

IAEA SAFETY STANDARDS SERIES

Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material

SAFETY GUIDE

No. TS-G-1.2 (ST-3)



INTERNATIONAL
ATOMIC ENERGY AGENCY
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www.iaea.org/ns/coordinet

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PLANNING AND PREPARING FOR
EMERGENCY RESPONSE TO
TRANSPORT ACCIDENTS
INVOLVING RADIOACTIVE
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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

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FOREWORD

by Mohamed ElBaradei
Director General

One of the statutory functions of the IAEA is to establish or adopt standards of safety for the protection of health, life and property in the development and application of nuclear energy for peaceful purposes, and to provide for the application of these standards to its own operations as well as to assisted operations and, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of nuclear energy.

The following bodies oversee the development of safety standards: the Commission on Safety Standards (CSS); the Nuclear Safety Standards Committee (NUSSC); the Radiation Safety Standards Committee (RASSC); the Transport Safety Standards Committee (TRANSSC); and the Waste Safety Standards Committee (WASSC). Member States are widely represented on these committees.

In order to ensure the broadest international consensus, safety standards are also submitted to all Member States for comment before approval by the IAEA Board of Governors (for Safety Fundamentals and Safety Requirements) or, on behalf of the Director General, by the Publications Committee (for Safety Guides).

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA. Any State wishing to enter into an agreement with the IAEA for its assistance in connection with the siting, design, construction, commissioning, operation or decommissioning of a nuclear facility or any other activities will be required to follow those parts of the safety standards that pertain to the activities to be covered by the agreement. However, it should be recalled that the final decisions and legal responsibilities in any licensing procedures rest with the States.

Although the safety standards establish an essential basis for safety, the incorporation of more detailed requirements, in accordance with national practice, may also be necessary. Moreover, there will generally be special aspects that need to be assessed on a case by case basis.

The physical protection of fissile and radioactive materials and of nuclear power plants as a whole is mentioned where appropriate but is not treated in detail; obligations of States in this respect should be addressed on the basis of the relevant instruments and publications developed under the auspices of the IAEA. Non-radiological aspects of industrial safety and environmental protection are also not explicitly considered; it is recognized that States should fulfil their international undertakings and obligations in relation to these.

The requirements and recommendations set forth in the IAEA safety standards might not be fully satisfied by some facilities built to earlier standards. Decisions on the way in which the safety standards are applied to such facilities will be taken by individual States.

The attention of States is drawn to the fact that the safety standards of the IAEA, while not legally binding, are developed with the aim of ensuring that the peaceful uses of nuclear energy and of radioactive materials are undertaken in a manner that enables States to meet their obligations under generally accepted principles of international law and rules such as those relating to environmental protection. According to one such general principle, the territory of a State must not be used in such a way as to cause damage in another State. States thus have an obligation of diligence and standard of care.

Civil nuclear activities conducted within the jurisdiction of States are, as any other activities, subject to obligations to which States may subscribe under international conventions, in addition to generally accepted principles of international law. States are expected to adopt within their national legal systems such legislation (including regulations) and other standards and measures as may be necessary to fulfil all of their international obligations effectively.

EDITORIAL NOTE

An appendix, when included, is considered to form an integral part of the standard and to have the same status as the main text. Annexes, footnotes and bibliographies, if included, are used to provide additional information or practical examples that might be helpful to the user.

The safety standards use the form 'shall' in making statements about requirements, responsibilities and obligations. Use of the form 'should' denotes recommendations of a desired option.

The English version of the text is the authoritative version.

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1. INTRODUCTION

BACKGROUND

1.1. The use of radioactive material is an important part of modern life and technology. Radioactive material is used extensively in medicine, industry, agriculture, research, consumer products and electrical power generation. Tens of millions of packages containing radioactive material are consigned for transport each year throughout the world. The quantity of radioactive material in these packages varies from negligible quantities in shipments of consumer products to very large quantities in shipments of irradiated nuclear fuel.

1.2. In order to ensure the safety of people, property and the environment, national and international transport regulations have been developed. They are used by the appropriate authorities in each State to control the transport of radioactive material. Stringent measures are required in these regulations to ensure adequate containment, shielding and the prevention of criticality in the event of a transport accident. Radioactive material is transported by land (road and rail), inland waterways, sea and air. These modes of transport are regulated by international ‘modal’ regulations. For example, the sea mode is covered by the International Maritime Dangerous Goods Code, which is issued by the International Maritime Organization [1]. The consignors, carriers and consignees of radioactive material are required to comply with the requirements set forth in the State or international modal regulatory documents. The IAEA’s 1998 General Conference noted that “compliance with regulations which take account of the Agency’s Transport Regulations is providing a high level of safety during the transport of radioactive materials” [2].

1.3. Despite the extensive application of these stringent safety controls, transport accidents involving packages containing radioactive material have occurred and will occur. Whenever a transport accident involving radioactive material occurs, and although many will pose no radiation safety problem, emergency response actions are needed to ensure that radiation safety is maintained. If a transport accident occurs that results in a significant release of radioactive material, loss of shielding or loss of criticality control, the consequences should be controlled or mitigated by proper emergency response actions. Historically, there have been no reported transport accidents involving radioactive material that have resulted in serious radiological consequences. Despite this excellent safety record, plans should be developed, responsibilities should be defined and preparedness actions should be taken to ensure that an adequate emergency response capability is available when transport accidents involving radioactive material do occur.

1.4. The type of emergency planning and preparedness for responding to transport accidents involving radioactive material is, to some extent, similar to that required for responding to transport accidents involving the other types of dangerous goods, such as flammables, explosives, poisonous gases, corrosives and toxic chemicals, that are in transport every day.

1.5. The responses to an accident involving any type of dangerous goods can be initiated properly once it has been determined that dangerous goods are present and the material has been properly identified. The various international and State regulatory bodies require the use of communication tools to allow those who are first on the scene of a transport accident to define the hazard involved and hence determine how to respond properly. Thus emergency response organizations and personnel should be required to develop or should be provided with practical emergency response plans and procedures. They should demonstrate an adequate level of preparedness such that they are ready to provide the necessary response to transport accidents involving all types of dangerous goods, including radioactive material. The plans and procedures should ensure that the basic knowledge, skills and equipment are available to deal effectively with the wide range of possible consequences of such accidents.

1.6. A Safety Guide, Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material, was published in 1988¹. This Safety Guide reflected the requirements of the 1985 edition of the Transport Regulations². The publication of the 1996 edition of the IAEA's Transport Regulations [3]³ necessitated that Safety Series No. 87 be reviewed and revised to reflect the new regulatory requirements.

¹ INTERNATIONAL ATOMIC ENERGY AGENCY, Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material, Safety Series No. 87, IAEA, Vienna (1988).

² INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, 1985 edition (as amended 1990), Safety Series No. 6, IAEA, Vienna (1990).

³ In June 2000 errata were issued for the English language edition of ST-1. The English edition was reprinted in 2000 with the corrections shown in the errata and given the new designation of TS-R-1 (ST-1, Revised) and the French and Spanish editions were reprinted in 2002 with similar corrections.

