).	✓	✓	✓	✓	✓	✓	✓	✓
Assign personnel to all the positions in the response organization needed to perform the functions specified in Section 4.2 and ensure they can be staffed adequately to meet the response time objectives in Appendix 10. Tasks that are performed promptly (for example, making protective action decisions) must be assigned to personnel who are available immediately and over a 24-hour period. Assign personnel according to their ability to perform under stressful and other difficult conditions present during an emergency in addition to their technical abilities or normal responsibilities.	✓	✓	✓	✓	✓	✓	✓	✓
B2.4 Provide sufficient qualified personnel to be available at all times to ensure that appropriate positions can be promptly staffed following the declaration and notification of a radiation emergency (5.9).	✓	✓	✓	✓	✓	✓	✓	✓

B2 - ORGANIZATION	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Identify personnel to take over key emergency management positions in situations where primary staff is unavailable. Provide for continuous 24-hour emergency operations, where appropriate, ensuring personnel work no longer than 18-hour shifts. The movement or unavailability of individuals should not affect key emergency management functions.	✓	✓	✓	✓	✓	✓	✓	✓
Make arrangements to expand the response organization during an emergency. This could include procedures for recruiting personnel from institutions/facilities that have experience in radiation protection and use of those viewed by the population as "life-savers", such as fire fighters. Use true volunteers who are fully aware of the risks rather than conscripts and provide them with protection from personal liability and provision for long term support if injured.	✓	✓		✓		✓	✓	✓
Provide response teams consistent with Appendix 15.	✓	✓	✓	✓	✓	✓[29]	✓	✓

4.2.15. Co-ordination of emergency response (B3 elements)

B3- CO-ORDINATION OF EMERGENCY RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B3.1 Adopt legislation to establish or identify an existing governmental body to act as a national co-ordinating authority, whose function, among others, is to resolve differences and incompatible arrangements between the various participating parties (see Section 2.2.3) (3.4).	✓	✓	✓	✓	✓			✓
Ensure that the functions and responsibilities of operators and response organizations are clearly assigned and understood and that arrangements are in place for ensuring that these organizations maintain the capability to perform their responsibilities.	✓	✓	✓	✓	✓			✓
Assign a full time national co-ordinator and provide with sufficient resources to co-ordinate response planning at the national level. Seek commitment to support and respect the efforts of such co-ordination from all response organizations.	✓	✓	✓	✓	✓			✓
B3.2 The national co-ordinating authority should make all reasonable efforts to foster the implementation by other States of measures to fulfill their obligations (3.5).	✓	✓		✓	✓			✓
This must include arrangements to receive prompt notifications of a site area or general emergency at any (see Element A2.16) threat category I or II facility located in another State that is within the distances specified in Appendix 5 for the emergency zones and food restriction planning radius. These notifications should be made within the time specified in Appendix 10 and should be made directly by the facility. In addition, there should be arrangements to address the requirements under Elements A1.5, A2.16, A4.8 and B3.4. The IAEA may be able to assist in fostering the development of agreements with other States if direct negotiation between the States is difficult.	✓	✓		✓	✓			✓
B3.3 Arrange for the co-ordination of emergency response and protocols for operational interfaces between operators and local, regional and national governments to be developed, as applicable. Include the organizations responsible for emergency services and for response to conventional emergencies. Document arrangements and make them available to all relevant parties (5.10).	✓	✓	✓	✓	✓	✓[29]	✓	✓

B3- CO-ORDINATION OF EMERGENCY RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Develop written protocols (agreements, memoranda of understanding, etc.) clearly defining the concept of operations and operational interfaces between the operators and local, regional and national response organizations, including those responsible for conventional emergencies. These protocols should define which organizations interact together, where how they interact (e.g. liaison staff at the emergency response centre, telephone), and the interface point within each organization. These protocols should be summarized under the agreements section of the emergency plans (see Appendix 12).	✓	✓	✓	✓	✓	✓	✓	✓
Integrate radiation emergency planning with conventional emergency planning under the ICS shown in Appendix 13. The local police, fire fighting and other conventional response organizations should respond as they do normally, with radiological expertise provided by the operator or other specialized teams.	✓	✓	✓	✓	✓	✓	✓	✓
B3.4 Arrange to harmonize the tools, procedures or criteria used in responding to the same emergency to make assessments of contamination, doses and health effects and any other appropriate assessments made in a radiation emergency to avoid inconsistency and confusion (5.11).	✓	✓	✓	✓	✓	✓	✓	✓
This applies to all States and jurisdictions with territory within the emergency zones or food restriction planning radius (Appendix 5) of a facility within threat category I or II. These States and jurisdictions should have integrated (or at least compatible) organizations (Elements A1, Appendix 13), response facilities (Appendix 14), classification systems (Elements A2, Appendix 6), units, decision making principles and criteria (Elements A4, A10 and Appendix 6), communication frequencies/system, environmental monitoring methods, strategies and criteria (Elements A7 and A10), public warning and information (Elements A5 and A9), long term medical follow-up criteria and registries (Element A8.5) and systems to address inappropriate public response (Element A11.2).	✓	✓	✓	✓	✓	✓	✓	✓
If neighbouring States cannot develop common criteria for protective actions, each State should understand the basis for the differences and be prepared to explain these differences to the public and media during an emergency.	✓	✓			✓	✓	✓	✓
Neighbouring States and local jurisdictions should establish emergency planning committees that include representatives from all organizations having a role or capabilities for responding to hazardous material	✓	✓			✓	✓	✓	✓

B3- CO-ORDINATION OF EMERGENCY RESPONSE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
emergencies, including radiation emergencies. These committees should identify all significant hazardous material threats and develop an integrated emergency plan and procedures for responding to these threats.								
B3.5 Ensure that all States within defined emergency zones are provided with information for developing their own preparedness to respond to an emergency and that transnational co-ordination arrangements are in place. Include agreements and protocols to provide: information necessary to develop a co-ordinated means for notification; classification schemes; intervention criteria; criteria for the introduction and revoking of protective actions; arrangements for public information; and arrangements for the exchange of information between decision making authorities. Determine in advance the language and physical units to be used. Exercise care between States pending the establishment of such agreements and protocols in order to minimize the consequences of a radiation emergency (5.12).	✓	✓			✓		✓	✓
Provide information to all States and jurisdictions with territory within the emergency zones or food restriction planning radius (see Appendix 5) of a facility within threat category I or II. Include a description of the characteristics of potential emergencies and effectiveness of various protective action strategies.	✓	✓					✓	✓

4.2.16. Plans and procedures (B4 elements)

B4 - PLANS AND PROCEDURES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B4.1 Make plans or other arrangements for co-ordinating the national response to the range of potential nuclear and radiological emergencies. Designate the organization responsible for the development and maintenance of arrangements for co-ordinated national response; describe the responsibilities of the operators and other response organizations; and describe the co-ordination effected with the arrangements for response to a conventional emergency. Include provisions that can be used to formulate a detailed response to events such as serious exposure or contamination resulting from contact with a source by a member of the public; notification of a potential transnational release; discovery of a shipment containing a dangerous source that is not under control; notification of the potential re-entry of a satellite; public concern or rumours about an actual or perceived threat; and other unanticipated events warranting intervention (5.13).	✓	✓	✓	✓	✓			✓
The national response could be co-ordinated through the use of plans, letters of agreement, a standing organization (e.g. a national response committee).	✓	✓	✓	✓	✓		✓	✓
The national response arrangements should address the events described in Appendix 7 and, if appropriate, Appendix 6. The national response should be consistent with the concept of operation contained in Section 4.1, and Appendix 6 and 7.	✓	✓	✓	✓	✓			✓
B4.2 Ensure that each response organization prepares a general plan for co-ordinating and performing their assigned functions. Include situations involving such sources of exposure as sources illegally brought into the State, falling satellites equipped with sources, or radioactive materials released in accidents beyond national borders. Prepare emergency plans that specify how the responsibilities for the management of interventions will be discharged on the site, off the site and across national boundaries, as appropriate, in separate but interconnecting plans (5.14).	✓	✓	✓	✓	✓	✓	✓	✓
Develop a set of consistent emergency plans for the national, local and facility levels as described in Appendix 12. Integrate these plans with those used to respond to conventional emergencies. The resulting integrated response should be consistent with the concepts of operations in Section 4.1 and Appendix. 6 and 7.	✓	✓	✓	✓	✓	✓	✓	✓

B4 - PLANS AND PROCEDURES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B4.3 Base emergency response plans on an assessment of the threats including severe emergencies (5.15).	✓	✓	✓	✓	✓	✓	✓	✓
Develop plans for the threats identified by the threat assessment as discussed in Section 2.2.5. Every State should have plans to address the emergencies described in Appendix 7. States with territory within the emergency zones or food restriction planning radius (see Appendix 5) of a facility in threat category I or II should prepare plans consistent with Appendix 6.	✓	✓	✓	✓	✓	✓	✓	✓
B4.4 Co-ordinate plans for response to a radiation emergency with other emergencies (such as physical security, law enforcement or fire fighting) that may be implemented in an emergency in order to ensure that simultaneous implementation of the plans would not reduce their effectiveness or cause conflicts (5.16).	✓	✓	✓			✓	✓	✓
Ensure that the response is co-ordinated even if responsibilities differ (Element B1.2) under different conditions such as a function of the source of the radiation hazards (e.g. licensed practice/material, natural material, international, military, unknown); or simultaneous involvement of other emergency plans or hazards (e.g. major natural disaster or criminal activity). The results of the allocation of responsibilities described in Section 2.2.7 should be taken into consideration. In the plans, describe how responsibilities are delegated or transferred (Element B1.4) and how the responsibilities of local response organizations, operators and conditions are affected when these may change (Elements B1.2 and B4.2).	✓	✓	✓			✓	✓	✓
B4.5 Ensure that appropriate responsible authorities: 1) prepare and approve emergency plans for any practice or source that could give rise to a need for an emergency intervention, involving appropriate response organizations; 2) within the content, features and extent of emergency plans, take into account the results of any threat assessment and any lessons learned from operating experience and from emergencies that have occurred with sources of a similar type; and 3) review and update emergency plans (5.17).	✓	✓	✓	✓	✓		✓	✓

B4 - PLANS AND PROCEDURES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Clearly assign this responsibility to the national co-ordinating authority (Element B3.1). The regulatory body may be responsible for licensing the practice, but should input into the larger general assessment performed by the co-ordinating authority.	✓	✓	✓	✓	✓			✓
B4.6 Include in emergency plans as appropriate: 1) allocation of responsibilities for performing functions; 2) identification of various conditions of the source that could lead to the need for intervention; 3) intervention levels, based on specified guidelines, for the relevant protective actions and the scope of their application, with account taken of the possible degrees of severity of accidents or emergencies that could occur; 4) procedures, including communication, for contacting relevant response organizations and for obtaining assistance from fire fighting, medical, police and other relevant organizations; 5) a description of the methodology and instrumentation for assessing the radiation emergency and its consequences on and off the site; 6) a description of the public information arrangements in the event of a radiation emergency; and 7) the criteria for terminating each protective action (5.18).	✓	✓	✓	✓	✓	✓	✓	✓
This can be accomplished by developing plans consistent with Appendix 12.	✓	✓	✓	✓	✓	✓	✓	✓
B4.7 Operators prepare an emergency plan covering all activities under their responsibility to be adhered to in the event of an emergency. Co-ordinate the plan with other bodies having responsibilities in an emergency, including public authorities, and submit it to the regulatory body (5.19).	✓	✓	✓	✓				✓
B4.8 In the emergency plan of the operating organization, include as appropriate: 1) a description of the on-site organization used to perform functions, including the designation of persons for directing on-site activities and for ensuring liaison with off-site organizations; 2) conditions for an emergency declaration, including criteria for classifying the event, a list of job titles and functions of persons empowered to declare it, and a description of suitable arrangements for alerting response personnel and public authorities; 3) arrangements for initial and subsequent assessment of the conditions at the facility and radiological conditions on and off the site; 4) arrangements for minimizing the exposure of persons on and off the site to ionizing radiation and for	✓	✓	✓			✓		

B4 - PLANS AND PROCEDURES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
ensuring medical treatment of casualties, including protective action, if warranted, based on conditions at the facility in order to reduce the risk of severe deterministic health effects; 5) assessment of the state of the facility or practice and the actions to be taken on the site to limit the extent of any radioactive release; 6) the chain of command and communication, including a description of related facilities and procedures; 7) an inventory of the emergency equipment to be kept in readiness at specified locations; 8) the actions to be taken by persons and organizations involved in the implementation of the plan for each class of emergency; and 9) arrangements for declaring the termination of an emergency (5.20).								
This can be accomplished by having an emergency plan consistent with the outline in Appendix 12.	✓	✓	✓	✓		✓		
B4.9 Develop procedures, analytical tools and computer programs to perform the functions specified to meet the requirements for emergency response (5.21).	✓	✓	✓	✓	✓	✓	✓	✓
Develop the tools needed to perform the emergency response functions specified in Section 4.2. Develop procedures and technical support for all tasks that are not normally performed and provide detailed instructions and the required information. The technical aspects of the procedures used by groups/organizations performing the same tasks (e.g. sampling or analysis) should be the same.	✓	✓	✓	✓	✓	✓	✓	✓
Develop procedures according to a writer guide in order to have a common structure, appearance and terms. The procedures should: *1) be, as much as possible, stand-alone (that is provide all the information needed without referring to other procedures, manuals or references);* *2) identify the response position or team responsible for their performance;* *3) prominently display the entry conditions on the first page (when the procedure is to be used);* *4) list safety steps (e.g. notify control room,) performed before use of the procedures;* *5) list tools, protective equipment, resources or information needed to use the procedures;* *6) identify the customer - who gets the product (if appropriate);* *7) show the date approved and identify who is responsible for maintenance of the procedures ;be provided for each individual or team performing a task/function;*	✓	✓	✓	✓	✓	✓	✓	✓

B4 - PLANS AND PROCEDURES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
8) contain limited text that clearly describes the actions to be performed; *9) describe each action on a separate line;* *10) start each line with an action verb if possible;* *11) use the terms commonly used in the facility/organization/profession;* *12) include steps to verify that the response has been successfully completed;* *13) clearly indicate decision points with what to do if it is a " yes" or "no";* *14) provide precautions or risks clearly highlighted with words such as "Attention" or "Caution"; and* *15) as much as possible, be designed to respond to readily available information (observable) such as readings and units on the instruments where the procedure will be performed.* *Appendix 12 provides an outline for procedures.*								
Ensure that procedures and associated information, reference materials, tools, protective equipment and documents required to perform a function are available at the location where the function is to be carried out.	✓	✓	✓	✓	✓	✓	✓	✓
B4.10 Ensure that procedures, analytical tools and computer programs used in performing functions to meet the requirements for emergency response are tested under simulated conditions and validated prior to use (5.22).	✓	✓	✓	✓	✓	✓	✓	✓
Before use procedures should be: *1) co-ordinated with all appropriate organizations or departments;* *2) independently reviewed and integrated into the training programmes;* *3) field tested under conditions that maximize realism; and* 4) *integrated into a QA programme to ensure that the procedures remain up to date (see Element B7.1).*	✓	✓	✓	✓	✓	✓	✓	✓
B4.11 Arrange that on-site emergency plans are implemented by the operators (5.23).	✓	✓	✓	✓				✓
B4.12 Arrange that off-site emergency plans and any transboundary plan be implemented by the appropriate response organizations (5.24).	✓	✓	✓	✓	✓		✓	✓

4.2.17. Logistical support and facilities (B5 elements)

B5 - LOGISTICAL SUPPORT AND FACILITIES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B5.1 Provide adequate tools, instruments, supplies, equipment, communication systems, facilities, and documentation such as procedures, checklists, telephone numbers, and manuals for performing functions specified in Elements A1-A12. Ensure that items and facilities are selected or designed to be operational under postulated conditions (such as radiological, working and environmental conditions) that may be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (such as the communication frequencies of other response organizations) as appropriate (5.25).	✓	✓	✓	✓	✓	✓	✓	✓
List in the emergency plan and ensure the availability of adequate tools, instruments, supplies, equipment, communication systems, emergency facilities and documentation needed to perform the critical functions identified in Section 4.2. If possible, equipment used for emergencies should be the same as used in normal situations but with controls to ensure that their availability is not compromised. Arrange to replace supplies of items that are likely to be expended, contaminated or need replacement (perishables) such as cables/connectors, batteries, air tanks, filters, clothing, sample containers, and clerical supplies should be available. This should include a central store of radiological monitoring and protective equipment that can be provided to local response personnel, to include law enforcement, in the event of an actual or potential radiological emergency such as those described in Appendix 7. Provisions should be made to provide radiation detection equipment to law enforcement in areas particularly vulnerable to terrorist activities during periods of concern.	✓	✓	✓	✓	✓	✓	✓	✓
Ensure the ongoing compatibility of equipment used by different response organizations (see Element B3.4). This includes communication systems/frequencies, monitoring and sampling instruments and methods, power supplies, and transportation systems. Ensure that upgrades or ongoing revisions to the communications systems (e.g. buying new equipment) do not result in an incompatibility in crucial parts of the response communication system (a common problem). To this end, conduct regular (e.g. monthly) communication tests between the various response organizations.	✓	✓	✓	✓	✓	✓	✓	✓
The communication systems should be resistant to loss under emergency conditions due to overloading or loss of power. Do not use normal public telephone systems, including mobile phone systems, for critical response purposes because of their vulnerability to overloading during emergency.	✓	✓	✓		✓	✓	✓	✓

B5 - LOGISTICAL SUPPORT AND FACILITIES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Demonstrate that the emergency response equipment is adequate for response purposes. Include tests during which typical responders use the equipment under possible response conditions (light, temperature, moisture, weather, time in the field, workload and other conditions). These tests can also be used to identify vulnerability or limitations that should be placed on the use of the equipment.	✓	✓	✓	✓	✓	✓	✓	✓
In the procedures, include any limitations concerning use of the equipment (e.g. should not be exposed to temperatures below 10 ℃).	✓	✓	✓	✓	✓	✓	✓	✓
B5.2 Designate emergency facilities where the following will be performed during the response: co-ordination of on-site response actions; co-ordination of local off-site response actions (radiological and conventional); co-ordination of national response actions; co-ordination of public information; and co-ordination of off-site monitoring and assessment. Several of these activities may be performed at a single centre and the location may change in the different phases of the response. Ensure that emergency facilities are suitably located and protected so as not to permit the exposure of emergency workers, in compliance with international standards (5.26).	✓	✓	✓	✓	✓	✓[29]	✓	✓
Emergency facilities within the facility or UPZ should be suitably protected in order to control risk of radiation and other hazards (e.g. high temperatures, chlorine) to emergency workers and to prevent functions (e.g. dispatch of monitoring teams) from being jeopardized during postulated emergency conditions. Off-site facilities that are not protected against a radiological release (e.g. shielding and filters) should have backups beyond the UPZ. There should be provisions to continuously monitor radiological conditions and control of contamination within the facilities and for evacuation if warranted. See Appendix 14 for additional information on facilities.	✓	✓				✓	✓	✓

B5 - LOGISTICAL SUPPORT AND FACILITIES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B5.3 Provide an on-site emergency control centre, separated from the facility control room, to serve as a meeting place for the staff who will operate there in the event of an emergency. Make information available about facility parameters and radiological conditions in the facility and its immediate surroundings. In the room, provide a means of communication with the control room, the supplementary control room and other important points in the facility, and the on-site and off-site emergency response organizations. Take appropriate measures to protect the occupants for a protracted time against hazards resulting from a severe accident (5.27).	✓					✓		
This can be accomplished by providing an on-site technical support centre (TSC) and operational support centre (OSC) (see Element A3.6 and Appendix 14), separated from the facility control room to serve as meeting place for the emergency staff not directly associated with control room operations. Information about important facility parameters and radiological conditions in the facility and its immediate surroundings should be available within the TSC. The facilities should provide means for communication with the control room, the supplementary control room, and other important points in the facility, on-site teams, off-site officials in the EOF (see Element A1.5) and other emergency response organizations. Appropriate measures should be taken to protect the occupants for a protracted time against hazards resulting from a severe accident. .	✓					✓		
Establish means within the emergency facilities (e.g. TSC, EOF, RMAC – see Appendix 14) to analyse, record, transmit and display information to support effective decision-making. This may include the status of facility systems, weather data, radiological assessments (e.g. dose projections), environmental data, protective action implementation, and the status of response actions (see Element A3.6). Include only the information needed in the decision-making process. The system should account for uncertainties, and synthesize data. Evaluate the effectiveness of data presentation during exercises that simulate response conditions.	✓					✓		
B5.4 Designate laboratories to perform appropriate and reliable analyses of environmental and biological samples and measurements of internal contamination for the purposes of an emergency response. Ensure that these facilities would be operational under postulated emergency conditions (5.28).	✓	✓		✓	✓	✓[29]	✓	✓

B5 - LOGISTICAL SUPPORT AND FACILITIES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Establish or identify a laboratory (fixed or mobile) outside the UPZ for the chemical (e.g. boron levels) and radiological analyses needed to perform the functions assigned to the facility in Section 4.2. This should include analysis of high activity samples (e.g. reactor coolant) and environmental samples. The laboratory should be able to provide analysis of facility samples within three hours.	✓	✓				✓	✓	
Establish or identify a laboratory to perform analyses of environmental and biological samples (outside the UPZ for threat category I and II facilities) with capabilities consistent with Appendix 15. These laboratories should have arrangements to support and co-ordinate with forensic laboratories and to preserver the "chain of evidence" if requested by law enforcement.	✓	✓		✓	✓	✓[29]	✓	✓
B5.5 Designate a national emergency facility or facilities for co-ordinating public relations (5.29).	✓	✓	✓	✓	✓	✓[29]	✓	✓
For any emergency, establish a single public information centre (PIC) for the release of official information, discussed in Element A9.1 and Appendix 12 and 14. Establish the PIC promptly (within hours) in the vicinity of a local event. All organizations (facility, local and national government) with a potential role during the response should provide information releases to the media through the PIC as soon as possible. Attempting to provide information to the media from more than one location or from a location not in the vicinity of the emergency has resulted in the release of confusing information and loss of public trust.	✓	✓	✓	✓	✓	✓	✓	✓
A location, to be used as the PIC, (see Appendix 14) should be pre-established outside the UPZ.	✓					✓	✓	✓
B5.6 Arrange to obtain support for logistics, communication, the provision of social welfare, and other areas from organizations responsible for such support in conventional emergencies (5.30).	✓	✓	✓	✓	✓		✓	✓
Ensure that provisions will be in place to promptly re-supply and obtain additional resources. This should include provisions to bypass normal (time consuming) procurement procedures, to request international radiological assistance through the IAEA using the process in Ref. [23] and to expedite the entrance of personnel and equipment into the State.	✓	✓	✓	✓	✓	✓[29]	✓	✓

4.2.18. Training, drills and exercises- (B6 elements)

B6 - TRAINING, DRILLS AND EXERCISES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B6.1 Identify the knowledge, skills and abilities necessary to perform specified response functions, and make arrangements for the selection of personnel and training to ensure that the personnel have the requisite knowledge, skills, abilities, equipment, and procedures to perform their assigned response functions. Ensure that the operator and response organizations develop ongoing refresher training for personnel assigned to positions with responsibilities for emergency response (5.31).	✓	✓	✓	✓	✓	✓	✓	✓
Identify the knowledge, skills and abilities needed to perform the critical functions specified in Section 4.2. Establish and document ongoing training requirements for each position and team within the response organization to ensure that response personnel have the required knowledge, skill and abilities to perform their assigned response functions. Develop a programme that provides and documents the training to each individual assigned to a position in the response organization. Audit the attendance to ensure that the training is being received. Conduct training under simulated emergency conditions with the procedures, equipment and facilities to be used during an actual response. Training in functions performed by teams should include drills for the entire team. Include the teams performing communication and activation, environmental monitoring, security response (e.g. to an intruder), fire fighting, damage control, co-ordination of mitigatory action (e.g. control room actions - see Element A3.5), accident assessment and decision-making. Field teams should exercise under the extremes of weather conditions possible during an emergency. Develop a set of training materials and provisions to update the material after evaluation of the training.	✓	✓	✓	✓	✓	✓	✓	✓
Provisions should be made to provide training on the radiological aspects of the response to those national, official and response teams that would respond as part of the conventional, law enforcement or military response to a radiation emergency. This should include the response to the radiological emergencies listed in Appendix 7.				✓			✓	✓
Provisions should be made to promptly give anywhere in the State "just in time training" to conventional responders, law enforcement and military personnel responding to or preparing to respond to a radiation emergency. This should include training or, as appropriate, radiation risks and protection, use of detection equipment (see Element B5.1), and coordination with the radiological response.				✓			✓	✓

B6 - TRAINING, DRILLS AND EXERCISES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Develop a system (e.g. tests, evaluations) to ensure that appropriate proficiency levels needed to carry out assigned emergency functions have been achieved and maintained.	✓	✓	✓	✓	✓	✓	✓	✓
B6.2 Ensure that for all employees and all other persons on the site there are arrangements for them to be notified of an emergency and informed of their expected actions when notified (5.32).	✓	✓	✓			✓		
Include visitors or others within the area controlled by the operator (e.g. construction workers or fishermen). This could be accomplished by signs. (See Element A4.7).	✓	✓	✓			✓		
B6.3 Conduct drill and exercise programmes for specified functions required to be performed for emergency response and all organizational interfaces and the national level programmes at suitable intervals. Include the participation of as many as possible of the organizations concerned. Arrange for the exercises to be systematically evaluated and for some to be evaluated by the regulatory body. Ensure ongoing review and updating of the programmes (5.33).	✓	✓	✓	✓	✓	✓	✓	✓
Exercise scenarios, simulation, or play should be realistic. The goal should be to generate realistic experience, including realistic timing, media interest, workloads, confusion, weather conditions, and emergency progression. Organizations that are not part of the response organization, but that could play an important role (e.g. the builder of the facility, the IAEA) should participate in exercises periodically.	✓	✓	✓	✓	✓	✓	✓	✓
B6.4 Staff responsible for critical response functions for a facility in threat category I, II or IV should participate in a training exercise or drill at least once per year (5.34).	✓	✓	✓			✓	✓	✓
B6.5 Staff responsible for critical response functions for facilities, practices or jurisdictions in threat category IV or V should participate in training exercises or drills on an appropriate schedule (5.34).				✓	✓	✓	✓	✓
B6.6 In regular exercises, train the officials off the site responsible for making decisions on protective actions for the population within the PAZ/UPZ in the strategy for protective actions (5.35).	✓	✓	✓				✓	✓
The individuals (e.g. Minister of Emergencies) who would fill crucial leadership roles should participate in the training, drills or exercises. Substitutes who would not fill those positions during a real emergency should not be allowed.	✓	✓	✓				✓	✓

B6 - TRAINING, DRILLS AND EXERCISES	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B6.7 Evaluate the performance of exercises against established response objectives that demonstrate that identification, notification, activation and implementation of other initial response actions can be performed in time to achieve the practical goals (see Section 2.1.1) of emergency response (5.36).	✓	✓	✓	✓	✓	✓	✓	✓
Exercise performance should be evaluated against pre-established criteria and pre-established response time objectives consistent with Appendix 10.	✓	✓	✓	✓	✓	✓	✓	✓

4.2.19. Quality assurance (B7 elements)

B7 - QUALITY ASSURANCE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
B7.1 The operator of a facility, practice or source and the off-site response organizations should establish an appropriate quality assurance programme, in compliance with international standards, ensuring a high degree of availability and reliability of all supplies, equipment, communication systems and facilities necessary to perform specified functions in an emergency. Ensure that the programme includes inventories, resupply, tests and calibrations, in order to ensure that these items and facilities are continuously available and functional for use. Arrange for maintenance, review and updating of emergency plans, procedures and other arrangements and incorporate lessons learned from research, operating experience (such as response to emergencies) and emergency drills and exercises (5.37).	✓	✓	✓	✓	✓	✓	✓	✓
Arrange a regular quality assurance review of the emergency plans and procedures, including updating perishable information (phone numbers etc.). Correct critical deficiencies in procedures within a month and make improvements and modifications that are not critical within 12 months. Take lessons learned from around the world and during drills and exercises into account.	✓	✓	✓	✓	✓	✓	✓	✓
Periodically test equipment to be used during a response if not routinely used in order to ensure that it is operational and compatible (see Element B5.1).	✓	✓	✓	✓	✓	✓	✓	✓
Ensure that logistical support items and facilities are continuously available, including inventories, resupply, tests and calibrations on an appropriate schedule (e.g. as recommended by the manufacturer). Develop procedures for each facility, team or system (e.g. warning system) for the conduct of inventories, tests, calibration, and restocking of perishable items such as batteries, fuel, and food.	✓	✓	✓	✓	✓	✓	✓	✓
Arrange a control programme to ensure that the radiological analysis capability (monitoring teams and laboratories) produces consistent and adequate results. As part of these arrangements, laboratories should take part in the IAEA intercomparison programme, and an annual intercomparison should be conducted for groups that are expected to work together during an emergency.	✓	✓	✓	✓	✓	✓	✓	✓

B7 - QUALITY ASSURANCE	Threat category					Responsibility		
Elements	**I**	**II**	**III**	**IV**	**V**	**O**	**L**	**N**
Arrange for prompt maintenance, repair and calibration of equipment during an emergency and for prompt intercomparisons (field calibrations) during an emergency for the monitoring teams and equipment that may be added ad hoc to supplement the response.	✓	✓	✓	✓	✓	✓	✓	✓
B7.2 Put in place a comprehensive quality assurance programme covering all activities of the emergency response programme that are subject to the requirements of the Code on Quality Assurance for Safety in Nuclear Power Plants and Other Nuclear Installations, Ref. [32] (5.38).	✓	✓				✓	✓	✓
B7.3 Ensure that the operator of a facility, practice or source and the off-site response organizations arrange to review and evaluate responses in real events and in drills and exercises, to record the areas in which improvements are necessary, and to make the improvements (5.39).	✓	✓	✓	✓		✓	✓	✓
The regulatory body should investigate all significant emergencies and ensure that the appropriate response actions were taken and identified deficiencies corrected. Lessons learned that may have international significance should be reported to the IAEA. IAEA reports and other reports of international emergencies should be reviewed to identify relevant lessons learned. Responsibility for implementation of corrective action must be clearly assigned and implementation of corrective actions audited. Establish a system to investigate emergencies and resulting response to determine the causes, problems and corrective actions. Include determination of whether there was a failure of the regulatory process.	✓	✓	✓	✓	✓			✓

APPENDICES

Appendix 1

GENERIC INTERVENTION AND ACTION LEVELS

The following three tables (A1-I, II, III) provide the generic intervention and action levels from the international guidance [2, 3, 4].

TABLE A1-I. RECOMMENDED GENERIC INTERVENTION LEVELS FOR URGENT PROTECTIVE ACTIONS

Protective action	Generic intervention level[33, 34]
Sheltering	10 mSv[35]
Evacuation	50 mSv[36]
Iodine prophylaxis	100 mGy[37]

A joint IAEA/WHO technical committee meeting (TCM)[38] reviewed the guidelines issued in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (Basic Safety Standards, BSS) [3] for intervention in emergency situations involving exposure[39], the intervention level for iodine prophylaxis, long term iodine prophylaxis to reduce the uptake of radioiodine from contaminated food[40], planning, and distribution strategies for iodine prophylaxis[41].

With regard to the intervention level for iodine prophylaxis (the administration of stable iodine to reduce the uptake of radioiodine) in a nuclear emergency, the TCM advised the

[33] These levels are of avertable dose, i.e. the action should be taken if the dose that can be averted by the action, taking into account the loss of effectiveness due to any delays or for other practical reasons, is greater than the figure given.

[34] The levels in all cases refer to the average over suitably chosen samples of the population, not to the most exposed individuals. However, projected doses to groups of individuals with higher exposures should be kept below the thresholds for deterministic effects (see Appendix 2).

[35] Sheltering is not recommended for longer than two days. Authorities may wish to recommend sheltering at lower intervention levels for shorter periods or so as to facilitate further protective actions, e.g. evacuation.

[36] Evacuation is not recommended for a period of longer than one week. Authorities may wish to initiate evacuation at lower intervention levels, for shorter periods and also where evacuation can be carried out quickly and easily, e.g. for small groups of people. Higher intervention levels may be appropriate in situations in which evacuation would be difficult, e.g. for large population groups or with inadequate transport.

[37] Avertable committed absorbed dose to the thyroid due to radioiodine. For practical reasons, one intervention level is recommended for all age groups.

[38] 17-19 September 2001 at the IAEA in Vienna.

[39] With regard to the action level of dose for acute thyroid exposure (see Table IV-1 of the BSS [3]), the TCM advised the IAEA and WHO secretariats to re-examine the action level with a view to lowering it.

[40] With regard to long term iodine prophylaxis as a possible protective action against the ingestion of food contaminated with radioiodine, the TCM advised the IAEA and WHO Secretariats to consider amending the BSS to reflect the following: (a) that iodine prophylaxis is intended primarily as a protective action against inhalation and that it is therefore primarily a short term measure (up to a few days); (b) that iodine prophylaxis should only be used to reduce the uptake of ingested radioiodine if it is impossible to provide supplies of uncontaminated food, especially for children and particularly in relation to milk; and that, even if this is the case, iodine prophylaxis is intended for relatively short periods of time, since efforts should be made to provide supplies of uncontaminated food as soon as possible.

[41] With regard to planning, distribution zones and distribution strategies, the TCM advised the IAEA and WHO secretariats to consider amending the BSS to emphasize the need for considering the early administration of stable iodine in a nuclear emergency in conjunction with other possible protective actions such as evacuation. This would imply the possible need for the predistribution of stable iodine in certain areas and rapid distribution strategies for other areas.

IAEA and the WHO secretariats to consider amendments to the Basic Safety Standards [3][42] that reflect the following consensus:

(1) The administration of stable iodine to the public is an effective early measure for the protection of the thyroid to prevent deterministic effects and to minimize stochastic effects for persons of any age. However, it is primarily intended for the protection of children and the embryo/foetus.

(2) The current generic optimized intervention level for the iodine prophylaxis of 100 mGy provides an operational basis for prompt decision-making and efficient application in the event of a nuclear or radiological emergency. However, as there are strong indications of an age dependence at risk of induction of thyroid cancer by radioiodine, the administration of stable iodine at significantly lower levels of dose to the thyroid may be recommended in order to take into account the higher sensitivity to radioiodine of children and the embryo/foetus.

(3) This advice is proffered to serve as a basis for planning, which should be optimized to take into account practical, operational, social and economic considerations; other protective actions to reduce the intake of radioiodine such as sheltering and control of food supplies should also be considered.

This advice to the IAEA and WHO secretariats, which is presented here for information, will only become a requirement if established as such in an IAEA safety standard and agreed to by co-sponsoring organizations of the Basic Safety Standards [3]. Nevertheless, relevant operating and response organizations with responsibilities for the formulation of emergency plans may wish to take it into consideration, particularly the need to give priority to the protection of children, newborn babies and the embryo/foetus.

TABLE A1-II. RECOMMENDED GENERIC INTERVENTION LEVELS FOR TEMPORARY RELOCATION AND PERMANENT RESETTLEMENT [2]

Protective action	**Generic intervention level**[43]
Temporary relocation	Initiate at 30 mSv in 30 days [44] Terminate at 10 mSv in 30 days[45]
Permanent resettlement	1 Sv in lifetime

[42] In revising the Basic Safety Standards [3] and related Safety Guides, the IAEA and co-sponsoring organizations will need to take account of all the recommendations of the joint IAEA/WHO technical committee meeting to the IAEA and the WHO Secretariats.

[43] The avertable dose applies to an average population being considered for temporary relocation.

[44] If the dose accumulated in a month is not expected to fall below this level in a year or two, permanent resettlement should be considered.

[45] Provided the total life time dose to any member of the population will be less than 1 Sv.

