

IAEA Safety Standards

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Preparedness and Response for a Nuclear or Radiological Emergency Involving the Transport of Radioactive Material

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Specific Safety Guide No. SSG-65



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The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

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The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at: Vienna International Centre, PO Box 100, 1400 Vienna, Austria.

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The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

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Security related publications are issued in the **IAEA Nuclear Security Series**.

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PREPAREDNESS AND
RESPONSE FOR A
NUCLEAR OR RADIOLOGICAL
EMERGENCY INVOLVING
THE TRANSPORT OF
RADIOACTIVE MATERIAL



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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".

IAEA SAFETY STANDARDS SERIES No. SSG-65

PREPAREDNESS AND RESPONSE FOR A NUCLEAR OR RADIOLOGICAL EMERGENCY INVOLVING THE TRANSPORT OF RADIOACTIVE MATERIAL

SPECIFIC SAFETY GUIDE

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INTERNATIONAL ATOMIC ENERGY AGENCY
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Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna, Austria
fax: +43 1 26007 22529
tel.: +43 1 2600 22417
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FOREWORD

by Rafael Mariano Grossi
Director General

The IAEA's Statute authorizes it to "establish...standards of safety for protection of health and minimization of danger to life and property". These are standards that the IAEA must apply to its own operations, and that States can apply through their national regulations.

The IAEA started its safety standards programme in 1958 and there have been many developments since. As Director General, I am committed to ensuring that the IAEA maintains and improves upon this integrated, comprehensive and consistent set of up to date, user friendly and fit for purpose safety standards of high quality. Their proper application in the use of nuclear science and technology should offer a high level of protection for people and the environment across the world and provide the confidence necessary to allow for the ongoing use of nuclear technology for the benefit of all.

Safety is a national responsibility underpinned by a number of international conventions. The IAEA safety standards form a basis for these legal instruments and serve as a global reference to help parties meet their obligations. While safety standards are not legally binding on Member States, they are widely applied. They have become an indispensable reference point and a common denominator for the vast majority of Member States that have adopted these standards for use in national regulations to enhance safety in nuclear power generation, research reactors and fuel cycle facilities as well as in nuclear applications in medicine, industry, agriculture and research.

The IAEA safety standards are based on the practical experience of its Member States and produced through international consensus. The involvement of the members of the Safety Standards Committees, the Nuclear Security Guidance Committee and the Commission on Safety Standards is particularly important, and I am grateful to all those who contribute their knowledge and expertise to this endeavour.

The IAEA also uses these safety standards when it assists Member States through its review missions and advisory services. This helps Member States in the application of the standards and enables valuable experience and insight to be shared. Feedback from these missions and services, and lessons identified from events and experience in the use and application of the safety standards, are taken into account during their periodic revision.

I believe the IAEA safety standards and their application make an invaluable contribution to ensuring a high level of safety in the use of nuclear technology. I encourage all Member States to promote and apply these standards, and to work with the IAEA to uphold their quality now and in the future.

PREFACE

In March 2015, the IAEA's Board of Governors approved a Safety Requirements publication, IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency, which was jointly sponsored by 13 international organizations. GSR Part 7 establishes requirements for an adequate level of preparedness for and response to a nuclear or radiological emergency, irrespective of the initiator of the emergency.

The Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency ('the Assistance Convention'), adopted in 1986, place specific obligations on the States Parties and on the IAEA. Under Article 5a(ii) of the 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 response to nuclear accidents or radiological emergencies".

In March 2018, the IAEA's Board of Governors approved the most recent edition of the IAEA's Transport Regulations, which were issued as IAEA Safety Standards Series No. SSR-6 (Rev. 1), Regulations for the Safe Transport of Radioactive Material, 2018 Edition. The IAEA's Transport Regulations establish requirements that must be satisfied to ensure safety and to protect people, property and the environment from harmful effects of ionizing radiation during the transport of radioactive material.

The IAEA General Conference, in resolution GC(59)/RES/9 requested "the Secretariat, Member States and relevant international organizations to emphasize the specific challenges and requirements for efficient international cooperation in response to nuclear and radiological incidents and emergencies relating to the transport of radioactive material".