1.7. In order to update the previous recommendations on emergency planning for transport accidents involving radioactive material, the IAEA convened a consultants services meeting and followed this with a technical committee meeting in 1996. Additional actions were later taken by the Secretariat to make this Safety Guide final. These included adding recently published information from the IAEA Safety Requirements publication on Preparedness and Response for a Nuclear or Radiological Emergency [4] and a related IAEA TECDOC [5].

OBJECTIVE

1.8. The objective of this Safety Guide is to provide guidance to the public authorities and others (including consignors, carriers and emergency response authorities) who are responsible for developing and establishing emergency arrangements for dealing effectively and safely with transport accidents involving radioactive material. It may assist those concerned with establishing the capability to respond to such transport emergencies. It provides guidance for those States whose involvement with radioactive material is just beginning. It also provides guidance for those States that have already developed their radioactive material industries and the attendant emergency plans but that may need to review and improve these plans. This Safety Guide is neither a collection of rules nor a list of approved steps and actions.

1.9. This Safety Guide reflects the requirements specified in the 1996 edition of the Transport Regulations as revised in 2000 [3] and those of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources [6]. It provides guidance on various aspects of emergency planning and preparedness, including the assignment of responsibilities. This Safety Guide may be used to assist in the preparation of national, regional and local emergency plans and procedures, account being taken of the specific governmental and legislative structures.

1.10. In using this Safety Guide it should be recognized that emergency response plans and the ways in which they are implemented may vary from State to State (see, for example, para. 103 of the Transport Regulations [3]). In each State the responsible authorities should decide how best to apply the information contained in this Safety Guide, considering the actual shipments that may be encountered and the associated hazards. Additional detailed guidance on the many components of an emergency programme is available from a variety of other sources, some of which are cited in this Safety Guide.

SCOPE

1.11. This Safety Guide has been developed to deal specifically with the particular problems associated with transport emergencies involving radioactive material. It should be recognized that the emergency planning and preparedness elements for responding to transport related accidents involving radioactive material are, to a great extent, similar to those for other dangerous goods. It is for this reason that all emergency planning and preparedness elements for responding to transport accidents involving radioactive material should be co-ordinated with those required for responding to transport related accidents involving other dangerous goods. In addition, while this Safety Guide has been developed for responding to accidents known to involve radioactive material, the concepts involved herein should also be applied to transport accidents where the presence of radioactive material is suspected.

1.12. A loss or theft of radioactive material during transport is not specifically dealt with in this Safety Guide. However, procedures developed for the notification of transport accidents involving radioactive material by various international, State and local organizations may also be applicable to cases of loss or theft during transport.

1.13. Detailed information concerning the nature and hazards of radioactivity and radioactive material is not included in this Safety Guide. This information can be found in publications listed in the References and Bibliography.

STRUCTURE

1.14. This Safety Guide provides a framework for planning and preparing for the appropriate responses to transport accidents. It provides guidance on the responsibilities that various agencies and individuals will have in planning, preparing and actually responding to transport accidents. Finally, it elaborates on the steps necessary to provide an adequate response.

1.15. To support this guidance, six appendices are provided. They contain:

- A review of features of the Transport Regulations [3] as they influence emergency response,
- An emergency response reference matrix to guide the first on the scene responders,
- Guidance on suitable instrumentation for assessing radiation levels and contamination,
- An overview of emergency response actions that can be taken to guide the efforts of an emergency manager when at the scene,

- A discussion of examples of responses to accidents and how some of the principles outlined in the guidance have been or could have been applied,
- An example of an equipment kit for a radiation protection team.

1.16. To support the guidance, annexes are also provided as follows:

- A sample of the emergency response guidance that was provided to a carrier by a consignor of radioactive material, and
- A sample of the emergency response guidance that is provided by governments.

2. FRAMEWORK FOR PLANNING AND PREPARING FOR RESPONSE TO ACCIDENTS IN THE TRANSPORT OF RADIOACTIVE MATERIAL

2.1. IAEA safety standards [3, 6] establish a framework for requiring an adequate emergency response capability for responding to transport accidents involving radioactive material.

2.2. The Safety Fundamentals publication Radiation Protection and the Safety of Radiation Sources [7] sets out the objectives of protection and safety as follows:

“Protection objective: to prevent the occurrence of deterministic effects in individuals by keeping doses below the relevant threshold and to ensure that all reasonable steps are taken to reduce the occurrence of stochastic effects in the population at present and in the future.

“Safety objective: to protect individuals, society and the environment from harm by establishing and maintaining effective defences against radiological hazards from sources.”

2.3. The Fundamentals [7] also note that to achieve these objectives “a system of protection founded on basic principles is needed. Intervention may be necessary to deal with the radiological consequences of an accident...”. Intervention in this case is defined as “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”. Thus a transport accident involving radioactive material, irrespective of the magnitude or the nature of the accident, should be responded to using these objectives and principles.

2.4. The requirements on actions to be taken have been established at an international level [6]. These include:

- Requiring intervention in the case of accidents or emergencies in which an emergency plan or emergency procedures have been activated;
- Requiring each registrant or licensee responsible for sources for which prompt intervention may be required to ensure that an emergency plan exists;
- Requiring employers to provide workers who could be affected by an emergency plan with the appropriate information, instruction and training.

2.5. The Transport Regulations [3] require that emergency provisions, as established by the relevant national and/or international organizations, be observed in the event of radioactive material transport accidents or incidents. Further, they require that emergency procedures account for the formation of dangerous substances, other than radioactive, that may result from interactions between the radioactive contents of a consignment and substances in the environment in the event of an accident.

2.6. The Transport Regulations [3] provide the framework for much of the needed protection. They establish stringent design, test and operational controls on the packaging and transport of radioactive material. They impose the regulatory controls exercised by the competent authorities at the State level. They impose these controls through a graded approach on packaging and on both the operational and regulatory controls. This graded approach can be useful to emergency responders in determining the hazard posed by the packages and their contents should they be involved in transport accidents. In addition, a regime of communications is used to allow the personnel involved in responding to an accident to identify the contents, assess the potential hazard and determine the appropriate response actions. These features of the Transport Regulations [3] and the manner in which they may influence the potential consequences and emergency response actions in the event of a transport accident involving radioactive material are summarized in Appendix I. In Ref. [4] five categories of nuclear and radiation related threats for emergency preparedness and response purposes are established, where emergency planning for category I is the most demanding (i.e. it is viewed as having the greatest potential consequences) and for category IV is the least demanding (category V is a special case). The transport of radioactive material is rated in category IV.

2.7. The goal of a programme for planning and preparedness for an emergency involving radioactive material should be to assist in building competence and confidence that an emergency arising from a transport accident would be managed effectively; that is, that the objectives and requirements elaborated in the Safety

Fundamentals and Safety Requirements publications can be met. Any response should be capable of being undertaken in a timely, effective, appropriate and co-ordinated manner wherever the accident may occur.