TABLE A1-III. GENERIC ACTION LEVELS FOR FOODSTUFFS[46] [2]

Radionuclides in foods destined for general consumption	**kBq/kg**
Cs-134, Cs-137, I-131, Ru-103, Ru-106, Sr-89	1
Sr-90	0.1
Am-241, Pu-238, Pu-239, Pu-240, Pu-242	0.01
Radionuclides in milk, infant foods and drinking water	**kBq/kg**
Cs-134, Cs-137, Ru-103, Ru-106, Sr-89	1
I-131, Sr-90	0.1
Am-241, Pu-238, Pu-239, Pu-240, Pu-242	0.001

The levels shown in Table A1-III apply to situations where alternative food supplies are readily available. Where food supplies are scarce, higher levels can apply. The levels are for food prepared for consumption, and would be unnecessarily restrictive if applied to dried or concentrated food prior to dilution or reconstitution. For practical reasons, the criteria for separate radionuclide groups should be applied independently to the sum of the activities of the radionuclides in each group.

Classes of food that are consumed in small quantities (e.g. less than 10 kg per person per year), such as spices, which represent a very small fraction of the total diet and would make very small additions to individual exposures, may have action levels ten times higher than those for major foodstuffs. The table is based on, and consistent with, the Codex Alimentarius Commission's guideline levels for radionuclides in food moving in international trade following accidental contamination (Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission, Codex Alimentarius, Volume 1 (1991) Section 6.1, 'Levels for Radionuclides'), but it is limited to the nuclides usually considered relevant to emergency exposure situations. The use of these levels is intended to be limited to the first year after a nuclear or radiological emergency.

[46] Table V from Ref. [3] revised for clarification.

Appendix 2

ACTION LEVELS FOR INTERVENTION UNDER ANY CIRCUMSTANCES

Table A2-I provides the action levels at which intervention is expected to be undertaken under any circumstances to prevent absorbed dose from low LET radiation.

Intervention is expected to be undertaken under any circumstances to prevent 25 Gy absorbed dose to the lung delivered over 1 year from inhalation of high LET radiation[47].

TABLE A2-I. ACTION LEVEL OF DOSE FOR ACUTE EXPOSURE TO LOW LET RADIATION [2, 4].

Organ or tissue	**Action level of dose: Projected absorbed dose from low LET radiation to the organ or tissue in less than 2 days [Gy]**
Whole body (bone marrow)	1[48]
Lung	6
Skin	3
Thyroid	5
Lens of the eye	2
Gonads	3
Foetus	0.1

[47] This exception is not derived from the Refs. [2, 3 or 4] but for inhalation of high LET emitters (e.g. alpha emitters) it is an estimate of the threshold for development of severe deterministic health effects [46]. Also see discussion in Annex I.
[48] Vomiting could occur in radiosensitive individuals in the first day after exposure for doses above 0.5 Gy.

Appendix 3

EMERGENCY WORKER GUIDANCE LEVELS

The guidance in Table A3-I is based on Ref. [3], Appendix V, para. V.27-V.32 and Annex I of Ref. [2]. Emergency workers should not be exposed to doses in excess of those listed in Table A3-I except where noted. Operational levels based on these guidance levels should be developed as discussed in element A6.5 for use during an emergency.

TABLE A3-I. EMERGENCY WORKER DOSE GUIDANCE LEVELS[49]

Tasks	**Level[50] [mSv]**
Life saving actions, such as: 1. rescue from immediate threats to life; and 2. prevention or mitigation of conditions resulting in a general emergency in a threat category I facility.	>500[51,52]
Potential life saving actions, such as: 1. implementation of urgent protective actions on site for a threat category I, II or III facility; 2. prevention or mitigation of conditions (e.g. fires) that potentially endanger lives; 3. environmental monitoring of populated areas in the emergency zones to identify where urgent protective actions are needed; and 4. implementation of urgent protective actions off the site for a threat category I or II facility. **Actions to prevent the development of catastrophic conditions, such as** prevention or mitigation of conditions resulting in an alert or higher class of emergency in threat category II or III facility; or alert or site area emergency in a threat category I facility.	500[51]
Actions to prevent serious injury, such as: 1. rescue from potential threats of serious injury; 2. immediate treatment of serious injuries; and 3. decontamination of people. **Actions to avert a large collective dose, such as:** 1. environmental monitoring of populated areas to identify where protective actions or food restrictions may be needed; and 2. implementation of protective actions and food restrictions off site.	100
Other emergency phase intervention, such as: 1. longer term treatment of exposed and contaminated individuals; 2. sample collection and analysis; 3. short term recovery operations; 4. localized decontamination; and 5. keeping the public informed.	50
Recovery operations, such as: 1. repairs to the facility not related to safety; 2. large scale decontamination; 3. waste disposal; and 4. long term medical management.	Occupational exposure guidance (50 mSv in a single year)[53]

Once the emergency phase has ended, workers shall be subject to the full system of detailed requirements for occupational exposure prescribed in Appendix I of Ref. [3].

[49] Source Ref. [3], Appendix V, para. V.27.
[50] Total effective dose E_T (external and inhalation).
[51] Workers shall be volunteers and be instructed in the potential consequences of exposure to allow them to make an informed decision.
[52] This dose level may be exceeded only if the benefits outweigh their risk; but every effort shall be made to keep the dose below this level. The workers should be trained in radiation protection and understand the risk they face.
[53] Para. II-5 of Schedule II in Ref. [3]

All reasonable steps shall be taken to provide appropriate protection and to record the doses received by emergency workers. When an emergency is over, the doses received and consequent health risks must be communicated to the workers involved.

Workers should not normally be prevented from incurring further occupational exposure because of doses received in an emergency situation. However, qualified medical advice should be obtained before any further exposure is incurred if a worker has undergone emergency exposure ten times the maximum single year dose limit (500 mSv) or at a worker's request.

Appendix 4

TYPICAL THREAT CATEGORIES OF PRACTICES

Practice	Threat summary	Typical threat category
Facilities manufacturing or using radioisotopes for industry, medical or scientific research.		
Radiopharmaceutical manufacturing	*Off site*: No potential for deterministic health effects. A small potential for a release in excess of urgent GILs near the facility. Major facility and loading dock fires appear to represent the greatest potential for a release in excess of urgent GILs. The threat will be a function of inventory and volatility. Explosions, tornadoes, spills and leaks represent small risks.	None[54] or III[55]
	On site: Severe deterministic health effects very unlikely on site, but dose in excess of occupational limits possible.	
Radiopharmacies	*Off site*: No potential for releases in excess of urgent GILs.	None[54]
	On site: No potential for exceeding urgent GILs on site. Very small potential for exposures above occupational limits.	
Hospitals	*Off site*: No potential for releases in excess of urgent GILs unless dangerous sources are lost or stolen.	III
	On site: Severe deterministic health effects possible to staff or patients if sealed sources (e.g. brachytherapy or radiation beams) are misused or not controlled/secured. In addition radioactive medication and diagnostic drugs can represent a hazard if not properly controlled or administered.	
Sealed source manufacturing	*Off site*: No potential for deterministic health effects. A small potential for a release in excess of urgent GILs near the facility. A major facility fire appears to represent the greatest potential for a release in excess of urgent GILs. The release will be a function of inventory and volatility. Explosions, tornadoes, spills and leaks represent small risks.	III[55]
	On site: Severe deterministic health effects possible during manufacturing process due to loss of shielding or intake (inhalation – ingestion).	
Research laboratories	*Off site*: Unless large quantities of radioactive or fissile[21] materials are stored or used in a single location, there is no potential for exposures in excess of urgent GILs.	None[54] or III [55]

[54] No special emergency preparations required for the radiological hazard beyond those warranted to address perceived concerns and normal industrial and workplace safety and measures needed because of chemical toxicity and other non-radiological hazards associated with the practice.

[55] Use method in para. 2.2.5 or Appendix 8 to determine threat category based on the inventory.

Practice	Threat summary	Typical threat category
	On site: Potential for severe deterministic health effects due to external exposure and intake. This will be site specific.	
Low level waste warehousing and burial	*Off site*: No potential for exceeding urgent GILs for low-level burial operations.	None[54]
	On site: No potential for exceeding urgent GILs on site. Small potential, if the waste contains radioiodine. A major fire involving warehousing of waste may result in a release in excess of occupational exposure limits.	
Depleted uranium products	*Off site*: No potential for exceeding urgent GILs. Potential for deaths from a UF_6 release due to chemical toxicity from HF (product of UF_6 release). The potential is a function of UF_6 inventory. Greatest risk appears to be ruptures of heated tanks of many tons.	None[54,57]
	On site: No potential for exceeding urgent GILs.	
Source		
-Sterilization -Irradiators -Industrial -Radiography -Teletherapy -High medium dose brachytherapy -Category 1 and 2 in Ref. [36]	*Off site*: If controlled, no potential for exceeding urgent GILs; if uncontrolled (lost or stolen), *potential for fatal exposure in minutes if unshielded,* and severe tissue damage if held.	III or IV[56]
	On site: Localized dose sufficient for fatal exposure in minutes if unshielded.	
-Gauges -Well logging -Category 3 in Ref. [36]	*Off site*: If uncontrolled, (lost or stolen), *potential for fatal exposure if unshielded,* and severe tissue damage if held.	IV[56]
	On site: Potential for fatal exposure if unshielded.	
-Moisture density gauge -Static eliminator -Tritium exit signs -Pu pacemaker -Consumer products -Category 4 and 5 in ref. [36]	*Off site:* No potential for exceeding urgent GILs.	None[54]
	On site: No potential for exceeding urgent GILs.	
Dangerous source use or storage	*Off site:* No potential for exceeding urgent GILs unless control over the sources is lost. If uncontrolled, potential for severe tissue damage or fatal exposure. The threat is dependant on the inventory of the source (See appendices 8 and 18)	

[56] Threat category IV dangerous mobile source.

Practice	Threat summary	Typical threat category
	On site: If uncontrolled, potential for severe tissue damage or *fatal exposure*. The threat is dependant on the inventory of the source (See appendices 8 and 18)	
Fuel cycle		
Uranium milling and mining	*Off site:* No potential for releases in excess of urgent GILs. Contamination warranting intervention (e.g. water contamination) could result from tailing pond failures.	None[54]
	On site: No potential for exceeding urgent GILs.	
Yellow cake processing	Same as uranium milling and mining.	None[54]
UF_6 conversion plants	*Off site:* Potential for deaths from a UF_6 release due to chemical toxicity from HF (product of UF_6 release). The potential is a function of UF_6 inventory. Greatest risk appears to be ruptures of heated tanks of many tons.	None[54, 57,]
	On site: Same as off site.	
Enrichment plants	*Off site:* Same as UF_6 conversion plants.	None[54,57]
	On site: Same as UF_6 conversion plants.	
Fuel fabrication using uranium	*Off site:* Risk for UF_6 same as for UF_6 conversion plants. Potential for doses in excess of urgent GILs from criticality accidents[21] if the fissile material is processed in an unshielded location within 200-500 m of the site boundary.	II or III [55]
	On site: Risk for UF_6 same as for UF_6 conversion plants. Potential for deterministic health effects and doses in excess of urgent GILs on-site from criticality accidents.	
Fuel fabrication using plutonium	*Off site:* Potential for doses in excess of urgent GILs from criticality accidents[21] if the fissile material is processed in an unshielded location within 200-500 m of the site boundary. Large fires or explosions could result in doses off site in excess of urgent GILs near the facility. This will be a function of inventory.	II or III [55]
	On site: Potential for deterministic health effects and doses in excess of urgent GILs from criticality accidents. Fires and explosions could result in doses in excess of urgent GILs from inhalation.	
New fuel (not-irradiated)	*Off site:* No potential for doses in excess of urgent GILs.	None[54]

[57] Chemical toxicity due to a UF_6 release is far more important than radiation dose even for highly enriched uranium. Lethal (due to chemical toxicity) concentration of HF may be possible off site (See Ref. [19]).

Practice	Threat summary	Typical threat category
irradiated)	*On site:* No potential for doses in excess of urgent GILs.	
Spent fuel pool storage	*Off site:* For damage to fuel in a pool (under water), no potential for doses in excess of urgent GILs. If the fuel in the pool is totally uncovered, doses exceeding urgent GILs may be possible. Distance of concern depends on inventory. If the pool drains and contains fuel discharged from the core within a few months, severe deterministic health effects are possible. The potential and distances of concern depend on quantities and pool design[17].	I, II or III [55]
	On site: For damage to fuel in a pool (under water) doses from Kr-85 could exceed urgent GILs in the pool area. For a drained pool, the dose from the direct shine from the pool could be several Sv/h near the pool. If fuel is uncovered, the dose near the pool could result in severe deterministic health effects.	
Spent fuel - dry cask storage	*Off site:* No potential for doses in excess of urgent GILs.	III
	On site: No potential for doses in excess of urgent GILs from inhalation. If shielding is lost, direct shine dose could exceed urgent GILs.	
Reprocessing of spent fuel	*Off site:* Small potential for doses in excess of urgent GILs from criticality accidents[21] (depending on location of criticality). Large fires or explosions could result in doses in excess of urgent GILs several kilometres from the facility depending on the inventory and its volatility. Ruptures of large liquid storage tanks could result in expensive contamination warranting intervention. This will be a function of inventory and volatility.	I or II or III [55]
	On site: Potential for severe deterministic health effects and doses in excess of urgent GILs from criticality accidents. Fires and explosions could result in inhalation doses in excess of urgent GILs and that result in severe deterministic health effects. If shielding is lost, direct shine dose could exceed urgent GILs or result in severe deterministic health effects.	
Reactors (power, ship, research)		
>100 MW(th)	*Off site:* Emergencies involving severe core damage have the potential for causing severe deterministic health effects, including deaths. Doses in excess of the urgent GILs are possible more than 5 km from the facility. Deposition resulting in doses in excess of the relocation GILs and ingestion GALs is possible at great distances from the facility. An emergency not involving core damage has only a small potential for exceeding urgent GILs.	I or II[58]
	On site: For core damage emergencies, doses sufficient to result in severe deterministic health effects, including deaths, are possible.	

Practice	Threat summary	Typical threat category
≥ 2 ≤100 MW(th)	*Off site:* Doses due to inhalation of short lived iodine in excess of urgent GILs are possible if cooling of the core is lost (core melt).	II or III[58]
	On site: Potential for doses in excess of urgent GILs if fuel cooling is lost. If shielding is lost, direct shine dose could exceed urgent GILs or result in severe deterministic health effects.	
< 2 MW(th)	*Off site:* No potential for doses in excess of urgent GILs.	III[58]
	On site: Potential for doses in excess of urgent GILs from inhalation (depending on design) if fuel cooling is lost. If shielding is lost, direct shine dose could exceed urgent GILs or result in severe deterministic health effects.	
Transport		
Excepted packages UN 2910 UN 2911 UN 2909 UN 2908	These shipments contain only minor amounts of radioactive materials. There is no risk of any radiological consequences requiring special protective actions. Ground contamination resulting from the emergency, may require decontamination.	None
Industrial packages UN 2912 UN 3321 UN 3322 UN 2913	These packages contain only qualified "low specific activity" materials or qualified "surface contaminated objects". Urgent GILs may be exceeded, however, in the vicinity of a damaged package, since industrial packages are not designed to survive accidents and the only external radiation limit on the *unshielded* but qualified contents is 10mSv/h at a distance of *3m*. Ground contamination resulting from the emergency may require decontamination.	None
Type A packages UN 2915 UN 3332	The activity allowed for Type A packages limits the radiological hazard. Doses in excess of urgent GILs are possible beyond the immediate vicinity of the package. Ground contamination resulting from the emergency may require decontamination.	None or IV[59]
Type B packages [B (U) and B (M)] UN 2916 UN 2917	Type B packages will normally contain large amounts of radioactive material. Type B packages have been designed to withstand all credible land and sea transport accidents. The radioactive content of a Type B package shipped by air is restricted. For materials that have been certified as "low dispersible radioactive material", the limit is as authorized by the Competent Authority for the package design. For other material, if it is special form, 3000 A_1 or 100 000 A_2 [24], whichever is the lower, or if it is other than special form, 3000 A_2. Doses in excess of the urgent GILs are considered possible in an air accident but not credible in land or surface mode transport. However, in the event of an emergency, this should be confirmed by monitoring.	None or IV[59]

[58] For research reactors, due to great variety in the designs and operations of research reactors a site-specific analysis should be performed to determine if there is sufficient inventory and energy to result in a significant airborne release off-site. The methods described in Appendix 8 or in Ref.[18] could be used.

Practice	Threat summary	Typical threat category
Type C packages UN 3323	Type C packages will normally contain large amounts of radioactive material. Therefore, Type C packages have been designed to withstand all credible land, sea *and air* transport accidents. Doses in excess of the urgent GILs are not considered credible. However, in the event of an emergency, this should be confirmed by monitoring.	None or IV[59]
Special arrangements UN 2919	Shipments of non-fissile or fissile excepted radioactive material transported under special arrangement require seven days prior notification to the competent authorities of each State involved. In an accident, urgent GILs may be exceeded. Ground contamination resulting from the accident may require decontamination.	None or IV[59]
Package containing fissile material UN 2977 UN 3324 UN 3325 UN 3326 UN 3327 UN 3328 UN 3329 UN 3330 UN 3331	Industrial, Type A, Type B and Type C packages may all contain fissile materials. Such packages containing fissile material are designed with the contents limited, so as to maintain subcriticality during both normal and accident conditions of transport. The risk summary is therefore the same as that for the relevant Industrial, Type A, Type B or Type C package. Type IF, Type AF, Type B(U)F or Type B(M)F packages that are involved in an air accident and contain only *fissile* UF_6, may release UF_6 with the associated chemical hazard. However packages containing only UF_6 have no risk of any radiological consequences requiring special protective actions. Ground contamination resulting from the emergency may require decontamination.	None or IV[59]
Packages containing UF_6 UN 2978	Packages containing non-fissile or fissile excepted quantities of UF_6 that are involved in an air accident may release UF_6 with the associated chemical hazard. There is no risk of any radiological consequences requiring special protective actions. Ground contamination resulting from the emergency may require decontamination.	None[57]
Other		
Nuclear weapon accident (Pu dispersal)	If there is a fire or explosion resulting in dispersal of Pu from a weapon, deterministic health effects are possible from inhalation of the plume or resuspension of deposited material within about 1 km. The area of significant contamination could be on the order of a square kilometre. It may not be possible to detect dangerous levels of airborne contamination with common radiation survey instruments.	IV

[59] These are not considered dangerous sources provided they are properly controlled and not removed from the packaging except in supervised conditions. However, if they are lost, stolen or inadvertently removed from their packaging, the information in Appendix 7 for a "Lost dangerous source" or 'Theft of a dangerous source" should be followed.

Practice	Threat summary	Typical threat category
Lost /stolen dangerous source	Lethal doses are possible for persons handling an unshielded dangerous source (see Glossary and Appendix 8). Lethal doses and considerable contamination resulting in doses above the urgent GILs are possible from a ruptured source. A considerable area can be contaminated due to dispersal by human activities.	IV
Contamination from transboundary release	Deposition resulting in doses in excess of the relocation GILs and ingestion GALs is possible at great distances from facilities in threat categories I or II.	V
Nuclear powered satellite re-entry	The risk is very small and it will be virtually impossible to limit the area of concern so that reasonable protective action can be taken. The handling of debris (external exposure or inadvertent ingestion) could result in deterministic health effects.	IV
Import of contaminated food or material	*Off site:* Uncontrolled (unknowing) use of contaminated steel and other products could result in doses in excess of the occupational limits but it is very unlikely that the urgent protective GILs can be exceeded. Food contamination could exceed the GAL for food restriction.	V

Appendix 5

AREA AND ZONE SIZES

RADIOLOGICAL EMERGENCIES - INNER CORDONED AREA RADIUS (SAFE DISTANCES) SIZES

Table A5-I provides suggestions for the approximate radius of the of inner cordoned area radius (safe distances – see Fig. 1) in radiological emergencies [11].

TABLE A5-I SUGGESTED INNER CORDONED AREA RADIUS (SAFE DISTANCES) FOR RADIOLOGICAL EMERGENCIES [11]

Situation	Initial radius of inner cordoned area (safe distance)[60,61]
Intact package with a I-WHITE, II-YELLOW or III-YELLOW label	Immediate area around the package
Damaged package with a I-WHITE, II-YELLOW or III-YELLOW label	30 m radius or at: - Ambient dose readings of 100 μSv/h - 1000 Bq/cm^2 gamma/beta deposition - 100 Bq/cm^2 alpha deposition
Undamaged common source (consumer item) such as smoke detector	None
Other unshielded or unknown source (damaged or undamaged)	30 m radius or at - Ambient dose readings of 100 μSv/h - 1000 Bq/cm^2 gamma/beta deposition - 100 Bq/cm^2 alpha deposition
Spill	Spill area plus 30 m around
Major spill	Spill area plus 300 m around
Fire, suspected RDD, explosion or fumes, spent fuel, plutonium spill	300 m radius (or more to protect against effects of an explosion) or at - Ambient dose readings of 100 μSv/h - 1000 Bq/cm^2 gamma/beta deposition - 100 Bq/cm^2 alpha deposition
Explosion/fire involving nuclear weapons (no nuclear yield)	1000 m radius or at: - Ambient dose readings of 100 μSv/h - 1000 Bq/cm^2 gamma/beta deposition - 100 Bq/cm^2 alpha deposition

Consider the following generic protective actions for inner cordoned area (inside safety perimeter). **First Responders:** remove non-essential personnel and members of the public; if contamination is suspected monitor them and decontaminate as necessary; perform life saving actions (do not delay due to the presence of radiation); use respiratory protection (if airborne contamination is suspected), avoid inadvertent ingestion. **Public** (in approximately twice the radius of inner cordoned area): do not eat possibly contaminated food until monitored; avoid the smoke; if in smoke get monitored; avoid inadvertent ingestion. For other response actions in radiological emergencies see Appendix 7: Action guide for radiological emergencies.

[60] Initial safe distances recommended for open-air emergencies. Inside facilities smaller distances may be dictated by the ease of controlling access and that structures provide shielding/filtering.

[61] The radiological operational intervention levels (dose rate and deposition OILs) are set for evacuation GIL (50 mSv/week). The deposition levels OILs consider inhalation of re-suspension and inadvertent ingestion. The beta contamination OILs are for unknown or high toxicity radionuclides. The beta contamination OILs for low toxicity beta emitters such as H-3, C-14, S-35, Cr-51, Fe-55, Ni-63, Tc-99m or I-125 could be 10 to 100 times higher. Ambient dose rate is measured 1m above ground level.

THREAT CATEGORY I AND II FACILITIES - EMERGENCY ZONES AND RADIUS SIZES

Table A5-II provides suggestions for the approximate radius of the emergency zones and food restriction planning radius for threat categories I and II facilities. Site or facility specific studies (e.g. Refs. [12,13]) could also be used to determine appropriate radii for the zones.

The suggestions are provided with recognition of the great uncertainties involved and variation by a factor of two or more during application is reasonable. The choice of the suggested radii represents a judgment of the distance to which making advanced arrangements is reasonable in order to ensure effective response. In a particular emergency, protective actions may have been warranted only in a small part of the zones. For the worst possible emergencies, protective actions might need to be taken beyond the radii suggested.

The sizes are shown in terms of a radius of a circle centred at the source of the potential release or criticality. However, the actual boundary of the zones should not be a circle but should be established to conform to geographical features such as roads, rivers, or political boundaries as illustrated in Figures 2 and 6. Following Table A5-II, there is a discussion of the basic philosophy used to establish the size.

TABLE A5-II. SUGGESTED EMERGENCY ZONES AND RADIUS SIZES FOR THREAT CATEGORY I AND II FACILITIES

Facilities	Precautionary action zone (PAZ) radius [62, 63, 64, 65]	Urgent protective action planning zone (UPZ) radius [62, 64, 65, 66]	Food restriction planning radius[67]
Threat category I facilities			
Reactors > 1000 MW (th)	3-5 km	25 km	300 km
Reactor > 100-1000 MW (th)	0.5–3 km	5–25 km	50–300 km
A/D_2 from Appendix 8 is $\geq 10^5$ [68]	3-5 km	25 km	300 km
A/D_2 from Appendix 8 is $\geq 10^4$ - 10^5 [68]	0.5–3 km	5–25 km	50–300 km
Threat category II facilities			
Reactors 10-100 MW (th)	None	0.5–5 km	5–50 km
Reactors 2-10 MW (th)	None	0.5 km	2–5 km
A/D_2 from Appendix 8 is $\geq 10^3$ - 10^4 [68]	None	0.5–5 km	5–50 km
A/D_2 from Appendix 8 is $\geq 10^2$ - 10^3 [68]	None	0.5 km	2–5 km
Fissionable mass possible within 500 m of site boundary[69]	None	0.5–1 km	None[70]

[62] The radius is the approximate distance from the facility that the boundary of the zone should be established.
[63] The suggested radii are the approximate distance to which the acute (2 day) dose to the bone marrow or lung could (with a very low probability) approach those that are life threatening (exceed the values in Annex 2). A maximum radius of 5 km is recommended as discussed elsewhere in the appendix. The source term (release) used for the reactor emergencies was typical of that postulated for the range of low probability accidents [12] that could potentially result in severe deterministic health effects off the site.
[64] The radii were selected based on calculations performed using the RASCAL 3.0 computer model [17]. The calculation assumed average meteorological conditions, no rain, ground level release; 48 hours of exposure to ground shine, and calculates the centreline dose to a person outside for 48 hours.
[65] These calculations probably overestimate the distance to which the relevant doses are possible because no credit is given for dose reduction due to people performing normal activities and because the recipient is always assumed to be in the exact centre of the plume. Under these assumptions, only a very small area would be affected to these levels.
[66] The suggested radii are the approximate distance to which the total effective dose for inhalation, cloud shine and 48 hours of ground shine will not exceed 1-10 times the GIL for evacuation with a maximum radius of 25 km as recommended for the reasons discussed elsewhere in the appendix.
[67] This represents the area that should be considered to be in threat category V.
[68] Assumes that 10% of the inventory is released to the atmosphere.

Precautionary action zone (PAZ)

The PAZ only applies to facilities in threat category I and is the area within which arrangements should be made to implement precautionary urgent protective actions before or shortly after a severe release with the aim of preventing or reducing the occurrence of severe deterministic effects.

The suggested sizes for the PAZ were based on expert judgment considering the following:

(1) Urgent protective actions taken before or shortly after a release within this radius will prevent doses above the early death thresholds for the vast majority of severe emergencies postulated for these facilities.

(2) Urgent protective actions taken before or shortly after a release within this radius will avert doses above the urgent protective action GILs for the majority of emergencies postulated for the facility.

(3) Dose rates that could have been fatal within a few hours were observed at these distances during the Chernobyl accident.

(4) The maximum reasonable radius for the PAZ is assumed to be 5 km because: a) except for the most severe emergencies, it is the limit to which early deaths are postulated [12]; b) it provides about a factor of ten reduction in dose compared to the dose on the site; c) it is very unlikely that urgent protective actions will be warranted at a significant distance beyond this radial distance; d) it is considered the practical limit of the distance to which substantial sheltering or evacuation can be promptly implemented before or shortly after a release; and e) implementing precautionary urgent protective actions to a larger radius may reduce the effectiveness of the action for the people near the site, who are at the greatest risk.

Urgent protective action planning zone (UPZ)

The UPZ applies to facilities in threat categories I and II and is the area where preparations are made to promptly shelter in place, perform environmental monitoring and implement urgent protective actions based on the results of monitoring within a few hours following a release (see Appendix 11).

The suggested sizes for the UPZ are based on expert judgment considering the following:

Threat category I facilities

(1) These are the radial distances to which studies [12] suggest that monitoring to locate and evacuate hot spots (deposition) within hours/days may be warranted in order to significantly reduce the risk of early deaths for the worst emergencies postulated for power reactors.

[69] The radial distance (500 m) is the distance at which the GIL for evacuation is exceeded assuming the building containing the criticality (fissile material) does not provide significant shielding and that the criticality results in 10^{19} fissions. This includes the dose from external radiation (gamma and neutron) and was calculated using the RASCAL 3.0 [17] model.
[70] Airborne releases of radioactive material from criticality accidents are insignificant.

(2) At these radial distances there is a factor of approximately ten reduction in concentration (and thus risk) from a release compared to the concentration at the PAZ boundary.

(3) This distance provides a substantial base for expansion of response efforts.

(4) 25 km is assumed to be the practical limit for the radial distance within which to conduct monitoring and implement appropriate urgent protective actions within a few hours or days. Attempting to conduct initial monitoring to a larger radius may reduce the effectiveness of the protective actions for the people near the site, who are at the greatest risk.

(5) For average meteorological (dilution) conditions, beyond this radius, for most postulated severe emergencies, the total effective dose for an individual would not exceed the urgent protective action GILs for evacuation.

Threat category II facilities

Atmospheric release

(1) For average meteorological (dilution) conditions, beyond the UPZ radius, only the most severe postulated emergencies would result in a total effective dose for an individual exceeding the urgent protective action GILs for evacuation.

(2) Preparations within this radius provide a substantial base for implementation of effective urgent protective measures beyond it, if needed.

(3) 0.5 km was selected as the smallest radius considering of building wake effects.

Fissionable mass (criticality)

(1) The radiological risk from a criticality is dominated by the external dose from gamma and neutron radiation.

(2) Beyond this radius, most accidental criticalities would not result in a total effective dose for an individual exceeding the urgent protective action GILs for evacuation.

(3) The off-site doses from past criticality accidents have not warranted urgent protective measures beyond 0.5-1 km.

Food restriction planning radius (threat category V distance)

This is the area where preparations for effective implementation of protective actions to reduce the risk of stochastic health effects from the ingestion of locally grown food should be developed in advance. In general, protective actions such as relocation, food restrictions and agricultural countermeasures will be based on environmental monitoring and food sampling. The suggested radii were based on expert judgment considering the following:

(1) Detectable excess stochastic effects (cancers) are very unlikely beyond this distance.

(2) Detailed planning within this distance provides a substantial basis for expansion of response efforts.

(3) Food restrictions were warranted to about 300 km following the Chernobyl accident in order to prevent detectable excess thyroid cancers among children.

Appendix 6

CLASSIFICATION AND INITIAL RESPONSE ACTIONS FOR EMERGENCIES AT A FACILITY[71]

Emergency class description	Immediate response actions
	Threat category I and II facilities
General emergency	
Events resulting in an actual or substantial risk of an atmospheric release or radiation exposure (e.g. from criticality or loss of shielding) requiring implementation of urgent protective actions off-site. This could be: - actual or projected[72] severe core damage or damage to large amounts (e.g. > 1/3 of the core of a 3000 MW(th) reactor) of recently discharged reactor fuel. - actual damage to barriers or critical safety systems that will result in a release (e.g. of reprocessing waste) or criticality protective action off-site	**Operator and on-site:** - Take life saving actions and give first aid on site. - Notify off-site officials; recommend protective actions consistent with Appendix 11, and request emergency services if needed. - Evacuate non-essential personnel and visitors or provide them with special on-site shelter and account for all persons on the site. - Provide protection from hazardous conditions for on-site emergency response personnel and for those arriving from off the site. - Take action to mitigate the emergency to include requesting off-site assistance; provide technical assistance to control room. - Conduct off-site monitoring near facility and integrate into the RMAC (see Appendix 14). - Activate full response. - Establish continuous communication with off-site officials. - Establish, with off-site officials, an integrated response under the ICS (see Appendix 13). - Conduct joint media briefings at PIC with off-site officials (see Appendix 14).

[71] Threat category I, II and III facilities

[72] Indicated by a loss of critical safety functions needed to protect the core or large amounts of recently discharged fuel.

Emergency class description	Immediate response actions
	Threat category I and II facilities
General emergency	
protective action off-site - potential or actual criticality near the facility boundary - detection of radiation level off site warranting implementation of urgent protective measures - terrorist or criminal act resulting in an inability to monitor or control critical safety systems needed to prevent a release or exposure that could result in doses off site warranting urgent protective actions. that would warrant taking precautionary	**Off site:** **(within PAZ and UPZ):** - Establish an integrated response using the ICS (see Appendix 13) under an incident commander. - Implement immediate protective actions as recommended by facility and consistent with Appendix 11. - Establish the RMAC (see Appendix 14) and conduct monitoring in and around the UPZ and revise protective actions based on OILs. - Activate the full response co-ordinated under a single incident commander under the ICS (see Appendix 13). - Provide radiation protection for emergency workers. - Ensure all governmental agencies are informed. - Notify potentially affected sates and the IAEA. - Establish provisions to monitor and decontaminate evacuees and manage the medical response and initial treatment and consult with experts on treatment of severe overexposures. - Initiate joint media briefings at the PIC with on-site officials (see Appendix 14). **(within food restriction planning radius):** - Issue instructions to farmers to protect crops and put animals on stored feed as appropriate. - Restrict movement of contaminated food until monitored. - Conduct monitoring to determine where ingestion OILs may be exceeded and provide appropriate protective recommendations.

Emergency class description	Immediate response actions
	Threat category I and II facilities
Site area emergency	
Events resulting in a major decrease in the level of protection for those on the site and near the facility. This could be: - a major decrease in the level of protection provided to the core of a reactor or a large amount of actively cooled spent fuel. - a major decrease in protection against an accidental unshielded criticality - conditions such that any additional failures could result in a general emergency - doses off site approaching the urgent protective action intervention levels - terrorist or criminal activity with the potential to disrupt performance of critical safety functions or result in severe release or exposure.	**Operator and on-site:** - Take life saving actions and give first aid on site. - Notify off-site officials, recommend preparations be made to implement protective actions, consistent with Appendix 11, and request emergency services if needed. - Evacuate non-essential personnel and visitors or provide them with special on-site shelter, and account for all persons on the site. - Provide protection from hazardous conditions for on-site emergency response personnel and from those arriving from off the site. - Activate full response. - Take action to mitigate the emergency to include requesting off-site assistance; provide technical assistance to control room. - Conduct off-site monitoring near facility and integrate into the RMAC (see Appendix 14). - Establish continuous communication with off-site officials. - Establish, with off-site officials, an integrated response under the ICS (see Appendix 13). - Conduct, with off-site officials, joint media briefings at the PIC (see Appendix 14). - Reassess the classification and revise if warranted.

Emergency class description	Immediate response actions
	Threat category I and II facilities
Site area emergency	
	Off site: - Prepare to implement urgent protective actions off site and take measures consistent with Appendix 11 to protect the food supply. - Alert the population in the PAZ/UPZ advising them to remain attentive for further instructions. - Activate the full response co-ordinated under a single incident commander, under the ICS (see Appendix 13). - Provide radiation protection for emergency workers. - Provide fire fighting, police or medical support to the facility if requested. - Establish the RMAC (see Appendix 14) and conduct monitoring in and around the UPZ and revise classification if appropriate. - Ensure all governmental agencies are informed. - Notify the potentially affected States and IAEA. - Establish provision to manage the medical response, initial treatment and consult with experts on treatment of severe overexposures. - With on-site officials, initiate joint media briefings at the PIC (see Appendix 14).

Emergency class description	Immediate response actions
	Threat category I, II and III facilities
Facility emergency	
Event resulting in a major decrease in the level of protection for on-site personnel – however, these events cannot evolve into one (general or site-area emergency) warranting implementation of protective actions off the site. For threat category I and II facilities this could be: - fuel handling emergency - in-facility fire or other emergency not affecting safety systems - terrorist or criminal activity resulting in hazardous on-site conditions but with no potential to result in a criticality or release off-site that would warrant urgent protective actions. For threat category III, this could be: - a major decrease in the level of protection provided to the core of a small reactor (see Threat Category III in Table II) - loss of shielding or control for a large gamma emitter or spent fuel - a criticality away from the site boundary - high doses on site approaching the urgent protective action intervention levels	**Operator and on-site:** - Take life saving actions and give first aid on site. - Notify off-site officials and request emergency services if needed. - Evacuate non-essential personnel and visitors or provide special shelter on site and account for all persons on the site consistent with Appendix 11. - Monitor on-site personnel for contamination and ensure contaminated people or items do not leave the site undetected. - Provide first aid, decontaminate, estimate exposure and transport injured and exposed individuals for treatment. - Conduct monitoring near facility to confirm that off-site protective actions are not needed. - Provide protection from hazardous conditions for on-site and off-site emergency response personnel - Activate partial response. - Take actions to mitigate the emergency, provide technical assistance to control room or operating staff. - Establish continuous communication with off-site officials. - With off-site officials establish an integrated response under the ICS (see Appendix 13). - With off-site officials, conduct joint media briefings at the PIC (see Appendix 14). - Reassess the classification and revise if warranted.