This Safety Guide is intended to assist Member States in the application of GSR Part 7 and of the Transport Regulations. It provides guidance and recommendations on emergency arrangements for the transport of radioactive material. The recommendations in this Safety Guide are aimed at States, regulatory bodies and response organizations, including consignors, carriers and consignees.

This Safety Guide supersedes IAEA Safety Standards Series No. TS-G-1.2 (ST-3), Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material.

The IAEA, the International Civil Aviation Organization and the International Maritime Organization are joint sponsors of this Safety Guide.

THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures¹ have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety, and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it

¹ See also publications issued in the IAEA Nuclear Security Series.

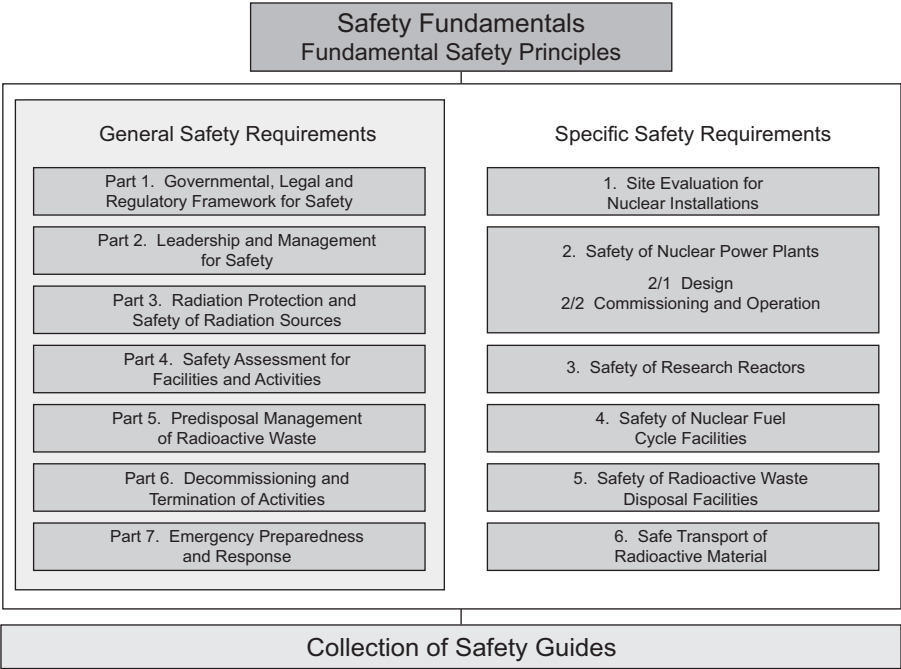


FIG. 1. The long term structure of the IAEA Safety Standards Series.

is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be

used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including the development of educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and five Safety Standards Committees, for emergency preparedness and response (EPReSC) (as of 2016), nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

All IAEA Member States may nominate experts for the Safety Standards Committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards.

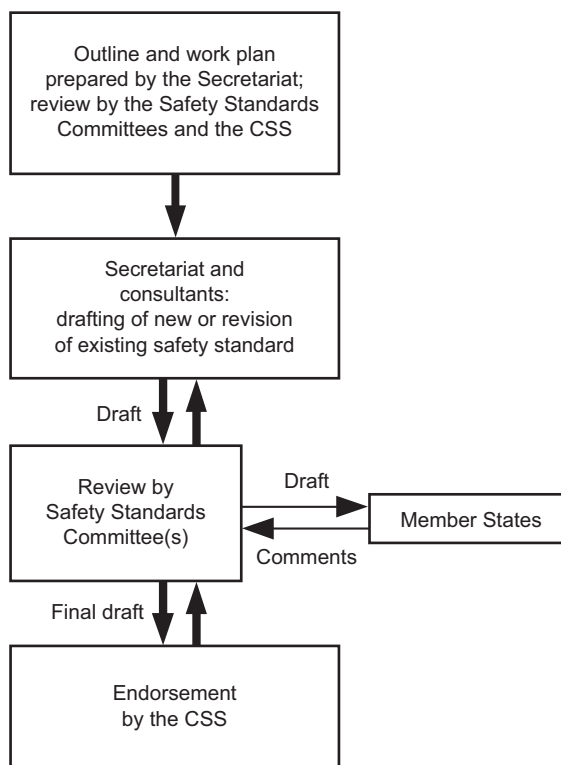


FIG. 2. The process for developing a new safety standard or revising an existing standard.