3. RESPONSIBILITIES FOR PLANNING AND PREPARING FOR RESPONSE TO ACCIDENTS IN THE TRANSPORT OF RADIOACTIVE MATERIAL

GENERAL

3.1. When a transport accident involving radioactive material occurs, several governmental organizations, the consignor, the carrier and their personnel may have responsibilities to act to mitigate its consequences. In most transport accident situations this response consists of life saving, medical aid, fire suppression and control, and the normal police work associated with any accident. In addition, consideration should be given to calling in specialized organizations trained to deal with radioactive material to assess the accident and implement the protective measures used to contain, control or eliminate any radiological hazard. The degree of involvement of the various organizations may vary during the progress of the operation.

RESPONSIBILITIES OF THE NATIONAL CO-ORDINATING AUTHORITY

3.2. The responsibilities for planning and dealing with a transport accident involving radioactive material are generally divided among several involved organizations and persons [7]. The severity of the accident in terms of its consequences generally determines the level of governmental response and involvement. Because the governmental responsibilities and responses are dependent on the legal framework of the State concerned, and therefore may vary between different States, designation within a State of a 'national co-ordinating authority' to provide a focal point may be useful for developing and co-ordinating governmental response plans for transport accidents involving radioactive material. This may be useful for co-ordinating the development of national, provincial and local emergency response plans and facilitating proper emergency preparedness.

3.3. The national co-ordinating authority should consult with other organizations and agencies to ascertain their functions, roles and responsibilities in responding to

an emergency. The local and provincial response plans and procedures (para. 3.9) should be checked by the lead agency to ensure that they are in full compliance with the national emergency plan. It should also, as part of the planning process, determine what resources these organizations and agencies have that may be useful in responding to a transport accident involving radioactive material.

3.4. At each governmental level several organizations and agencies that have responsibilities concerning transport accidents may exist. One agency should be assigned the lead agency responsibility; others should be assigned supportive roles. Assigning lead agency responsibility provides a focal point for developing emergency response plans and demonstrating emergency preparedness capabilities. The concept of a lead agency is also applicable in cases where only a single national plan is envisioned.

3.5. The national co-ordinating authority concept, if applied, should also be extended to the assignment of a co-ordination and control responsibility at the accident site. At the accident scene an 'incident commander' should be designated with the authority and responsibility to direct the on-scene response. The agency or organization assigned this operational responsibility may or may not (depending upon the governmental framework) be the same agency or organization assigned the responsibility for co-ordinating the development of plans. The national co-ordinating authority selected for this operational response function should have the authority and responsibility to direct and control the activities of supporting agencies and organizations during an actual emergency once its representatives arrive on an accident scene. This authority and responsibility typically would be assigned to the individual in the organization who has the primary role during each phase of the response. As the emergency progresses this would typically flow from the first responders to a local official and finally to a national official or command group for events involving several jurisdictions or ministries.

RESPONSIBILITIES FOR NOTIFICATION AND COMMUNICATION

3.6. Although the persons and organizations involved may be different, notification and communications concerning transport accidents involving radioactive material should be handled in a manner similar to that used for other transport incidents involving dangerous goods [8]. The use of communication networks and procedures that are common to all dangerous goods could be advantageous in terms of maintaining a high level of expertise and ensuring the proper and complete staffing of the communication facilities.

3.7. The establishment of regional emergency centres for any kind of accident that are manned 24 hours per day by trained staff should be considered. These centres could provide an effective liaison capability for alerting the appropriate agencies to the actions required. The centres should have information on the areas of jurisdiction of all the agencies that may become involved. They should have available up to date lists of names and the telephone numbers of agencies to be notified and experts who can be expeditiously dispatched to the accident scene. Ideally, the staff at the centres should also have the capability to give advice on how to handle accidents involving a broad spectrum of hazardous materials. Such centres could prove particularly advantageous in the case of an accident where a large number of agencies may become involved. The responsibility for establishing and maintaining such centres should be defined at the governmental level. The centres should also establish provisions to notify forthwith directly or through the IAEA those States that may be affected by a transboundary emergency⁴. Provisions should be in place also to notify the IAEA promptly of a transboundary emergency and to respond to requests for information relating to the emergency in accordance with IAEA requirements [4, 9].

RESPONSIBILITIES OF GOVERNMENTS

3.8. In developing governmental response plans and procedures for transport accidents involving radioactive material, the relevant government bodies:

- Should establish legislation to define the areas of responsibility and the functions of the various national authorities having expertise in this field;
- Should define the responsibilities of national, provincial and local governments;
- Should establish radiation protection services;
- Should identify the authorities to be notified when a transport accident involving radioactive material occurs and establish a communications and notification system;
- Should determine and periodically review and test the adequacy of the plans, as well as the adequacy of the available trained personnel and equipment;
- Should provide for the periodic review and update of the plans;

⁴ Transboundary emergencies are events that are of actual, potential or perceived radiological significance for other States. This includes events that have resulted in significant exposures or contamination in other States, lost or stolen dangerous sources that could have passed over a national border, events influencing international trade or travel, and events perceived to be of radiological significance by the news media or public in another State.

- Should establish, where appropriate, liaison with the authorities in relevant States for notification concerning accidents whose consequences may extend beyond national boundaries;
- Should define the responsibility for public information and education concerning the transport of radioactive material;
- Should establish (or ensure establishment of) appropriate training programmes;
- Should provide resources to implement the plans when required.

3.9. Provincial and local governments should develop their own emergency response plans and procedures. At the local level planning should at least encompass the development of the capability to recognize a radioactive material package, being familiar with basic precautions and knowing who should be called on to provide further assistance [6]. It should cover the operation of their own organizations and the deployment of their own resources. The development of these plans should be co-ordinated among governments at the local, provincial and national level. Anticipated actions under any plan should be supported, as necessary, by checklists.

RESPONSIBILITIES OF CONSIGNORS AND CARRIERS

3.10. The primary responsibility for ensuring preparedness for a given shipment of radioactive material in principle should rest with the consignor. The consignor should ensure that, before undertaking the transport of radioactive material, carriers are fully aware of the procedures to be followed in the event of a transport accident. An example of guidance that was provided to a carrier prior to undertaking the transport of radioactive material is provided in Annex I.

3.11. Although the prime responsibility for safe shipping is with the consignor, the carrier also has responsibilities both for safety during transport and for the proper reaction in the event of an accident. In general, both the carrier and the consignor should be prepared to respond to an accident and provide the appropriate technical assistance to emergency responders.

3.12. The consignor should ensure that adequate arrangements are available to deal effectively with transport accidents involving radioactive material. These arrangements could include being prepared to provide information about the shipment, knowing how to deal with such an accident and providing emergency and/or technical assistance to an accident site, when requested or required.

3.13. In addition, the consignor should make available to the carrier the appropriate emergency instructions and other information concerning emergency responses.

3.14. The carrier should ensure that proper emergency instructions are carried on board the transport unit. All efforts should be made by the carrier to ensure that applicable emergency information will be available to the first on the scene personnel, even in the event that the carrier personnel are incapacitated.

3.15. Carrier personnel should be instructed that immediately after an accident, if they are able to do so, they should inform the police (or another appropriate emergency agency), the consignor and other appropriate authorities of the event. They should also be instructed to act according to the relevant emergency procedures.