Emergency class description	Immediate response actions
	Threat category I, II and III facilities
Facility emergency	
- emergencies resulting in significant exposure or contamination of the public or staff on site - terrorist or criminal activity potentially resulting in hazardous on-site conditions	**Off site:** - Conduct monitoring around the facility to confirm that off-site actions are not needed. - Activate the partial response, as needed, co-ordinated under a single incident commander under the ICS (see Appendix 13). - Ensure that governmental agencies are informed. - Provide fire, police or medical support to the facility if requested. - Provide initial treatment for injured and consult with experts to determine treatment strategy for overexposures. - With on-site officials, initiate joint media briefings at the PIC (see Appendix 14).

Emergency Class Description	Immediate Response Actions
	Threat Category I, II and III facilities
Alert	
Events[73] involving unknown or significant decrease in the level of protection of the public or on-site personnel	**Operator and on-site:** - Take life saving actions and give first aid on site. - Notify off-site officials. - Activate the appropriate part of the response, using the incident command system under an incident commander, needed to analyse and resolve the condition resulting in the alert or reduce the potential threat. - Conduct off-site monitoring near facility (if appropriate). - Implement actions to mitigate the event and provide technical assistance to control room or operational staff (if required). - With off-site officials, initiate joint media briefings at a PIC if the alert receives media or public attention. **Off site:** - Increase readiness. - Implement the minimum components of the ICS, including appointing an incident commander. - Ensure that all governmental agencies are informed. - Provide fire, police or medical support if requested. - With on-site officials, initiate joint media briefings at the PIC if the alert receives media or public attention.

[73] Involving release barriers, critical safety systems, instrumentation, staff, natural occurrences, fires, terrorist or criminal acts.

Appendix 7

ACTION GUIDES FOR RADIOLOGICAL EMERGENCIES[74]

This appendix provides "action guides" for each of the radiological emergencies listed below. These guides delineate the major response actions to be taken by selected organizational elements shown in Figure A13-III and areas and locations shown in Figure 1. The appendix does not address law enforcement actions, which are partially addressed in Ref. [34].

- Detection of medical symptoms of radiation exposure
- Lost dangerous source
- Theft of a dangerous source
- Recovery of an uncontrolled dangerous source
- Radiography: disconnected or damaged source
- Dangerous source in a fire
- Damaged dangerous source
- Public contamination/exposure
- Radioactive satellite re-entry
- Nuclear weapons accident
- Transport
- Serious overexposure (non medical)
- Accidental medical overexposures
- Detection of elevated radiation levels
- Credible or confirmed terrorist threats
- Non-credible terrorist threats
- Explosive radiological dispersal device (RDD)
- Intentional contamination of water supply
- Intentional contamination of food/products

[74] Emergencies that fall within threat Category IV.

Detection of medical symptoms of radiation exposure

Description

Symptoms of radiation exposure are diagnosed or suspected and the source of the exposure is unknown. The physician should consider the possibility of radiation induced injures when facing burns without an apparent cause, suspicions expressed by the patient that some 'object' was making them sick, the patient being in a profession where there is an increased risk of encountering a dangerous source (e.g. scrap metal dealer).

Potential hazards

The patient could be suffering from radiation injuries warranting specialized treatment. This could indicate a public contamination/exposure emergency and the source of exposure or contamination that could continue to represent a severe hazard unknown to those in the vicinity.

There is little or no health hazard to the medical staff treating or transporting exposed or contaminated people provided they protect themselves from inadvertent ingestion of contamination by use of the normal barrier methods (e.g. gloves) used to protect against infectious agents.

Emergency response

Diagnosing medical professional:

- Prevent inadvertent ingestion of contamination (e.g. wear gloves, do not smoke or eat).
- Perform life saving measures and provide first aid for serious injuries immediately, before conducting radiological monitoring.
- Keep people away from any potential source of exposure (at least 10 m from the public).
- Arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- Identify and register potentially exposed/contaminated individuals, gather information that could be useful in reconstructing their dose to include medical symptoms and description of events.
- Report to appropriate officials and obtain instructions (see Elements A3.1, A8.1).
- Remain in the area until monitored.

Incident commander (lead first responder ⇒ local official):

- Co-ordinate the response using the ICS (see Appendix 13) from an incident command post near the scene. If illicit trafficking or criminal act is suspected, notify and incorporate law enforcement in the response under the ICS.
- Continue actions listed above
- Isolate potential sources of exposure in accordance with Table A5-1
- Obtain radiological assessment assistance to co-ordinate radiological response in accordance with Ref. [11].
- Obtain emergency medical assistance to co-ordinate the medical response.
- If the emergency receives media or public attention obtain public information officer (see Element A9.1)[75] to keep the public informed.
- Ensure that all governmental agencies are informed.
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed**

[75] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

terrorist threats.

- If public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**

Radiological assessment (Radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Provide the medical professional and incident commander reporting the event with instructions by phone on radiation protection actions to take before assistance arrives (see Element A3.1).
- Dispatch radiation assistance team (radiological assessor) (see Element A3.1) to perform monitoring to determine if injuries are radiation induced and isolate possible sources of exposure. If public exposure is possible, recommend that the action guide for **Public contamination/exposure** be followed.

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Obtain national medical advice on determining if the injuries are radiation induced and on the immediate precaution s to be taken during treatment. If public exposure is possible, recommend that the action guide for **Public contamination/exposure** be followed.
- Gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- Arrange to alert local medical facilities of the potential for arrival of concerned people (worried-well[76]) if there is wide spread public concern.
- Reconstruct/record the doses received and inform those exposed about the risks. Arrange, where appropriate (See element A8.5) for long term medical follow-up.

Public information officer/team:

- Operate under the ICS incident commander.
- If the emergency receives media or public attention, implement media briefings, from a single official source, on the threat and appropriate public action; activate a PIC if needed (see Element A9.1)[77].

[76] A person who has received neither radiation exposure nor contamination sufficient to warrant medical treatment or decontamination but who is worried and wishes to be assessed for radiation exposure/contamination.

[77] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

Lost of a dangerous source

Description

Loss of a source containing sufficient radioactive material to be a dangerous source (see Appendix 8). If theft is suspected, follow the guide for **Theft of a dangerous source**.

Potential hazards

Unknowingly handling unshielded/unconfined dangerous quantities (see Appendix 8) can result in permanent injuries from external exposure or inadvertent ingestion and in localized contamination, requiring cleanup. Unknowingly handling quantities 10-100 times the criteria in Appendix 8 for a dangerous source could be immediately life threatening.

Emergency response

Operator (Responsible for control of the source):

- Report loss to the appropriate officials, providing a description of the device and threat.
- Conduct a local search and investigate possible means of loss (e.g. returned shipping container, waste, left in patient).
- Obtain assistance from the radiation protection officer (radiological assessor) (see Element A3.3).
- Check and ensure physical security and control of other sources.
- If the source is found, ensure it is not damaged or leaking – if damaged or leaking notify officials and ensure it is surveyed for contamination.

Incident commander (lead first responder ⇒ local official):

- Co-ordinate the response using the ICS (see Appendix 13).
- Ensure that all governmental agencies are informed.
- Evaluate all available information; retrace the sequence of events. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate the law enforcement response into the ICS.
- Obtain radiological assessment assistance to co-ordinate the radiological response and radiation protection in accordance with Ref. [11].
- Brief the responders on the risks and provide measures to protect emergency workers, including law enforcement, and control their dose (see Elements A6.7, A6.10).
- Obtain emergency medical assistance to advise and co-ordinate with medical facilities on recognition of radiation injuries.
- Obtain public information officer (see Element A9.1)[78] assistance to provide information to the public.
- Promptly inform nearby medical facilities, border crossings and scrap metal dealers to be alert for the source or for radiation-induced injuries. Provide them with a description of the source and its container and indications of radiation injuries (e.g. burns with no apparent cause).
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- Initiate public searches if appropriate.
- If potential source is found, confirm the location and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**

[78] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

- If public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a device is found, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**

Radiological assessment (Radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Develop search strategy in co-operation with the incident commander.
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Promptly locate and keep people away from the significant source(s)/contamination in accordance with Ref. [11].
- If public exposure or contamination is possible or reported, recommend that, as appropriate, the action guide for **Public contamination/exposure** be followed.
- Reconstruct /record the doses received and inform those exposed about the risks. Arrange, where appropriate, (See element A8.5) for long term medical follow-up.

Public information officer/team:

- Operate under the ICS incident commander.
- Promptly make a public announcement describing the source and stressing the hazard (see Element A3.4 and Appendix 18) and action being taken [77].
- Initiate media briefings from a single official source and activate a PIC if needed (see Element A9.1).

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Provide medical advice and support to local medical community on recognition of radiation injuries and treatment of contaminated/exposed individuals and on staff risk (negligible).

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries and provide information on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Theft of a dangerous source

Description

Theft of a source containing sufficient radioactive material to qualify as a dangerous source (see Appendix 8).

Potential hazards

Unknowingly handling unshielded/unconfined dangerous quantities (see Appendix 8) can result in permanent injuries from external exposure or inadvertent ingestion and in localized contamination, requiring cleanup. Unknowingly handling quantities 10-100 times the criteria in Appendix 8 for a dangerous source could be immediately life threatening.

Emergency response

Operator (Responsible for control of the source):

- Report theft to the appropriate officials, providing a description of the device and threat.
- Obtain assistance from the radiation protection officer (radiological assessor) (see Element A3.3).
- Secure the scene to allow for forensic examination.
- Conduct additional response actions in co-operation with law-enforcement, including:
  - local search;
  - providing technical support to off-site officials;
  - checking and ensuring physical security and control of other sources.
- If the source is found, ensure it is not damaged or leaking – if damaged or leaking notify officials and ensure it is surveyed for contamination.

Incident commander (lead first responder ⇒ local official):

- Co-ordinate all response actions in co-operation with law-enforcement using the ICS (see Appendix 13) from an incident command post near the scene.
- Ensure that all governmental agencies are informed.
- Obtain radiological assessment assistance to co-ordinate the radiological response and radiation protection in accordance with Ref. [11].
- Obtain emergency medical assistance to advise and co-ordinate with medical facilities in the recognition of radiation injuries.
- Obtain public information officer (see Element A9.1)[79] to provide information to the public.
- Brief the responders on the risks and provide measures to protect emergency workers, including law enforcement, and control their dose (see Elements A6.7, A6.10).
- Promptly inform nearby medical facilities, border crossings and scrap metal dealers to be alert for the source or for radiation-induced injuries. Provide them with a description of the source and its container and indications of radiation injuries (e.g. burns with no apparent cause).
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- If potential source is found, establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**

[79] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

- If a device is found, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source**

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Assess hazards and provide technical assistance to off-site officials and operator.
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Promptly locate and keep people away from the significant source(s)/contamination in accordance with Ref. [11].
- If public exposure or contamination is possible, recommend that, as appropriate, the action guide for **Public contamination/exposure** be followed.
- Reconstruct /record the doses received and inform those exposed about the risks, arrange, where appropriate (See element A8.5) for long term medical follow-up.

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation, in close co-operation with law enforcement, to determine why the source was not properly controlled and if additional sources may have been lost or stolen.

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Provide medical advice and support to local medical community on recognition of radiation injuries and treatment of contaminated/exposed individuals and on staff risk (negligible).

Public information officer/team:

- Operate under the ICS incident commander.
- Promptly make a public announcement[80] describing the source and stressing the hazard (see Element A3.4 and Appendix 18) [77].
- Initiate media briefings from a single official source and activate a PIC if needed (see Element A9.1).

Law enforcement (Conduct response actions in co-operation with public safety officials):

- Operate under the ICS incident commander.
- Conduct a law enforcement response consistent with the information in Ref. [34].
- If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries and provide information that is not confidential, on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

[80] While public notification of the hazard may hinder a criminal investigation, they have been found to be very effective in preventing public exposure and have resulted in information being provided that resulted in recovery of very dangerous sources.

Recovery of an uncontrolled dangerous source

Description

Recovery of an unshielded/confined dangerous source.

Potential hazards

Unknowingly handling unshielded/unconfined dangerous quantities (see Appendix 8) can result in permanent injuries from external exposure or inadvertent ingestion and in localized contamination, requiring cleanup. Unknowingly handling quantities 10-100 times the criteria in Appendix 8 for a dangerous source could be immediately life threatening.

Emergency response

Incident commander (local official):

- Take life saving and first aid action immediately, before conducting radiological monitoring.
- Evacuate people from affected area and establish a safety perimeter at 100 μSv/h and in accordance with Table A5-I.
- Evaluate all available information; retrace the sequence of events. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate them into the ICS.
- If public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- Obtain radiological assessment assistance to co-ordinate radiological response in accordance with Ref. [11].
- Obtain emergency medical assistance to co-ordinate the medical response.
- If the emergency receives media or public attention obtain public information officer (see Element A9.1)[81] to keep the public informed.
- Activate response using the ICS (see Appendix 13) co-ordinated under an incident commander near the scene.
- Fully characterize the radiological and physical situation before proceeding.
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- Develop recovery plan that addresses:
  - determination of the location of the source and any contamination and of the radiological characteristics (beta, alpha, and gamma emitters), chemical characteristics affecting spread of contamination (e.g. water solubility), and physical characteristics (e.g. size, weight, shape, robustness) affecting worker safety or recovery methods;
  - if there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State)
  - on-scene issues including local inhabitants, assembly areas, access routes, and means for spreading contamination (e.g. streams);
  - control of worker risk (e.g. protection from hazardous chemicals, tracking and limiting dose) and provision of medical support (see also guide for Radiography disconnected or damaged source);
  - co-ordination with local officials;
  - transport/storage containers (design and construction), storage and long term security;
  - public and media relations;
  - security, legal and law enforcement concerns;
  - gathering and preservation of information;
  - recovery methods and remote handling tools;
  - transport (e.g. special approval for uncertified containers, security, and vehicle);
  - formation of a recovery team (with replacements) using the ICS (see Appendix 13) that supports incident

[81] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

command, operational safety, public information, planning, operations (liaison, radiological assessment, recovery, security, law enforcement/investigation, medical), logistics (transport, food, housing, communication), and financial and administrative issues; and

- conduct of team training to limit individual dose, involving realistic rehearsals of all aspects of the recovery operations.

— If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**

— If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**

— If public exposure or contamination is possible or reported, follow the action guide for **Public contamination/exposure**

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

— Operate under the ICS incident commander.

— Monitor for gamma, beta and alpha, confirm exact location of the source and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I) and with Ref. [11].

— If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State)

— Determine if the source is leaking and check for contamination spread;

— Provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).

— Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).

— If public exposure or contamination is possible or reported, recommend that, as appropriate, the action guide for **Public contamination/exposure** be followed.

— Reconstruct /record the doses received and inform those exposed about the risks and arrange, where appropriate, (See element A8.5) for long term medical follow-up.

Emergency medical responder/team:

— Operate under the ICS incident commander.

— Implement and manage the on-scene medical support

— If public exposure or contamination is possible or reported, recommend that, as appropriate, the action guide for **Public contamination/exposure** be followed.

Public information officer/team:

— Operate under the ICS incident commander.

— If the emergency receives media or public attention, implement media briefings from a single official source on the threat and appropriate public actions; activate a PIC if needed (see Element A9.1)[82].

Incident investigator/team:

— Operate under the ICS incident commander.

— Conduct an investigation, in close cooperation with law enforcement if criminal activity is suspected, to determine the cause, origin of material or device involved, and possible involvement of other sources. Take appropriate action to prevent similar emergencies.

IAEA resources (if provided):

— Operate under the ICS incident commander.

— Respond to international inquiries and provide information on transnational emergencies.

— Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

[82] If the public announcement is delayed prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

Radiography emergency: disconnected or damaged dangerous source

Description

Emergencies involving disconnected or damaged radiography source that cannot be returned to its shielded container.

Potential hazards

Handling an unshielded source can cause permanent injury within minutes and being in the vicinity of an unshielded source can be life threatening within hours.

Emergency response

Operator (See Ref. [25] and Element A3.3):

- Carry out a radiation survey; verify the location of the source; set up barricades at new controlled area boundary at 100 μSv/h.
- Prevent access to the area; do not leave controlled area unattended.
- Record names of potentially exposed individuals.
- Obtain radiological assessment assistance to co-ordinate radiological response in accordance with Ref. [11].
- If there is public interest, exposure, contamination possible, immediately call offsite officials and follow the action guide for **Public contamination/exposure.**
- Stop operation, secure site, notify off-site officials and obtain additional assistance if anyone is injured, the source cannot be fully shielded, public exposure or contamination is possible, illegal or criminal acts are suspected, or there is excessive public interest in the operations.
- Develop mitigatory retrieval (recovery and decontamination) plan to minimize dose to the workers.
  - obtain technical assistance from the manufacturer if appropriate;
  - estimate the dose during the operation and rehearse mitigatory operations; (see Elements A6.7, A6.10, A12.4);
  - keep the doses as low as possible; they should not exceed the occupational dose limits (50 mSv whole body or 150 mSv to the hands) in Ref [3].
- Have an observer ensure that dose limits are not exceeded and that other dangerous situations are avoided.
- Once a source has been shielded, confirm this by monitoring and check for contamination immediately
- Investigate and conduct interviews to document the cause of the event, provide a report to the regulatory body.
- If serious overexposure or contamination is suspected, implement, as appropriate, the action guide for **Serious overexposure.**

Radiological assessment (Radiological assessor⇒national team) (Element A3.1)

- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- Ensure location of the source is known at all times during the operation
  - Brief workers on radiation protection and other safety issues and continuously monitor their doses during recovery operations.
  - Ensure that source is not damaged or leaking. If it is damaged, notify off-site officials and check for contamination spread.
  - Store source in an appropriate container in a secure area.
- Reconstruct /record the doses received and inform those exposed about the risks, inform off-site officials of any dose in excess of occupational limits and arrange, where appropriate (See element A8.5), for long term medical follow-up.

Incident investigator/team:

- Operate under the ICS incident commander.

- Conduct an investigation, in close co-operation with law enforcement if criminal activity is suspected, to determine the cause and take appropriate action to prevent similar emergencies.

Regulatory body:

- Operate under the ICS incident commander.
- Determine that the device involved is safe before reuse.

Dangerous source in a fire

Description

Emergencies involving a dangerous source in a fire.

Potential hazards

The primary risk comes from the fire. There is a small probability that the shielding or container for the radioactive material could be damaged. Handling an unshielded dangerous source can cause permanent injury and being in the vicinity of an unshielded source can be life threatening within hours. There may be a small inhalation hazard for those within a room or within with a fire or within a few metres of a source in the open that is in a fire

There will be little or no health risks to response personnel provided that in taking response actions near any hazardous material they take normal precautions, such as the use of respiratory protection against material released in a fire or explosion. Limited stays (such as for rescues) near a radioactive source or material would probably not be dangerous.

Emergency response

Operator:

- Evacuate area and perform immediate actions to save lives.
- Request local emergency services immediately, informing them of the hazard and that they should not delay life saving actions.
- Carry out a radiation survey; verify the location of the source; set up barricades at new controlled area boundary at 100 m from the fire or at 100 μSv/h (consistent with Appendix 5)
- Prevent access to the area; do not leave controlled area unattended.
- Record names of potentially exposed individuals.
- Obtain assistance from the radiation protection officer (radiological assessor) to provide support to emergency services when they arrive.
- If public exposure or contamination is possible, follow, as appropriate, the action guide for **Public contamination/exposure.**

Radiological assessment (Radiological assessor⇒national team) (Element A3.1)

- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State)
- Monitor the emergency services and victims for contamination.
- Reconstruct /record the doses received and inform those exposed about the risks, inform off-site officials of any dose in excess of occupational limits and, arrange, where appropriate (See element A8.5), for long term medical follow-up.

Regulatory body:

- Operate under the ICS incident commander.
- Determine that the device involved is safe before reuse.

Damaged dangerous source

Description

Radioactive contamination or exposure from damage to a dangerous source in manufacturing research or educational facilities.

Potential hazards

Unknowingly handling unshielded/unconfined dangerous quantities of radioactive material (see Appendix 8) can result in permanent injuries from external exposure or inadvertent ingestion and in localized contamination, requiring cleanup. Unknowingly handling quantities 10-100 times the criteria in Appendix 8 for a dangerous source could be immediately life threatening. These events have resulted in contamination exceeding acceptable levels of products produced at facilities. There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution concerns are not promptly addressed.

Emergency response

Operator (See Element A3.3):

- Take life saving and first aid action immediately, before conducting radiological monitoring.
- Evacuate people from affected area.
- Reconfirm/establish a safety perimeter at 100 μSv/h and in accordance with Table A5-I.
- Prevent access to the area; do not leave controlled area unattended.
- Notify off-site officials and request emergency services (if needed) ensuring that they are aware of on-site conditions.
- Arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- Gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- Operate under the ICS incident commander.
- Take action to control doses and spread of contamination and estimate the dose to exposed individuals.
- Ensure that any products that have left the facility are monitored to determine if they are contaminated.
- Provide protection from hazardous conditions for on-site and off-site emergency response personnel (see Elements A6.7, A6.10).
- Record names of potentially exposed individuals.
- Obtain radiological assessment assistance to co-ordinate radiological response in accordance with Ref. [11].
- Prevent/report any spread of contamination or contaminated products that may have left the facility.

Incident commander (lead first responder ⇒ local official):

- Co-ordinate the response, using the ICS (see Appendix 13), from an incident command post near the scene.
- Evaluate all available information; retrace the sequence of events. Be aware of the possibility of criminal acts. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate them into the ICS.
- If warranted, request national radiation assistance team (radiological assessor) (see Element A3.1)

to perform monitoring in accordance with Ref. [11] if contamination or public exposure is suspected.

- Implement action to protect the public, workers, responders, and the economy from the actual or perceived radiological risk by implementing action consistent with international standards (see. Ref. [11]).
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**
- If public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State).
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their doses (see Elements A6.7, A6.10).
- Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.
- Monitor on-site personnel for contamination and ensure that contaminated people or items do not leave the site undetected.
- Develop retrieval/cleanup plan to minimize the dose to the workers.
  - Rehearse/test recovery/cleanup operations and provide measures to protect recovery workers (see Element A6.8);
  - Ensure that doses during recovery are kept within occupational limits unless actions to be performed are considered an emergency response.
- Reconstruct /record the doses received and inform those exposed about the risks, inform off-site officials of any dose in excess of occupational limits and, arrange, where appropriate (See element A8.5), for long term medical follow-up.

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):
  - establish, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
  - identify local medical facilities to be used for treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.
- Implement provisions to assess the concerns of members of the public (worried-well) about radiation exposure/contamination (not at a hospital or other crucial facility).
- Provide medical advice and support to local medical community on treatment of

contaminated/exposed individuals and the risk (negligible) to their staff.

Public information officer/team:

- Operate under the ICS incident commander.
- If the emergency receives media or public attention, implement media briefings, from a single official source, on the threat and appropriate public actions; activate a PIC if needed (see Element A9.1)[83].

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation, in close co-operation with law enforcement if criminal activity is suspected, to determine the cause and take appropriate action to prevent similar emergencies.

Regulatory body:

- Operate under the ICS incident commander.
- Determine if the device involved is safe before reuse.

IAEA resources (if provided)

- Operate under the ICS incident commander.
- Respond to international inquiries and provide information on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

[83] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

Public contamination/exposure

Description

Discovery of contamination of the public or public places. This could occur as the result of members of the public, unaware of the hazard, handling a lost or stolen dangerous source (see Appendix 8). This could also occur as a result of a deliberate act. These emergencies are often discovered; unfortunately, after several people have been exposed and there has been considerable spread of radioactive material.

Potential hazards

The exposed individuals could be suffering from radiation injuries warranting specialized treatment. The source of exposure or contamination could represent a severe hazard unsuspected by those in the vicinity. The material could be dispersed by human activity and could involve widespread contamination of areas and local products. There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution concerns are not promptly addressed. Limited stays (minutes) near the material by response personnel should not be hazardous but holding the material could produce injuries in minutes. The inhalation hazard is probably limited to the plume (e.g. within the smoke) within 100 metres of a source in a fire or explosion. Resuspension of material on the ground should not be hazardous except for Pu contamination. External contamination is probably not hazardous but inadvertent ingestion (e.g. by putting hands in the mouth) of contamination could be hazardous. Excess cancers should not be detected following these types of emergencies, even those involving large amounts of radioactive material.

Fire fighters are generally equipped with respiratory protection that provides good protection against the inhalation hazard. Common radiation survey instruments can detect significant external exposure hazards but may not be able to detect significant inhalation hazards. There is little or no health hazard to the medical staff treating or transporting exposed or contaminated people provided they protect themselves from inadvertent ingestion of contamination by use of the normal barrier methods (e.g. gloves) used to protect against infectious agents.

Emergency response

Incident commander (lead first responder) (First officials to be aware of a potential emergency):

- Ensure that those approaching scene take action to prevent inadvertent ingestion of contamination (e.g. wear gloves, do not smoke- or eat).
- Perform life saving measures and provide first aid for serious injuries immediately, before conducting radiological monitoring.
- Conduct interviews to identify the possible source of the contamination and its possible location.
- Keep people away from suspected contaminated areas. Establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- Arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- Gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- Notify national officials.
- Obtain radiological assessment assistance to co-ordinate the radiological response and radiation protection in accordance with Ref. [11].
- Obtain emergency medical assistance to advise and co-ordinate with medical facilities
- Obtain public information officer (see Element A9.1)[84] to provide information to the public.

[84] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

— Activate response using the ICS (see Appendix 13) co-ordinated under an incident commander from an incident command post near the scene.

Incident commander (local official):

— Evaluate all available information; retrace the sequence of events. Be aware of the possibility that radioactive material may be a subject of illicit trafficking or other criminal act. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate them into the ICS.

— Implement action to protect the public, workers, responders, and the economy from the actual or perceived radiological risk by implementing action consistent with international standards (see. Ref. [11]).

— Relocate people from areas, identified by the emergency team of radiation specialists (radiological assessor), where contamination levels exceed OILs for relocation and keep them informed of their status, the risks to their health and the status of their homes and property (see Element A10.6).

— Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).

— Monitor public response and deal with inappropriate behaviour (see Element A11.2).

— If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**

— If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**

— If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source**.

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

— Operate under the ICS incident commander.

— Provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).

— Identify and keep people away from significant contamination and identify potentially contaminated people, products and locations based on appropriate OILs:

- areas that should be evacuated;
- members of the public and workers who should:
  - be immediately decontaminated,
  - be decontaminated as soon as reasonable,
  - be released – no further action needed,
  - get a medical follow up.
- water/food/products that should be restricted.

— Brief incident commander and responders on risks and provide measures to protect emergency workers (including law enforcement) and control their doses (see Elements A6.7, A6.10).

— Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.

— If national radiological response resources are insufficient – request international assistance through the IAEA.

— Inform those monitored of the results, risk, and actions they should take.

— Establish, if appropriate, a programme to assess long term radiological consequences.

— Establish radiological assessor base near the scene and activate an RMAC (see Appendix 14) if needed to co-ordinate radiological field operations.

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[85] A person who has received neither sufficient radiation exposure nor been sufficiently contaminated to warrant medical treatment or decontamination but who is worried and wishes to be assessed for radiation exposure/contamination.

[86] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

- If national radiological response resources are insufficient – request international assistance through the IAEA.
- Reconstruct /record the doses received and inform those exposed about the risks, inform off-site officials of any dose in excess of occupational limits and, arrange where appropriate (See element A8.5), for long term medical follow-up.

Emergency medical responder/team:

- Implement and manage medical response, including (see Elements A8.4, A 8.5):
  - establish, with support from radiological assessment, a victim assembly point near the scene of the emergency to perform medical and radiological triage – field treatment.
  - identify medical facilities for use in treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks.
- Provide selected medical facilities with expert support, if needed, on radiological monitor, decontamination or radiation protection.
- Implement provisions to assess concerned people (worried-well[85]) for radiation exposure/contamination (not at a hospital or other crucial facility).
- Arrange to alert local medical facilities of the potential for arrival of concerned people (worried-well) wanting to be monitored if there is wide spread public concern.
- Provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the risk (minimal) to their staff.

Public information officer/team:

- Operate under the ICS incident command.
- If the emergency receives media or public attention, implement media briefings, from a single official source, on the threat and appropriate public actions; activate a PIC if needed (see Element A9.1)[86].

National officials:

- Operate under the ICS incident commander.
- Ensure that all governmental agencies are informed of who is leading the response and that they receive an explanation of the risk and their role.
- Provide an emergency team of radiation specialists (radiological assessor) (see Element A3.1).
- Take action to mitigate the economic and psychological consequences of the threat, including:
  - restricting national and international trade or movement of potentially contaminated items or people;
  - promptly making a public announcement describing the hazard realistically followed by media briefings from a single official source and activating a PIC if needed (see Element A9.1).
- Develop a recovery plan (include objectives and criteria) before recovery efforts begin (see Element A12.1).
- Implement a longer-term medical monitoring programme if appropriate (see Element A8.5 and Ref. [29]).

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation, in close co-operation with law enforcement if criminal activity is suspected, to determine the cause, origin of the material or device involved, and the possible involvement of other sources. Take appropriate action to prevent similar emergencies.

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries and provide information on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Radioactive satellite re-entry

Radioactive satellite re-entry

Description

Re-entry of nuclear power sources from space. Re-entry may be foreseen several weeks or months in advance, although some accident sequences could occur within hours. Estimates of the time and location for the re-entry are often inaccurate. Typically, the radioactive components are less than one cubic metre in volume and shatter upon re-entry. Debris can fall over an area of 100 000 km^2 or more and in most cases it would be virtually impossible to identify the area of impact with sufficient accuracy to allow reasonable precautionary protective actions to be taken.

Potential hazards

The risk is very low and comes principally from someone finding and handling radioactive debris. Surface radiation levels of up to 5 Gy/h have been recorded from satellite debris, which could result in severe or fatal injuries. However, none of the re-entries to date has resulted in a known case or significant public exposure or significant food or water contamination.

Emergency response

State responsible for the satellite:

- Notify the IAEA of the estimated time and location of re-entry and provide an assessment of risks to the public and a recommendation on protective actions.

IAEA:

- Inform potentially affected States.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Incident commander (in each potentially affected State):

- Co-ordinate the response using the ICS (see Appendix 13) under an incident commander.
- Obtain radiological assessment assistance to co-ordinate the radiological response and radiation protection in accordance with Ref. [11].
- Obtain emergency medical assistance to advise and co-ordinate with medical facilities
- Obtain public information officer (see Element A9.1)[87] to provide information to the public.
- Implement action to protect the public, workers, responders, and the economy from the actual or perceived radiological risk by implementing action consistent with international standards (see. Ref. [11]).
- If, after re-entry, the area of impact can be bounded, implement provision to locate debris and instruct the public to avoid and report suspicious objects.
- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**

Public information officer/team:

- Operate under the ICS incident commander.
- Initiate media briefings from a single official source if the emergency receives media or public

[87] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

attention. Activate a PIC if needed (see Element A9.1)[77]

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Advise medical community on recognition of radiation induced injuries and immediate action to take if such injuries are suspected.
- Prepare to assess concerned people (worried-well) for radiation exposure/contamination (not at a hospital or other crucial facility)

Radiological assessment (national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Establish an RMAC (see Appendix 14) and conduct monitoring to locate radioactive debris if the search area can be reasonably limited.
- If national radiological response resources are insufficient – request international assistance through IAEA.
- On locating satellite debris, perform immediate actions to render it safe.
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).

Nuclear weapons accident

Description

A crash, without a nuclear explosion, of a vehicle or aircraft carrying a nuclear weapon.

Potential hazards

Detonation of the high explosives contained in the weapon represents a hazard near the crash. Inhalation of plutonium and other toxic material from the smoke from a burning aircraft, vehicle or conventional explosives and from resuspension of the Pu deposited on the ground could be immediately life threatening to those without inhalation protection to about 1 km downwind. Normally available radiation monitoring instruments may not be able to detect hazardous levels of Pu. Fire fighters are generally equipped with respiratory protection, which provide good protection against the inhalation hazard.

Emergency response

Incident commander (lead first responder):

- Observe from a distance and assess all possible hazards.
- Approach from upwind or use respiratory protection if possible and other available protective clothing and ensure those approaching scene take action to prevent inadvertent ingestion of contamination (e.g. wear gloves, do not smoke- or eat).
- Perform life saving measures and provide first aid for serious injuries immediately, before conducting radiological monitoring.
- Control fires and other consequences that are an immediate threat to life.
- Establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- Record names of potentially exposed individuals.
- Activate response using the ICS (see Appendix 13) co-ordinated under an incident commander from an incident command post near the scene.
- Establish the incident command post upwind[88], at a safe distance (> 1 km) and in a secure area.
- Arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- Gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- Arrange to alert local medical facilities of the potential for arrival of concerned people (worried-well[89]) if there is wide spread public concern.

Incident commander (local officials):

- Notify national officials.
- Ask national officials for advice and an emergency team of radiation specialists (radiological assessor) (see Element A3.1).
- Provide respiratory protection to protect emergency workers and control their dose (see Elements A6.7, A6.10).
- Implement action to protect the public, workers, responders, and the economy from the actual or perceived radiological risk by implementing action consistent with international standards (see. Ref. [11]).

[88] Wind direction is often very variable, especially in an urban area; thus, this is a secondary concern.

89 A person who has received neither radiation exposure nor contamination sufficient to warrant medical treatment or decontamination but who is worried and wishes to be assessed for radiation exposure/contamination.

- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**

Radiological assessment (Radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Provide emergency team of radiation specialists (radiological assessor) (see Element A3.1).
- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.
- Establish radiological assessor base near the scene and activate an RMAC (see Appendix 14) if needed to co-ordinate radiological field operations.
- If national radiological response resources are insufficient – request international assistance through the IAEA.
- If needed, request support of specialist from the responsible State.
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).

Responsible State:

- Operate under the ICS incident commander.
- Provide specialized monitoring (integrated into the RMAC) and technical support, including recommending OILs for relocation and return to normal.
- Support recovery operations.

Public information officer/team:

- Operate under the ICS incident commander.
- Initiate media briefings from a single official source if the emergency receives media or public attention. Activate a PIC if needed (see Element A9.1)[77].

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):
  - establish, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
  - identify local medical facilities to be used for treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.
- Implement provisions to assess the concerns members of the public (worried-well) who are concerned about radiation exposure/contamination (not at a hospital or other crucial facility).
- Provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the risk (negligible) to their staff.

National/local officials:

- Operate under the ICS incident commander.

- Co-ordinate with the State responsible for the weapon; ask them to provide monitoring and other assistance.

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Assist with co-ordination with responsible State if requested.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Transport

Description

An emergency involving radioactive material being transported in accordance with international standards [24].

Potential hazards

For package types shown in Figure A7-1 with a medium and medium to high hazard level, there is a small possibility of: 1) a release resulting in an inhalation hazard near the source, 2) contamination that is hazardous if ingested and 3) hazardous levels of external exposure from being near the accident for an extended time. Fire fighters are generally equipped with protective clothing and respiratory protection equipment, which provides good protection against radioactive contamination and inhalation of airborne radioactive material. Being in the vicinity of the material for a short period (e.g. to conduct life saving) should not be hazardous. There have been no reported transport emergencies involving radioactive material that have had serious radiological consequences [16].

Emergency response

Carrier (See Ref. [16]):

- Perform life saving measures and provide first aid for serious injuries immediately, before conducting radiological monitoring.
- Keep people away from the emergency scene and implement other actions in carrier response guidance.
- Call local emergency response services.
- Operate under the ICS incident commander.