It articulates the mandate of the IAEA, the vision for the future application of the safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see <https://www.iaea.org/resources/safety-standards/safety-glossary>). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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1. INTRODUCTION

BACKGROUND

1.1. Under Article 5(a)(ii) of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [1], 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 response to nuclear accidents or radiological emergencies”.

1.2. IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency [2], establishes requirements for an adequate level of preparedness and response for a nuclear or radiological emergency¹, irrespective of the initiator of the emergency.

1.3. IAEA Safety Standards Series No. SSR-6 (Rev. 1), Regulations for the Safe Transport of Radioactive Material, 2018 Edition [3] (hereinafter referred to as the ‘Transport Regulations’), establishes requirements to be complied with by competent authorities, package designers, consignors, carriers and consignees. Meeting these requirements ensures a high level of safety for the transport of radioactive material. However, events during transport can occur, and some of these events might lead to a nuclear or radiological emergency. Advance planning and preparation are necessary to provide an efficient and effective response to such emergencies. Consequently, the Transport Regulations [3] require arrangements for emergency preparedness and response for the transport of radioactive material.

1.4. Packages used for the transport of radioactive material are designed with a graded approach to meet requirements that include consideration of the effects on the package of prescribed accident conditions of transport. Consequently, most emergencies during transport have limited radiological consequences and can be resolved in a relatively short period. The emergency response may last only hours or days. However, this Safety Guide considers a wide range of possible emergencies, including those associated with very low probability events that might have significant radiological consequences.

¹ A nuclear or radiological emergency is an emergency in which there is, or is perceived to be, a hazard due to (i) the energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction or (ii) radiation exposure [2].

1.5. This Safety Guide supersedes IAEA Safety Standards Series No. TS-G-1.2 (ST-3), Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material².

1.6. Unless otherwise specified, terms used in this Safety Guide are as defined in the IAEA Safety Glossary [4]. For reasons of brevity, in this Safety Guide the term ‘emergency’ is intended to mean a nuclear or radiological emergency, unless otherwise specified.

OBJECTIVE

1.7. The objective of this publication is to provide recommendations on emergency preparedness and response for the transport of radioactive material. These recommendations form the basis of achieving the goals of emergency response described in GSR Part 7 [2].

1.8. The recommendations in this Safety Guide are aimed at States³, regulatory bodies and response organizations, including consignors, carriers and consignees.

1.9. This Safety Guide should be used in conjunction with the requirements established in GSR Part 7 [2] and the Transport Regulations [3] for emergency preparedness and response for the transport of radioactive material⁴, with due account taken of the recommendations provided in IAEA Safety Standards Series Nos GS-G-2.1, Arrangements for Preparedness for a Nuclear or Radiological Emergency [5]; GSG-2, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency [6]; and GSG-11, Arrangements for the Termination of a Nuclear or Radiological Emergency [7].

² INTERNATIONAL ATOMIC ENERGY AGENCY, Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2 (ST-3), IAEA, Vienna (2002).

³ GSR Part 7 [2] uses the term ‘State’, while the Transport Regulations [3] use the term ‘country’. In this Safety Guide, the terms ‘State’ and ‘country’ are used synonymously.

⁴ In this Safety Guide, the term ‘radioactive material’ means “Material designated in national law or by a *regulatory body* as being subject to *regulatory control* because of its *radioactivity*” [4]. This matches the definition in GSR Part 7 [2] and includes all material that falls within the definition of radioactive material in the Transport Regulations [3]. The term ‘radioactive material’ also includes nuclear material, as defined in the IAEA Nuclear Security Series.

SCOPE

1.10. This Safety Guide considers emergency preparedness and response for the transport of radioactive material, irrespective of the initiator of the emergency, which could be a natural event, a human error, a mechanical or other failure, or a nuclear security event [2].

1.11. The scope of this Safety Guide is limited to transport activities under emergency preparedness category IV⁵, as defined in table 1 of GSR Part 7 [2].