RESPONSIBILITIES OF THE RADIATION PROTECTION TEAM

3.16. To support the emergency response organizations that generally respond to all transport accidents, specially trained and equipped radiation protection teams should be available to assess properly any consequences of an accident involving the release of radioactive material. The teams should be identified as a part of governmental emergency response planning. Team members should be experienced persons with professional and technical training in the radiological safety field.

3.17. Communications capabilities with the teams should exist on a 24 hours per day, 7 days per week basis so that the team members can be quickly and reliably notified when their assistance is required at an accident scene. Rapid means of transport for the team and its equipment, with preapproved funds, should be available to ensure the timely movement from their locations to the site of an accident.

3.18. More specifically, the team should be authorized, prepared and equipped to:

- Travel to the site, with the appropriate equipment, in an expeditious manner;
- Evaluate the radiological hazard;
- Take the appropriate steps to minimize personnel exposure to radiation and/or radioactive material;
- Take the appropriate steps to minimize the spread of radioactive contamination;
- Provide technical information and advice to the appropriate authorities that would help in the treatment of affected people;
- Carry out other general emergency measures as required.

3.19. For large area or long term monitoring and assessment, additional personnel and equipment to augment the team at the accident site may be required. Methods for identifying the personnel, equipment and supplies required to support a large area or

long term monitoring and assessment should be documented during the emergency planning process.

4. PLANNING FOR RESPONSE TO ACCIDENTS IN THE TRANSPORT OF RADIOACTIVE MATERIAL

GENERAL

4.1. Radioactive material is transported by land (road and rail), inland waterways, sea and air. The Transport Regulations [3], summarized briefly in Appendix I, are applied to these shipments throughout the world, either directly by national regulations or by way of the requirements of relevant international modal organizations. The Transport Regulations [3] require that emergency provisions, as established by the relevant national or international organizations, shall be observed to protect persons, property and the environment.

4.2. A minimum level of planning for emergency response arising from transport accidents involving radioactive material is appropriate in every State [4]. As noted in Section 3, emergency response planning for transport accidents involving radioactive material is a responsibility that should be discharged by the responsible government authorities, consignors (shippers) and carriers.

4.3. Five categories of nuclear and radiation related threats have been established for emergency preparedness and response purposes [4]. The first category poses the greatest potential for large releases. The fourth category relates to areas of “little or no known threat”. Transport is identified in the fourth of these five categories. This category provides for the minimum level of preparedness, but applies to “all States because accidents involving... transport of radioactive material are possible anywhere”.

EMERGENCY PLANNING AND PREPAREDNESS

4.4. A main national plan for responding to transport accidents involving radioactive material should be developed. All provincial and local plans should be based on this plan. Consignors and carriers should also have emergency plans and the appropriate preparedness procedures. The responsibilities of different organizations are dealt with in Section 3. For protecting workers in the event of transport accidents,

planning should be undertaken by both the consignor and the carrier, whereas, for protecting the public, planning should be undertaken by the appropriate local, regional, national and international officials [6].

4.5. The main national plan should be flexible enough to cope with a wide variety of accidents. However, the plan should at least cover:

- (a) The planning basis;
- (b) The responsibilities, capabilities and duties of the organizations involved;
- (c) The procedures for alerting and notifying key organizations and persons;
- (d) The methods for warning and advising the public;
- (e) The intervention and action levels for exposure and contamination;
- (f) The protective measures;
- (g) The procedures for response actions;
- (h) The resources for medical and public health support;
- (i) The procedures for training, exercises and updating plans;
- (j) Public information.

4.6. For determining the planning basis the responsible authorities should conduct an assessment of the radioactive material transported in their State and the systems used for transporting this material in their State. They should generally determine which types of shipments (material and package types) pass through these systems and which main routes are used. For States that have large numbers and types of radioactive material consignments, consideration may be given to performing assessments using statistical sampling to facilitate identifying those areas where accidents are more frequent and locations in which the possible accidents may have consequences that are more serious. A planning basis should then be defined with account taken of the potential consequences of the results of these analyses.

4.7. Clear step by step procedures should be prepared for implementing the emergency plan, using the graduated response (e.g. local, provincial and national responses) required for the severity of the accident and its consequences. This response could range from a simple confirmation that there is no radiological hazard, with a minimal involvement of expert responders, to situations where large scale remedial measures may be required at the accident site, including a significant involvement of experts.

4.8. Pre-established radiation exposure and contamination levels should be defined by governmental authorities as operational intervention levels (OILs) [6]. These OILs are required to be consistent with international standards [6]. If these OILs are exceeded certain response and protective measures should be taken. A major consideration is that

transport accidents may occur in any location, including remote areas where access for responders may be difficult and in populated areas where the control of public access may be required. As a result, response plans should include considerations for implementation on difficult terrain and in adverse weather conditions.

4.9. Since the type of emergency plans for responding to transport accidents involving radioactive material (designated as Class 7) is often the same in structure as the plans for responding to accidents involving other dangerous goods (Classes 1–6, and 8 and 9 [8]), many of the same organizations will be involved and many of the same actions will be required. It is therefore preferable, wherever possible, to integrate the transport emergency plans for radioactive material with the plans for responding to accidents involving other dangerous goods. For such a master plan, the incorporation of national or regional alerting centres for all types of transport accidents involving dangerous goods should be considered. Such a system would be activated more frequently than a separate system for a particular class of dangerous goods. The experience gained by this combined response system could strengthen its reliability and effectiveness. In doing this, however, it should always be noted that low probability, high consequence transport accidents involving radioactive material may result in certain problems that may require unique responses.

4.10. Emergency plans for dealing with accidents involving radioactive material should conform as closely as possible to the existing capabilities and procedures for dealing with other transport accidents. Police, fire fighting or military organizations frequently provide the first line of response action. The carrier's employees, or members of the public who may be directly involved and initially on the scene of the accident, will most likely contact the police. The carrier's employees involved in transporting radioactive material should be given advance instructions on the procedures to be followed in the event of an accident and in notifying the police and/or other organizations defined in the emergency plans. Annex I provides an example of such guidance. Since para. 555 of the Transport Regulations [3] requires that the consignor provide information in the transport documents specifying the emergency arrangements that are appropriate for the consignment, carriers should ensure that this is accomplished before undertaking transport.

4.11. The emergency plans and procedures should also include provisions to provide information to the first on the scene personnel (e.g. the police and fire brigades) on the immediate response required for a transport accident involving radioactive material, as discussed in para. 5.11.

4.12. Emergency plans and the implementation procedures should specify the distribution of copies of these documents. All the organizations involved in the

overall emergency response system should receive copies of the plans and procedures and all changes to them. A mechanism should be established for those on the distribution list to receive, and acknowledge receipt of, changes to these documents.

4.13. Additional detailed guidance on emergency response planning and preparedness [4, 9] and on developing procedures for assessing and responding to emergencies [5] is available.