Incident commander (lead first responder ⇒ local official):

- Observe from a distance and assess all possible hazards.
- Approach from upwind or use respiratory protection if possible and ensure those approaching scene take action to prevent inadvertent ingestion of contamination (e.g. wear gloves, do not smoke- or eat).
- Take life saving and first aid action immediately, before conducting monitoring.
- Control fires and other consequences that are an immediate threat to life.
- Obtain radiological assessment assistance to co-ordinate radiological response in accordance with Ref. [11].
- Obtain emergency medical assistance to co-ordinate the medical response.
- If the emergency receives media or public attention obtain public information officer (see Element A9.1)[90] to keep the public informed.
- Establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- Arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- Gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- Activate response using the ICS (see Appendix 13) co-ordinated under an incident commander near the scene. Establish the incident command post upwind[91], at a safe distance and in a secure area.

[90] If the public announcement is delayed, prepare public information and a spokesperson to be used when the news of the emergency reaches the media and public.

[91] Wind direction is often variable, especially in an urban area; thus, this is a secondary concern.

- Evaluate all available information; retrace the sequence of events. Be aware of the possibility that radioactive material may be a subject of illicit trafficking or other criminal act. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate law enforcement into the ICS.
- On the basis of data on the labels and shipping papers, take the initial action appropriate as shown in Figure A7-I:
  - keep people away from the emergency scene, establish cordon-off area and controlled access area;
  - get the names of people who may have been in the emergency area (for possible follow up);
  - request radiological assistance from regional or national officials (if appropriate) (see Element A3.1);
  - control the potential spread of contamination (e.g. by water) if it will not delay or interfere with other response actions.
- If terrorism is indicated, implement, as appropriate, the action guide for **Credible or confirmed terrorist threats.**
- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).

Radiological assessment (radiological assessor⇒national team): (See Element A3.1)

- Operate under the ICS incident commander.
- If warranted, dispatch radiation assistance team (radiological assessor) (see Element A3.1) to perform monitoring in accordance with Ref. [11].
- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
- If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State).
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Provide medical advice and support to on scene response and local medical community on treatment of contaminated/exposed individuals and the risk (negligible) to their staff.

Public information officer/team:

- Operate under the ICS incident commander.
- If the emergency receives media or public attention, implement media briefings, from a single official source, on the threat and appropriate public action. Activate a PIC if needed (see Element A9.1)[77].

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation, in close co-operation with law enforcement if criminal activity is suspected, to determine the cause and take appropriate action to prevent similar emergencies.

Serious overexposure (non-medical)

Description

Severe overexposure not involving a medical procedure. For medical overexposures follow the guide for **Accidental medical overexposures**.

Potential hazards

Inadequate treatment of the overexposure resulting in unnecessary suffering. Additional unnecessary overexposures from failure to promptly identify and correct the cause of the overexposure.

Emergency response

Operator (Operator, if known, of practice resulting in the overexposure):

- At the scene, conduct interviews and gather and secure information needed to estimate the dose.
- Report the event to national officials.
- Initiate measures to protect emergency workers and control their doses (see Elements A6.7, A6.10).
- Conduct an investigation to determine the cause of the overexposure, take action to prevent further overexposure, and protect information that may be important for further investigation.

Medical facility treating the victim:

- Operate under the ICS incident commander.
- Treat injuries.
- Brief medical staff treating casualties on negligible risk in treating exposed/contaminated patients and appropriate precautions.
- Initiate measures to protect emergency workers and control dose (see Elements A6.7, A6.10).
- Perform physical examinations and blood tests promptly to assist in estimating the dose (see Ref. [29]).
- In consultation with the experts, determine a course of treatment based on the estimated dose received. Consider both the physical and psychological suffering of the patient. (See Element A.8.4).

Incident commander (local officials):

- Co-ordinate the response using the ICS (see Appendix 13) from an incident command post near the scene.
- Ensure that all governmental agencies are informed.
- Ask national officials for advice and an emergency team of radiation specialists (radiological assessor) (see Element A3.1).
- Evaluate all available information: retrace the sequence of events. Be aware of the possibility of criminal acts. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate them into the ICS.
- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure**.
- If radiological terrorism is suspected/confirmed implement, as appropriate, the action guide for **Credible or confirmed terrorist threats**.

National officials:

- Operate under the ICS incident commander.
- Contact the IAEA to arrange for consultation with physicians with expertise in treating severe overexposures.
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see

Element A2.15).

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation, in close co-operation with law enforcement if criminal activity is suspected, to determine the cause and take appropriate action to prevent similar emergencies.

Public information officer/team:

- Operate under the ICS incident commander.
- Respond to international inquiries and rumours.
- If there is public interest in the event, initiate media briefings from a single official source and activate the PIC if needed (see Element A9.1)[77].

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Accidental medical overexposures[92]

Description

Significant unplanned overexposures of patients resulting from controlled medical sources such as radiotherapy devices. Equipment, software, human factors, or confusing procedures could be contributing causes.

Potential hazards

Other users (national and international) using similar devices or procedures could have similar emergencies. Inadequate treatment resulting in unnecessary suffering of the overexposed patient.

Emergency response

Operator (registrant – licensee):

- Reconstruct the scenario of the accidental medical overexposure; include an assessment of the dose and dose distribution within the patient needed for medical prognosis.
- Perform a clinical assessment of the radiation effects due to the overexposure.
- Initiate appropriate treatment; consult with physicians with relevant expertise in treating severe overexposures (possibly through the IAEA).
- Conduct an investigation to determine the cause of the overexposure, take action to prevent further overexposures, and protect information that may be important in a further investigation of the case.
- Submit to the regulatory body, as soon as possible after the investigation, a report that states the cause of the incident.
- Inform the patient and his/her doctor about the incident.

Incident commander (local officials):

- Co-ordinate the response using the ICS (see Appendix 13) from an incident command post near the scene.
- Ensure that all governmental agencies are informed.
- Ask national officials for advice and an emergency team of radiation specialists (radiological assessor) (see Element A3.1).
- If significant public contamination or exposure is possible, implement, as appropriate, the action guide for **Public contamination/exposure**.

Incident investigation (regulatory body):

- Operate under the ICS incident commander.
- Promptly determine the cause of the overexposure. If it may have resulted from a problem that could occur in another facility or State (e.g. potentially a transnational emergency), promptly request the national competent authority to notify the IAEA (Element A2.15).

Public information officer/team:

- Operate under the ICS incident commander.
- If there is public interest in the emergency, initiate media briefings from a single official source and activate the PIC if needed (see Element A9.1)[77].
- Initiate action, as appropriate, to prevent similar emergencies at this facility or others using similar practices.

National competent authority for domestic accidents (if appropriate)[93, 94]

- Operate under the ICS incident commander.
- Contact the IAEA to arrange for consultation with physicians with expertise in treating severe overexposure.

[92] See Ref. [3], para. II.30 for a related requirement.
[93] The contact point that is authorized to issue a notification, warning messages or request for assistance to the IAEA ERC.
[94] In accordance with the guidelines in Ref.[23]

- Notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected or may have involved a fault and/or problem (such as in equipment or software) that could have serious implications for safety internationally (transnational emergency - Element A2.15).

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Detection of elevated radiation levels

Description

Elevated radiation levels of ambient radiation or radioactive contamination in air, food/water or commercial products (at the time of discovery of unknown origin) raising suspicion of an emergency situation of actual, potential or perceived radiological significance.

Potential hazards

Elevated radiation levels of unknown origin in air/food/water/products resulting in significant exposure of the public[95] are very unlikely. However, if the elevated radiation levels in air or water are due to a significant release of radioactive material from a facility in threat category I or II, contamination in excess of national and international standards is possible. Allowing contaminated food/water/products in the international or local distribution system could have serious economic consequences. Detection of elevated radiation levels in food or consumer products can indicate an accident at a manufacturing facility, possibly from another State (e.g. accidental incorporation of an 'orphan source' into recycled scrap metal). There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution's concerns are not promptly addressed. (See Element A2.15)

Emergency response

Incident commander (local official⇒national official):

- Obtain radiological assessment assistance to identify and investigate the source of elevated radiation levels and to assess possible impact and its radiological significance.
- Obtain public information officer (see Element A9.1) to provide information to the public.
- Evaluate all available information: retrace the sequence of events. Be aware of the possibility of criminal acts. If illicit trafficking or any criminal act is suspected, notify appropriate law enforcement authorities and integrate them into the ICS.
- Take actions to prevent contaminated products from entering the distribution system. Keep people away from and remove potentially contaminated food or products from public use until they have been assessed.
- Inform the public of the risk.
- Have the national competent authority notify the IAEA, if transnational emergency.
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- If a lost or stolen dangerous source may be involved, implement, as appropriate, the action guide for a **Theft of a dangerous source.**
- If radiological terrorism is suspected/confirmed implement, as appropriate, the action guide for **Credible or confirmed terrorist threats**.
- If significant public contamination or exposure is possible implement, as appropriate, the action guide for **Public contamination/ exposure.**.

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

- Increase the frequency of routine monitoring; enhance environmental and food monitoring; use locations where contamination may have been introduced and possible contamination concentrators (e.g. filters).
- Establish a system to take and analyse samples of contaminated items.
- Identify the contaminant and assess the radiological significance of contamination.
- Brief local/national officials on risks based on actual radiological data.
- Analyse the course of events and identify members of the public and workers (if any) who should be checked for contamination.

[95] Resulting in early health effects or warranting long term medical screening.

— Assess likely exposures of public and workers since originating event

— Inform those assessed of the results, risk, and actions they should take.

Public information officer/team:

— Prepare for media attention once the event becomes publicly known.

— Provide media briefings from a single official source on the threat and appropriate and inappropriate public response actions (e.g. do not drink water) and actions being taken to ensure public safety, to protect products and international trade etc.; activate a PIC if needed (see Element A9.1).

National officials:

— Ensure all governmental agencies are informed of who is leading the response and that they receive an explanation of the risk and their role.

— Restrict national or international export of potentially contaminated water/food or items.

— Notify the IAEA if:

- the elevated levels are unusually high (for example, at least ten times above normal),
- there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).

IAEA:

— Respond to international inquiries.

— Assist in locating origin of contamination if suspected to arise from another State.

Credible or confirmed terrorist threats

Description

A credible threat (see Appendix 17) of committing a terrorist act perceived by the public or officials as a nuclear or radiological emergency. This could involve an RDD, contamination of places, food, water or products, exposure of people, sabotage, or attacks on facilities.

Potential hazards

For a description of the radiological hazards, see the potential hazards sections of the action guides for RDD, intentional contamination of water supplies, intentional contamination of food/products, theft of a dangerous source or public contamination / exposure. The objective of the perpetrators may be to create "terror" among the public with the resulting psychological and economic impact. Experience shows that the public's *perception* of the risk posed by the threat may be more important than the actual risk. Consequently, an important part of the response will be providing the public with timely, informative (understandable) and consistent information on the true risk.

Emergency response

Incident commander (lead first responder ⇒ local official⇒national official):

- Activate an integrated response (including law enforcement, investigative and public safety/radiation components) using the ICS (see Appendix 13) under an incident commander operating from an incident command post.
- Take actions to neutralize the threat such as:
  - apprehending suspects;
  - eliminating the opportunity to carry out the threat (e.g. improved security, establish means for early detection); or
  - removing the motive for the threat.
- Take action to mitigate the economic and psychological consequences of the threat, including provisions to promptly make a public announcement describing the hazard realistically and to limit the spread of contamination and contaminated products.
- Implement action consistent with international standards (see. Ref. [11]) to protect the public, workers, responders, and the economy from the actual or perceived radiological risk.
- Prepare secondary/simultaneous threats
- Prepare for bobby traps, a second devise intended to injure responders, a second devise intended to injure evacuees.
- Prepare for hoaxes once the threat is publicly known.
- Prepare to implement additional response actions using one of the following guides as appropriate:
  - RDD
  - Intentional contamination of water
  - Intentional contamination of food/products
  - Theft of a dangerous source
  - Public contamination/exposure
  - Serious overexposure
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).

Radiological assessment (radiological assessor⇒national team):

- Operate under the ICS incident commander.
- Prepare a radiation assistance team (radiological assessor) (see Element A3.1) to perform monitoring consistent with Ref. [11].
- If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State).

- Ensure operational guidance (OILs) is available for assessment and implementation of evacuation, relocation, medical follow-up and treatment of contaminated individuals, restriction of water and food and restriction of products and commodities. Provide a plain language explanation of the risk and appropriate public action with the guidance.
- Provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- If national radiological response resources are insufficient, request international assistance through the IAEA.

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Make provisions to implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):
  - establishing, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
  - identifying local medical facilities to be used for treatment of potentially contaminated/exposed victims. Brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.
  - Implementing provisions to assess the concerns members of the public (worried-well) who are concerned about radiation exposure/contamination (not at a hospital or other crucial facility).
- Prepare to provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the negligible risk to their staff.

Public information officer/team:

- Operate under the ICS incident commander.
- If the emergency receives media or public attention, implement media briefings from a single official source on the threat and appropriate public action. Activate a PIC if needed (see Element A9.1)[77].

IAEA provided assistance:

- Operate under the ICS incident commander.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Non-credible terrorist threats

Description

A non-credible (see Appendix 17) threat to commit a terrorist act perceived by the public as posing a radiological hazard.

Potential hazards

The objective of the perpetrators may be to create "terror" among the public with the resulting psychological and economic impact. Experience shows that the public's *perception* of the risk posed by the threat may be more important than the actual risk. These perceptions could result in significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution concerns are not promptly addressed.

Emergency response

Incident commander[96] (lead first responder ⇒ local official⇒national official):

- Ensure that all governmental agencies are informed of the results of assessment, the names of those leading the response and an explanation of their role.
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- Report to law enforcement criminal hoaxes for investigation.

Public information officer/team:

- Operate under the ICS incident commander.
- If the emergency receives media or public attention, implement media briefings from a single official source on the threat and appropriate public action; activate a PIC if needed (see Element A9.1)[77];

Incident investigator/team:

- Operate under the ICS incident commander.
- Conduct an investigation and further analysis to confirm the assessment of credibility.

[96] Typically from law enforcement.

Explosive radiological dispersal device (RDD)

Description

An RDD [97] has been or may be used to spread radioactive material or has been located before detonation.

Potential hazards

The greatest threat comes from the direct effects of an explosion rather than from radiation exposure or contamination. The greatest radiological hazard comes from inadvertent inhalation or inadvertent ingestion of the material dispersed by an explosion or fire or from handling radioactive debris or material in an unexploded device. There would only be a negligible radiological threat if less than dangerous quantities (see Appendix 8) are involved. An RDD containing quantities 10 or more times the criteria in Appendix 8 for a dangerous source would be required to result in dispersal of material that is life threatening to unprotected people. The inhalation hazard is probably limited to the plume (e.g. within the smoke) within 100 metres of the source of the release. Resuspension of Pu on the ground could be hazardous near the source. External contamination is probably not hazardous but inadvertent ingestion (e.g. by putting hands in the mouth) of contamination could be hazardous. Limited stays near the source in an unexploded RDD or large pieces of debris by response personnel should not be hazardous but holding such material could produce injuries in minutes. Fire fighters are generally equipped with respiratory protection that provides good protection against the inhalation hazard. Common radiation survey instruments can detect significant external exposure hazards but cannot detect significant inhalation hazards. There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution concerns are not promptly addressed. Excess, radiation induced, cancers should not be detected following this type of emergency, even for emergencies involving large amounts of radioactive material.

Emergency response

Incident commander[96] (lead first responder):

- Observe from a distance and assess all possible hazards- be aware of the potential for other bombs/devices/threats.
- Approach from upwind.
- Save lives and prevent/treat serious injuries before conducting radiological monitoring.
- Deal with the conventional hazard; request assistance from bomb experts (do not handle the device).
- Conduct immediate field assessment for indications that the device may be radioactive:
  - Was a threat received in advance?
  - Is there a message at the scene?
  - Radiation symbol? (Not a reliable indicator)
  - Gamma radiation levels significantly above background (> 1 μSv/h)98
- Prepare for bobby traps, a second devise intended to injure responders, a second devise intended to injure evacuees.
- Activate response using the ICS (see Appendix 13) co-ordinated under an incident commander near the scene. Establish the incident command post upwind[99], at a safe distance and in a secure area.
- If radiological terrorism is suspected/confirmed:
  - establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).
  - request assistance from law enforcement responders;
  - avoid the smoke or use standard inhalation protection while in the smoke; and ensure those approaching scene take action to prevent inadvertent ingestion of contamination (e.g. wear gloves, do not smoke- or eat).
  - request assistance from radiological assessor (see Element A9.1);
  - only approach the device or debris to protect lives until radiological assessment is performed; keep time in the immediate vicinity (< 1 m) of device to a minimum;

[97] A bomb containing radioactive material. The conventional bomb is used as a means to spread radioactive contamination. This includes unsophisticated improvised nuclear devices (INDs) that are not expected to result in a significant yield.
[98] There could be a significant radiological hazard even if gamma dose rates are at about background level (e.g, from Pu).
[99] Wind direction is often very variable especially in an urban area, thus this is a secondary concern.

- arrange to transport seriously injured people to local medical facility. If they may be contaminated, wrap them in a blanket to control the spread of contamination. Tell those transporting the victim and the receiving medical facility that the person may be contaminated and that the risk to those treating such a patient is negligible but care should be taken to prevent inadvertent ingestion of contamination.
- gather potentially exposed or contaminated people, who are not seriously injured, in a safe location (victim assembly point) to: register them, give them a medical and radiological evaluation (triage) and arrange for their treatment.
- get monitored by the radiological team before leaving;
- get equipment monitored before leaving the area.

Incident commander (local official⇒national official):

- Integrate the response (including law enforcement, investigative, radiological components and public safety/administration) using the ICS (see Appendix 13) (the incident commander should be a member of law enforcement).
- Ensure that all governmental agencies are informed of who is leading the response and that they receive an explanation of the risk and their role.
- Make arrangements to dispatch a radiation assistance team (radiological assessor) (see Element A3.1) to perform monitoring.
- Implement action to protect the public, workers, responders, and the economy from the actual or perceived radiological risk by implementing action consistent with international standards (see. Ref. [11]).
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- Once it becomes known to the public, implement provisions to address public concerns and to mitigate the economic and psychological consequences.
- Be prepared for hoaxes once the event is publicly known.
- If a lost or stolen dangerous source may be involved implement, as appropriate, the action guide for a **Theft of a dangerous source.**
- If significant public contamination is possible, implement, as appropriate, the action guide for **Public contamination.**
- If serious overexposure is suspected, implement, as appropriate, the action guide for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**
- Develop and implement a recovery and cleanup plan in order to return to normality (see Elements A12.1-4).

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):
  - establish, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
  - identify local medical facilities to be used for treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.
- Implement provisions to assess the concerns of members of the public (worried-well) about radiation exposure/contamination (not at a hospital or other crucial facility).
- Provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the risk (negligible) to their staff.

Public information officer/team:

- Operate under the ICS incident commander.
- Prepare for immense media attention once the emergency becomes publicly know.
- Provide media briefings from a single official source on the threat and the appropriate and inappropriate public response actions (e.g. who should be monitored and where to go) and actions being taken to ensure public safety, to protect products and international trade etc; activate a PIC if

needed (see Element A9.1)[77].

Radiological assessment (radiological assessor⇒national team): (See Element A3.1)

- Operate under the ICS incident commander.
- Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I) and Ref. [11].
- If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State).
- Prepare for bobby traps, a second devise intended to injure responders, a second devise intended to injure evacuees.
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.
- Establish radiological assessor base near the scene and activate an RMAC (see Appendix 14) if needed to co-ordinate radiological field operations.
- If national radiological response resources are insufficient – request international assistance through the IAEA.
- Protect evidence needed by law enforcement to the extent possible consistent with public protection including:
  - working with law enforcement;
  - preventing possible criminal acts at the scene (e.g. theft, introduction of contamination);
  - preserving documents, samples etc. associated with radiological response;
  - identifying and recording people involved.Ensure that law enforcement activities do not cause safety concerns.
- Ensure that law enforcement responders are provided with adequate protection as emergency workers.
- Ensure that the radiological response does not interfere with law enforcement (e.g. unnecessary interference with collection or preservation of evidence).
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).

IAEA resources (if provided):

- Operate under the ICS incident commander.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Intentional contamination of water supply

Description

Actual or potential contamination of public water supplies.

Potential hazards

It is probably impossible to contaminate a public water supply with a volume greater than 1000 m^3 to a level that would result in doses that are immediately life threatening, or that would warrant long term medical follow-up. It would be possible to contaminate water supplies to levels above the action levels recommended for emergencies [Table A1-III]. However, water contaminated to levels of 100 or more times these levels could be consumed safely[100] for a limited time. There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institution's concerns are not promptly addressed. Restrictions of the use of the water supply could result in public safety and sanitation concerns. Excess, radiation induced, cancers should not be detected following this type of emergency, even if large amounts of radioactive material are involved.

Emergency response

Incident commander (lead first responder ⇒ local official⇒national official):

- Integrate the response (including law enforcement, investigative, radiological components and public safety/administration) using the ICS (see Appendix 13). Operate from an incident command post near the scene.
- Conduct immediate field assessment for indications that there may be radioactive contamination:
  - Was a credible threat received?
  - Is there a message at the scene?
  - Radiation levels significantly above background (> 1 μSv/h)[101]
- If radiological terrorism is suspected/confirmed: Request assistance from radiological assessor;
  - Take action to prevent, delay, and reduce contamination of water supply if it will not have an immediate impact on public health or safety.
- Evacuate workers from potential areas with high levels of contamination (e.g. site where contamination may have been introduced) unless they are needed for continued safe operations.
- Restrict use of the water if replacement water is available.
- If replacement water is not available, allow use of levels up to 100 times the levels in Table A1-III for a short time.
- Inform the public of the risk; note that consumption at levels of the water is safe if levels are < 100 times those in Table A1- III.
- If water with contamination levels above the levels in Table A1-III are being used have the medical and radiological assessment teams conduct an assessment of the risks and make recommendations – this can be dose with consultation with IAEA.
- Prepare for hoaxes once the threat is publicly known.
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- If a lost or stolen dangerous source may be involved, implement, as appropriate, the action guide for a **Theft of a dangerous source.**
- If significant public contamination is possible, implement, as appropriate, the action guide for **Public contamination.**
- If serious overexposure is suspected, implement, as appropriate, the actions for **Serious overexposure.**

[100] Will not result in early health effects or require long term medical monitoring (see Element A8.5).
[101] There could be a significant radiological hazard even if gamma dose rates are at about background level (e.g. from Pu).

— If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**

Emergency medical responder/team:

— Operate under the ICS incident commander.

— Implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):

- establish, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
- identify local medical facilities to be used for treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.

— Implement provisions to assess the concerns of members of the public (worried-well) about radiation exposure/contamination (not at a hospital or other crucial facility).

— Provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the risk (negligible) to their staff.

Radiological assessment (radiological assessor⇒national team) (See Element A3.1):

— Operate under the ICS incident commander.

— Monitor for gamma, beta and alpha and establish an inner-cordoned area (safety distance) in accordance with Appendix 5 (Table A5-I).

— If there are indications that a dangerous neutron source (e.g. Cf-252, Be/Am well logging) may be involved obtain experts to conduct neutron monitoring (possibly with IAEA assistance if not available within the State).

— Promptly locate and keep people away from the significant source(s)/contamination in accordance with Ref. [11].

— Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).

— Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.

— Establish radiological assessor base near the scene and activate an RMAC (see Appendix 14) if needed to co-ordinate radiological field operations.

— Establish a system to take and analyse samples of potentially contaminated water at the source; use locations where contamination may have been introduced and possible contamination concentrators (e.g. filters).

— Estimate possible levels of contamination at the points of use, and time contamination will arrive there.

— Establish a process to control the dose to the water system processing workers.

— Identify members of the public and workers who should:

- be immediately decontaminated;
- be decontaminated as soon as reasonable;
- be released – no further action needed;
- get a medical follow-up because of possible exposures.

— Inform those assessed of the results, risk, and actions they should take.

— Protect evidence needed by law enforcement to the extent possible consistent with public protection including:

- working with law enforcement;
- securing the scene against possible criminal acts (e.g. theft, introduction of contamination);
- preserving documents, samples etc. associated with radiological response.

— Ensure law enforcement activities do not cause safety concerns.

— Ensure law enforcement responders are provided with adequate protection as emergency workers.

— Ensure that the radiological response does not interfere with law enforcement (e.g. unnecessary

interference with collection or preservation of evidence).

- If national radiological response resources are insufficient – request international assistance through the IAEA.

Public information officer/team:

- Operate under the ICS incident commander.
- Prepare for immense media attention once the emergency becomes publicly known.
- Provide media briefings from a single official source on the threat and appropriate and inappropriate public response actions (e.g. do not drink water) and actions being taken to ensure public safety, to protect products and international trade etc.; activate a PIC if needed (see Element A9.1)[77].

National officials:

- Operate under the ICS incident commander.
- Ensure all governmental agencies are informed of who is leading the response and that they receive an explanation of the risk and their role.
- Restrict national or international export of potentially contaminated water or items.
- Develop and implement a recovery and cleanup plan in order to return to normality (see Elements A12.1-4).

IAEA provided resources:

- Operate under the ICS incident commander.
- Respond to international inquiries on transnational emergencies.
- Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

Intentional contamination of food/products

Description

Actual or potential contamination of food and commercial products.

Potential hazards

Contamination of food/products resulting in significant exposure of large numbers of the public[102] is very unlikely. However, there is a potential for significant exposure to small numbers (e.g. contamination of products on store shelves) and to those working with or transporting the products/food. Contamination in excess of national and international standards for commodities is possible. Allowing contaminated or potentially contaminated products in the international or local distribution system could have large economic consequences. Excess cancers should not be seen following this type of emergency, even if large amounts of radioactive material are involved

There can be significant adverse and inappropriate public reaction (see Element A11.2) and economic consequences if public and financial institutions concerns are not promptly addressed.

Emergency response

Incident commander (lead first responder ⇒ local official⇒national official):

- Activate an integrated response (including law enforcement and radiological components) using the ICS (see Appendix 13) under an incident commander to implement actions to reduce any radiological, psychological, and economic impact.
- Ensure that all governmental agencies are informed of who is leading the response and that they receive an explanation of the risk and their role.
- Take actions to prevent contaminated products from entering the distribution system – consider cross contamination by use of common process or distribution systems. Keep people away from and remove potentially contaminated food or products from public use until they have been assessed.
- Track existing supplies through the distribution chain and recall all suspect products.
- Conduct national monitoring of potentially contaminated food, products and population to confirm adequacy of controls.
- Prepare for hoaxes once the threat is publicly known.
- Monitor public response and deal with inappropriate behaviour (see Element A11.2).
- Make arrangements to dispatch a radiation assistance team (radiological assessor) to perform monitoring and analyses (see Element A3.1).
- Provide measures to protect workers in the industry involved and emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Have the national competent authority notify potentially affected States and the IAEA if there are indications that other States or their citizens may be affected (Transnational emergency - see Element A2.15).
- If a lost or stolen dangerous source may be involved, implement, as appropriate, the action guide for a **Theft of a dangerous source.**
- If significant public contamination is possible, implement, as appropriate, the action guide for **Public contamination.**
- If serious overexposure is suspected, implement, as appropriate, the actions for **Serious overexposure.**
- If a dangerous source is to be recovered, implement, as appropriate, the action guide for **Recovery of an uncontrolled dangerous source.**
- Develop and implement a recovery and cleanup plan in order to return to normality (see Elements

[102] Resulting in early health effects or warranting long term medical screening.

A12.1-4).

Public information officer/team:

- Operate under the ICS incident commander.
- Prepare for immense media attention once the emergency becomes publicly known.
- Once the emergency receives media or public attention, implement media briefings from a single official source on the threat and the appropriate and inappropriate public response actions (e.g. who should be monitored and where to go) and actions being taken to ensure public safety, to protect products and international trade etc.; activate a PIC if needed (see Element A9.1).

Emergency medical responder/team:

- Operate under the ICS incident commander.
- Implement and manage the on-scene medical response, including (see Elements A8.4, A 8.5):
  - establish, with support from the radiological assessor, a victim assembly point near the scene of the emergency for medical and radiological triage – field treatment.
  - identify local medical facilities to be used for treatment of potentially contaminated/exposed victims; brief their staff on treatment of exposed and contaminated casualties and risks. Arrange, with the radiological assessor, to provide these local medical facilities with expert support, if needed, on radiological monitoring, decontamination and radiation protection.
- Implement provisions to assess the concerns of members of the public (worried-well) about radiation exposure/contamination (not at a hospital or other crucial facility).
- Provide medical advice and support to local medical community on treatment of contaminated/exposed individuals and the risk (negligible) to their staff.

Radiological assessment (Radiological assessor⇒national team) (See Element A3.1):

- Operate under the ICS incident commander.
- Take and analyse samples at possible locations were contamination may have been introduced.
- Determine if members of the public may have been exposed or if there may have been a spread of contamination.
- Estimate possible levels of contamination at the points of use, and time contamination will arrive there.
- Monitor for gamma, beta and alpha and establish a safety perimeter at 100 μSv/h and where there is a potential for significant alpha emitter contamination.
- Brief incident commander on risks and provide measures to protect emergency workers (including law enforcement) and control their dose (see Elements A6.7, A6.10).
- Provide support to medical response to include conducting radiological assessment at victim assembly point and arranging support for the medical facilities treating possibly contaminated victims.
- Establish radiological assessor base near the scene and activate an RMAC (see Appendix 14) if needed to co-ordinate radiological field operations.
- If national radiological response resources are insufficient – request international assistance through the IAEA.
- Establish a system to take and analyse samples of potentially contaminated food or products at their source; use locations and possible contamination concentrators (e.g. filters).
- Establish a process to control the doses to food or process workers.
- Identify members of the public and workers who should:
  - be immediately decontaminated;
  - be decontaminated as soon as reasonable;
  - be released – no further action needed;
  - get a medical follow up because of potential exposures.
- Inform those assessed of the results, risk, and actions they should take.
- Protect evidence needed by law enforcement to the extent possible consistent with public protection, including:
  - working in concert with law enforcement;

- securing the scene against possible criminal acts (e.g. theft, introduction of contamination);
- preserving documents, samples etc. associated with radiological response.

— Ensure law enforcement activities do not cause safety concerns.

— Ensure law enforcement responders are provided with adequate protection as emergency workers.

— Ensure that the radiological response does not interfere with law enforcement (e.g. unnecessary interference with collection or preservation of evidence).

IAEA provided resources:

— Operate under the ICS incident commander.

— Respond to international inquiries on transnational emergencies.

— Arrange for activation of appropriate ERNET teams if assistance is requested (see Element A8.4).

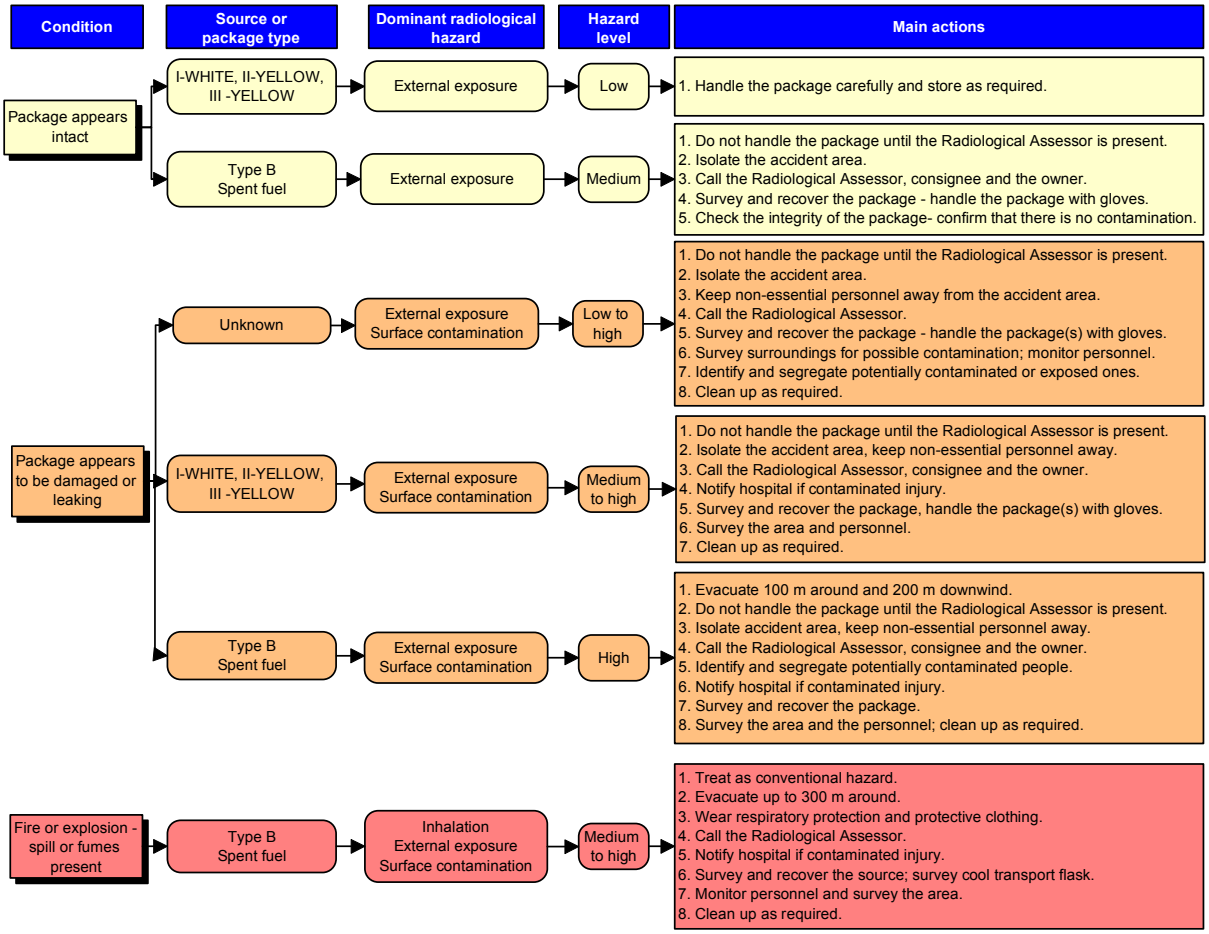

Figure A7-1 Overview of basic emergency management actions for transport emergencies involving radioactive material [Ref. 16].

Appendix 8

DANGEROUS QUANTITIES OF RADIOACTIVE MATERIAL

This information should not be used for irradiated fuel (e.g. reactor or spent fuel). In these cases Table III should be used to determine the threat category. Appendix 18 provides a plain language statement of the risk to the public for an uncontrolled dangerous source. Annex 1 provides some background information concerning the values in Table A8-I.

Step 1: For all materials calculate the following:

$$A / D_1 = \sum_i \frac{A_i}{D_{1,i}}$$

Where:

A_i is the activity (TBq) of each radionuclide over which control could be lost during an emergency/event.

$D_{1,i}$ from Table A8-I for each radionuclide i.

Step 2: For dispersible material [103] calculate the following:

$$A / D_2 = \sum_i \frac{A_i}{D_{2,i}}$$

Where:

A_i is the activity (TBq) of each radionuclide i that is in a dispersible form over which control could be lost during an emergency/event.

$D_{2,i}$ from Table A8-I for each radionuclide i.

Step 3: A mobile source or uncontrolled material is categorized as a 'dangerous source[104]' if either of the A/D values calculated above is greater than 1.

[103] Powders, gases, and liquids, and especially volatile (at temperature during emergency), combustible, water soluble and pyrophoric material, should be considered to be at risk of dispersal.

[104] It is possible, but unlikely, that a smaller amount could cause injuries. However, sources this large are considered sufficiently dangerous to warrant taking extraordinary measures (searches, public announcements) to secure them if control over them is lost (e.g. by being stolen or lost) and they could be in the public domain. See Appendix 18 for a plain language statement of the hazard.