1.12. This Safety Guide does not apply to events occurring during the transport of radioactive material that do not initiate a nuclear or radiological emergency, for example a vehicle involved in a minor traffic accident or an accident involving radioactive material categorized as LSA-I, as defined in para. 409(a), or SCO-I, as defined in para. 413(a) of the Transport Regulations [3]. An accident during the transport of these types of material, whether packaged or unpackaged, is unlikely to lead to a nuclear or radiological emergency.

1.13. This Safety Guide does not apply to emergencies involving the movement of radioactive material fully within the boundaries of authorized facilities. Such emergencies should be addressed as part of the on-site emergency arrangements for the facility, consistent with the relevant requirements in GSR Part 7 [2].

⁵ Emergency preparedness category IV is defined as follows (footnotes omitted):

“Activities and acts that could give rise to a nuclear or radiological emergency that could warrant protective actions and other response actions to achieve the goals of emergency response in accordance with international standards in an unforeseen location. These activities and acts include: (a) transport of nuclear or radioactive material and other authorized activities involving mobile dangerous sources such as industrial radiography sources, nuclear powered satellites or radioisotope thermoelectric generators; and (b) theft of a dangerous source and use of a radiological dispersal device or radiological exposure device. This category also includes: (i) detection of elevated radiation levels of unknown origin or of commodities with contamination; (ii) identification of clinical symptoms due to exposure to radiation; and (iii) a transnational emergency that is not in category V arising from a nuclear or radiological emergency in another State. Category IV represents a level of hazard that applies for all States and jurisdictions” [2].

1.14. This Safety Guide does not address measures specific to nuclear security; such measures are addressed in the publications of the IAEA Nuclear Security Series. The interface with nuclear security response measures is addressed in Section 5.

1.15. Emergency preparedness and response for transport should consider all hazards that might be present. The hazards may include radiological hazards, other hazards from the shipment and operational hazards at the emergency site. Non-radiological hazards are outside the scope of this Safety Guide and are considered only when they might affect the response to radiological hazards.

STRUCTURE

1.16. Section 2 describes the overall national emergency arrangements and framework for emergency preparedness and response for transport. It defines the roles and responsibilities of States, regulatory bodies, consignors, carriers and radiological assessors. Section 3 describes preparedness and response elements, including the preparedness stage, the concept of operations, and training, drills and exercises. Section 4 describes specific considerations for each mode of transport, which can be considered in the overall context of the concept of operations described in Section 3. Section 5 describes the interface with nuclear security and provides references to relevant publications in the IAEA Nuclear Security Series.

1.17. Appendix I sets out considerations for States that are developing a national capability for emergency preparedness and response for transport. Appendix II describes the types of initiating event that could lead to an emergency. Annex I provides background information on the requirements of the Transport Regulations [3] that are relevant to emergency response. Annex II provides an example event notification form. Annex III provides a template for the emergency response plan for carriers or consignors. Annex IV describes possible radiological consequences of postulated emergency situations.

2. NATIONAL ARRANGEMENTS AND FRAMEWORK

2.1. This section provides recommendations on establishing and maintaining arrangements for emergency preparedness and response for the transport of radioactive material. Additional guidance on developing arrangements is contained in Appendix I.

2.2. The arrangements described in this section are intended to help States achieve the goals of emergency preparedness and response, as defined in para. 3.2 of GSR Part 7 [2], and are intended to be part of an effective governmental, legal and regulatory framework (see IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [8]) in relation to emergency preparedness and response for transport.

EMERGENCY MANAGEMENT SYSTEM

2.3. In accordance with Requirement 1 of GSR Part 7 [2], the government is required to establish and maintain an emergency management system. This system should integrate all relevant elements (e.g. organizational structure, resources, policies, processes) into one coherent system to enable the organizations involved to set clear goals and strategies in emergency preparedness and response for any emergency during transport in an effective manner, commensurate with the results of the hazard assessment.

2.4. An incident during the transport of radioactive material might occur in any location. This level of hazard applies to all States and jurisdictions, as defined in emergency preparedness category IV in table 1 of GSR Part 7 [2].

2.5. In accordance with para. 4.10 of GSR Part 7 [2], the government is required to establish a national coordinating mechanism designed “To ensure that roles and responsibilities are clearly specified and are understood by operating organizations, response organizations and the regulatory body”. This mechanism should also ensure that emergency arrangements are established in accordance with a graded approach.