5. PREPARING FOR RESPONSE TO ACCIDENTS IN THE TRANSPORT OF RADIOACTIVE MATERIAL

GENERAL

5.1. In responding to transport accidents involving radioactive material the main actions to be taken are to:

- (a) Rescue and provide emergency medical aid to any victims,
- (b) Control fires and the other common consequences of transport accidents,
- (c) Identify the hazards of the material involved,
- (d) Control any radiation hazard and prevent the spread of radioactive contamination,
- (e) Recover the package or packages and transport vehicle,
- (f) Decontaminate personnel,
- (g) Decontaminate and restore the thoroughfare and delineate the borders of other contaminated areas,
- (h) Decontaminate in the vicinity and restore to a safe state.

Once the radioactive material is under control and traffic flow has been restored at the accident scene, the emergency should be considered ended. In addition, if a release or contamination has been identified, decontamination and the restoration of adjoining areas may be required. Although decontamination actions (items (f)–(h) above) are not part of immediate emergency response planning and preparedness, a brief discussion of these activities is provided in this Safety Guide to facilitate understanding.

5.2. Although the carrier and consignor and the national, provincial and local government organizations may all have a role in the response, the primary

responsibility, in principle, should rest with the consignor and the carrier to ensure that adequate arrangements are available to deal effectively with accidents involving radioactive material. At all times during shipment, the consignor and/or carrier should be able to provide information concerning the hazards of the shipment and should be able to send a properly equipped and trained radiation protection team to the site of the accident.

5.3. The need for international co-operation in responding to transport accidents should be considered. The Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [10] provide the basis for such co-operation. Further guidance on international co-operation is given in Ref. [9]. Information on obtaining radiological and specialized medical assistance can be found in Ref. [11].

PHASES OF RESPONSE FOR TRANSPORT ACCIDENTS

5.4. The response actions in any accident can be divided into three phases:

- The initial phase,
- The accident control phase,
- The post-emergency phase.

In any actual accident many of the response actions described in the section on the accident control phase may be commenced in the initial phase of the accident.

PHASES OF RESPONSE FOR ROAD TRANSPORT ACCIDENTS

5.5. The detailed discussion of the three response phases that follow (paras 5.6–5.60) deal directly with land based, road transport accidents. Special considerations for other than land based, road transport accidents are provided in paras 5.61–5.70.

Initial phase

5.6. The carrier and the consignor have responsibilities for some initial emergency actions. They should notify the local and other defined authorities at the earliest practicable time. However, because the operators of the vehicle and crew members may be incapacitated in the accident and may not be able to act, others, who may happen to be on the accident site, may report the accident, most likely to the local civil emergency services.

5.7. Local civil emergency services should assume responsibility and should respond appropriately to an accident and assume the initial command and control responsibilities when they arrive at the accident scene. Their capability for handling accidents involving radioactive material is often limited because of their lack of knowledge and because assistance from persons with radiation safety knowledge and specialized equipment may not be readily available in the early period following an accident. Planning at the local level will usually involve being able to recognize a radioactive material package, being familiar with the basic precautions to be taken and knowing who should be called on to provide further assistance [4]. Furthermore, in some cases sufficient information for assessing the hazard regarding the nature of the consignment may not be immediately available. For these reasons local government emergency response planning should provide for the proper initial steps required to acquire this information. Generally, local authorities should identify the consignor and contents of the package or packages involved and seek assistance from the responsible consignor and carrier, and from the provincial and national authorities. These organizations and authorities should, in turn, have access to expert advice and resources. An arrangement for such access should be specified in the emergency plans.

5.8. During the first minutes after an accident, emergency actions by the local first responders should be directed towards [4]:

- Saving lives;
- Attending to any injured persons;
- Isolating the location;
- Preventing or extinguishing fires;
- Identifying hazards;
- Determining the actions necessary to prevent a further threat to human life, property or the environment;
- Calling for the appropriate expert support.

Priority should be given to life saving and first aid actions. In general, the presence of radioactive material should not impede such actions, as the risks to the emergency responders will generally be low [4].

5.9. Essentially, only visual information will be readily available to the local, first on the scene personnel. This will be in the form of the transport documents, markings and labels on the packages and/or placards on the vehicles or freight containers (see Appendix I). Police, fire fighters or the other first on the scene personnel should be trained to recognize this visual information, to assess the situation by means of standard accident investigation procedures and to notify the appropriate experts for assistance and advice [4]. This will enable the proper decisions to be made on what

further action is necessary (para. 5.76). Emergency response guides and procedures are essential resources for conducting a response action. Typical emergency guides reflecting the requirements of the 1996 edition of the Transport Regulations [3] are provided in Annex II. The level of response should be generally determined based upon the potential hazard posed by the contents of the packages involved. This can be assessed in terms of the external radiation levels associated with the undamaged packages (as defined by the labels, see Appendix I) and the contents of radioactive material present, which will be related to the United Nations numbers for the consignment (tabulated in Annex II). Additional guidance on the level of response the first responders may take is provided in the preliminary emergency response reference matrix given in Appendix II.

5.10. Police, fire fighters or other qualified emergency response personnel should ensure that the scene is kept clear out to an appropriate distance. A later assessment of radiation levels (information on instruments that may be used for these measurements is provided in Appendix III) may prove that these actions were unnecessary, but until the situation is properly evaluated such actions are prudent. Generally, the public should be excluded (evacuated) from an accident site. Only police, fire fighters and other emergency response personnel should be allowed in the limited access (exclusion) area (see paras 5.39–5.47), and only for life saving or other emergency services.

5.11. The distance for such exclusion will depend on the circumstances of the accident. A guideline has been developed [5] and is included in Appendix IV. In addition, Tables II–III to II–XIII of Annex II provide guidance on how to meet the requirements in the 1996 edition of the Transport Regulations [3].

5.12. The police or other emergency personnel should record the names and addresses of the persons involved at the accident scene or in the immediate vicinity. If contamination is later found the people who have left the scene should be contacted to arrange for radiological monitoring. If it is not known exactly how many people or vehicles have passed through the contaminated area, the public should be informed about the accident through the local news media.

5.13. A clear chain of communication should be established from the person in charge at the scene to the relevant authorities. The person in charge at the scene should ensure that an open line of communication is maintained.

5.14. An initial investigation should be carried out by emergency personnel, taking into account the effect on human life, property and the environment, and those outcomes that could occur because of circumstances related to the accident. This initial investigation should determine the subsequent actions to be taken during the accident

control and post-emergency phases. The results of the investigation should also form the basis of an initial report to the emergency response organizations and involved persons.

5.15. The investigation should include inquiries that answer such questions as:

- (a) Were there any injuries to people?
- (b) What labels, markings, placards and transport documents are present?
- (c) Is there (or was there) a fire near the radioactive material packages?
- (d) Are there large quantities of flammable liquids or gases in the immediate vicinity of the accident site?
- (e) Is there explosive, toxic or corrosive material in the immediate vicinity of the accident site?
- (f) Has containment of any of the packages been breached?
- (g) What kind of radiological or other hazards exist?
- (h) What are the meteorological conditions (including wind direction)?
- (i) Has relevant information concerning the location of the population, the expected path of runoff water, the accessibility of the site and alternative roads been gathered?
- (j) Were significant exposures possible? If yes, obtain information to allow the dose to be estimated.