Table A8-I D Values [TBq]

Sources and material [105]		
Radionuclide	**D_1 [106]**	**D_2 [107]**
H-3	UL[108]	2.E+03[109]
C-14	2.E+05	5.E+01
P-32	1.E+01	2.E+01
S-35	4.E+04	6.E+01
Cl-36	3.E+02	2.E+01[110]
Cr-51	2.E+00	5.E+03
Fe-55	UL	8.E+02
Co-57	7.E-01	4.E+02
Co-60	3.E-02	3.E+01
Ni-63	UL	6.E+01
Zn-65	1.E-01	3.E+02
Ge-68	7.E-02	2.E+01
Se-75	2.E-01	2.E+02
Kr-85	3.E+01	2.E+03[111]
Sr-89	2.E+01	2.E+01
Sr-90 (Y-90)[112]	4.E+00	1.E+00
Y-90	5.E+00	1.E+01[113]
Y-91	8.E+00	2.E+01
Zr-95 (Nb-95m/Nb-95)[112]	4.E-02	1.E+01
Nb-95	9.E-02	6.E+01
Mo-99 (Tc-99m) [112]	3.E-01	2.E+01[113]
Tc-99m	7.E-01	7.E+02[113]
Ru-103 (Rh-103m) [112]	1.E-01	3.E+01

[105] The amount of material if not controlled in the public domain (i.e. allowing removal of shielding or allowing dispersal) that could give rise to exposure resulting in a permanent injury that would decrease the quality of life. Appendix 18 provides a plain language statement of the risk to the public for an uncontrolled dangerous source.

[106] This is for external exposure and applies to both dispersible and non-dispersible materials. It is the amount of material without shielding that, if carried in a pocket for 10 hours could result in a severe injury (deliver 25 Gy at 2.0 cm in 10 hours) except where the amount needed would be too big to put in a pocket for which it is the amount that could be life threatening if people are near it for a long time (days–weeks) (deliver 0.01 Gy/h at 1 m). Both gamma emissions and bremsstrahlung from beta and conversion electrons were considered. They were based, except for neutron sources, on absorbed dose coefficients from Ref. [48].

[107] This is the quantity of material that if dispersed could deliver long term doses that could result in permanent injuries that decrease the quality of life. Airborne dispersal by fire or explosion, inadvertent ingestion and intentional contamination of water was considered. For low LET emitters, quantities that can result in 6 Gy to the lung, 1 Gy to the red bone marrow, or 5 Gy to the thyroid delivered over two days [2, 3, 47] following intake and for high LET emitters (e.g. alpha) quantities that can deliver 25 Gy to the lung over one year [46] were considered to deliver long term doses that are at the threshold for the onset of permanent injuries that would decrease the quality of life. The absorbed doses from intake were, except for Cf-252, based on absorbed dose coefficients from Ref. [48].

[108] UL - Unlimited quantity - Emergency planning for dealing with radiological consequences is not recommended.

[109] Assumes skin absorption doubles the absorbed dose from intake via inhalation.

[110] Emergencies involving these amounts of these radionuclides may result in airborne concentrations exceeding the immediate danger to life or health (IDLH) [35] concentration for chemical toxicity. Emergency arrangements to deal with the chemical toxicity and perceived risks may be warranted.

[111] The amount of Kr-85 that can deliver 1 Gy from submersion in 0.5 hours if 100% is released into a $300m^3$ room – the exposure scenario from Ref. [42].

[112] It was assumed that this source is up to 10 years old at the time of the emergency and that the D value is the quantity of the parent remaining at the time of the emergency. The D values were calculated considering both the parent and important decay products that are present after up to 10 years (radionuclide shown in parenthesis). Decay products with a half-life of less than 1 year can be assumed to be in equilibrium with their parents.

[113] Not a long term concern as it is short lived (has a half life of less than about 7 days) and within one month (and in most cases much less), the radiological hazard will be greatly diminished.

Sources and material [105]		
Radionuclide	**D_1 [106]**	**D_2 [107]**
Ru-106 (Rh-106) [112]	3.E-01	1.E+01
Pd-103 (Rh-103m) [112]	9.E+01	1.E+02
Cd-109	2.E+01	3.E+01
Te-132 (I-132) [112]	3.E-02	8.E-01 [113]
I-125	1.E+01	2.E-01
I-129	UL	UL [110]
I-131	2.E-01	2.E-01 [113]
Cs-134	4.E-02	3.E+01
Cs-137 (Ba-137m) [112]	1.E-01	2.E+01
Ba-133	2.E-01	7.E+01
Ce-141	1.E+00	2.E+01
Ce-144 (Pr-144m, Pr-144) [112]	9.E-01	9.E+00
Pm-147	8.E+03	4.E+01
Eu-152	6.E-02	3.E+01
Eu-154	6.E-02	2.E+01
Gd-153	1.E+00	8.E+01
Tm-170	2.E+01	2.E+01
Yb-169	3.E-01	3.E+01
Re-188	1.E+00	3.E+01
Ir-192	8.E-02	2.E+01
Au-198	2.E-01	3.E+01
Hg-203	3.E-01	2.E+00
Tl-204	7.E+01	2.E+01
Po-210	8.E+03	6.E-02
Ra-226 (progeny) [112]	4.E-02	7.E-02
Th-230	9.E+02	7.E-02 [110]
Th-232	UL [108]	UL [108, 110]
U-232	7.E-02	6.E-02 [110]
U-235 (Th-231) [112]	8.E-05 [114]	8E-05 [114]
U-238	UL [108]	UL [108, 110]
U Natural	UL [108]	UL [108, 110]
U Depleted	UL [108]	UL [108, 110]
U Enriched > 20 %	8E-05 [114]	8E-05 [114]
U Enriched > 10 %	8E-04 [114]	8E-04 [114]
Np-237 (Pa-233) [112]	3.E-01 [115]	7.E-02
Pu-238	3.E+02 [114]	6.E-02
Pu-239	1.E+00 [114]	6.E-02
Pu-239/Be [116]	1.E+00 [114]	6.E-02
Pu-240	4.E+00 [114]	6.E-02
Pu-241 (Am-241) [112]	2.E+03 [114]	3.E+00
Pu-242	7.E-02 [114]	7.E-02 [110]
Am-241	8.E+00	6.E-02

[114] There is no immediate radiation hazard from this material; the D value is established at a level that places them in "Nuclear Material Category II" according to Ref.[45] (10 kg for 10 % U-235; 1 kg for 20% U-235, or 0.5 kg for Pu). These amounts are about one tenth of the amount at which there is a criticality threat. They warrant an immediate response to promptly regain control of lost or stolen material. These and lesser amounts should be physically protected in accordance with Ref. [45].

[115] The D value represents a radiological and criticality hazard and is set at one half of the critical mass limit in Refs [43, 44].

[116] Neutron generator.

Sources and material [105]		
Radionuclide	**D_1 [106]**	**D_2 [107]**
Am-241/Be[116]	1.E+00	6.E-02
Cm-242	2.E+03	4.E-02
Cm-244	1.E+04	5.E-02
Cf-252	2.E-02	1.E-01

Appendix 9

INFORMATION NEEDS FOR THE PLANNING PROCESS

This is the information that should be collected when developing the planning basis (see Section 2.2.6).

Threat category					Information needed before planning begins
I	**II**	**III**	**IV**	**V**	
National laws/regulations:					
✓	✓	✓	✓	✓	Laws or acts assigning responsibility for co-ordination of conventional (natural and criminal) and radiological response (military, licensed and sources of unknown origins)
✓	✓	✓	✓	✓	Laws or regulations establishing criteria for food quality, import quality, worker protection, public health, radiation protection and environmental protection
✓	✓	✓	✓	✓	International agreements governing international trade or response to international emergencies (e.g. Assistance Convention, regional transport agreements)
✓	✓	✓	✓	✓	Bilateral and multilateral emergency response agreements
Organization or person responsible for:					
✓	✓	✓	✓		Co-ordination for facility or operator planning
✓	✓	✓	✓	✓	Co-ordination for national radiological planning (national co-ordinating authority)
✓	✓	✓	✓	✓	Co-ordination for national conventional response planning
✓	✓	✓			Co-ordination for local off-site planning (radiological and conventional)
✓	✓		✓	✓	Notification of other States and requesting international assistance
✓	✓		✓		Making decisions on urgent protective actions
✓	✓		✓		Implementing urgent protective actions
✓	✓		✓		National co-ordination of emergency service standards and training
✓	✓	✓	✓		Providing emergency service support
✓	✓	✓	✓		Providing response to criminal activities (tactical response and investigation)
✓	✓			✓	Making decisions on longer term and ingestion protective actions
✓	✓			✓	Implementing longer term and ingestion protective actions
✓	✓	✓	✓	✓	Co-ordination with the media
✓	✓		✓	✓	Off-site monitoring and laboratory analysis capabilities
Facility or operator information:					
✓	✓	✓			Emergencies that could result in on-site exposure or off-site release warranting protective actions

✓	✓	✓			Information in facility that can give prior warning of release or potential exposure
✓	✓	✓			Typical radiological composition and timing of a release
✓	✓	✓			Radiological and other environmental conditions in the facility during a response
✓	✓	✓			Actions in the facility that could be taken to mitigate the emergency or reduce a release
Off-site general information:					
✓	✓	✓			Medical, police and fire fighting support available
✓	✓				Typical sheltering available in the UPZ
✓	✓				Typical transportation available for evacuation within the UPZ
✓	✓	✓	✓	✓	Communications available for decision makers
✓	✓	✓	✓	✓	Communications available to alert and inform the public
✓	✓			✓	Locally produced food and milk that may be directly contaminated
✓	✓			✓	Information on agricultural product collection and distribution system
✓	✓			✓	Drinking water supply systems
✓	✓				Population distribution
✓	✓				Special populations (e.g. hospitals) and transients within UPZ
✓	✓				Special facilities (e.g. factories that can not be evacuated) that may be affected by an emergency
✓	✓				Transportation systems that may be affected by an emergency (e.g. road, rail, air, sea, canals)
✓	✓			✓	Points of import and export of food
Off-site environment conditions:					
✓	✓	✓	✓	✓	Range of weather conditions under which protective actions and monitoring may be conducted
✓	✓	✓	✓	✓	Severe conditions that may result in an emergency

Appendix 10

RESPONSE TIME OBJECTIVES

These are suggested time objectives for selected critical response functions or tasks. They form part of the objectives for a response capability once established and can be used as part of the evaluation criteria for exercises.

Element/task	Threat category I facility			Threat category II facility			Threat category III facility	
	Facility	**Local**	**National**	**Facility**	**Local**	**National**	**Facility**	**Local**
ESTABLISHING EMERGENCY MANAGEMENT OPERATIONS (A1 ELEMENTS)								
OSC functional	< 30 min							
EOF /ICP activated	< 1 h	<1 h		< 1 h	< 1 h			< 2 h
EOF /ICP fully functional (all organizations represented)	< 2 h	< 2 h		< 2 h	< 2 h			< 3 h
IDENTIFYING, NOTIFYING AND ACTIVATING (A2 ELEMENTS)								
Classify the emergency	< 15 min.			< 15 min.			< 15 min.	
Notify local (PAZ and UPZ) authorities after classification	< 30 min.			< 30 min.			< 1 h	
Fully activate emergency organization[117]	< 2 h	< 6 h	< 12 h	< 2 h	< 6 h		< 2 h	
Notify all States in the UPZ			< 1 h			< 1 h		
Notify potentially affected States the IAEA			< 2 h			< 2 h		
PERFORMING MITIGATORY ACTIONS (A3 ELEMENTS)								
Initiate mitigation actions	< 15 min.			< 15 min.			< 15 min.	
Provide technical assistance to the on-site responders (activate TSC)	< 1 h							

[117] The components of the response organizations should be activated in time to perform their functions consistent with the recommendations elsewhere in the checklist.

Element/task	Threat category I facility			Threat category II facility			Threat category III facility	
	Facility	**Local**	**National**	**Facility**	**Local**	**National**	**Facility**	**Local**
Provide on-site damage control teams	< 30 min.			< 1 h			< 1 h	
Obtain off-site emergency services support	< 30 min			< 30 min			< 30 min	
TAKING URGENT PROTECTIVE ACTION (A4 ELEMENTS)								
Recommend urgent protective actions for the public based on emergency classification	< 30 min			< 30 min.				
Make decisions on urgent protective actions[118]	< 30 min	< 30 min		< 30 min.	< 30 min.			
Complete implementation of facility protective actions	< 1 h			< 1 h			< 1 h	
PROVIDING INFORMATION AND ISSUING INSTRUCTIONS AND WARNINGS TO THE PUBLIC (A5 ELEMENTS) AND KEEPING THE PUBLIC INFORMED (A9 ELEMENTS)								
Initially warn and inform the public within the PAZ and UPZ of urgent protective actions required [118].		< 1 h			< 2 h			
Activate the PIC and commence co-ordinate (facility and offsite officials) briefing for the media.		< 4 h			< 4 h			< 6 h
ASSESSING THE INITIAL PHASE (A6 ELEMENTS)								
Conduct environmental monitoring near the facility	< 1 h			< 1 h			< 2 h	
Conduct environmental monitoring within PAZ, near facility		< 4 h						
Conduct environmental monitoring within UPZ		< 12 h	< 12 h		< 12 h	< 12 h		
RMAC fully functional		< 24 h			< 24 h			

[118] The time beginning when the initial notification is received from the facility.

Appendix 11

URGENT PROTECTIVE ACTIONS FOR THREAT CATEGORY I AND II FACILITIES

Threat category	Suggested protective action
I	**General emergency:** - Promptly evacuate or provide special shelter[119] for the public and non-essential workers on site. - Promptly evacuate or provide substantial shelter[120] for the public in the PAZ (in all directions). - For reactors, provide iodine prophylaxis (thyroid blocking) within PAZ and UPZ. - Recommend to the public within UPZ that they remain indoors and listen to the radio for further instructions (in-place sheltering). - Promptly conduct monitoring within UPZ (include shelters in PAZ) to determine where OILs may be exceeded and evacuate if appropriate. - Restrict consumption of potentially contaminated food within food restriction planning radius until monitored and provide instruction to protect agriculture products. - Restrict access to the evacuated area. - Monitor a sample of the evacuated people and determine if decontamination or medical treatment is needed.
II	**General emergency:** - Recommend to the public within UPZ to remain indoors and monitor the radio for further instructions. - Promptly conduct monitoring of UPZ to determine where OILs may be exceeded and evacuate if appropriate. -Restrict consumption of potentially contaminated food within the food restriction planning radius until monitored. - Restrict access to the evacuated area. - Monitor a sample of the evacuated people and determine if decontamination or medical treatment is needed.
I & II	**Site area emergency:** - Provide instructions to protect agriculture products within the food restriction planning radius.

[119] Special shelters are designed to provide inhalation and shine dose protection (shielding and filtering).
[120] Substantial sheltering is provided in large multistorey structures without any special features.

Appendix 12

OUTLINES OF EMERGENCY PLANS AND PROCEDURES

The response to a radiation emergency may be caused by or may involve different types of hazards, including natural (e.g. storms), technological (e.g. radiation), biological or criminal activity (e.g. theft, sabotage, terrorist attacks). The response to each of these hazards probably involves different response organizations with their own response terminology, cultures and plans. Consequently, the plans and procedures for response to all hazards should be structured into a coherent and interlocking system (see Figure 4 in Section 2.1.7).

The composition and size of a response may vary considerably from one emergency to another, involving elements from the national, regional, local and operator levels and conventional response organizations such as law enforcement. Emergency preparations should allow for the response elements from all these levels and organizations to be quickly integrated, expanded or contracted to meet the requirements of the particular emergency. Consequently, plans at all these levels must have compatible:

(1) terminology;
(2) concepts of operations;
(3) emergency operations management;
(4) organization and functional descriptions;
(5) co-ordination, activation and integration;
(6) facilities, communications;
(7) procedures, methods and equipment used for performing common or integrated tasks;
(8) training and exercises; and
(9) maintenance and quality assurance.

The following are outlines of proposed plans and implementing procedures. The plan outlines presented here take essentially a “process” approach for developing an emergency plan, to respond to an emergency (Section 3 of the plans) and to develop and maintain a response capability (Section 4 of the plans). The plans should contain information that other organizational elements (e.g. States, ministries, local governments facilities, teams) need in order to develop an effective response capability and to ensure that the plans are compatible. Detailed information or information that may change frequently should be provided by reference to other publications available to planners. Other formats or structures can be entirely adequate provided that they are comprehensive and compatible in the above areas with the other national and local emergency plans. Information for completing various sections of the plans is provided in *italicized text*. Important emergency preparedness elements from Section 4.2 are referenced in curved brackets. However, the plans should address all the appropriate elements in Section 4.2.

A12.1 NATIONAL RADIATION EMERGENCY PLAN (NREP) OUTLINE

The NREP provides the basis for emergency preparations by both local and national response organizations.

TITLE (COVER) PAGE

On the title (cover) page write the title of the plan, approval date, version number and signatures. The signatures should include the heads of all the participating organizations.

CONTENTS

1. INTRODUCTION

1.1 Purpose

Describe the purpose of the plan, for example: "The NREP provides the basis for a national level response to a radiation emergency that is effectively integrated with an accompanying international, national and local response."

1.2 Participating organizations

List all organizations participating in the NREP. This should include all national level organizations and also non-governmental organizations (NGOs), that may be a significant part of a response to an emergency involving a radiation hazard, and should include those responsible for response to conventional emergencies and criminal activities.

1.3 Scope

Describe the scope of the plan, for example: "The NREP addresses the response to an actual or perceived radiation hazard involving a national response in order to:

1. *provide co-ordination of a response involving multi-jurisdictions or significant national responsibilities; or*
2. *provide national support to local governments.*

The plan does not provide sufficient detail for an adequate response. This level of detail should be contained in procedures that are developed based on the plan.

1.4 Legal basis (see Element B1.1)

List the national laws, codes or statutes that define responsibility for planning, decisions and actions governing the response to radiation and conventional emergencies and criminal activities (see Task 1, Section 2.2.4).

1.5 Related plans and documents

Give a brief description of how the NREP relates to other major national plans that may be used along with the NREP, including those for response to conventional emergencies and criminal activates. Provide a complete list of all the supporting documents in an appendix.

2. PLANNING BASIS

2.1 Types of threats

Give a brief description of the radiation threats that were considered in developing the plan. This should be a summary of the results of the threat assessment discussed in Section 2.2.5 and should include findings on uncontrolled source emergencies (see Element B4.2) and other appropriate threats discussed in Section 4.1. In appendices or other referenced documents list and show on a map any threat category I, II and III facilities and local jurisdictions which fall within emergency zones (see Task 2, Section 2.2.5) or food restriction planning radius.

2.2 Terms

Refer to an appendix for standard definitions of terms that should be used consistently in other plans and procedures in order to promote co-ordination. Where possible, the terms used by the organizations involved in the response to conventional emergencies should be adopted.

2.3 Response roles and responsibilities (see Element B1.2)

Describe the roles and responsibilities of national and local response organizations (see Section 2.2.4). This could be accomplished by a table showing the organizations: 1) responsible for authorizing/activating the national response, 2) directing the total national response, and 3) responsible for the different functional areas listed in Sections 3 and 4. This table should show how responsibilities could differ (see Element B1.1) under different conditions such as: the source of the radiation hazards (e.g. licensed practice/material, natural material, international, military, unknown); or simultaneous involvement of other emergency plans or hazards (e.g. major natural disaster or criminal activity: see Element B4.4). This could be based on the result of the allocation of responsibilities described in Section 2.2.7. Describe how responsibilities are delegated or transferred (see Element B1.4) and the responsibilities of local response organizations and the operators and conditions when these may change (see Elements B1.2, B4.2).

2.4 Response organization

Provide a block diagram of the national level response organization components (sections, groups and teams) with a brief description of responsibilities of each "block" and where the organizational element will probably perform (see Appendix 14 and Element B1.3). The emergency response organization structure discussed in Appendix 13 should be used for the national and local response organizations to foster integration. It should show how the national level response interfaces with the response of other organizations (see Element B2.1).

2.5 Response facilities (see Element B5.1)

Describe the response facilities that may be functional during a response. This should include, as appropriate, those described in Appendix 14 (see Elements B5.4, B5.5).

2.6 Response communications (see Elements B4.6, B5.1)

Describe the communications system to be used during an emergency, which should include provision to ensure continued inter-compatibility with those used by other response organizations.

2.7. Logistics/resource commitments (see Elements B4.6, B5.1)

Describe the arrangements, including the organizational component responsible during a response for providing logistics support, for prompt procurement of needed supplies and services, possibly bypassing normal procurement arrangements. Describe the resources of government agencies and other organizations that will be made available to meet their obligations under the plan or that could be provided as assistance to local governments or other States. Describe the conditions under which resources will be provided.

2.8 Concept of operations

Give a brief description of the ideal response to the various types of radiation emergencies. Section 4.1 provides examples.

3. EMERGENCY RESPONSE PROCESS

Describe the national response arrangements process to perform the response functions listed in the subsections below, providing an appendix with detailed information needed by other organizations to develop compatible response arrangements. Identify which organizational component (section, group, team or position) within the response organization will be responsible for all or part of the performance of these functions (see Appendix 13).

3.1 Notification, activation and request for assistance

Describe the arrangements and process for notification, activation, and deployment of national response resources (see Element A2.12). This should include how decisions will be made to activate or deploy for: 1) emergency class declaration or notification of an emergency (see Elements A2.1, A2.2); 2) a request for assistance; 3) an event not addressed in the plans (see Element A2.13;) and 4) notification by the IAEA or other State of a transnational emergency (see Elements A2.14, A2.15). Describe arrangements to receive and authenticate the notification (notification points, warning points) (see Elements A2.1, A2.7, A2.14, A2.15). Describe the arrangements for local governments to request national assistance.

3.2 Emergency management (see Section 2.2.4)

Describe the command and control system (see Element A1.4) used to manage the response, including responses involving several different national (see Element A1.3, B3.3) (e.g. for response to conventional emergencies and criminal activity), international (see Element A1.5, A2.14, A2.15) and local plans. The system should have a unified command system (ICS), as described in Appendix 13, which should be used at all levels (national–local) to allow maximum flexibility (see Element B1.3). Describe how authority would be transferred (see Element B1.3).

3.3 Performing mitigation

Describe the arrangements to provide expertise and services in radiation protection promptly to assist local officials and first responders (see Element A3.1) in mitigating an uncontrolled source emergency and in searching for lost sources (see Element A3.4).

3.4 Taking urgent protective action

Describe the arrangements for providing support to local officials taking urgent protective actions. Any national role must support prompt decision-making. Local officials should make these decisions in most cases (see Element A4.5).

3.5 Providing warnings and instructions to the public

Describe the national role in providing information, warnings or instruction to the public for regional or national emergencies (see Elements A5.2, A5.3) such as for a large release or loss of a dangerous source (see Element A3.4).

3.6 Protecting emergency workers

Describe the arrangements for protecting emergency workers (including those responding to the scene from agencies with no radiological expertise or who are recruited during the response) and for supporting local governments in protecting their workers (see Elements A6.7, A6.8, A6.10). Provide the criteria in an appendix. Describe the arrangements for providing for legal protection (e.g. protection from being personally liable for actions taken while responding) and social welfare (e.g. compensation for injuries) of responders.

3.7 Provide medical assistance and mitigating the non-radiological consequences

Describe the arrangements to make medical personnel nationwide aware of the medical symptoms of radiation exposure and of the appropriate immediate action (see Element A8.1). Describe the arrangements to treat people who may suffer severe deterministic health effects from exposure or contamination (see Element A8.4). Describe the arrangements to assess exposure incurred by members of the public and workers (see Element A6.9) and to make the results publicly available (see Element A9.2). Describe arrangements for identification, tracking and long term medical monitoring and treatment for those groups of people who are at greater risk of getting cancer as a result of radiation exposure (see Element A8.5). Describe the arrangements for responding to concern, anxiety, distress and inappropriate actions on the part of workers and the public (see Element A11.2). Describe the arrangements for requesting international assistance in providing treatment of severely exposed/contaminated individuals.

3.8 Assessing the initial phase

Describe the national arrangements for providing support to local officials in assessing the radiological situation during the initial phase of a radiation emergency (see Elements A7.3, A7.4).

3.9 Keeping the public informed (media relations)

Describe the arrangements for co-ordinating information from the national level with that from local government, the operator and the IAEA in order to ensure the information provided to the public through the media is timely, consistent and helpful. This is best

accomplished by use of a single spokesperson or joint briefings at a public information centre (see Appendix 14) near the scene of the emergency as soon as possible (see Elements A9.1, A9.2).

3.10 Taking agriculture, ingestion and longer-term countermeasures.

Describe the national arrangements for: taking agricultural countermeasures within the food restriction radius (see Element A10.2); implementation of temporary relocation (for States with territory near a threat category I or II facility) (see Element A10.3); and management of radiation waste (see Element A10.5).

3.11 Conducting recovery operations

Describe the arrangements for the transition from emergency phase operations to routine long term recovery operations (see Element A12.1) and for cancelling restrictions and other arrangements imposed during the emergency phase of the response (see Element A12.2).

3.12 Financing operation

Describe the system for financing of operations and reimbursement of organizations that provide support during a response. This could be that the cost of each government agency's participation in support of the plan is the responsibility of that organization, unless other agreements exist.

3.13 Maintaining records and management of data

Describe the arrangements to ensure that relevant information is recorded and retained for use in evaluations conducted after the emergency, and for long term health monitoring and follow-up of emergency workers and members of the public who may be affected (see Element A7.5).

4. EMERGENCY PREPAREDNESS PROCESS

Describe the arrangements used to perform the preparedness functions listed, which are needed to develop and maintain the capability to respond to an emergency. Identify which organizational component (section, group, team or position) within the response organization will be responsible for all or part of the performance of these functions.

4.1 Authorities and responsibilities

Describe the arrangements for developing and maintaining the NREP and supporting infrastructure.

4.2 Organization

Describe the arrangements for selection and recruitment of adequate numbers response personnel (see Elements B2.3, B2.4).

4.3 Co-ordination

Describe the arrangements used to ensure that planning is continually co-ordinated with other planning efforts at the national and local level (see Element B3.3). This should include

co-ordination with the planning for response to conventional emergencies and criminal activities and provision to ensure that intercompatibility of equipment (e.g. communication frequencies), concepts (e.g. command and control) and methods (e.g. monitoring) is maintained where appropriate. This should include the designation of a national co-ordinating authority (see Elements B3.1, B3.2) and possibly an "emergency preparedness committee" which ensures the co-ordination of all planning efforts between ministries, local governments, agencies, facilities and operators.

4.4 Plans and procedures

Describe the arrangements for production, distribution and maintenance of the plan and supporting procedures and documents.

4.5 Logistical support and facilities (see Element B5.1)

Describe the arrangements for ensuring the availability of the logistical support and facilities (see Appendix 14) needed to execute the plan. A list of the resources available and the agencies/organizations that provide them should be provided in an appendix.

4.6 Training (see Element B6.1)

Describe the arrangements for ensuring adequate training for personnel responding under the plan.

4.7 Exercises (see Element B6.3)

Describe the arrangements for the preparation and conduct of emergency preparedness exercises (see Elements B6.3, B7.3).

4.8 Quality assurance and programme maintenance

Describe the arrangements to ensure a high degree of availability and reliability of all personnel, training, supplies, equipment, communication systems and facilities necessary to perform the functions specified in the plan and the arrangements to maintain, review and update the plan, procedures and other arrangements and to incorporate lessons learned from research, operating experience (such as response to emergencies) and emergency drills and exercises (see Element B7.1).

REFERENCES

LIST OF ABBREVIATIONS

DISTRIBUTION LIST

List (and distribute to) all individuals/organizations that are parties to the plan or that will be developing response arrangements that should be consistent with the plan.

APPENDICES

Appendix 1 - Authorities, responsibilities and capabilities of national agencies, ministries and organizations

List all major ministries and agencies that play a role in the development, maintenance or implementation of the NREP, along with their authorities and responsibilities, main capabilities and major resources. This Appendix should include responsibility for performance of the critical tasks listed in Section 3.

Appendix 2 - Table of international legal authorities and agreements

List international legal authorities, conventions, agreements (bilateral, multilateral) and standards important for the response. (See Element B1.3)

Appendix 3 - National guidance

Provide detailed national guidance or refer to documents providing such information needed by other planners in order to develop compatible plans and procedures, including:

(1) national information for first responder (see Elements A2.2, A2.3, A6.4) and medical practitioners (see Element A8.1);

(2) national emergency classification system and appropriate response for each class (see Elements A2.4, A2.6, A2.10, B4.6);

(3) national intervention levels and OILs for taking urgent protective actions (see Element A4.1);

(4) national guidance and OILs for protection of emergency workers (see Elements A6.1, A6.3);

(5) national intervention levels and OILs for agriculture countermeasures (see Element A10.1);

(6) national intervention levels and OILs for restrictions on foodstuffs and water (see Element A10.1); and

(7) *national intervention levels and OILs for relocation (see Element A10.1).*

Appendix 4 - Emergency planning maps

Provide (or refer to documents providing) maps showing the locations of threat category I, II and III facilities (including threat category I and II facilities in nearby States), boundaries of the PAZ, UPZ and food restriction radius, other areas of interest or concern, and emergency facilities.

Appendix 5 - Facilities and specialized radiological resources

List (or refer to documents listing) major facilities (see Appendix 14) and radiological resources that are needed to implement the plan and that may be provided to support local governments and the organizations responsible for providing them. This should include, as appropriate, the response teams listed in Appendix 15. List organizations (e.g. research reactors, universities) that could be sources of additional specialized personnel and equipment.

Appendix 6 - Event specific co-ordination

Provide (or refer to documents providing) a description of how the radiological response will be co-ordinated with the pre-planned response for:

(1) threat category I and II facilities – co-ordination with the response of the site and local jurisdictions;

(2) terrorist and criminal threats and acts – co-ordination with national and local law enforcement; and

(3) natural disasters/emergencies – co-ordination with the response for storms, food, wild fires, and earthquakes.

Appendix 7 - Supporting documentation/plans

List all the supporting documentation/plans relevant for maintenance and implementation of the plan. This should include the plans for various functional areas such as: command and control, logistical and financial support, public affairs, radiological monitoring and assessment and medical management and response.

Appendix 8 - Preparedness and response terms

Provide a glossary of terms that should be used consistently in the national and local response plans and procedures in order to integrate the response effectively during an emergency. This should include consistent definitions for parts of the organization, facilities, and response stages.

A12.2 PARTICIPATING ORGANIZATIONS OR LOCAL GOVERNMENT EMERGENCY PLAN OUTLINE

This outline is for the plans of the governmental organizations and NGOs that will respond under the NREP and for the local governments (jurisdictions) that have territory within the emergency zones of a threat category I or II facility or that contains a threat category III facility.

TITLE (COVER) PAGE

On the title (cover) page write the title of the plan, approval date, version number and signatures. The title should clearly indicate the organization or jurisdictions (e.g. province) addressed by the plan. The signatures should include those of the heads of any participating organizations, such as the local fire brigade.

CONTENTS

Give a brief description of the characteristics of radiation threats that are important in the organizations' planning. See the outline for the NREP (Section A12.1). If the plan is for a jurisdiction around a threat category I, II or III facility, summarize the characteristic emergencies postulated for that facility.

2.2 Terms

See the outline for the NREP (Section A12.1) for guidance.

2.3 Response roles and responsibilities (see Element B1.2)

Describe the roles and responsibilities of organizations that participate in this plan. This should discuss responsibility for authorizing/activating the plan and directing the total local (jurisdiction's or organization's) response. It should show how responsibilities could differ (see Element B1.2) under different conditions (see Element B4.4). Describe how responsibilities are delegated or transferred (see Elements B1.2, B1.4, B4.2). See the outline for the NREP (Section A12.1) for related guidance.

2.4 Response organization

Provide a block diagram of the response organization components (sections, groups, teams or positions) with a brief description of responsibilities of each "block" and the emergency facility (see Appendix 14) where these organizational elements will probably be performed (see Element B1.3) their responsibilities. The organization structure discussed in Appendix 13 should be used. A detailed discussion of authorities, responsibilities, and duties of the organizational components should be provided in the implementing procedures for the component.

2.5 Response facilities (Element B5.1).

See the outline for the NREP (Section A12.1) for guidance

2.6 Response communications (see Elements B5.1, B4.6)

See the outline for the NREP (Section A12.1) for guidance.

2.7 Logistics/resource commitments (see Elements B5.1, B4.6)

See the outline for the NREP (Section A12.1) for related guidance

2.8 Concept of operations

Give a brief description of the ideal response of your organization in the context of the total response. Section 4.1 provides examples.

3. EMERGENCY RESPONSE PROCESS

Describe the arrangements for the organization to perform its functions assigned under the NREP or for local jurisdictions to carry out the functions listed in the following subsections, and, where appropriate, to co-ordinate them under the NREP. Identify the response organization component responsible for performing the functions. Refer to the appropriate

implementing procedures that will be used during an emergency to carry out each function. See the outline for the NREP (Section A12.1) and elements of Section 4.2 indicated for related guidance.

3.1 Notification, activation and request for assistance (see Element B4.6)

Describe the tasks and responsibilities for notification, activation, and deployment of the local response jurisdiction or organization (see Element A2.13). Describe how decisions will be made to activate or deploy the response upon notification of activation under the NREP and include an emergency classification system to be used for prompt activation of response consistent with that in the NREP. Describe the level of activation and immediate action to be taken by various components of the response organization for each possible emergency class (see Elements A2.1, A2.4), for requests for assistance (e.g. from a threat category I, II or III facility) or for an event not addressed in the plan (see Element A2.13). Describe how national authorities will be notified of an emergency. The call lists used for activation and notifications should be part of the procedures. In local jurisdiction plans, describe the arrangements to have a notification point available continuously (see Elements A2.1, A2.8) to receive and react to a notification from a facility.

3.3 Emergency management

Describe the command and control system (see Element A1.4) used to manage the response and the relationship to the NREP command and control system and, if appropriate, how it will function in the event of simultaneous response at the local level by other organizations to conventional emergencies or criminal activity (see Element A1.5). Plans for local jurisdictions should provide for an incident commander (see Element B1.3) who will direct the response under a unified command system (ICS) as described in Appendix 13. The incident commander should operate from an incident command post (ICP) as described in Appendix 14.

Include an overall management procedure for the incident commander that describes the immediate actions for each type of emergency (e.g. general emergency or terrorist threat).

3.3 Performing mitigation

In local jurisdiction plans, describe the provisions for emergency service support to a threat category I, II or III facility (see Elements A3.1, A3.4) and how this will be requested by, and co-ordinated with, the facility.

3.4. Taking urgent protective action

In local jurisdiction plans describe the provisions, including those for the position in the response organization responsible for making urgent protective action decisions promptly (see Element A4.5) on the basis of classification (see Element A4.4) or environmental measurements (see Element A4.5). The local plan should also describe the provisions for implementing urgent protective measures that are consistent with the criteria in the NREP. The plan should include a description of the emergency zones, and the criteria (in an appendix) and organizational components responsible for implementing evacuation, sheltering, implementing thyroid prophylaxis, protecting sources of food and water; imposing restrictions on immediate consumption of produce from farms or gardens and of locally produced milk; monitoring and decontaminating evacuees; care for evacuees; arrangements for special facilities; and control of access to and restriction of traffic by air, water and rail.

Describe the arrangements for co-ordinating with all jurisdictions (including those beyond national borders) within any emergency zone (see Element A4.6). Maps of the emergency zones showing population densities, special populations, special facilities, water sources should be provided in an appendix. See the outline for the NREP (Section A12.1) for related guidance.

3.5 Providing information, warnings and instructions to the public

In local jurisdiction plans, describe the arrangements for dissemination of information to the public within the emergency zones on their response and means for public warning and providing people with instructions in the event of an emergency (see Elements A5.1, A5.2).

3.6 Protecting emergency workers

See the outline for the NREP (Section A12.1) for related information (see Elements, A6.7, A6.8, A6.10).

3.7 Providing medical assistance and mitigating the non-radiological consequences

See the outline for the NREP (Section A12.1) for related information (see Elements A6.9, A8.1, A8.4, A8.5, A9.2, A11.2).

3.8 Assessing the initial phase

In local jurisdiction plans, describe the arrangements for conducting environmental monitoring to determine if urgent protective actions are needed and include the default OILs (consistent with those in the NREP) to be used. This should include descriptions of the teams available (see Appendix 15) and other organizational elements involved (see Elements A7.3, A7.4), and provision for establishing a radiological monitoring and assessment centre (RMAC) where environmental data will be assessed (see Appendix 14).