2.6. The national coordinating mechanism should identify all the response organizations and agencies involved in emergency preparedness and response for the transport of radioactive material at the national and local levels, including any foreign consignors, carriers and consignees.

2.7. The national coordinating mechanism should include the relevant competent authorities for emergency preparedness and response, for transport safety and for transport security, in accordance with the relevant national circumstances. These competent authorities might be the same organization.

2.8. Within the national coordinating mechanism, various organizations may have distinct responsibilities concerning a transport emergency. Where practicable,

one organization should be assigned responsibility for each aspect of emergency preparedness and response.

2.9. Emergency arrangements should be put in place for a transport emergency involving consignors or carriers, including foreign consignors and carriers operating within or through the State. The arrangements of foreign consignors and carriers should comply with national regulations and should be compatible with the actions of national response organizations, including coordination and communication.

2.10. In accordance with para. 5.7 of GSR Part 7 [2], at the preparedness stage, arrangements are required to be made for the establishment of a unified command and control system with clear authority and responsibility⁶ to direct the response at the site area⁷ during an emergency, including the response of public and private response organizations that may be present at a transport emergency.

ROLES AND RESPONSIBILITIES

2.11. In accordance with Requirement 2 of GSR Part 7 [2], at the preparedness stage, the roles and responsibilities of all organizations involved in emergency preparedness and response for transport — the government, the response organizations (national and local), and emergency workers, including first responders, radiological assessors, carriers and consignors — are required to be clearly specified and clearly assigned. In some cases, consignees may also have responsibilities in the event of a transport emergency.

2.12. Since the preparedness and response actions for a transport emergency involving any class of dangerous goods have much in common, the aspects that are specific to nuclear or radiological emergencies should be developed and incorporated into the overall emergency management system under the all-hazards approach: see para. 4.3 of GSR Part 7 [2].

⁶ This authority and responsibility would typically be assigned to an individual in the organization that has the primary role during each phase of the response. The authority and responsibility may be transferred between organizations as the emergency response progresses.

⁷ For a transport emergency, the term ‘site area’ refers to the inner cordoned off area established by first responders around a suspected hazard [2].

Government

2.13. Paragraph 4.5 of GSR Part 7 [2] states:

“The government shall make adequate preparations to anticipate, prepare for, respond to and recover from a nuclear or radiological emergency at the operating organization, local, regional and national levels, and also, as appropriate, at the international level.”

With regard to the transport of radioactive material, the operating organization includes consignors, carriers and consignees, as appropriate.

2.14. The relevant governmental bodies should ensure that:

- (a) Specific provisions regarding emergency preparedness and response for the transport of radioactive material are taken into account by the national coordinating mechanism (see para. 4.10 of GSR Part 7 [2]), which should include representatives of the transport safety competent authority. These provisions should be kept up to date.
- (b) The national regulatory requirements for emergency preparedness and response for consignors and carriers, including foreign consignors and carriers operating within or through the State, are defined and included in the international regulatory framework for dangerous goods, as appropriate.
- (c) Arrangements are in place to respond to the loss or theft of radioactive material during transport. If radioactive material has been lost during transport, it should be treated as material out of regulatory control. Recommendations and guidance on nuclear and other radioactive material out of regulatory control are provided in the IAEA Nuclear Security Series.

2.15. In developing emergency arrangements, the relevant government bodies, including the competent authorities for transport safety, transport security and emergency preparedness and response, should do the following:

- (a) Ensure that legislation defines the areas of responsibility and the functions of the various national authorities that have expertise in transport safety, transport security and emergency preparedness and response;
- (b) Ensure that the national coordinating mechanism includes the transport safety competent authority;
- (c) Define the responsibilities of national and local governments for a transport emergency, which could occur in any location;

- (d) Identify consignors, carriers and consignees involved in the regular transport of consignments of radioactive material within or through the State, to enable an accurate hazard assessment to be performed;
- (e) Ensure that any persons with relevant technical expertise (e.g. experts on the package design, radiological assessors) are available in the event of a transport emergency;
- (f) Identify the authorities and organizations to be notified when an incident occurs during the transport of radioactive material, and establish notification procedures;
- (g) Ensure the periodic review, testing and updating of response organization plans, which may include those of private response organizations;
- (h) Establish proper training, drill and exercise programmes that include all response organizations;
- (i) Consider establishing arrangements with the governments in relevant States, including neighbouring States, for a transport emergency that extends beyond national boundaries;
- (j) Specify the responsibility for the provision and coordination of public information in the event of a transport emergency, including the role of the consignor and carrier;
- (k) Ensure that the necessary human, financial and other resources are available to prepare for and deal with a transport emergency;
- (l) Ensure that arrangements are in place for the compensation of victims for damage due to a transport emergency.