5.16. The investigation should evaluate the situation at the accident site by making four basic determinations:

- (a) Confirming the presence of radioactive material,
- (b) Identifying the specific radionuclides involved and their quantities,
- (c) Ascertaining whether or not the integrity of the shipping containers or packages has been breached,
- (d) Assessing the potential radiological and related hazards.

Each of these is addressed in more detail below.

Confirming the presence of radioactive material

5.17. The initial problem will probably be one of recognition. Some radioactive material may be shipped in corrosive, toxic or chemically irritating forms, but radioactive material is frequently not in these forms and if released its presence is not readily observable. Information confirming the presence of a package containing radioactive material is given by a visual inspection of the package; any markings or labels on the outside of the package; any placards on the outside of the vehicle, freight containers or tanks; and the available transport documents (see Appendix I).

5.18. If suitable radiation monitoring equipment is available to properly trained emergency personnel responding to the accident, it should be used to assist in confirming the presence or absence of radioactive material. The type of instrumentation selected for monitoring a specific accident site should be based on the type of radiation likely to be present. Guidance on the type of equipment to use, depending upon the radionuclides present, has been provided [12], and is reproduced in Appendix III.

Identifying the specific radionuclides involved and their quantity

5.19. The information summarized in Appendix I concerning transport documents and labels should be used to assist in recognizing and providing specifics concerning the nature of the consignment.

Ascertaining the integrity of the shipping containers or packages

5.20. A visual inspection of the consignment may indicate whether the shipping containers or packages have been damaged. The presence of fire, smoke and fumes could preclude an initial determination in this regard. The presence of other toxic materials that have been released as a result of the accident may also hamper the assessment. Saving lives, suppressing fires and dealing with flammable, explosive and toxic materials should generally take priority before any assessment of package integrity can or should be made.

5.21. External damage to a container or package of radioactive material does not necessarily mean that the interior packaging components containing the radioactive material or providing shielding have been breached. However, external damage is an indication that the package should be thoroughly examined by properly equipped and qualified personnel. Leaking liquids, gases or powders may indicate that package integrity has been compromised. All released material should be considered hazardous unless and until otherwise determined by competent personnel. Package integrity might also have failed with no visible indication. This can only be determined by radiological monitoring of the package with the appropriate instruments by qualified experts. Consequently, all packages involved in an accident should initially be treated with caution.

Assessing the potential radiological and related hazards

5.22. An early assessment of hazards should be undertaken. Early information at the scene is useful in determining the extent of the hazard and in preventing unnecessary radiological exposure to emergency response personnel and the public. Early

information is also useful for medical personnel caring for any injured persons who might be contaminated.

5.23. A thorough evaluation of the radiological conditions at an accident site during the early phase of response may not be possible. It requires considerable knowledge and experience with radioactive material and specialized instruments. It may be a time consuming process, especially in cases involving the contamination of persons, objects and the environment. Such an evaluation will generally occur during the accident control phase.

5.24. Information concerning radiation levels, the loss of shielding and any release of radioactive material from a container or package generally may only be obtained early in the emergency response if radiation monitoring equipment is available to the first on the scene emergency response personnel (such as the police, fire, rescue and emergency medical services). If such is the case these personnel should be specifically trained in the operation of such equipment, in any limitations in the use of such equipment that may apply and in the proper interpretation of the results. These personnel should also be trained with respect to the limits on radiation levels for the packages under normal transport conditions and on the limits for personnel safety.

5.25. In the absence of trained and equipped personnel, and in order to gain a better understanding of the potential hazard associated with the contents of the packages included in a specific incident, the first on the scene personnel may apply the guidance set forth in Appendix II.

5.26. Appendix V presents four typical or hypothetical accident scenarios involving radioactive material.

Accident control phase

5.27. The basic information that is available as a result of the actions taken during the initial phase should be used by the individual responsible for the accident control phase (who may be identified as the ‘incident commander’) in defining the primary actions needed during the accident control phase. One method for defining these actions is provided in Appendix IV.

5.28. As a part of the emergency planning process, prior arrangements — authorizing, preparing and equipping a radiation protection team — should be made. This will allow the accident control phase to be handled properly by qualified, experienced and equipped persons or teams. This team should come from governmental authorities, nuclear establishments, hospitals or other organizations where radiological assessment

and protection services exist. It should be capable and authorized to perform the necessary radiation monitoring, assess the hazard and provide appropriate advice.

5.29. The primary purpose of radiation monitoring is to provide timely information on the basis of which proper decisions can be made to initiate protective and recovery actions. In order to achieve these goals, measurements of radiation levels (in mSv/h) and local contamination levels (in Bq/cm²) should be made. The decisions should be made based on the predetermined OILs, as discussed in para. 4.8. The following additional measurements should be considered, depending upon the results of these first measurements:

- Measurements of airborne radioactive material and ground contamination around the scene of the accident;
- Measurements for assessing exposure to members of the public, transport workers and emergency personnel (including, if appropriate, internal contamination).

5.30. The team responding to an accident should have available the appropriate radiation monitoring instruments and should include qualified, trained personnel to operate that equipment, otherwise valid assessments of the radiological hazard may not be possible. This equipment should be available as a basic instrument kit. It should be well maintained and properly calibrated for radiological monitoring. The initial work accomplished at the accident site by the team would be accomplished with this kit. The kit should contain equipment as defined by the appropriate competent authority. An example of an equipment kit for a radiation protection team is shown in Appendix VI. More detailed lists for various types of response teams, depending upon the severity of the accident, are provided in Appendix 7 of IAEA-TECDOC-953.

5.31. In some cases a mobile radiological laboratory may be needed.

5.32. The characteristics of many types of instruments that could be used in assessing the accident scene can be found in standard texts on instruments, for example Ref. [12].

5.33. The appropriate mobile communications capabilities should be provided for the team.

5.34. Based on the results of the measurements, a qualified person, for example the leader of the team, should evaluate the radiological hazards and provide advice to other emergency responders, including the emergency manager. A good practice to follow is to use a map or sketch of the accident area and to document the measurement results on it.

5.35. Other duties of the radiation protection team are discussed in paras 3.16–3.19. These duties may include instructing emergency personnel to provide for radiologically safe working conditions within the accident area. Specifically, the radiation protection team should consider conducting personal monitoring and decontamination and assisting the person in charge with communicating with the local population and the news media.

5.36. Based on an evaluation of the accident situation, a decision should be taken as to what must be done with the package(s) and what further remedial action is necessary. If fissile material is involved, special considerations, such as ensuring the appropriate spacing between groups of packages, should be defined and implemented to ensure criticality safety.

5.37. Where a release of radioactive material in a transport accident necessitates a decision concerning the evacuation of persons from certain areas, that decision and the subsequent actions should be made by the responsible local authorities and the decision should be based upon expert advice [6]. These same authorities would normally also make similar decisions concerning evacuation after transport accidents involving other hazardous materials.