3.9 Keeping the public informed (media relations)

Describe the arrangements for co-ordinating the release of information to the public and to the news and information media in the event of an emergency. Public information should be released by a single spokesperson or during joint briefings with national and facility representatives at the public information centre (see Appendix 14) (see Elements A9.1, A9.2). See the outline for the NREP (Section A12.1) for related guidance.

3.10 Taking agriculture, ingestion and long term countermeasures

In local jurisdiction plans, describe the local implementation of these countermeasures and their integration into the national response under the NREP (see Elements A10.2, A10.3, A10.5). See the outline for the NREP (Section A12.1) for related guidance.

3.11 Conducting recovery operations

In local jurisdiction plans, describe provisions to integrate with the national response in this area (see Elements A12.1, A12.2). See the outline for the NREP (Section A12.1) for related guidance.

3.12 Financing operations

See the outline for the NREP (Section A12.1) for related guidance.

3.13 Maintaining records and management of data

See the outline for the NREP (Section A12.1) for related information (see Element A7.5).

4. EMERGENCY PREPAREDNESS PROCESS

Identify the position responsible and describe the arrangements to perform the functions, listed in the subsections below, which are needed to develop and maintain the capability to respond to an emergency described in the plan. See the outline for the NREP (Section A12.1) for related guidance.

4.1 Authorities and responsibilities

4.2 Organization

4.3 Co-ordination

4.4 Plans and procedures

4.5 Logistical support and facilities

4.6 Training

4.7 Exercises

4.8 Quality assurance and programme maintenance

REFERENCES

LIST OF ABBREVIATIONS

DISTRIBUTION LIST

List (and distribute to) all individuals/organizations that are parties to this plan or that will be developing response arrangements that should be consistent with this plan.

APPENDICES

Appendix 1 - Organization authorities, responsibilities and capabilities

Describe the organization authorities, responsibilities, capabilities and resources in emergency situations.

Appendix 2 - Agreements

List (or refer to documents listing) and summarize agreements to provide assistance (e.g. for threat category I, II or II facilities) or to receive support (e.g. from laboratories) or memoranda of understanding concerning common response (e.g. with local law enforcement) (see Element B1.3).

Appendix 3 - Emergency planning maps and emergency zone data

For local jurisdiction plans, provide (or refer to documents providing) maps showing locations of threat category I, II and III facilities, boundaries of the emergency zones, evacuation routes, traffic control points, population densities, special populations, special facilities, water sources, pre-established monitoring locations, and emergency facilities.

Appendix 4 – Protective Actions

For local jurisdiction plans, provide (or refer to documents providing) a summary of the protective actions to be taken based on emergency classification and OILs.

Appendix 5 - Facilities and specialized radiological resources

List (or refer to documents listing) emergency facilities (see Appendix 14) and resources that are needed to implement the plan or that may be provided to support local governments. Identify the organizations responsible for providing them, including, as appropriate, the response teams listed in Appendix 15. List organizations (e.g. research reactors, universities) that could be sources of additional specialized personnel and equipment.

Appendix 6 - Supporting documentation/plans

List all the supporting documentation relevant for maintenance and implementation of the plan. List all the supporting documentation/plans relevant for maintenance and implementation of the plan. This should include the plans for various functional areas such as: command and control, logistical and financial support, public affairs, radiological monitoring and assessment and medical management and response.

A12.3 FACILITY (ON-SITE) EMERGENCY PLAN OUTLINE

This outline is for the plans for threat category I, II or III facilities. Detailed information or information that may change frequently should be provided by reference to other documents available to planners.

TITLE (COVER) PAGE

On the title (cover) page write the title of the plan, approval date, version number, and signatures. The signatures should include those of the heads of all the participating departments in the facility and authority responsible for the local off-site response and any organization providing emergency services support to on-site response such as local emergency services or supporting medical institutions.

CONTENTS

Describe the purpose of the plan, for example: "The plan provides the basis for (name of the facility) response to a radiation emergency that is effectively integrated with an accompanying international, national and local response."

List all organizations participating in the plan.

Describe the scope of the plan, for example: "The plan addresses the response by (name of facility) to an actual or perceived radiation hazard in order to co-ordinate the response to protect public health and safety."

The plan does not provide sufficient detail for an adequate response. This level of detail should be contained in procedures that are developed based on the plan.

See the outline for the NREP (Section A12.1) for guidance.

Describe the relationships to the local jurisdictions' emergency plan, the NREP and other plans that are to be used simultaneously with this plan. Provide a complete list of all the supporting documents in an appendix.

Give a brief description of the characteristics of facility emergencies that were considered in development of the plan. This should include the results of a comprehensive safety analysis and low probability events (see Section 2.2.5).

2.2 Terms

See the outline for the NREP (Section A12.1) for guidance.

2.3 Response roles and responsibilities (see Element B1.2)

Describe the roles and responsibilities of the on-site departments, off-site organizations and corporate management in this plan. Discuss responsibility for authorizing/activating the response (e.g. shift supervisor) and directing the total on-site response in relation to time. Show how responsibilities would differ (see Elements B1.2, B4.4) as the on-site staff is augmented or in other circumstances (e.g. simultaneous execution of the security plan). Describe how responsibilities are delegated or transferred (see Elements B1.2, B1.4, B4.2).

2.4 Response organization

Provide a block diagram of the on-site response organization components (sections, groups, teams or positions) with a brief description of responsibilities of each "block" and the emergency facility or location (see Appendix 14) where these organizational elements will probably perform (see Element B1.3). Show how the organization integrates into the off-site organization structure, and describe participation in the off-site response command group and other appropriate organizational components, such as the public information or radiological assessment groups as discussed in Appendix 13. A detailed discussion of authorities, responsibilities, and duties of the organizational components should be provided in the implementing procedures for the component.

2.5 Response facilities (see Element B5.1)

See the outline for the NREP (Section A12.1) for guidance.

2.6 Response communications (see Elements B5.1, B4.6)

Describe systems used for communication with off-site officials (see Element A2.9), emergency services, in-plant personnel (see Element A4.8) and teams, and environmental monitoring teams. Describe how continued compatibility of communications will be maintained.

2.7 Logistics/resource commitments (see Elements B5.1, B4.6)

See the outline for the NREP (Section A12.1) for related guidance.

2.8 Concept of operations

Give a brief description of the ideal response of your organization in the context of the total response. Section 4.1 provides examples.

3. EMERGENCY RESPONSE PROCESS

Describe the arrangements for the organizations to perform their functions assigned under the NREP or for local jurisdictions to carry out the functions in the following subsection and, where appropriate, to co-ordinate them under the NREP. Identify the response organization component responsible for performing the functions. Refer to the appropriate implementing procedures that will be used during an emergency to carry out each function. See the outline for the NREP (Section A12.1) and indicated elements in Section 4.2 for related guidance.

3.1 Notification, activation and request for assistance (see Element B4.6)

Describe the arrangements, including those for the emergency organization responsible, for declaration of an emergency (see Element A2.8), off-site notification (see Element B1.3), activation of the response organization (Element A2.12), and transition (see Element A1.1) to the on-site response organizations. The classification system (see Element A4.4) and the emergency action levels (EALs) used to decide on the level of emergency to declare (see Elements A2.4, A2.5, A2.8) should be consistent with the NREP and described in an appendix.

3.2 Emergency management

Describe the command and control system (see Element A1.4, B3.3) used to manage the on-site response and the relationship to the local jurisdiction command and control system and, if appropriate, how it will function in the event of simultaneous response under other on-site plans (e.g. security plan) (see Element A1.5). This should include a single on-site emergency manager (see Element B1.3) and integration, as soon as practical, into the off-site ICS command group (see Appendix 13). Refer to the appropriate implementing procedures that will be used during an emergency to carry out these functions. This should include an overall procedure for on-site response for the on-site emergency manager guiding the response to each type of emergency (e.g. general emergency).

3.3 Performing mitigation

Describe the arrangements for technical support for the operations staff, on-site damage control, fire fighting, and medical aid (see Elements A3.5, A3.6) and describe arrangements to obtain off-site emergency services assistance (see Element A3.6).

3.4 Taking urgent protective action

Describe the arrangements to promptly recommend off-site protective actions to off-site officials, including criteria based on facility conditions and environmental measurements (see Element A4.4). Describe the arrangements for protection of on-site personnel (see Element A4.6). Maps of the on-site area, showing assembly points, sheltered areas, and evacuation routes should be provided in an appendix.

3.5 Providing information, warnings and instructions to the public

Describe the provisions for the on-site organization to support the local jurisdiction arrangements to perform this function (see Elements A5.1, A5.2).

3.6 Protecting emergency workers

Describe the arrangements to protect on-site responders against all anticipated hazards (see Element A6.7, A6.8, A6.10).

3.7 Providing medical assistance and mitigating the non-radiological consequences

Describe the on-site arrangements for treatment/first aid, dose reconstruction, decontamination and transport of injured people and for initial off-site treatment (see Element A8.2).

3.8 Assessing the initial phase

Describe the on-site system to assess plant conditions and environmental releases used to assess the course of the emergency and determine the event classification and potential off-site consequences (see Elements A2.9, A7.2). Describe the arrangements for conducting environmental monitoring on and near the site in co-ordination with off-site response, and include the default OILs to be used. Describe the teams available (see Appendix 15) and other organization elements involved (see Elements A7.3, A7.4) and provisions for participation in the radiological monitoring and assessment centre (RMAC) (see Appendix 14).

3.9. Keeping the public informed (media relations)

Describe the arrangements to co-ordinate providing information to the media with the off-site jurisdictions through a single spokesperson or during joint briefings with off-site officials at the PIC (see Appendix 14 and Element A9.1).

3.10 Taking agricultural, ingestion and long term countermeasures.

Describe the arrangements to provide the agreed on support (if any) to off-site jurisdictions in this functional area.

3.11 Conducting recovery operations (see Elements A12.1, A12.2)

Describe how the transition to recovery operations will be co-ordinated with off-site officials.

3.12 Financing operations

See the outline for the NREP (Section A12.1) for related guidance.

3.13 Maintaining records and management of data

See the outline for the NREP (Section A12.1) for related guidance.

4. EMERGENCY PREPAREDNESS PROCESS

Describe the arrangements, and the responsible person, to perform the functions listed in the subsections below which are needed to develop and maintain the capability to respond to an emergency as described in the plan. Refer to the appropriate implementing procedures that will be used routinely to ensure these preparedness functions are adequately performed. See the outline for the NREP (Section A12.1) for related guidance.

4.1 Authorities and responsibilities

4.2 Organization

4.3 Co-ordination

4.4 Plans and procedures

4.5 Logistical support and facilities

4.6 Training

4.7 Exercises

4.8 Quality assurance and programme maintenance

REFERENCES

LIST OF ABBREVIATIONS

DISTRIBUTION LIST

List (and distribute to) all individuals/organizations that are parties to this plan or that will be developing response arrangements that should be consistent with this plan.

APPENDICES

Appendix 1 - Organization authorities, responsibilities and capabilities

Describe (or refer to a publication describing) organization authorities, responsibilities, capabilities and resources in emergency situations.

Appendix 2 - Agreements

List (or refer to a publication listing) summarized agreements to receive assistance from off-site emergency services and off-site medical institutions (see Element B1.3).

Appendix 3 - Emergency planning maps and diagrams

Provide (or refer to publications providing) maps/diagrams of the on-site area or facility showing assembly points, sheltered areas, evacuation routes, monitoring/sampling locations, emergency facilities, and areas that are potentially hazardous under emergency conditions.

Appendix 4 - Emergency classification system

Provide (or refer to publications providing) a description of the emergency classification system and associated EALs (see Element A7.2).

Appendix 5 – Protective Action

Provide (or refer to a publication providing) a summary of the protective actions to be implemented on-site and recommended to off-site authorities for each class of emergency.

Appendix 6 - Facilities and specialized radiological resources

List (or refer to publications listing) major facilities (see Appendix 14) and radiological resources that are needed to implement the plan and that may be provided to support local governments, and the organizations responsible for providing them. This should include, as appropriate, the response teams listed in Appendix 15. List the organizations (e.g. research reactors, universities) that could be sources of additional specialized personnel and equipment.

Appendix 7 - Supporting documentation

List all the supporting documentation relevant for maintenance and implementation of the plan.

A12.4 MOBILE SOURCE OPERATOR'S CONTINGENCY PLAN/PROCEDURE OUTLINE [121]

This outline is for the plan for the operator of a practice involving a dangerous mobile source (e.g. industrial radiography or brachytherapy). Unlike other plans, the contingency plan for operators of mobile sources should contain the detailed procedures needed for implementation. Include information that should be updated regularly (e.g. phone numbers) as attachments. The procedures should be tested with typical users to ensure that they work under emergency conditions (see Element B4.10).

1. EMERGENCY RESPONSE

On the title (cover) page write title of the plan, version No., and validation date. Other information such as: author(s) and preparation date, reviewer and review date, responsible manager and approval date, and signatures you may wish to put on the inner (second) page.

1.1. ENTRY CONDITIONS

Prominently display *the emergencies covered by the plan, e.g. 1) operator injury, 2) suspected overexposure, 3) lost or stolen sources, 4) stuck, damaged, or unshielded source, 5) fire, 6) suspected contamination, and 7) unanticipated.*

1.2 RESPONSIBILITY

Prominently display *who is responsible for implementation and maintenance of this plan. This should include the operator.*

1.3 CAUTIONS

Prominently display *the safety steps performed before use of the plan, potential hazards and protective equipment/measures to be used.*

1.4 IMMEDIATE RESPONSE ACTIONS

Refer to the page number of the section in the plan that lists the immediate actions for the emergency.

(Specify emergency) IMMEDIATE ACTIONS

Have separate procedures for each emergency that list the immediate steps (actions) to be taken by the operator (see Element A3.2). The procedures should follow the outline in Section A12.5. Refer to appendices for lists of phone numbers and other supporting details. The steps should refer to information in an appendix to be used by the radiological assessor or radiation protection officer (see Element A3.3) and local off-site officials. These procedures should be consistent, as appropriate, with information in Appendix 7.

[121] In this case, the plan and procedures are combined because of the limited planning needed.

2. NORMAL STANDING INSTRUCTIONS

2.1 OPERATOR DAILY CHECKS

List the checks that the operator should complete before starting and finishing work. This should list equipment, procedures etc. to be taken to the job site.

2.2. TRAINING AND EXERCISES (see Element B6)

Describe the employee training requirements and process

2.3 PLAN AND EQUIPMENT MAINTENANCE

Describe arrangements to maintain the contingency plan and equipment, naming the person responsible. This should include calibration and other equipment checks (see Element B7.1).

DISTRIBUTION LIST

List all individuals and organizations that are to receive the plan. This must include operators, their supervisors and the radiological assessors or radiation protection officers.

APPENDICES

Appendix 1 - Contact numbers

This should include the phone numbers of 1) the notification point for reporting emergencies (see Element A2.1), 2) radiological assessors or radiation protection officers (see Element A3.3), 3) sources of governmental radiation protection expertise and services (see Element A3.1).

Appendix 2 - Information for radiological assessor or radiation protection officer (see Element A3.3)

Provide information for the emergency assessment and mitigation actions to be performed by the radiological assessor or radiation protection officer (see Element A3.3).

Appendix 3 - Information for local off-site officials

This should include a description and picture of the device and a description of the associated hazard if lost or stolen (Element A3.4). Provide basic instructions to be given to local officials in the event of an emergency (see Element A3.2).

A12.5 GENERIC IMPLEMENTING PROCEDURES OUTLINE

See Element B4.9 and B4.10 for further information on development of procedures.

1. HEADER

On the cover page, write the title of the procedure, document code (if any), type of confidentiality (if any), version number, and validation date. Other information, such as author(s) and preparation date, reviewer and review date, responsible manager and approval date, and signatures, you may wish to put on the next page. All subsequent pages have header: procedure title, performed by, page number, total number, of pages, document code, version number, and validation date. Optional: type of confidentiality.

2. ENTRY CONDITION

Prominently display on the cover page *the entry conditions for use of the procedure, i.e. the condition indicating that the procedure is to be used (e.g. upon declaration of a general emergency).*

3. RESPONSIBILITY

Prominently display *the position or team responsible for completion of the procedure.*

4. CAUTIONS

Prominently display *the safety steps performed before use of the procedure (e.g. get permission from control room, ensure valve X is secure), potential hazards (e.g. heat, live steam, radiation) and protective equipment/measures to be used.*

5. LIMITATIONS (optional)

List the limitations of the method or technique used.

6. NEEDED BEFORE USE (optional)

List the tools, protective equipment, resources, documents or information needed to use the procedure, and the source of these items.

7. PURPOSE - CUSTOMER (optional)

List the expected results (outcome) of the procedure and the identity of the customer - who gets the product.

8. SUMMARY (optional)

For complex procedures, give a short explanation (summary) of the process (method, technique) followed by a discussion of the conditions under which the procedure is most effective; advise on possible alternatives and some recommendations may also be given.

9. DEFINITIONS (optional)

Give only those definitions that are needed to perform the procedure.

10. STEPS (ACTIONS)

List steps and tasks to be performed in order to achieve the purpose of the procedure in the sequence in which they should be performed. See Element B4.9 for additional guidance.

11. REPORTING (optional)

Describe a mechanism for reporting the results of the procedure. Give clear lines of internal and external communication.

12. DISTRIBUTION LIST

Give a list of all individuals or organizations that are to receive the procedure.

13. PROCEDURE MAINTENANCE

State an individual or organization that is responsible for reviewing and updating the procedure. Describe the reviewing and revision process.

ATTACHMENTS (optional)

Provide worksheets, phone numbers, equipment checklists, drawings, etc. needed in the implementation stage.

Appendix 13

EMERGENCY RESPONSE ORGANIZATION

A13.1 CONCEPT

This appendix describes overall and facility response organization. The concept is that the same basic response organization should be used for all emergencies (e.g. conventional and radiation), thus allowing rapid integration, co-ordination and expansion of the response. The same structure may be used to organize a response involving a few people in a transportation accident or hundreds of people in a major natural disaster such as an earthquake. Organizational structure takes account of all the organizations responding to the emergency, including those from the facility or operator, local and national governmental and non-governmental organizations. The organizations may also include radiological assessors, social services, law-enforcement, and other elements of the response. Consequently, to be effective this system or a similar one should be instituted nationwide.

The structure presented here is referred to as the incident[122] command system (ICS) and is currently being used in the United States, Canada and elsewhere.

An ICS structure is based on the following principles.

Common terminology, which ensures that all responders use terms that are standard and consistent:

(1) Major organizational functions and units named;

(2) In multiple incidents, each incident named;

(3) Common names used for personnel, equipment, and facilities; and

(4) Clear text used in radio transmissions (i.e. do not use agency specific codes).

A modular organization, which enables the ICS structure to expand or contract to meet the needs of the incident/emergency:

(1) Structure develops top down, from first-in unit;

(2) Structure based on incident/emergency management needs; and

(3) Incident commander always staffed; other functions staffed as needed.

Integrated communications, which establish a common communications plan, standard operating procedures, clear text, common frequencies, and common terminology:

(1) Common communications plan;
(2) Common terminology;
(3) Compatible communications systems; and
(4) Two-way communications following standard procedures.

[122] The term “incident” is here used as a generic term by the ICS for events requiring emergency response.

Unity of command, where each person within an organization reports to only one designated person: *Established/Uniform chain-of-command (reporting to immediate supervisor within ICS structure). Always have a single individual, the incident commander, in charge.*

A unified command structure, which allows all agencies with responsibility for the incident, either geographic or functional, to manage an incident by establishing a common set of incident/emergency objectives and strategies:

(1) used in single jurisdiction multi-agency response, multiple jurisdiction incidents; and
(2) share command responsibility - develop one incident action plan; all have input.

Consolidated incident/emergency action plans, which describe response goals, operational objectives, and support activities:

(1) requires a written or oral plan;
(2) written plan required for complex incidents or multi-agency incidents/emergencies; and
(3) plan describes response goals, operational objectives, and support activities.

A manageable span of control, which limits the number of resources that any supervisor may control:

(1) range 3-7; and
(2) optimum 5.

Designated incident/emergency facilities/locations, which include an incident command post and may include staging areas; other incident facilities may be designated, depending on the requirements of the incident:

(1) incident command post (the location at which the primary command functions take place); the incident commander is located at the ICP;
(2) facilities and locations described in Appendix 14; and
(3) others identified as needed (e.g. staging area, evacuee monitoring and registration area, heliport).

Comprehensive resource management, which maximizes resource use, consolidates control of single resources, reduces the communication load, provides accountability, reduces freelancing, and ensures personnel safety:

(1) consolidates control of multi-agency resources;
(2) staging area serves as resource marshalling location; and
(3) monitor resource status: assigned, available, out of service.

A13.2 BASIC STRUCTURE

The ICS organization is built around five major components: command, planning, operations, logistics and finance/administration. In small scale incidents/emergencies, one person, the incident commander, may manage or perform all of the components. Large-scale incidents/emergencies usually require that each component, or *section*, is set up separately. Each of the primary ICS sections may be divided into smaller functions as needed. Typically, the organization is divided into *branches* depending on the nature of the activity having functional or geographic responsibility, *groups* that are responsible for a specified functional assignment, and finally *teams*.

As the emergency operation expands the incident commander may also change. This responsibility would typically be assigned to an individual in the organization with a primary role during each phase of the response. As the emergency progresses, this would typically pass from the operator or first responders to a local official and finally to a national official supported by a command group (composed of representatives of the operator and other principal response organizations – including NGOs) for events involving several jurisdictions or ministries. The responsibility for being incident commander is only transferred to an individual who has been fully trained and briefed.

The basic structure of ICS is shown in Figure A13-I. Section A13.3 provides examples of the response organization needed to deal with small emergencies; Section A13.4 discusses the organization for very large radiation emergencies. Section A13.5 discusses the response organization for a facility in threat category I.

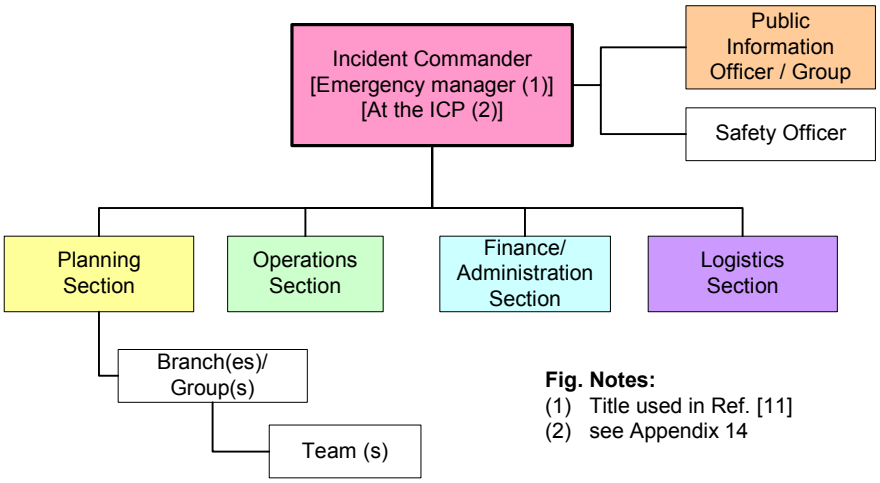

FIG. A13-I. Basic structure of ICS organization.

A13.3 SMALL RESPONSE - GENERAL ORGANIZATION

Figure A13-II shows the structure at its simplest where the incident commander manages or performs the functions of all the components. This could be the structure, for example, for a fire involving a truck carrying radioactive material. In this example, the incident commander, the fire brigade chief, directly commands the fire brigade, police and the radiological support from the incident command post (ICP) and performs other functions, such as briefing the media (acting as the public information officer/group). If the event becomes more complex the incident commander adds more staff under the ICS structure. For example, for more complex radiological emergencies (see Appendix 7), involving illegal activities and considerable media attention, the incident commander may expand the organization as shown in Figure A13-III.

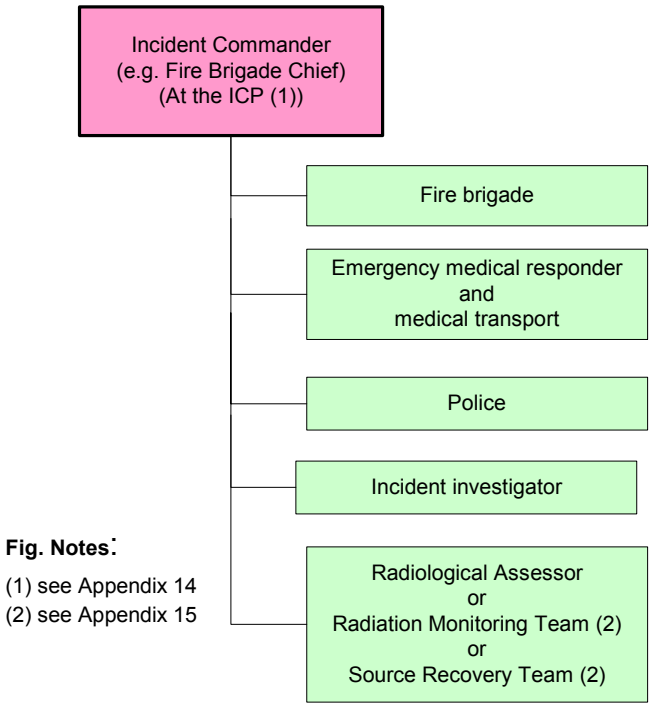

FIG. A13-II. Simple application of ICS organization.

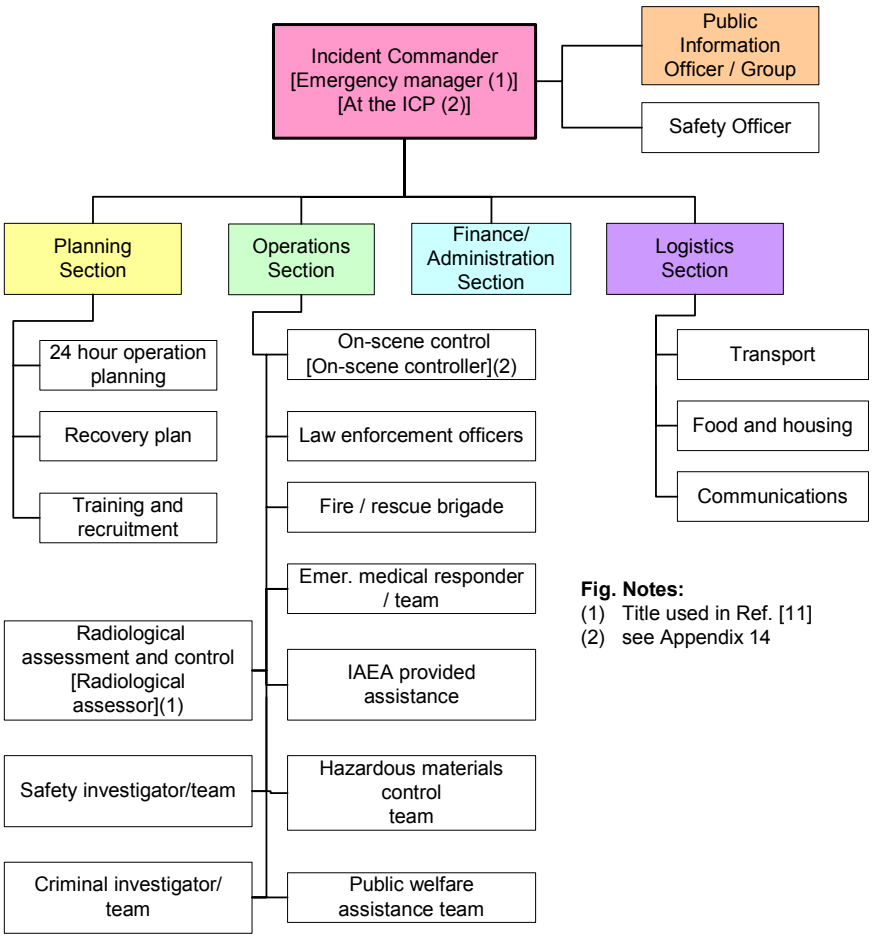

FIG. A13-III. Complex radiological emergency organization

A13.4 LARGE RESPONSE - GENERAL ORGANIZATION

This section illustrates the response organization for a very large response such as that for Goiânia [39] or Chernobyl accident. This organization may have over a 1000 people and take weeks to be fully activated.

Incident command

A unified command structure is used, consisting of local and national governmental representatives and the facility managers, including those responsible for conventional response functions as well as those responsible for the radiological response functions. Each manager is responsible for his or her own area of expertise. The command group is directed by the incident commander (emergency manager)[123] who has command over the entire response. The incident commander may delegate authority for performing certain activities to others (command staff), as required: the public information officer/group, the safety officer/group and the liaison officer/group. The command group normally operates at the incident command post. The public information officer/group handles all media inquiries and co-ordinates the release of information to the media. For an emergency with significant media interest, this is conducted from a public information centre (PIC - see Appendix 14). The safety officer monitors safety conditions and develops measures for ensuring the safety of all assigned personnel, including radiation protection (see Element A6.10). The liaison officer/group is the on-scene contact for all response organizations. Figure A13-IV shows an example of the organizational structure of the command element in a complex emergency.

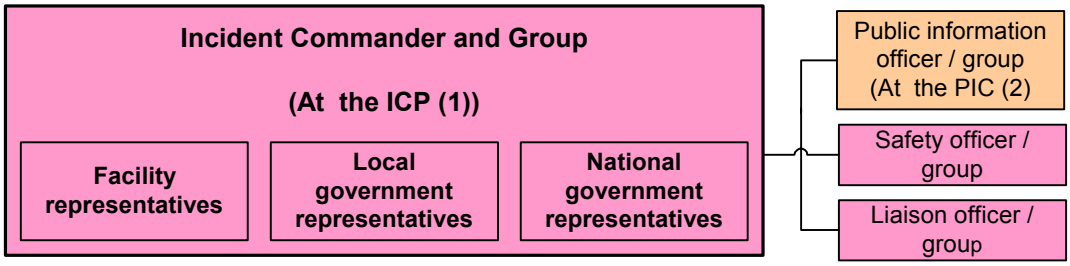

Fig. Notes:
(1) Radiological and conventional response organizations
(2) see Appenix 14

FIG. A13-IV. Command group staff positions in a complex emergency.

Planning section

The planning section is responsible for the collection, evaluation and dissemination of information used for direct response. One of its principal functions is to develop *incident action plans (IAPs)*. These plans define response activities and allocation of resources for different phases of the response and a specified time period, e.g. for the next 12 to 24 hours, for the remainder of the emergency phase and finally for long term recovery. Note that

[123] Initially, the incident commander will be the senior first responder to arrive at the scene as the emergency progresses, the lead may pass from the first responder (or operator) to local officials or a person supported by a command group for emergencies involving many jurisdictions.

planning for the long term and recovery phases begins very early in the event. The Planning Section is used to develop IAPs as needed at the time of an incident and based on facility, local and national emergency plans. Figure A13-V shows an example of the Planning Section organization for a major radiation emergency.

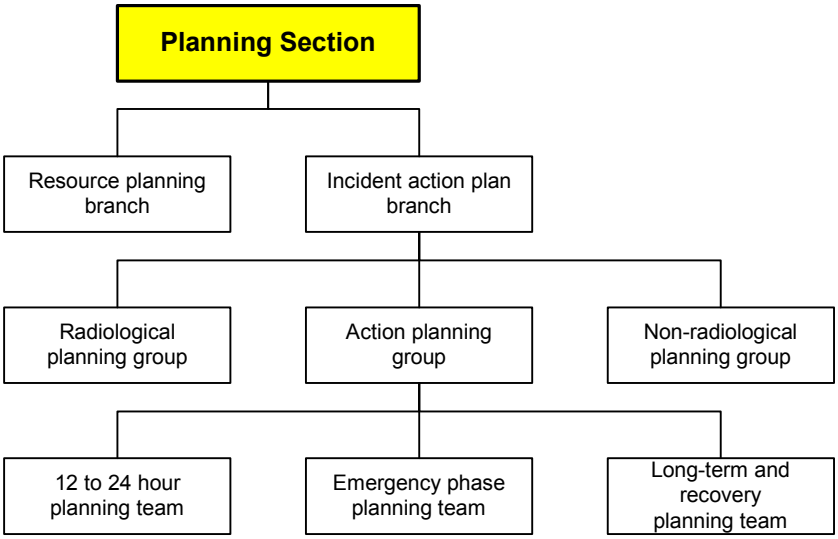

FIG. A13-V. Planning section in a complex radiation emergency.

Operations section

The operations section is responsible for implementing the response activities described in an IAP. These are typically field operations of the emergency response. Figure A13-VI shows an example of the operations section organization for a complex (major) radiation emergency. The radiological assessment branch operates out of the radiological monitoring and assessment centre (RMAC- see Appendix 14) along with all of the teams conducting environmental monitoring.

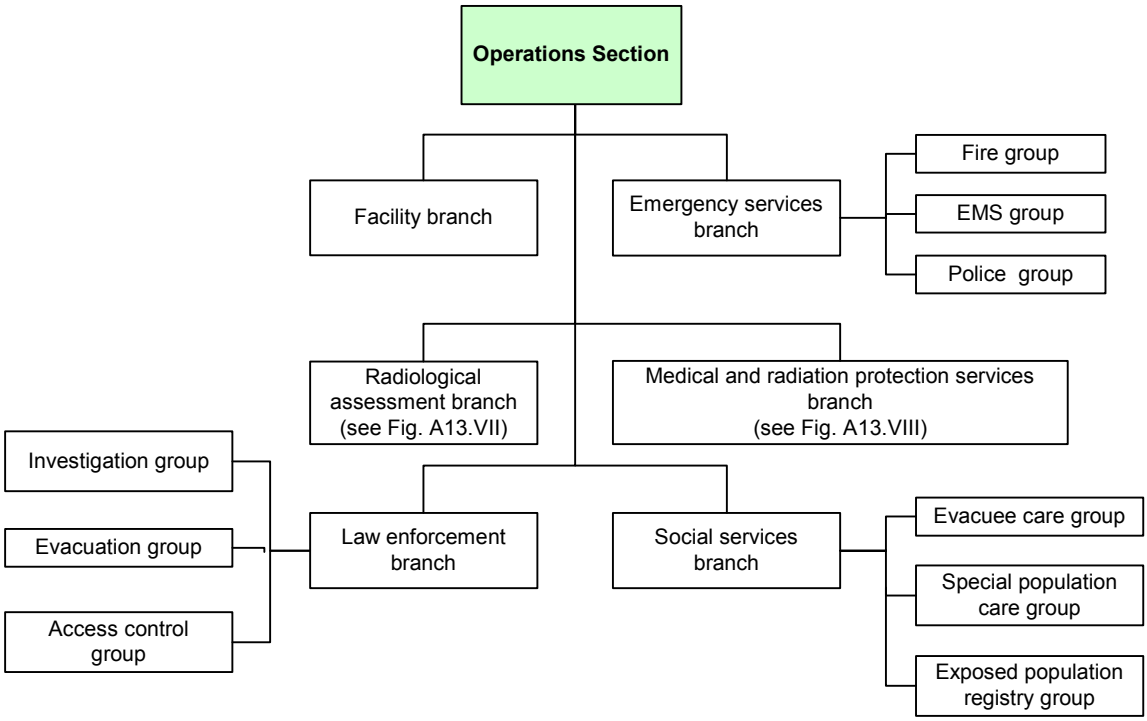

FIG. A13-VI. Operations section in a large radiation emergency.

The radiological assessment branch (RAB) (see Figure A13-VII) directs and co-ordinates the gathering and analysis of data on the radiological situation in the environment. This would include assessment of the risk posed by the facility. The RAB field operations section co-ordinates the deployment of the monitoring and sampling teams in support of the assessment and advisory team. Geographical areas may subdivide field operation in a large event. The RAB sampling analysis group controls the processing, shipping and analysis of environmental samples.