2.16. Local governments should develop emergency arrangements for a transport emergency based on the national requirements and the national hazard assessment. These arrangements should address the ability to recognize a consignment of radioactive material, provide familiarity with basic safety precautions, and specify whom to notify. These arrangements should include the deployment and operation of the local government's own resources.

Consignors and carriers

2.17. The consignor has the primary responsibility for ensuring that adequate emergency arrangements are in place for a given shipment of radioactive material and that those arrangements follow the national emergency arrangements of all the States relevant to the shipment. Some aspects of this responsibility may be assigned to the carrier. The States relevant to the shipment include the following, as appropriate:

- (a) The flag State of the conveyance;
- (b) The State of the consignor;

- (c) The State of the consignee;
- (d) States with land, air or territorial waters through which the shipment transits.

2.18. The consignor should ensure that, before carriers undertake the transport of a consignment of radioactive material, they are provided with the instructions to be followed in the event of a transport emergency.

2.19. The consignor should provide instructions, when appropriate, for any specific environmental conditions relevant to the shipment and its route (e.g. remote locations or areas with poor mobile phone reception, road tunnels or risk of severe adverse weather conditions).

2.20. The consignor should confirm that the carrier has made emergency arrangements with relevant organizations, which could include private companies, throughout the duration of the shipment, through all States and jurisdictions, taking account of the possibility of multiple modes of transport. These arrangements should be applied in a graded approach, considering the consignment and based on aspects such as distances, languages or applicable jurisdictional requirements for the shipment.

2.21. The carrier should ensure that written emergency instructions applicable to the consignment of radioactive material being transported are carried on board the conveyance. In addition, efforts should be made by the carrier to ensure that this emergency information will be available to the first responders, even if the carrier personnel are incapacitated.

2.22. During an emergency, the consignor or the carrier may need to communicate with the media and the public, depending on the national arrangements in place. When required, the information should be shared between the different authorities and response organizations involved, before being published, to help ensure that accurate and consistent information is provided [9].

Radiological assessor

2.23. In some cases, emergency services for conventional emergencies are sufficient to respond to a nuclear or radiological emergency. However, if it is suspected that the integrity of a package might have been compromised, a radiological assessor with specialized expertise may be needed to respond to the emergency. The emergency arrangements should include provisions for

identifying the necessary expertise and skills of radiological assessors⁸ and for the timely involvement of appropriate radiological assessors in the response.

2.24. The role of the radiological assessor, which can be fulfilled by either an individual or a team, is to perform radiological surveys, dose assessments and contamination control; to ensure the radiation protection of emergency workers; and to advise on protective actions and other response actions. This role may be fulfilled remotely or at the emergency site, depending on the emergency situation.

2.25. Radiological assessors should be trained and qualified in their necessary functions, including assessing radiation safety, assessing package containment, making dose rate and contamination measurements, and advising on protective actions. Depending on the results of the hazard assessment, the radiological assessor may also need to be trained in the assessment and prevention of criticality.

2.26. Capabilities to communicate with the radiological assessors should be continuously available so that they can be notified of an emergency in which their expertise is needed.

2.27. If the emergency arrangements rely on the presence of radiological assessors at the site of the emergency, such assessors should be able to reach the site area within an appropriate response time. This could be achieved by identifying assessors and equipment across the State or jurisdiction or by having a preidentified means of transport for a centralized team of assessors and equipment, to ensure their timely attendance at the site of the emergency.