5.38. Protective measures in transport accidents that should be considered where significant radiation or radioactive contamination may exist as a result of the loss of integrity of the packages include:

- The control of access to and egress from the accident vicinity,
- Protective actions within the cordoned-off area,
- Personal protective measures,
- Sheltering or evacuation,
- The decontamination of persons,
- Controlling potentially contaminated food and water supplies,
- The protection of the local drainage system and/or area.

Some of these protective measures might have already commenced, as discussed above, in the initial phase.

Control of access and egress

5.39. At each accident there are two principal areas of interest: a limited access area and an inner cordoned-off area (see Fig. 1). Limited access areas are areas that exclude public access. Cordoned-off areas are internal to limited access areas and are

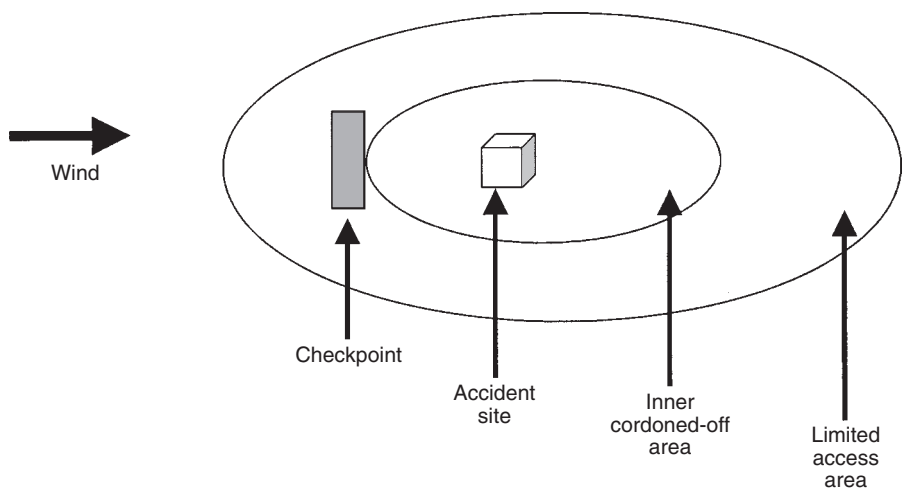
potentially contaminated and/or high radiation level areas that require controlled access and egress. See Appendix IV for additional details concerning distances.

5.40. The control of access to and egress from cordoned-off areas is accomplished using standard procedures. In addition to road blocking, cordoned-off areas should be established using any available material, such as rigid barricades, ropes and tapes. The size and shape of cordoned-off and limited access areas are highly dependent on the geographical terrain and other site conditions and may change during rescue operations. Factors affecting the shape and size of cordoned-off areas are the severity of the accident and the types and quantities of radioactive material released or the radiation levels outside packages, as well as weather conditions, the direction of the prevailing wind and monitoring results.

5.41. Access to and egress from cordoned-off areas by emergency personnel should be made only through an established checkpoint and/or decontamination point. This checkpoint and/or decontamination point should be located in the upwind direction and should serve as a radiological control station and a decontamination station for people, equipment and material, as well as an assembly point for emergency personnel. A written record should be maintained of all personnel access to or egress from cordoned-off areas.

Protective actions within cordoned-off areas

5.42. Emergency personnel working within cordoned-off areas may be exposed to a variety of hazards. These persons, and persons injured in the accident, may be exposed to radiation and may be contaminated with released radioactive material. Emergency workers should complete their work as quickly as possible in the cordoned-off area. Injured persons who need to be taken to a hospital should be wrapped in blankets, or other available coverings, which will help to control the spread of contamination, if present. If radiological monitoring instruments are available, it will be possible to confirm whether anyone is contaminated. If necessary for saving lives, injured persons should immediately be transported to medical facilities with the information that they may be radioactively contaminated. The receiving medical facility should be provided with the best available radiological information concerning the impending arrival of these injured persons. This information should be communicated as far in advance as possible by electronic means (such as radio, telephone, telefax, electronic mail). Contaminated persons taken to a hospital should be accompanied by a qualified person who is available to advise the hospital staff and to check the facilities for contamination after the patients' treatment. Evacuees who are not critically or seriously injured should be



Limited access area (outer cordoned-off area)	Keep public away (para. 5.10). Only police, fire fighters, ambulance service and other qualified personnel allowed inside (para. 5.10).
Inner cordoned-off area	Suspected to be contaminated (paras 5.42–5.45) or to have excessive radiation levels (para. 5.39) (external gamma dose rates >100 $\mu\text{Sv/h}$ [5] or predetermined evacuation distances as in Annex II). Only lifesaving/first aid/fire fighting actions or actions under personnel protective measures allowed (paras 5.39, 5.42, 5.47). Access or egress allowed only through the checkpoint/decontamination point (para. 5.41).
Checkpoint and decontamination point	Locate upwind (para. 5.41). Provide a radiological control station to check for possible contamination (para. 5.41). If there is any contamination of persons or animals, arrangements should be made for decontamination (para. 5.41). If there is any contamination of equipment, vehicles or other items by radioactive material, it should be decontaminated or packed or suitably wrapped (para. 5.45).

Note: numbers in parentheses indicate paragraph numbers in this publication.

FIG. 1. Action areas and checkpoints for an emergency response scene.

detained to be radiologically monitored at a safe distance upwind from the accident scene. This monitoring point should be considered as part of a cordoned-off area.

5.43. As a conservative, safe practice all packages or containers of radioactive material that have been ejected from a vehicle as a result of an accident should also be encompassed by a cordoned-off area to await the arrival of qualified personnel to examine them and conduct radiological monitoring.

5.44. Runoff water from any fire fighting efforts or leakage from damaged containers or packages should be retained within a cordoned-off area by erecting temporary dykes using shovels or other available tools. However, fire fighting needed to protect lives or to mitigate the immediate hazard should not be delayed by actions to limit runoff.

5.45. Animals, vehicles, material, equipment or other items suspected of being contaminated should not be permitted to be removed from cordoned-off areas unless released by qualified radiological monitoring personnel.

5.46. Eating, drinking and smoking should be prohibited in cordoned-off areas.

5.47. The checkpoints controlling access by emergency personnel to the cordoned-off area should be upwind of the radioactive material packages. Emergency response personnel should approach any accident site where radioactive material might have been released from the upwind direction only to minimize the potential for the inhalation of any airborne radioactive material. The use of plastic sheets or tarpaulins should be considered to cover loose material to help minimize its dispersion by wind or rain.

Personal protective measures

5.48. Personal protective measures to minimize radiological exposure are essential when responding to transport accidents involving a release of radioactive material or the loss of package shielding. Such measures may include:

- Minimizing the time spent near the source of the radiation;
- Maximizing the distance from the source of the radiation;
- Using shielding between personnel and the source of the radiation, where available;
- Using respiratory protection equipment to reduce the possibility of inhaling radioactive material;
- Using protective clothing, followed by careful washing, to reduce the possibility of skin contamination or ingestion.