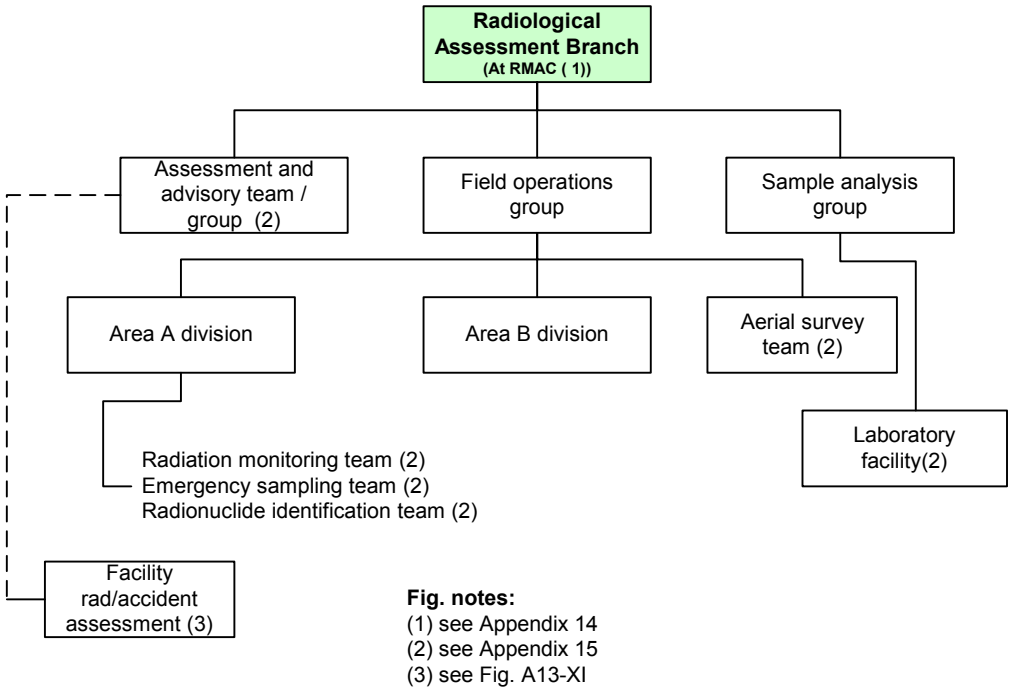

FIG. A13-VII. Radiological Assessment Branch in a large radiation emergency.

The medical and radiation protection services branch (see Figure A13-VIII) directs and co-ordinates the medical assessment and treatment of radiation induced and other injuries. This group is also responsible for monitoring and controlling the radiation doses received by members of the response organization.

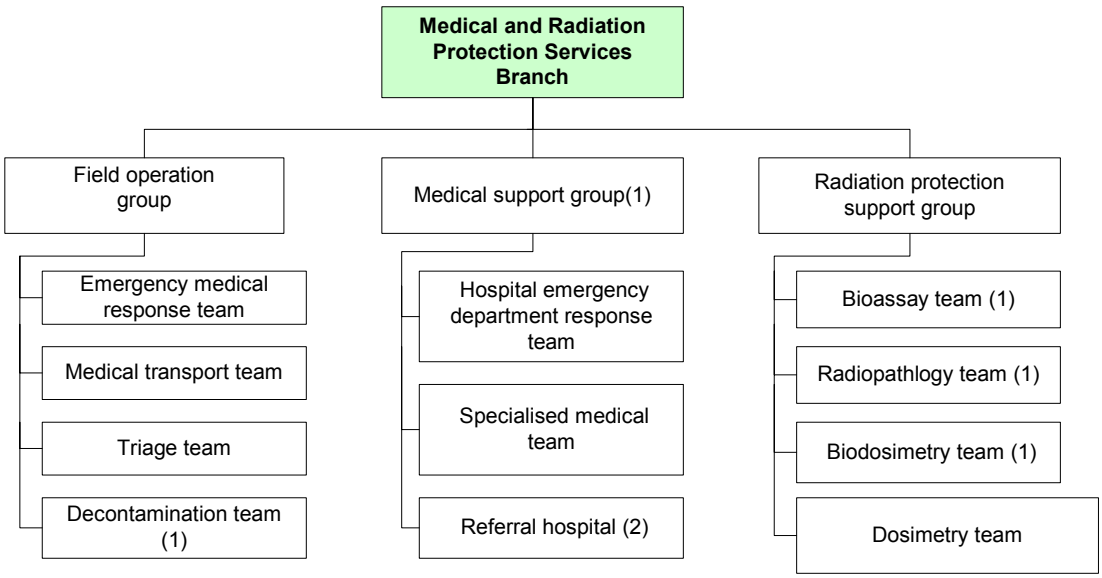

Fig. Notes:
(1) see Appendix 15
(2) Could be obtained through IAEA/WHO

FIG. A13-VIII. Medical and radiation protection services branch in a large radiation emergency.

Logistics section

The logistics section is responsible for providing facilities, services and materials needed by the responders. This section takes on great significance in long term or extended operations. It is important to note that the logistics section's functions are geared to support the incident responders. Figure A13-IX shows an example of the Logistics Section organization for a complex (major) radiation emergency.

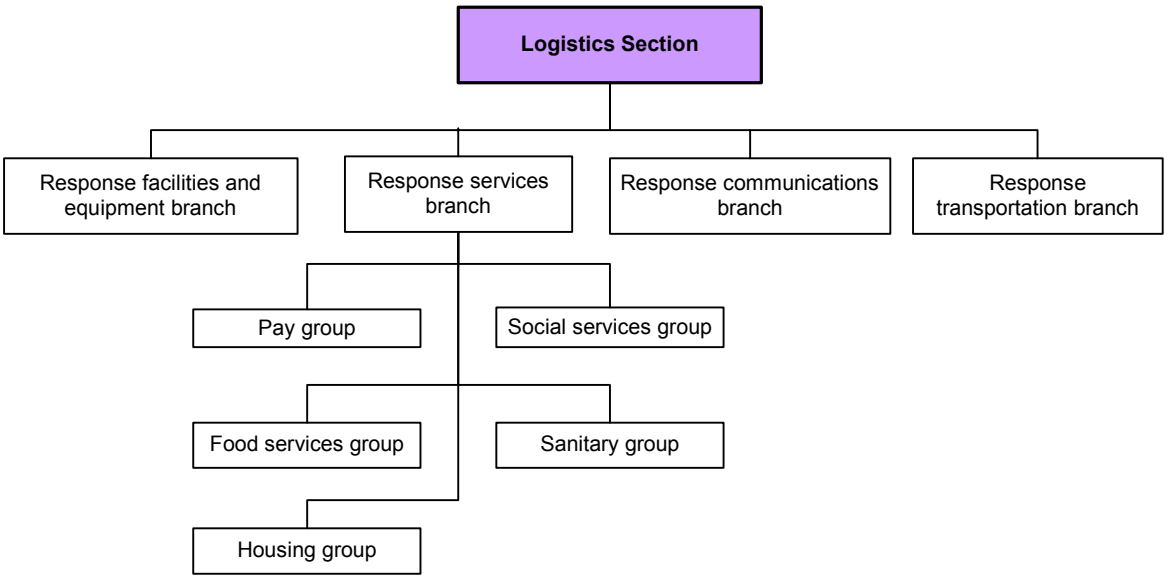

FIG. A13-IX. Logistics section in a large radiation emergency.

Finance/administration section

The Finance and Administration Section is responsible for tracking response costs and reimbursements. Figure A13-X shows an example of its organization for a major radiation emergency.

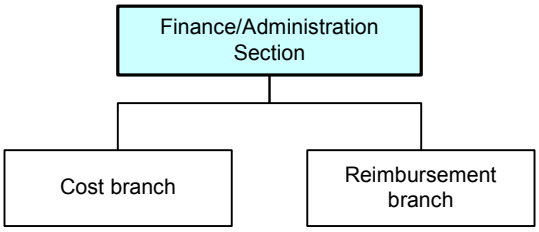

FIG. A13-X. Finance/administration section in a large radiation emergency.

A13.5 THREAT CATEGORY I FACILITY RESPONSE ORGANIZATION

Figure A13-XI shows the organization for a facility in threat category I. The organization is similar to the organization for overall response. Components that perform the same functions have similar names, which promote co-ordination. At the beginning of an emergency, these functions will be performed by the operational staff on the site. Upon activation of the response organization and associated response facilities, these functions will be transferred to the organizational elements and facilities shown in Fig. A13-XI. In many cases, the facility personnel will be fully integrated into the overall response organization as soon as possible by co-locating with the overall response organization component. In particular, the following facility response components will ultimately be fully integrated into the overall response:

(1) command functions as part of the command group in the ICP (EOF);
(2) public information functions as part of the public information group in the PIC;
(3) radiological assessment and environmental monitoring as part of the Operations Section, Radiological Assessment Branch in the RMAC; and
(4) long term planning as part of the planning group.

Other functions (e.g. logistics, fire fighting, police/security, medical) would also need to establish arrangements to co-ordinate.

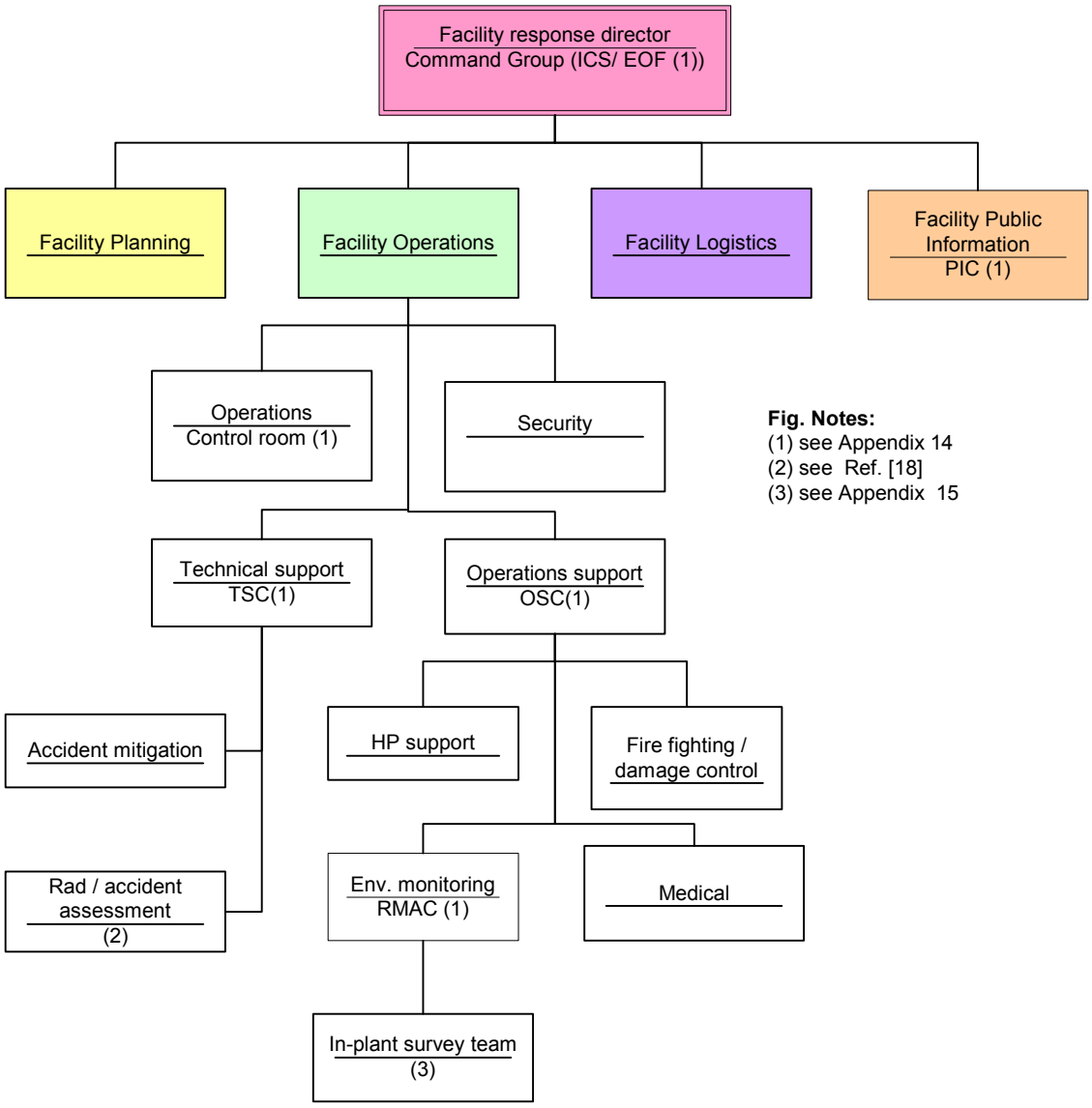

FIG. A13-XI. Facility organization for a threat category I facility.

Appendix 14

EMERGENCY FACILITIES AND LOCATIONS

The emergency facilities and locations are an integral part of the ICS described in Appendix 13. There are two different types of emergency facilities or locations: those established in advance and those established at the time of the emergency. In both cases the functions and operational conditions and requirements of the facilities or locations must be carefully considered and necessary advanced preparations made. Facilities or locations established in advance (e.g. TSC for a nuclear power plant) will be designed, built and equipped to support their functional and operational requirements. If the facility or location is to be established at the time of emergency, advance preparations must be made to find a suitable location and rapidly establish the centre under field conditions. These preparations would include developing site selection criteria, assigning the responsibility for acquiring a site during an emergency and, having procured and prepared equipment (e.g. generators) supplies and other items in advance needed to establish the centre in the field, also establishing a team for setting the centre up. Establishing such a centre under field conditions should be exercised.

Each emergency facility or location must be:

1. designed to support the functions that take place within it;
2. usable under emergency conditions; and
3. integrated into the ICS (Appendix 13).

The steps in developing an adequate facility or capability to establish a centre are to:

1. determine the functions of the facility;
2. determine the relationship of the facility to other facilities, areas or functions within the response system;
3. determine the operational conditions under which the facility must function (e.g. environmental, and radiological);
4. establish a design team;
5. analyse the organization of the facility or area;
6. assess the flows (e.g. people, information, samples) associated with each position within the organization;
7. determine the workstation requirements for each position;
8. determine the space, light, power and other environmental needs for each position, which would include food, water, and sanitary and sleeping arrangements;
9. determine the radiological and environmental conditions possible during operation;
10. develop a conceptual design; and
11. develop and test a prototype.

The facilities and locations recommended for each threat category are listed in Table A14-I and described in Table A14-II.

TABLE A14-I. RECOMMENDED EMERGENCY FACILITIES AND LOCATIONS

Facility or Location	Threat category				
	I	II	III	IV	V
Assembly Point	✓	✓	✓		
Assistance Centres[124],[125]	✓	✓	✓	✓	✓
Control Room (CR)[126]	✓	✓	✓		
Designated hospital[127]	✓	✓	✓	✓	
Emergency Operations Facility (EOF)[126]	✓	✓			
Facility medical service	✓	✓			
Incident Command Post[128] (ICP)	✓	✓[124]	✓[124]	✓[124]	✓[129]
Notification Point	✓	✓	✓	✓	
Operational Support Centre (OSC)	✓				
Public Information Centre (PIC)	✓	✓[124]	✓[124]	✓[124,125]	✓[125,129]
Radiological Monitoring and Assessment Centre (RMAC)	✓	✓	✓[125]	✓[125]	✓[129]
Referral hospital[130]	✓	✓	✓	✓	✓
Relocation/reception Centres	✓	✓	✓	✓	✓
Response Organization Emergency Operations Centres (EOC)	✓	✓	✓	✓	✓
Staging area	✓	✓	✓	✓	
Technical Support Centre (TSC)	✓				
Triage area [124]	✓	✓	✓	✓	
Warning Point				✓	

124 The location will be determined at the time of the event.
125 If needed.
126 A backup should be provided for use if the primary facility is unusable. The backup location should be provided within existing facility and provided with only minimum capabilities.
127 One designated for each category I, II or III facility, near by. A single one within a State without any Category I, II, III facilities should be sufficient.
128 May be located within an existing facility (e.g. EOF).
129 A single national facility will probably be established for a large contamination emergency.
130 Could be a single facility within or out side the State.

TABLE A14-II. DESCRIPTIONS OF RECOMMENDED EMERGENCY FACILITIES AND LOCATIONS

Facility/ location	Functions	Characteristics
Assembly point	Locations where non-essential personnel at the facility are assembled; accounted for and sheltered or evacuated (see Element A4.7).	Areas (one or more) within the facility security boundary with sufficient room for on-site non-essential (non-response) staff (including construction workers or other non-permanent personnel). The location must be easily accessible, provide some protection from a release or exposure, and be continuously monitored. **Activation time:** within 15 minutes of declaration of an emergency.
Assistance centres (e.g. reception/ relocation centres)	Used to provide members of the public with financial and other assistance during and after an emergency.	Locations determined at the time of emergency that are easily accessible to the affected public
Control room (CR)	Operational control of the facility, detection and classification of the emergency, and activation of response organization. Non-operational functions should be transferred to other facilities as soon as possible.	Access to data needed to detect and classify an emergency, and implement mitigation actions; remain habitable during severe emergencies[131]; continuous monitoring of radiation levels; and security to prevent unauthorized access.
Designated hospital	Provides treatment to exposed and/or contaminated people as a result of the radiation emergency at the facility.	Provisions - made in advance - to treat contaminated/exposed personnel from the threat category I, II or III facility to include provision for contamination control and access to qualified personnel.
Emergency operations facility (EOF)	Co-ordination of the on- and off-site response to an emergency warranting off-site protective actions. Typically staffed by the director of the on-site response, director of the off-site response and the incident commander. When the incident commander is present, this becomes the incident command post (ICP) (see Element A1.2).	Access to the information required to co-ordinate on- and off-site response decisions; reliable communications with on- and off-site response centres and organizations; continuous monitoring of radiation levels; security to prevent unauthorized access. If located within the UPZ, provided with sufficient protection to remain habitable[131] during a severe emergency or be provided with a backup. **Activation time:** within 1 hour of declaration of a site area or general emergency.
Facility medical service	Provide contaminated workers and public (if applicable) with the first aid at the facility and prepare them for transport to the designated hospital.	Available 24 hours a day. Only first aid and minimal provisions to prepare contaminated victims for transport (e.g. wrap in blanks) available.
Incident command post (ICP)	Location of the incident commander and other members of the unified command and support staff (see Appendix 13).	It could be located in another emergency facility (e.g. EOF or EOC). For threat category I or II facilities, it most likely will be located within the EOF. For other

[131] This should include provision to monitor and control radiological exposures and contamination, to control other hazards (e.g. heat, air quality) and to meet human needs (e.g. with food, water, and sanitary and sleeping arrangement) if the facility may be isolated for an extended period during an emergency.

Facility/ location	Functions	Characteristics
		emergencies, it will most likely be located in an area that is secure, safe and convenient for directing operations. **Activation time:** within 1 hour of declaration of an emergency
Notification point	This is the facility where notification of an actual or potential radiation emergency is received and from which the appropriate off-site response is initiated (see Elements A2.1 and A2.7).	Must be continuously (24 hours a day/7 days a week) operational, in a secure location, have redundant power and secure communications. This should be the facility used to receive notification of and initiate the off-site response to conventional emergencies (e.g. fires). If located within the emergency zones, it should be habitable during a severe emergency at the associated threat category I or II facility.
Operational support centre (OSC)	Operational control of personnel performing tasks within the facility (e.g. environmental monitoring, health physics, damage control, and fire fighting) and co-ordination and providing health physics support for personnel responding from off-site (see Elements A1.1 and A3.6).	Within the facility security boundary; secure/reliable communications with the control room, with teams within the facility and with off-site responders (e.g. fire brigade); sufficient room to assemble, equip and prepare teams; a location that will probably remain habitable under emergency conditions, continuous monitoring of radiation levels; ready access to equipment, instruments and protective clothing needed by response teams. **Activation time:** within 30 minutes of declaration of an emergency.
Public information centre (PIC)	Co-ordination of all information released to the media concerning the emergency by the facility, local governments and national governments. Staffed by representatives of all these organizations (see Element A9.1).	Located in the vicinity of the emergency with space and infrastructure to support media and conduct media briefings. For threat category I, it is a pre-designated facility outside the UPZ. **Activation time:** within 4 hours of declaration of an emergency requiring the facility.
Radiological monitoring and assessment centre (RMAC)	Co-ordination of the radiological monitoring, sampling and assessment provided by all response organizations (facility, local governments, national governments) (see Element A7.3).	Location to be determined at the time of emergency based on radiological and operational considerations. **Activation time:** within 24 hours of declaration of an emergency requiring the facility.
Referral hospital	Provides highly specialized treatment to exposed and/or contaminated people, as well as for people with combined injuries as a result of the radiation emergency.	Hospital that specializes in treatment (haematology, surgery) of radiation induced injures. If there is not such a hospital in the State, national arrangements should be in place to request treatment at such a facility through the IAEA or WHO under Assistance Convention.
Relocation/ reception centres	Location for initial reception, monitoring, decontamination, and registration of the evacuated public. Provides or arranges for humanitarian support (e.g. food, housing).	Located in an existing facility (e.g. school). For threat category I and II, it should be beyond the UPZ boundary.
Response	Facilities established by various response	Provisions for effective co-ordination with the

Facility/ location	Functions	Characteristics
organization emergency operations centres (EOC)	organizations from which the organization's support to the response will be directed. An EOC should be established by the regulatory body, ministries with responsibility for radiological or conventional response, local governments, corporate headquarters for the facility, national laboratories with expertise and radiological assessment response.	ICS response.
Staging area	Location used to collect and organize additional resources as they arrive in the vicinity of the emergency.	Location identified at the time of emergency. Should be in a location that will remain habitable, will not interfere with other ongoing response actions and can be secured.
Technical support centre (TSC)	Technical support of the Control Room operators in mitigating the consequences of the emergency (see Elements A1.1 and A3.6).	Secure/reliable communications with the control room and outside sources of technical support; access to plant data, information and tools needed to develop strategies for dealing with severe emergencies. If located at the facility, it must be protected to allow operations under severe emergency conditions. **Activation time:** within one hour of declaration of an emergency.
Triage area	Field location where medical and radiological triage is performed, first aid provided and victims are prepared for transport.	Location identified at the time of emergency. Should be a safe and secure location near the scene with access for medical transport.
Warning point	The facility able to be alerted at all times and promptly respond to incoming notification[132], warning message, request for assistance or request for verification of a message from the IAEA (see Element A2.14). The location through which the Competent Authority is contacted by IAEA (see Ref [23]).	Must be continuously (24 hours a day/7 days a week) operational, in a secure location, have redundant power, secure communications and prompt access to English speakers. The fax machines and other means used to receive notifications from the IAEA should be continuously operational and frequently monitored.

[132] A report submitted to a national or international authority providing details of an event, particularly an emergency, e.g. as required by the Early Notification Convention [15].

Appendix 15

EMERGENCY RADIATION RESPONSE TEAMS

Emergency radiation response activities include radiation monitoring, radionuclide identification, source recovery and assessment of radiological and medical consequences.

While *radiation-monitoring activities* include environmental and source monitoring, sampling and sample handling, the *radionuclide identification* includes in-situ gamma spectrometry and/or laboratory sample analyses. By s*ource recovery,* we mean the activities necessary to render radioactive sources safe and stabilize the situation.

Radiological assessments include evaluating the monitoring data, and using models or other techniques to evaluate the radiological consequences of the emergency, including individual external and internal dose assessment. These activities can be conducted in the field or at competent organizations. The activities also include provision of advice and recommendations on minimizing the consequences of the emergency.

Medical assessments include the evaluation of the medical consequences, the provision of advice or consultation to attending medical staff or assistance with medical care as necessary, assistance in decontamination, decorporation, and the provision of advice on public health issues. The activities also include radiopathology, bioassay and biodosimetry studies as appropriate.

Table A15-I shows the minimum number of emergency radiation response teams recommended for each threat category. Once established, these teams would be co-ordinated from the radiological monitoring and assessment centre (RMAC) discussed in Appendix 14.

In addition, the IAEA Emergency Response Network (ERNET) [38] has established arrangements to provide assistance teams qualified to perform the functions listed in Table A15-I. Ref. [38] provides additional descriptions of these teams. While the IAEA ERNET programme was not intended to replace need for preparations within a State, ERNET should be considered as a source of additional teams if local resources are overwhelmed. ERNET teams could be requested using the procedures in Ref. [23].

TABLE A15-I SUGGESTED RADIATION RESPONSE TEAMS FOR EACH THREAT CATEGORY

ERNET equivalent teams[133]				**Additional teams**[134]	
AST	Aerial Survey Team	MST	Medical Support Team	EST	Emergency Sampling Team
RMT	Radiation Monitoring Team	BIT	Bioassay Team	DET	Decontamination Team
RIT	Radionuclide Identification Team	RPT	Radiopathology Team	PST	In Plant Survey Team
SRT	Source Recovery Team	BDT	Biodosimetry Team	LAB	Laboratory facility
AAT	Assessment and Advisory Team				

Threat category	**Suggested minimum number of emergency radiation response teams and laboratories**[135]												
	AST	**RMT**	**RIT**	**SRT**	**AAT**	**MST**	**BIT**	**RPT**	**BDT**	**EST**	**DET**	**PST**	**LAB**
I	1	6	3	1	3	1	1	1	1	6	3	3	2
II	1	3	1	1	3	1	*[136]	*[136]	*[136]	2	2	2	2
III	*[136]	1	1	1	1	*[136]	*[136]	*[136]	*[136]	1	1	1	1
IV	*[136]	1	1	1	1	*[136]	*[136]	*[136]	*[136]	1	1	NR[137]	1
V	*[136]	1	2	NR[137]	1	NR[137]	NR[137]	NR[137]	NR[137]	3	NR[137]	NR[137]	1

133 The specifications for ERNET equivalent teams are described in Ref. [38].
134 The specifics for the additional team are found in Section A15.2.
135 If a team is expected to operate on a 24-hour basis, the minimum number of teams recommended is three.
136 If needed, assistance from the IAEA Emergency Response Network (ERNET) can be requested.
137 NR = not recommended.

A15.1 OBJECTIVES OF EMERGENCY RADIATION RESPONSE TEAMS

The general tasks for the emergency radiation response teams are:

(1) to assess the radiological situation;

(2) to render safe and perform stabilization activities including, where appropriate, source recovery; and

(3) to provide medical advice/consultation, medical assistance as necessary and public health advice.

The specific objectives are as follows:

AST: Aerial Survey Team

(1) to quickly detect, locate and identify lost or orphan radiation source(s) by aerial survey over large areas;

(2) to obtain information on contamination of large surface areas by radionuclide specific measurements; and

(3) to provide results and all other collected data in a timely fashion to the RMAC, as requested, according to established procedures.

RMT: Radiation Monitoring Team

(1) to detect, locate and demarcate small area(s) of contamination, lost or orphan source(s) by ground survey;

(2) to propose immediate protective actions, if necessary;

(3) to monitor personnel, object and equipment contamination;

(4) to monitor dose rates; and

(5) to perform sampling.

RIT: Radionuclide Identification Team

(1) to identify and quantify specific radionuclides;

(2) to determine radionuclide specific ground contamination;

(3) to perform sampling and sample preparation; and

(4) to measure radionuclide concentration in samples (air, soil, water, foodstuffs, etc.).

SRT: Source Recovery Team

(1) to organize source recovery operations;

(2) to recover sources with specialized devices;

(3) to provide temporary shielding and render the source safe; and

(4) to provide advice on source transportation and storage, if required.

AAT: Assessment and Advisory Team

(1) to collect, assess, validate and map the results performed by field teams;

(2) to make external dose calculation for individuals or critical groups;

(3) to model, calculate and evaluate radiological consequences; and

(4) to recommend strategies for measurement, protective actions, recovery operations, decontamination and waste management.

MST: Medical Support Team

(1) to evaluate the medical consequences of the radiation emergency;

(2) to provide medical advice or consultation and assist with medical care, as necessary, to overexposed people according to the type of radiological emergency situation:

(i) internal exposure to the whole body leading to clinical signs and symptoms of acute radiation syndrome; (ii) external contamination; (iii) internal contamination, (iv) local radiation injuries, and (v) combined injuries (radiation plus conventional trauma);

(3) if continued care of the casualties in the requesting State is not feasible, to recommend to authorities to co-ordinate their transfer to a specialized centre outside the State, taking into consideration the potential impact on their psychological status[138]; and

(4) to provide advice and recommend actions, if necessary, for decontamination and prevention of further radiation exposures of the population; to provide advice on public health actions.

BIT: Bioassay Team

(1) to identify and determine levels of specific radionuclides using in-vivo bioassay techniques (whole body and organ counting and external counting at wound sites);

(2) to identify and determine levels of specific radionuclides in body excreta and in other biological materials such as nasal swabs, hair, blood;

(3) to interpret the data in terms of committed effective dose, using appropriate models endorsed by the IAEA or the ICRP; and

(4) to interpret data during decorporation treatment, evaluate its efficiency, assess committed doses taking treatment into consideration.

RPT: Radiopathology Team

(1) to obtain the appropriate tissue samples through biopsy or autopsy procedures;

(2) to prepare samples for histopathological analysis; and

(3) to conduct the evaluation of the samples.

BDT: Biodosimetry Team

(1) to obtain the appropriate samples;

(2) to prepare samples; and

(3) to conduct the analysis and evaluation.

EST: Emergency Sampling Team

(1) to perform air sampling;

(2) to perform sampling of potentially contaminated soil, food, feed, water, etc.; and

(3) to conduct measurements of gamma dose rates.

DET: Decontamination Team

(1) to perform personal and equipment decontamination; and

(2) to conduct personal and equipment contamination monitoring.

PST: In-Plant Survey Team

(1) to conduct measurements of radiation levels inside the facility; and

(2) to identify contamination hazards inside the facility.

LAB: Laboratory Facility – Team (local, regional or national)

(1) to receive and prepare samples;

(2) to identify specific radionuclides in samples; and

(3) to measure radionuclide concentrations in samples.

[138] A patient's written informed consent is required prior to transfer to another State.

A15.2 SUGGESTED SPECIFICATIONS FOR TEAMS[139]

EST: EMERGENCY SAMPLING TEAM

Expertise The EST should have sufficient competence and experience within the following areas:

(1) sampling strategies and sampling techniques;

(2) dose rate monitoring; and

(3) basic radiation protection.

Staffing The EST should comprise at least two members with proficiency in all aspects from (1) to (3).

Equipment The following is an indicative list of equipment that should be available and maintained:

Radiation survey instruments and sources

EST.1 low range gamma plus beta survey monitor
EST.2 alpha/beta contamination monitor or probe
EST.3 set of check sources

Personal protection equipment and supplies per team member

EST.4 self–reading dosimeter
EST.5 permanent dosimeter
EST.6 protective overalls
EST.7 overshoes
EST.8 dust masks
EST.9 cotton gloves
EST.10 vinyl gloves
EST.11 rubber gloves
EST.12 thyroid blocking agent (reactor response only)
EST.13 decontamination kit
EST.14 identification badge
EST.15 torch

Sampling equipment

EST.16 portable air sampler – 12 V
EST.17 portable air sampler – mains/generator operated
EST.18 aerosol filters
EST.19 charcoal (or zeolite) cartridges
EST.20 soil sampling device
EST.21 filter paper for smears or shears
EST.22 shovel
EST.23 funnel
EST.24 knives and spoons
EST.25 measuring tape
EST.26 plastic bags
EST.27 plastic containers
EST.28 plastic bottles
EST.29 sample tags
EST.30 sampling location markers

[139] The specifications for ERNET equivalent teams are in [38].

General supplies

EST.31 portable radio
EST.32 navigation instrument (GPS or equivalent)
EST.33 cellular phone
EST.34 stop watch
EST.35 spare batteries
EST.36 first aid kit
EST.37 plastic sheets
EST.38 paper tissues
EST.39 plastic tape – narrow, wide
EST.40 writing pads
EST.41 administrative supplies
EST.42 logbook, worksheets
EST.43 cases for equipment transport

Supporting documentation

EST.44 survey maps
EST.45 sampling procedure
EST.46 personal radiation protection procedure
EST.47 communication procedure

Additional Requirements Means of transport

The actual equipment of EST when deployed will depend on the tasks to be performed.

DET: DECONTAMINATION TEAM

Expertise The DET should have sufficient competence and experience within the following areas:

(1) personal and equipment decontamination techniques;

(2) contamination monitoring; and

(3) basic radiation protection.

Staffing The DET should comprise at least three members with knowledge and experience in all aspects from (1) to (3).

Equipment The following is an indicative list of equipment that should be available and maintained:

Radiation survey instruments and sources

DET.1 low range gamma plus beta survey monitor
DET.2 alpha/beta contamination monitor or probe
DET.3 set of check sources

Personal protection equipment and supplies per team member

DET.4 self–reading dosimeter
DET.5 permanent dosimeter
DET.6 protective overalls,
DET.7 overshoes
DET.8 dust masks
DET.9 full face mask
DET.10 cotton gloves
DET.11 vinyl gloves
DET.12 rubber gloves
DET.13 identification badge

Decontamination equipment and supplies

DET.14 water supply
DET.15 pressurized water spray
DET.16 wet-dry vacuum cleaner
DET.17 brushes, swabs, nail brushes
DET.18 hair clippers, razors, shaving soap and brush
DET.19 detergents

Sampling equipment

DET.20 filter paper for smears or shears

General supplies

DET.21 portable radio
DET.22 cellular phone
DET.23 first aid kit
DET.24 plastic sheets, covers
DET.25 paper tissues
DET.26 plastic tape – narrow, wide
DET.27 waste bags
DET.28 bags for radioactive waste (with warning labels)
DET.29 indelible felt pens for marking contaminated spots
DET.30 writing pads
DET.31 radiation warning labels and signs
DET.32 tags for contaminated equipment

DET.33 administrative supplies
DET.34 logbook, worksheets
DET.35 power supply
DET.36 cases for transport

Supporting documentation

DET.37 procedure for conducting contamination monitoring and recording results
DET.38 decontamination procedures
DET.39 personal radiation protection procedure
DET.40 instructions to be given to contaminated persons
DET.41 communication procedure

Additional Requirements

The actual equipment and staffing of DET when deployed will depend on the tasks to be performed.

PST: IN-PLANT SURVEY TEAM

Expertise The PST should have sufficient competence and experience within the following areas:

(1) dose-rate monitoring techniques;

(2) contamination monitoring techniques;

(3) gross contamination mapping; and

(4) basic radiation protection.

Staffing The PST should comprise at least three members with knowledge and experience in all aspects from (1) to (4).

Equipment The following is an indicative list of equipment that should be available and maintained:

Radiation survey instruments and sources

PST.1 low range gamma/beta survey monitor
PST.2 high range gamma/beta survey monitor
PST.3 very high range gamma survey monitor (probe)
PST.4 alpha/beta contamination monitor or probe
PST.5 neutron dose rate meter
PST.6 set of check sources

Sampling equipment

PST.7 portable air sampler
PST.8 aerosol filters
PST.9 charcoal (or zeolite) cartridges

Personal protection equipment and supplies per team member

PST.10 self-reading dosimeter
PST.11 permanent dosimeter
PST.12 protective overalls
PST.13 overshoes
PST.14 respirator or full face mask with filter
PST.15 self containing breathing apparatus (SCBA)
PST.16 cotton gloves
PST.17 vinyl gloves
PST.18 rubber gloves
PST.19 thyroid blocking agent (reactor response only)
PST.20 decontamination kit
PST.21 identification badge
PST.22 torch

General supplies

PST.23 portable radio
PST.24 cellular phone
PST.25 binoculars 10x
PST.26 stop watch
PST.27 set of radiation warning labels and signs
PST.28 writing pads
PST.29 administrative supplies
PST.30 logbook
PST.31 set of worksheets
PST.32 cases for shipment

Supporting documentation

PST.33 in–plant maps
PST.34 survey procedure
PST.35 sampling procedure
PST.36 personal radiation protection procedure

Additional Requirements

The actual equipment and staffing of PST when deployed will depend on the tasks to be performed.