2.28. Radiological assessors should be prepared and equipped to undertake the following:

- (a) Travel to the site, if needed, with the appropriate equipment, within the time specified in the emergency arrangements;
- (b) Integrate into the unified command and control system and coordinate with response organizations;
- (c) Operate in emergency conditions, if necessary, while ensuring their own protection from radiological and non-radiological hazards at all times;
- (d) Evaluate the radiological hazard resulting from the radioactive material, through measurements, observations, sampling and other methods, as appropriate;

⁸ Depending on the situation and the national arrangements, the radiological assessor may come from government, technical support organizations, or consignors and carriers.

- (e) Advise on the appropriate steps to minimize the radiation exposure of people;
- (f) Minimize the spread of radioactive contamination;
- (g) Assess the package safety functions and provide a prognosis of their future development;
- (h) Provide technical information and advice to the appropriate authorities and response organizations to help in the emergency response.

HAZARD ASSESSMENT

2.29. Requirement 4 of GSR Part 7 [2] states that: “**The government shall ensure that a hazard assessment is performed to provide a basis for a graded approach in preparedness and response for a nuclear or radiological emergency.**” The potential hazards associated with a transport emergency are required to be identified to provide a basis for establishing emergency arrangements commensurate with the potential consequences of an incident. The hazard assessment is required to identify postulated initiating events and assess the potential consequences for people, property and the environment. Possible initiating events are listed in Appendix II. Possible consequences of an emergency are listed in Annex IV. The hazard assessment provides the basis for a graded approach and allows the development of emergency arrangements commensurate with the potential consequences.

2.30. The hazard assessment should be based on information provided by consignors, carriers, local governments and competent authorities.

2.31. In accordance with paras 4.18 and 4.24 of GSR Part 7 [2], the potential consequences of the identified hazards — radiation hazards, as well as non-radiation-related hazards that might impair the emergency response — are required to be assessed. This assessment should include an evaluation of the potential external dose, the potential for intakes of radioactive material and an evaluation of the associated internal doses that could be received.

2.32. There are multiple values associated with the activity of radioactive material that are used for different purposes in the transport of radioactive material and

in emergency preparedness and response. The A_1 and A_2 values⁹ defined in the Transport Regulations [3] are used “to determine the activity limits for the requirements of these Regulations.” In emergency preparedness and response, D values have been developed for individual radionuclides to specify the activity of a source that, if not under control, could cause severe deterministic effects in a range of scenarios that include both external exposure from an unshielded source and internal exposure following dispersal of the source material [10]. Thus, the A_1 and A_2 values are used to determine required package types, with the goal of applying the graded approach of the Transport Regulations [3] to shipments and withstanding accident conditions of transport. In contrast, D values should be used in determining the extent of the emergency arrangements — using a graded approach consistent with the recommendations provided in GS-G-2.1 [5] — that are necessary to avoid or minimize severe deterministic effects.

2.33. The different types of package and their radioactive contents transported within or through the State should be considered in the hazard assessment. The hazard assessment should consider events leading to single or combined failures of the package safety functions (e.g. containment, protection against external radiation, prevention of damage caused by heat, prevention of criticality), the risks arising from the transport mode and route, and the risk of human error.

2.34. For the assessment of identified hazards, other external conditions that could hinder or impair the response capability should be taken into account when their combination with a transport emergency is foreseeable. Such external conditions include the following:

- (a) A conventional emergency such as an earthquake, hurricane, flood or severe weather at sea (see para. 4.20(b) of GSR Part 7 [2]);
- (b) Another simultaneous emergency affecting a nearby facility;
- (c) Non-radiological hazards arising during the transport emergency.

⁹ The Transport Regulations [3] define the A_1 and A_2 values as follows:

“ A_1 shall mean the activity value of *special form radioactive material* that is listed in Table 2 or derived in Section IV [of the Transport Regulations] and is used to determine the activity limits for the requirements of these Regulations. A_2 shall mean the activity value of *radioactive material*, other than *special form radioactive material*, that is listed in Table 2 or derived in Section IV [of the Transport Regulations] and is used to determine the activity limits for the requirements of these Regulations.”