5.49. Fire fighting and radiological monitoring personnel are generally well equipped with standard protective clothing and respiratory protection equipment. This equipment should provide good protection against radioactive contamination and inhaling airborne radioactive material. It does not, however, protect them from direct gamma and neutron radiation, should those sources of penetrating radiation be present.

5.50. Police and emergency medical service personnel and other emergency workers will generally be less suitably equipped. They may acquire simple respiratory protection by covering their mouths and noses with an article of clothing or even soft absorbent paper products. However, if available, respirators should be used if the presence of airborne contamination is suspected. Any clothing, if it covers most of the body, provides a certain degree of protection against skin contamination.

5.51. Personal monitoring devices, such as pocket dosimeters, alarming dosimeters or badges (film or thermoluminescent dosimeters (TLDs)), should be used by emergency personnel as soon as they are available in order to measure personnel exposures. The members of the radiation protection team (paras 3.16–3.19) should be provided with the means to monitor and control their doses continuously in accordance with the applicable international standards [6].

5.52. Sheltering individuals may be necessary if dispersible radioactive material may be spread by local aerosol plumes or winds. Generally, houses and other buildings with closed doors and windows give good protection against contamination. Brick and concrete buildings provide better protection against penetrating radiation than most other types of construction.

5.53. Evacuating an area threatened by a release of radioactive material is the ultimate protective measure, but it should only be necessary in very rare circumstances in response to a transport accident. A precautionary evacuation of a limited area may be ordered while awaiting the arrival of radiological monitoring experts who are able to assess any potential radiological hazard. Decisions on evacuations should be governed by the predetermined operational intervention levels (see paras 4.8 and 5.29) or predetermined guides based on observable conditions at the scene (see Annex II).

Decontamination of persons

5.54. Removing the outer clothing and shoes of persons contaminated with radioactive material will minimize the spread of contamination. Skin decontamination requires shower and washing facilities and possibly some medical assistance in the

case of open wounds, which are unlikely to be available at the site of a transport accident. Persons contaminated or suspected of being contaminated should be initially decontaminated at the accident site. They should later be thoroughly monitored and decontaminated in an appropriate facility. They should be provided with a change of clothing at the accident site, if possible, and the contaminated clothes should be collected for later washing or disposal. Contaminated persons should be wrapped in blankets to help limit the spread of contamination while they are being taken to the decontamination facilities.

Handling damaged packages

5.55. Access to any packages that are damaged or leaking their radioactive contents in excess of the allowable limits for the normal conditions of transport should be limited. Such packages may, under proper supervision, be removed to an acceptable interim location, but should not be forwarded until repaired or reconditioned and decontaminated (see paras 510 and 511 of the Transport Regulations [3]).

Post-emergency phase

Termination of emergencies

5.56. In most cases emergencies may be terminated when items (a)–(h) in para. 5.1 have been accomplished. Termination should be declared by the local responsible authorities. Before a declaration is made it should be ensured that no further hazard exists in the accident area and that all of the necessary protective measures have been taken or are being taken. This should be done to protect the public, property and the environment from further contamination and to minimize exposures that may result from the long term consequences of the accident. If appropriate, the termination of an emergency should be announced to the public by the responsible authority using the news media. The members of the public and the responders who were potentially exposed should be advised of the exposures and associated health risks. For potentially serious exposures advice on treatment should be obtained from medical professionals experienced in treating such cases. These could be obtained through the IAEA under the Emergency Response Network (ERNET) programme [11].

5.57. Persons qualified in radiological protection should be used in decontamination and restoration. As a part of the emergency planning efforts, arrangements should be made to summon persons with additional expertise and equipment suitable for dealing with severe accidents.

5.58. Several decontamination and restoration methods may be employed, such as the following:

- Washing or vacuum sweeping of roads and other objects and surfaces. This can be done with fire fighting or industrial equipment; the water should be collected.
- The fixing of contaminants using paints, liquid to solid strippable plastics and paving materials such as asphalt. Depending upon the type of radioactivity involved, the fixing agent may be removed after it has solidified or it may be left in place.
- Washing and cleaning hard surfaces and equipment with water and appropriate detergents or other chemicals, with the liquids collected.
- The removal or resurfacing of contaminated surface layers of roads or the removal of contaminated earth.

5.59. The relevant local, provincial and national authorities should also be involved so as to ensure that decontamination and restoration are completed in a safe and proper manner and that vehicles, buildings, areas and equipment are not occupied or returned to service until they have been radiologically surveyed and declared safe for use.

Control of food and water supplies

5.60. It is unlikely that major protective measures involving agricultural land, the control and distribution of agricultural products, or potable water would have to be implemented because of contamination from a transport accident involving radioactive material. Although it is possible that an accident could affect these products, any contamination is likely to be localized to a specific area. Under such circumstances the agricultural products may have to be confiscated and disposed of under controlled conditions. If a potable water supply is contaminated by dispersed radioactive material it should be tested for contaminants, and control of the supply at its sources may then be necessary. In the event that an accident takes place near a waterway or on a bridge over water, the water should be monitored if a release of radioactive material is suspected.

SPECIAL CONSIDERATIONS RELATING TO TRANSPORT BY OTHER MODES

Rail transport

5.61. Road transport emergency response arrangements are generally applicable to rail transport. However, railways, which are often the carriers of spent fuel shipments

and many other types of radioactive material, have their own internal network of communication encompassing train crews, railway control points and consigning organizations. It is desirable to have a system for railway emergency response properly integrated into a general emergency system for transport accidents involving dangerous goods. Any such system should include provisions to inform the local, regional and national authorities in the area of an accident of which emergency services may be required of them. In some States railway authorities own their own rights of way and will be directly involved in the accident response and cleanup operations.

Water transport

5.62. Accidents occurring during the water transport of radioactive material may occur in three principal environments: (1) inland waterways, (2) ports and harbours and (3) oceans and seas. Consistent with the recommendations of Section 4, marine transport companies engaged in the transport of radioactive material should have an emergency response plan that should be incorporated into the overall plan for handling all shipboard emergencies.

5.63. Emergencies involving radioactive material on inland waterways and in ports and harbours can be managed in a manner similar to those occurring on land. However, the spread of contamination in a waterway may be much greater than that involved in a land accident. Further, locating and recovering radioactive material and contaminated debris may be more difficult, because of dispersion.

5.64. Emergencies occurring in ports and harbours may have the benefit of specialized emergency response teams. These port and harbour teams are usually trained to respond to marine related emergencies involving dangerous goods and may also prove a valuable asset in handling a radiological emergency. They should be provided with the appropriate level of training as described below.

5.65. Accidents involving radioactive material that occur on the ocean or sea pose some specific problems. An accident may occur in a remote location where the only available personnel to deal with the emergency is the crew of the ship. Crews of ships carrying radioactive material should be knowledgeable in determining when an emergency exists and in the notification procedures to be followed to obtain quick and reliable information about the initial actions to be taken. The crew should know that the only assistance that they may receive in a timely manner may be advice given by radio, based upon information gathered on board the vessel.

5.66. Emergency planning to deal with accidents on board a vessel should comply with the relevant regulations of the vessel's flag State. Further, shipboard personnel