LAB: LABORATORY FACILITIES – TEAM

A good practice is to have a fully equipped central laboratory (at least 30 km from threat category I facility) and local monitoring laboratories capable of screening materials. A central laboratory should have the facilities, equipment and personnel necessary to perform detailed analysis on all types of materials and food for the relevant radionuclides associated with the types of practices and threat categories in the State.

Expertise The LAB should have sufficient competence and experience within the following areas:

(1) sampling and sample preparation techniques;
(2) gamma spectrometry techniques; determination of gamma emitters;
(3) radiochemical analysis techniques; determination of strontium;
(4) liquid scintillation counting; determination of tritium;
(5) chemical separation and alpha spectrometry; determination of transuranic elements; and
(6) quality control and quality assurance programmes.

Staffing The LAB should have at least the following staff:

(1) 2 with proficiency in sampling and sample preparation techniques;
(2) 2 with proficiency in chemical separation and radiochemical techniques;
(3) 2 with proficiency in gamma ray spectrometry;
(4) 2 with proficiency in liquid scintillation and beta counting;
(5) 2 with proficiency in alpha spectrometry;
(6) 1 with proficiency in electronics and computers (maintenance and service)
(7) 1 with knowledge and experience in QC and QA programmes; and
(8) 1 for assistance and administration.

Equipment The following is an indicative list of equipment that should be available and maintained:

Radiation survey instruments and sources

LAB.1 low range gamma/beta survey monitor
LAB.2 alpha/beta contamination monitor or probe
LAB.3 set of check sources

Alpha spectrometer system

LAB.4 silicon surface-barrier detector in a vacuum chamber
LAB.5 all necessary nuclear electronics and software
LAB.6 standards

Beta counting systems

LAB.7 low background, gas-flow, anti-coincidence beta counter
LAB.8 liquid scintillation counter
LAB.9 standards

Gamma spectrometry systems

LAB.10 high resolution spectrometer system (germanium detector)
LAB.11 germanium detector shielding (lead)
LAB.12 liquid nitrogen supply
LAB.13 low resolution spectrometer system (NaI(Tl) detector)
LAB.14 NaI(Tl) detector shielding (lead)

LAB.15 personal computer (PC), printer
LAB.16 calibration sources (energy calibration) – 1 set
LAB.17 radionuclide standards (efficiency calibration) – 1 set

Other laboratory equipment

LAB.18 sample preparation equipment
LAB.19 standard geometry sample containers
LAB.20 electrolytic enrichment unit
LAB.21 multicelled electrodeposition system
LAB.22 centrifuge
LAB.23 air tight plastic bags
LAB.24 large refrigerator (for preserving samples)
LAB.25 freezer (for storing samples)
LAB.26 crusher, grinder
LAB.27 drying oven
LAB.28 muffle furnace
LAB.29 freeze dryer

Reagents

LAB.30 different, depending on the type of samples and radionuclide to be measured

Supplies

LAB.31 oscilloscope, spare parts, repair tools
LAB.32 administrative supplies, log book, forms
LAB.33 means of communication
LAB.34 back-up power supplies

Personal protection equipment

LAB.35 overshoes
LAB.36 gloves
LAB.37 TL dosimeters
LAB.38 first aid kit

Supporting documentation

LAB.39 sample preparation procedures
LAB.40 equipment operation manuals
LAB.41 radionuclide data tables (libraries)
LAB.42 procedures for conducting measurement and evaluation
LAB.43 procedures for recording results and record keeping
LAB.44 Procedures for handling and measuring high radioactive samples
LAB.45 procedures for personal radiation protection
LAB.46 QA and QC procedures

Additional

Requirements The following is an indicative list of rooms and areas recommended for a central radionuclide analysis laboratory:

(1) sample registration, storage and preparation (handling of higher activity samples);
(2) gamma ray spectrometry counting room;
(3) alpha spectrometry counting room;
(4) liquid scintillation counting room;
(5) beta counting room;
(6) radiochemical laboratory; and
(7) offices.

The actual facilities, equipment and staffing of the LAB will depend on the variety and amount of tasks to be performed.

Appendix 16

RADIATION PROTECTION EQUIPMENT FOR ON-SITE EMERGENCY WORKERS

(1) The equipment provided depends on the severity of the hazard, and could include the following:

(2) Respiratory protection: self-contained breathing apparatus is most effective. Filter-canister masks provide a good protection against iodines and particulate but are not effective against tritium.

(3) Protective clothing: protective clothing must be based on the type of hazard. For emergencies in threat categories I, II and III, the high skin doses which can be received from beta radiation should be taken into consideration. For example, there should be no exposed skin; for fire fighters, protective suits should be non-plastic (or of a material which melts on the skin); for personnel expected to perform hard work and/or get wet, suits should be waterproof.

(4) Thyroid blocking agent (threat categories I and II): it should be issued to all emergency workers prior to potential radioiodine exposures.

(5) Dosimeters: each worker should wear thermoluminescent dosimeters in order to provide a record of the accumulated dose after the emergency. Each person on the team should carry a self-reading (e.g. electronic) dosimeter (up to 250 mSv).

(6) Survey instruments: at least one person in each team should carry a very high dose rate metre (up to 10 Gy/h). Contamination survey instruments must be available to monitor emergency workers on their exit from contaminated areas. These could include: hand-and-foot monitors, portal monitors, portable portal monitors, contamination probes (pancake probes) and scintillator probes. Care must be taken to avoid contaminating the probes.

(7) Clothing: spare clothing and disposal facilities (plastic bags) should be available at the control point to replace contaminated clothing, as required.

(8) Communication equipment that is operational in the areas where personnel may travel.

Appendix 17

CATEGORIZATION OF TERRORIST ACTS AND THREATS THEREOF[140]

There are typically two types of terrorist acts or threats: specific and non-specific. Specific acts or threats involve an act or receipt of a threat to commit an act. A non-specific threat typically involves intelligence or other information indicating that someone is possibly preparing to commit a terrorist act. These acts or threats can be characterized as shown in Table A17-I. For each category the response should be predetermined as discussed in the table.

Specific acts or threats

An assessment of a specific threat should address the following issues:

(1) What is the motive and is it credible? Credible motives could include: extortion (e.g. demand for financial gain); political issues; social issues, moral outrage, revenge or a bizarre rationale of a mentally deranged person.

(2) Does it appear likely that the threatened action can be carried out? Does it appear they have the necessary expertise, information, material, supplies, access etc? Did they provide sufficient information on the material and device to support their threat?

(3) What would be the effects if the threat were carried out? This would include health, economic and psychological impacts. The economic and psychological impacts are a function of the *risk as perceived by the public* and not the actual health risk!

(4) What can be done to reduce the impact if the threat is carried out?

It is also essential to recognize that the culprits generally fall into three categories of individuals:

(1) Professional - a criminal or terrorist with scientific/technical knowledge of radioactive or nuclear materials, coupled with possible access to the resources necessary to carry out the threat.

(2) Amateur - a person lacking in scientific/technical knowledge and without any obvious resource capability to carry out the threat.

(3) Deranged - a person who is mentally deranged and operating to a personal rationale that may have no logic or reason.

An assessment of all known factors should be done to determine whether there is a realistic and viable threat and thus considered a credible threat. A threat is credible if it appears that it can be carried out so as to have a significant radiological, psychological or economic impact.

Individuals should conduct this assessment with expertise in law enforcement, psychology, radiological science and technology, radiation induced health effects, INDs, RDDs and terrorist acts involving radioactive or fissionable materials[141]. Support in assessing radiation or nuclear related threats could be obtained through the IAEA under the Assistance Convention using the procedures in Ref. [23].

[140] This includes bomb threats, bombings, sabotage, attacks, kidnapping, hostages taking, theft of radioactive or fissionable material, or suspicious acts potentially resulting in an actual or perceived radiation emergency.
[141] This includes contamination of people, areas, consumer products, mail or exposure of people or public areas.

Non-specific threats

A non-specific threat may involve many different sources of information. Some examples of these are:

(1) Information supplied by an informant or undercover-agent.

(2) Confession of an accomplice or associate.

(3) The sale or offer of sale, of radioactive or fissile materials, or radiological expertise.

(4) Discovery of missing/stolen radioactive or fissile materials.

(5) Discovery of radioactive materials being stored or transported illegally.

(6) Interception of communication between criminal parties.

(7) Intelligence from another State.

All such non-specific threats require a pro-active investigation to ascertain whether a credible threat exists.

TABLE A17-I PROPOSED TERRORIST/CRIMINAL THREAT CATEGORIZATION SYSTEM

Category	Description
Non-credible terrorist/criminal threat	Not considered a credible threat. At this level, the facility or individual identified as the target is informed but no additional actions are recommended.
Potentially credible terrorist/criminal threat	There are indications that the threat may be credible but the assessment of the credibility is inconclusive or incomplete. At this level a facility would declare an alert (see Appendix 6); and the facility or other potential target would take action to improve security; an incident commander would be appointed. In addition, other action would be taken to improve the ability to promptly execute a co-ordinated response as outlined in Appendix 6 or 7 in order to prevent the act or to reduce any radiological, psychological or economic impact.
Credible terrorist/criminal threat	There are indications that the threat is credible. At this level, a facility would declare an alert and take other action consistent with Appendix 6. For all threats, including those not involving a facility, actions would be carried out to implement a co-ordinated national and local response to the criminal activities and to reduce any radiological, psychological and economic impact, as outlined in Appendix 6 or 7.
Terrorist/criminal act	A terrorist or criminal act has occurred. At this level, a facility would declare an alert or facility, site area or general emergency consistent with Appendix 6. For all acts, including those not involving a facility, actions would be carried out to implement a co-ordinated national and local response to the criminal activities and to reduce any radiological, psychological and economic impact, as outlined in Appendix 6 or 7.

Appendix 18

Plain language statements of the risks associated with lost or stolen radioactive sources or material

DISCUSSION

This text provides plain language statements of the risks to the public and emergency responders due to lost or stolen radioactive sources or material. These statements can be used in alerting the public to the possible risks in the event that a radioactive source or radioactive material is uncontrolled and in the public domain. The statements are given for different ranges of the A/D value as calculated in Appendix 8. The risks are assessed on the assumption that the source or material concerned is not being managed safely or kept securely and that someone could — knowingly or unknowingly — remove the radioactive material from the container or packaging in which it was to be used or safely shipped.

An amount of radioactive material is considered 'dangerous' if it could cause permanent injury or be immediately life threatening if not managed safely and contained securely. Permanent injuries include burns requiring surgery and debilitating injuries to the hands. Temporary injuries include skin reddening and irritation and temporary changes in the composition of the blood. Exposures are considered to be immediately life threatening[142] if they could result in injuries to tissues or organs that are fatal within at most a few years. Exposures that are immediately life threatening:

– Typically arise from very high radiation doses received over a period of hours to months owing to the presence nearby of dangerous amounts of unshielded material — for example, from a dangerous source placed in a drawer next to the bed.

– Arise in rare cases from inadvertently eating or drinking (or for someone very close by, breathing in) small amounts of dispersible material — for example, if someone opens the container of a dangerous amount of radioactive material that is in a dispersible form. Powders, gases and liquids, and volatile, combustible, water-soluble and pyrophoric materials are all dispersible.

In developing the criteria presented in Appendix 8, such effects and such exposure scenarios were considered. It was assumed that a person removes radioactive material from its container or packaging and carries it in a pocket for 10 hours or leaves the material nearby (such as in the bedroom) for a long time. For dispersible material, it was assumed that a person opens a sealed container and either that the person inadvertently eats some of the material[143] or that the material is dispersed in a fire or an explosion.

Radiological emergencies involving these amounts of radioactive material are very unlikely to result in any detectable increase in the incidence of cancer.

[142] This does not refer to the possibility of causing cancer which is very small, as discussed below.
[143] It was assumed that the person eats ten times the largest fraction of the radioactive material known ever to have been accidentally eaten.

PLAIN LANGUAGE STATEMENTS

A/D< 0.01

INDIVIDUAL SOURCES[144]

Not dangerous: No one could be permanently injured by this amount of radioactive material.

DISPERSIBLE RADIOACTIVE MATERIAL

Not dangerous: Handling[145] this amount of radioactive material cannot cause permanent injuries. There is no risk of injuries from a fire or explosion involving this amount of radioactive material. The area in the immediate vicinity (within a few meters) of a spill, fire or explosion could be contaminated to non-dangerous levels that may warrant cleanup[146].

A/D = 0.01–1.0

INDIVIDUAL SOURCES

Unlikely to be dangerous: It is very unlikely that anyone could be permanently injured by this amount of radioactive material. Such an amount of radioactive material, if it is not managed safely and kept securely, could possibly — although it is unlikely — temporarily injure someone who is close to it for a period of many weeks.

DISPERSIBLE RADIOACTIVE MATERIAL

Unlikely to be dangerous: It is very unlikely that anyone handling this amount of radioactive material could suffer permanent injuries. There is no risk of permanent injury from a fire or explosion involving this amount of radioactive material. The area in the vicinity (within a few tens of metres or so) of a spill, fire or explosion could be contaminated to non-dangerous levels that may warrant cleanup.

A/D = >1.0 – 10.0

INDIVIDUAL SOURCES

Dangerous to the person: This amount of radioactive material, if not managed safely and kept securely, could cause the permanent injury of a person who handles it or is otherwise in contact with it for some hours. It could possibly — although it is unlikely — be fatal to be close to this amount of unshielded material for a period of days to weeks.

DISPERSIBLE RADIOACTIVE MATERIAL

Dangerous in the locality: Handling this amount of radioactive material could cause permanent injury and could possibly – although it is unlikely - be fatal. There is little or no risk of permanent injuries beyond the vicinity (a few metres or so) of a fire or explosion

[144] An 'individual source' means a radioactive source that can be picked up or otherwise handled (e.g. solids such as metals, ceramics, encapsulated powder, or liquid or gas in a sealed container).
[145] Intentional eating of this amount by an individual may be dangerous.
[146] This only applies to radionuclides that have long half-lives and refers to levels of contamination warranting cleanup in accordance with international guidance (10 mSv/year) [31]. These levels are not dangerous; there are numerous inhabited locations in the world where natural background radiation delivers more than 10 mSv/year.

involving this amount of radioactive material. However, a limited area, probably no more than a small fraction of a square kilometre (i.e. a few soccer pitches), may be contaminated to non-dangerous levels that may warrant long term control[147] or clean up[146]. The size of the area to be cleaned up would depend on many factors (including the size and type of source, whether and how it had been dispersed, and the weather). It would be virtually impossible for this amount of radioactive material to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

A/D >10.0 -1000

INDIVIDUAL SOURCES

Very dangerous to the person: This amount of radioactive material, if not managed safely and kept securely, could cause the permanent injury of a person who handles it or is otherwise in contact with it for a short time (minutes to hours). It could possibly be fatal to be close to unshielded material for a period of hours to days.

DISPERSIBLE RADIOACTIVE MATERIAL

Very dangerous in the locality: Handling this amount of radioactive material could be fatal. There would be little or no risk of permanent injuries beyond a hundred metres downwind of a fire or explosion involving this amount of radioactive material. However, a limited area, probably no more than one square kilometre, could be contaminated to non-dangerous levels that may warrant long term controls or clean up[146]. The size of the area to be cleaned up would depend on many factors (including the size and type of the source, whether and how it had been dispersed, and the weather).

It would be virtually impossible for this amount of radioactive material to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

A/D >1000

INDIVIDUAL SOURCES

Extremely dangerous to the person: This amount of radioactive material, if not managed safely and kept securely, could cause the permanent injury of a person who handles it or is otherwise in contact with it. It would probably be fatal to be close to unshielded material for a period of minutes to an hour.

DISPERSIBLE RADIOACTIVE MATERIAL

Very dangerous in the locality: Handling this amount of radioactive material would likely be fatal. There would be little or no risk of permanent injuries beyond a few hundred metres downwind of a fire or explosion involving this amount of radioactive material. However, a limited area, probably no more than a few square kilometres, could be contaminated to non-dangerous levels that may warrant long term controls or clean up. The size of the area to be

[147] This only applies to radionuclides that have long half-lives and refers to levels of contamination that could result in doses in excess of those warranting permanent resettlement in accordance with international guidance (1000 mSv over a lifetime) [2, 3].

cleaned up would depend on many factors (including the size and type of the source, whether and how it had been dispersed, and the weather).

It would be highly unlikely for this amount of material to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

FOR ALL RANGES

Risks to responders: There will be little or no health risks to response personnel provided that in taking response actions near any hazardous material they take normal precautions, such as the use of respiratory protection against material released in a fire or explosion. Limited stays (such as for rescues) near a radioactive source or material would probably not be dangerous. There would be little or no health hazard to medical staff treating or transporting exposed or contaminated persons provided that they protect themselves against the inadvertent ingestion of radioactive material by the use of normal barrier methods such as use of surgical gloves.

Other concerns: Public concern about any incident involving radioactive material must always be duly considered regardless of the threat indicator. Significant adverse (and unwarranted, in terms of the radiological risks involved) public reactions have occurred in the past, even though the levels of contamination and exposure were not dangerous. Such reactions have included having unnecessary abortions, discriminating against persons wrongly taken to be infectious or otherwise to prevent risks, submitting to unnecessary and invasive medical monitoring and treatment, and boycotting local businesses and products.

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GLOSSARY

accident: Any unintended event, including operating errors, equipment failures or other mishaps, the consequences or potential consequences of which are not negligible from the point of view of protection or safety.

action level: The level of dose rate or activity concentration above which remedial actions or protective actions should be carried out in chronic exposure or emergency exposure situations. An action level can also be expressed in terms of any other measurable quantity as a level above which intervention should be undertaken.

arrangements (for emergency response): The integrated set of infrastructural elements necessary to provide the capability for performing a specified function or task required in response to a nuclear or radiological emergency. These elements may include authorities and responsibilities, organization, co-ordination, personnel, plans, procedures, facilities, equipment or training.

authorized: The granting by the regulatory body [Regulatory Authority] or other governmental body of written permission for an operator to perform activities. .

avertable dose: The dose that could be averted if a countermeasure or set of countermeasures were to be applied.

critical safety function: A function that must be performed during normal operations and during an accident in order to protect the release barriers and thus to prevent a release of radioactive material.

dangerous source: A source that could, if not under control, give rise to exposure sufficient to cause severe deterministic health effects. This categorization is used for determining the need for emergency response arrangements and is not to be confused with categorizations of sources for other purposes.

deterministic effect: A health effect of radiation effect for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose. Such an effect is described as a 'severe deterministic effect' if it is fatal or life threatening or results in a permanent injury that reduces quality of life.

emergency: A non-routine situation or event that necessitates prompt action primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property or the environment. This includes nuclear or radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms or earthquakes. It includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

emergency action level (EAL): A specific, predetermined, observable criterion used to detect, recognize and determine the emergency class.

emergency class: A set of conditions that warrant a similar immediate emergency response. The term used for communicating to the response organizations and the public the level of response needed. The events that belong to a given emergency class are defined by criteria specific to the installation, source or practice, which if, exceeded indicate classification at the prescribed level. For each emergency class, the initial actions of the response organizations are predefined.

emergency classification: The process whereby an authorized official classifies an emergency in order to declare the applicable level of emergency class. Upon declaration of the emergency class, the response organizations initiate the predefined response actions for that emergency class.

emergency phase: The period of time from the detection of conditions warranting an emergency response until the completion of all the actions taken in anticipation of or in response to the radiological conditions expected in the first few months of the emergency. This phase typically

ends when the situation is under control, the off-site radiological conditions have been characterized sufficiently well to identify where food restrictions and temporary relocation are required, and all required food restrictions and temporary relocations have been implemented.

emergency plan: A description of the objectives, policy and concept of operations for the response to an emergency and of the structure, authorities and responsibilities for a systematic, co-ordinated and effective response. The emergency plan serves as the basis for the development of other plans, procedures and checklists**.**

(emergency) preparedness: The capability to take action that will effectively mitigate the consequences of an emergency for human health, safety, quality of life, property and the environment.

emergency procedures: A set of instructions describing in detail actions to be taken by response personnel in an emergency.

(emergency) response: The performance of actions to mitigate the consequences of an emergency on human health and safety, quality of life, property and the environment. It may also provide a basis for the resumption of normal social and economic activity.

emergency services: The local off-site response organizations that are generally available and that perform emergency response functions. These may include police, fire and rescue brigades, ambulance services, and control teams for hazardous materials.

emergency worker: A worker who may be exposed in excess of occupational dose limits while performing actions to mitigate the consequences of an emergency for human health and safety, quality of life, property and the environment.

emergency zones: The precautionary action zone and/or the urgent protective action planning zone.

exposure: The act or condition of being subject to irradiation. Exposure can be either external exposure (irradiation by sources outside the body) or internal exposure (due to a source within the body).

first responders: The first members of an emergency service to respond at the scene of an emergency.

improvised nuclear device (IND): A device constructed by a terrorist to produce a nuclear detonation or criticality.

initial phase: The period of time from the detection of conditions warranting the implementation of response actions that must be taken promptly in order to be effective until those actions have been completed. These actions included taking mitigatory actions by the operator and urgent protective actions on and off the site.

intervention: Any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident.

intervention level: The level of avertable dose at which a specific protective action is taken in an emergency or situation of chronic exposure.

longer term protective action: A protective action, which is not an urgent protective action. Such protective actions are likely to be prolonged over weeks, months or years. These include measures such as relocation, agricultural countermeasures and remedial actions.

mitigatory action: Immediate action by the operator or other party:

(1) To reduce the potential for conditions to develop that would result in exposure or a release of radioactive material requiring emergency actions on or off the site; or

(2) To mitigate source conditions that may result in exposure or a release of radioactive material requiring emergency actions on or off the site.

mobile source: A source authorized for use in a practice (e.g. radiography) that may be conducted at various locations under the control of the operator and is not confined to a specified facility. For dangerous mobile source, see the definition of **dangerous source**.

non-radiological consequences: Effects on humans or the environment that are not deterministic or stochastic effects. These include effects on health or the quality of life resulting from psychological, social or economic consequences of the emergency or the response to the emergency.

notification:

(1) A report submitted to a national or international authority providing details of an emergency or potential emergency, for example as required by the Convention on Early Notification Convention of a Nuclear Accident;

(2) A set of actions taken upon detection of emergency conditions with the purpose of alerting all organizations with responsibility for taking emergency response actions in the event of such conditions.

notification point: A designated organization with which arrangements have been made to receive notification (meaning 2 in this glossary) and promptly to initiate predetermined actions to activate a part of the emergency response.

notifying State: The State that is responsible for providing notification (meaning (1)) potentially affected States and the IAEA of an event or situation of actual, potential or perceived radiological significance for other States. This includes:

(1) The State Party that has jurisdiction or control over the facility or activity (including space objects) in accordance with Article 1 of the Early Notification Convention; or

(2) The State that initially detects, or discovers evidence of, a transnational emergency, for example by: detecting significant increases in atmospheric radiation levels of unknown origin; detecting contamination in transnational shipments; discovering a dangerous source that may have originated in another State; or diagnosing medical symptoms that may have resulted from exposure outside the State.

nuclear or radiological emergency: An emergency in which there is, or is perceived to be a hazard due to:

(1) The energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction; or

(2) Radiation exposure.

off-site: Outside the site area.

on-site: Within the site area.

operational intervention level (OIL): A calculated level, measured by instruments or determined by laboratory analysis, that corresponds to an intervention level or action level. OILs are typically expressed in terms of dose rates or of activity of radioactive material released, time integrated air concentrations, ground or surface concentrations, or activity concentrations of radionuclides in environmental, food or water samples. An OIL is a type of action level that is used immediately

and directly (without further assessment) to determine the appropriate protective actions on the basis of an environmental measurement.

operator (or operating organization): Any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste or transport safety when undertaking activities or in relation to any nuclear facilities or sources of ionizing radiation. This includes, private individuals, governmental bodies, consignors or carriers, licensees, hospitals, and self-employed persons. This includes those who are either directly in control of a facility or an activity during use (such as radiographers or carriers) or, in the case of a source not under control (such as a lost or illicitly removed source or a re-entering satellite), those who were responsible for the source before control over it was lost.

practice: Any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed.

precautionary action zone: An area around a facility for which arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to reduce the risk of server deterministic health effects off the site. Protective actions within this area are to be taken before or shortly after a release of radioactive material or exposure on the basis of the prevailing conditions at the facility (EALs).

protective action: An intervention intended to avoid or reduce doses to members of the public in emergencies or situations of chronic exposure.

radiation emergency: A nuclear or radiological emergency.

radiation protection officer: A person technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the relevant requirements established in international safety standards.

radiation specialist: A person trained in radiation protection and other areas of specialization necessary in order to be able to assess radiological conditions, to mitigate radiological consequences or to control doses to responders.

radiological assessor: A person who in the event of a nuclear or radiological emergency assists the operator of a dangerous source by performing radiation surveys, performing dose assessments, controlling contamination, ensuring the radiation protection of emergency workers and formulating recommendations on protective actions. The radiological assessor would generally be the radiation protection officer.

radiological dispersal device (RDD): A device constructed by terrorists to spread radioactive materials using conventional explosives or other means.

regulatory body: An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

response organization: An organization designated or otherwise recognized by a State as being responsible for managing or implementing any aspect of a response.

significant transboundary release: A release of radioactive material to the environment that may result in doses or levels of contamination beyond national borders from the release which exceed international intervention levels or action levels for protective actions, including food restrictions and restrictions on commerce.

site area: A geographical area that contains an authorized facility, activity or source, within which the management of the authorized facility or activity may directly initiate emergency actions. This is typically the area within the security perimeter fence or other designated property marker. It may also be the controlled area around a radiography source or a cordoned off area established by first responders around a suspected hazard.

severe core damage: The level of damage to the core that could result in a release warranting prompt implementation of urgent protective action off-site (e.g. failure of more than 20% of the fuel cladding).

source: Anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive substances or materials — and can be treated as a single entity for protection and safety purposes. For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X ray unit may be a source for the practice of radiodiagnosis; a nuclear power plant is part of the practice of generating electricity by nuclear fission, and may be regarded as a source (e.g. with respect to discharges to the environment) or as a collection of sources (e.g. for occupational radiation protection purposes). A complex or multiple installations situated at one location or site may, as appropriate, be considered a single source for the purposes of application of international safety standards.

special facility: A facility for which predetermined facility specific actions need to be taken if urgent protective actions are ordered in its locality. Examples include chemical plants that cannot be evacuated until certain actions have been taken to prevent fire or explosions and telecommunications centres that must be staffed in order to maintain telephone services.

special population groups: Those members of the public for whom special arrangements are necessary in order for effective protective actions to be taken. Examples include disabled persons, hospital patients and prisoners.

stochastic effect (of radiation): A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose. Stochastic effects may be somatic effects or hereditary effects, and generally occur without a threshold level of dose. Examples include thyroid cancer and leukaemia.

threat assessment: The process of analysing systematically the hazards associated with facilities, activities or sources within or beyond the borders of a State in order to identify:

(1) Those events and the associated areas for which protective actions and emergency countermeasures may be required within the State; and

(2) The actions that would be effective in mitigating the consequences of such events.

transient population groups: Those members of the public who are residing for a short period of time (days to weeks) in a location (such as a camping ground) that can be identified in advance. This does not include members of the public who may be travelling through an area.

transnational emergency: A nuclear or radiological emergency of actual, potential or perceived radiological significance for more than one State. This includes:

(2) A significant transboundary release of radioactive material (however a transnational emergency dose not necessarily imply a significant transboundary release or radioactive material);

(3) A general emergency at a facility or other event that could result in a significant transboundary release (atmospheric or aquatic) of radioactive material;

(4) A discovery of the loss or illicit removal of a dangerous source that has been transported across or is suspected of having been transported across a national border;

(5) An emergency resulting in significant disruption to international trade or travel;

(6) An emergency warranting the taking of protective actions for foreign nationals or embassies in the State in which it occurs;

(7) An emergency resulting in or potentially resulting in severe deterministic health effects and involving a fault and/or problem (such as in equipment or software) that could have implications for safety internationally;

(8) An emergency resulting in or potentially resulting in great concern among the population of more than one State owing to the actual or perceived radiological hazard.

urgent protective action: A protective action that, in the event of an emergency, must be taken promptly (normally within hours) in order to be effective, and the effectiveness of which will be markedly reduced if it is delayed. The most commonly considered urgent protective actions in a nuclear or radiological emergency are evacuation, decontamination of individuals, sheltering, respiratory protection, iodine prophylaxis, and restriction of the consumption of potentially contaminated foodstuffs.

urgent protective action planning zone: An area around a facility for which arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to avert doses off the site in accordance with international standards. Protective actions within this area are to be taken on the basis of environmental monitoring — or, as appropriate, prevailing conditions at the facility.

warning point: A contact point that is staffed or able to be alerted at all times for promptly responding to, or initiating a response to an incoming notification (meaning (1)), warning message, request for assistance or request for verification of a message, as appropriate, from the IAEA.

ABBREVIATIONS

ARR	airborne release rate
BSS	Basic Safety Standards
CP	command post
CR	control room
DDREF	dose and dose rate effectiveness factor
EAL	emergency action level
EMS	emergency medical specialist
ENATOM	IAEA Emergency Notification and Assistance Technical Operations Manual
EOC	emergency operations centre
EOF	emergency operations facility
EP	emergency planning
EPZ	emergency planning zone
ERC	emergency response centre
ERNET	IAEA Emergency Response Network
GAL	generic action level
GIL	generic intervention level
IAP	incident action plan
ICP	incident command post
ICS	incident command system
IDLH	immediately dangerous to life or heath
IND	improvised nuclear device
INES	International Nuclear Event Scale
LET	linear energy transfer
LPF	leak path factor
NCA(A)	national competent authority – for an accident abroad
NCA(D)	national competent authority – for a domestic accident
NPP	nuclear power plant
NREP	national radiation emergency plan
NWP	national warning point
OIL	operational intervention level
OSC	operation support centre
PAZ	precautionary action zone
PIC	public information centre
QA	quality assurance

RAB	radiological assessment branch
RDD	radiological dispersal device
RF	release fraction
RMAC	radiological monitoring and assessment centre
SPDS	safety parameter display system
SRF	source release fraction
T	threat indicator
TLD	thermoluminescent dosimeter/dosimetry
TSC	technical support centre
UL	unlimited quantity
UPZ	urgent protective action planning zone

Annex

BACKGROUND FOR D VALUES IN APPENDIX 8

AI.1 The Requirements [2] define a dangerous source as one "that could, if not under control, give rise to exposure sufficient to cause severe deterministic effects". The requirements go on to define a severe deterministic effect as one that "is fatal or life threatening or results in a permanent injury that decreases the quality of life". Table A8-I provides values for the quantities of material that, if not controlled, should be considered a 'dangerous source'.

AI.2 In determining quantities that should be treated as dangerous sources we considered the reasonable exposure routes or scenarios that could result in human exposures if control over a source was lost. These scenarios and assumptions were developed taking account of past experience and relevant concerns such as acts of terrorism.

EMERGENCY EXPERIENCE

AI.3 A review of the IAEA reports involving lost or stolen sources is summarized in table AI-I below. The table does not include an event involving leaving a 0.13 TBq Ir-192 brachytherapy source in a patient for 4 days resulting in her death [58].

AI.4 The smallest uncontrolled source, relative to the D values in Table A8-I, to result in an injury that reduced the quality of life due to external exposure was a 0.12 to 0.16 TBq Cs-137 source [49] This is just slightly larger than the D_1 value of 0.10 TBq for Cs-137 in Table A8-I. The smallest uncontrolled source that resulted in fatal exposure among the public was a 1.2 TBq Ir-192 source [50]. This is about ten times the D_1 value. The only death from intake was from the intake of 10^{-5} of the very dispersible material in a Cs-137 source [39]. This is one tenth of the intake fraction assumed in calculation of the D_2 values. Therefore it appears that the criteria for defining dangerous sources are consistent with the accident experience.

TABLE AI-I SUMMARY OF LOST OR STOLEN SOURCE EMERGENCIES

Emergencies			D_1 [148](TBq)	A/D_1	Health Consequences
Emergency	**Source**	**A[149] (TBq)**			
Istanbul [51]	Co-60	23.5	0.03	783	Severe injury - life threatening
Samut Prakarn [52]	Co-60	15	0.03	500	3 deaths
Tammiku [53]	Cs-137	7.4	0.1	74	1 death
Goiânia [39]	Cs-137	50	0.1	500	4 deaths
Lilo [49]	Cs-137	0.164	0.1	1.6	Severe injury
Lilo [49]	Cs-137	0.126	0.1	1.3	Severe injury
Yanango [54]	Ir-192	1.37	0.08	17.1	Severe injury - life threatening
Gilan [55]	Ir-192	0.185	0.08	2.3	Severe injury
Case 20 [50]	Ir-192	1.2	0.08	13.8	8 deaths
Case 37 [50]	Ir-192	0.26	0.08	3.3	Severe injury
Case 43 [50]	Ir-192	0.3	0.08	3.8	Severe injury
Georgia RTGs	Sr-90	1000	4	250	Severe injury- life threatening

[148] D_1 for the radionuclide involved
[149] Activity (TBq) involved in the emergency.

BENCHMARKS FOR INHALATION

AI.5 Selection of proper D_2 values requires knowledge of the possible deterministic effects of internally deposited radionuclides. In contrast to deterministic effects from external radiation sources, there is very little information available on deterministic effects in human subjects from intake of radionuclides. A meeting of consultants was held to review the use of data on deterministic effects in laboratory animals to independently verify, in benchmark calculations, some of the D_2 values calculated. Models were used for deterministic health effects that were based on effects seen in life-span studies in dogs and rats [56,57]. The consultants focused on radiation pneumonitis/pulmonary fibrosis as the deterministic effect of interest for inhaled radionuclides because it would be the most likely cause of a permanent injury that decreases in the quality of life. Benchmark calculations were made for a number of representative radionuclides using basic principles from these models and doses calculated to the alveolar-interstitial (AI) region of the lung. The calculations estimated, assuming an intake faction of 10^{-4}, the activity (TBq) that would result in an approximate threshold (5%) for morbidity from radiation pneumonitis/pulmonary fibrosis. Table AI-II compares these benchmark D_2 values with the D_2 values from Table A8-I. Generally speaking, there is good agreement between the two sets of D_2 values for alpha- and beta, gamma-emitting radionuclides.

AI.6 A second set of calculations examined whether the criterion of 6 Gy to the lung in 2 days is an appropriate way to consider the chronic irradiation patterns for various beta, gamma-emitting radionuclides in the AI region. This was needed because of the broad range of effective retention and physical half-lives that might be involved. The consultants looked at several long-lived beta, gamma-emitting radionuclides. A different dose criterion, a cumulative absorbed dose of 75 Gy to the AI region in 1 year, was considered because it could lead to an approximate 5% morbidity level from radiation pneumonitis/pulmonary fibrosis. Table AI-III gives the results of these benchmark D_2 values compared with the Table A8-I values. Again, the two sets of numbers agree within factors of 2 or 3.

AI.7 These benchmark calculations indicate that the Table A8-I values that have been examined are consistent within factors of 1 to 5 of values derived from the best currently available models on deterministic health effects in the lung. In most cases the D_2 values in Table A8-I appear to be slightly conservative.

TABLE AI-II. COMPARISON OF TABLE A8-I D_2 VALUES WITH VALUES CALCULATED FROM MODELS FOR RADIATION PNEUMONITIS/PULMONARY FIBROSIS (AI, TYPE S).

Nuclide	Table A8-I	Benchmark
Beta, Gamma Emitters		
Sr-90	1	4.7
Ce-144	9	63
Cs-134	30	30
Co-60	30	25
Alpha Emitters		
Pu-238	0.06	0.08
Pu-239	0.06	0.08
Pu-240	0.06	0.08
Am-241	0.06	0.08

TABLE AI-III. COMPARISON OF TABLE A8-I D_2 VALUES FOR INHALED BETA, GAMMA-EMITTING RADIONUCLIDES WITH VALUES CALCULATED USING AN ABSORBED DOSE CRITERION OF 75 GY TO THE AI REGION IN 1 YEAR (TYPE S).

Nuclide	**Table A8-I**	**Benchmark (75 Gy in 1 yr)**
Co-60	30	11
Sr-90	1	2
Cs-137	20	8
Ir-192	20	25

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