2.35. The graded approach to the requirements for package classification and design, as described in the Transport Regulations [3], has been developed in part to limit the radiation exposure of workers. However, foreseeable events, even those with low probabilities, in which the package can be compromised beyond the design requirements should be considered in the hazard assessment. Events of this type include the following:

- (a) Operational errors associated with human and organizational factors in package preparation, resulting in excessive dose rates. Examples include making an error in preparation for shipment, forgetting to engage a closure bolt or failing to install the required shielding.
- (b) Exceptional environmental loadings, such as tunnel fires, burying in soft soil, covering with debris, high energy crushing (exceeding the energy of the 9 m drop test), sharp impacts (e.g. impact from a forklift truck) and airplane crashes (except for Type C packages).

2.36. Modalities of transport should also be considered when identifying initiating events and potential consequences. Factors for consideration include route, nearby infrastructure, terrain, distance, timing, seasonal weather and sensitive environments (e.g. environments that contain local food and water supplies). Additional factors, including the frequency of transport, should be taken into account when applying a graded approach to identifying the planning basis for emergency preparedness and response.

2.37. In accordance with para. 4.25 of GSR Part 7 [2], a periodic review of the hazard assessment is required to be undertaken to ensure that any major change in transport activities is adequately considered and that existing arrangements remain appropriate, taking into account any information obtained from the implementation or testing of the emergency arrangements.

PROTECTION STRATEGY

2.38. Paragraph 4.27 of GSR Part 7 [2] states:

“The government shall ensure that, on the basis of the hazards identified and the potential consequences of a nuclear or radiological emergency, protection strategies are developed, justified and optimized at the preparedness stage for taking protective actions and other response actions effectively in a nuclear or radiological emergency to achieve the goals of emergency response.”

2.39. Paragraph 4.30 of GSR Part 7 [2] states that the government “shall ensure that interested parties are involved and are consulted, as appropriate, in the development of the protection strategy.” Interested parties include regulatory bodies, consignors and carriers.

2.40. Protective actions for a transport emergency should be consistent with those for other emergencies and should be based on a reference level described in terms of residual dose (see para. 1.24 of IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [11], and para. 4.28(2) of GSR Part 7 [2]) and on national generic criteria expressed in terms of projected dose or received dose (see para. 4.28(3) of GSR Part 7 [2]).

2.41. Operational intervention levels (OILs)¹⁰ for a nuclear or radiological emergency are provided in GSG-2 [6]. However, OILs can only be used in conjunction with observables and indicators to initiate an emergency response. Exceeding an OIL should not be used as the sole basis for initiating an emergency response. The declaration of an emergency class¹¹ should be based on specific observable conditions. In some rare cases, such as the active monitoring of the temperature of consignments, emergency action levels (EALs) may also be used to initiate an emergency response.

2.42. In incidents during transport, measured dose rates in excess of the operational intervention levels should not be used as the sole justification for declaring an emergency class and triggering emergency response actions. When dose rate measurements show that operational intervention levels are exceeded, the dose rate measurements should be compared with the measurement results and transport index recorded at the beginning of the shipment and with other observables and indicators to help identify abnormal conditions that justify the triggering of appropriate emergency response actions.

¹⁰ Operational intervention levels are “A set level of a measurable quantity that corresponds to a generic criterion” [2].

¹¹ An emergency class is “A set of conditions that warrant a similar immediate emergency response” [2]. In accordance with para. 5.14(e) of GSR Part 7 [2], a transport emergency is classified as “other nuclear or radiological emergency”, while recognizing that in some States the emergency classes may differ from those specified in GSR Part 7 [2].

2.43. For radioactive material regularly transported within a State, the size of any inner cordoned off area¹² to be established in an emergency should be determined and should be based on the national hazard assessment.

2.44. For recurring international shipments, governments should, when practicable, harmonize protection strategies for similar postulated emergencies through agreements or working groups.

PLANS AND PROCEDURES

2.45. The national arrangements for emergency preparedness and response relating to transport should incorporate the responsibilities of domestic and regular foreign consignors and carriers, as applicable. The emergency arrangements of the carrier should be consistent with the national arrangements of all the States in which it operates.

2.46. Transport emergencies should be addressed in the national radiation emergency plan (see para. 3.21 of GS-G-2.1 [5]). This plan should include the results of the hazard assessment and either include or make reference to the protection strategy.

2.47. Consignors and carriers are required by para. 304 of the Transport Regulations [3] to have emergency arrangements in place. These arrangements should be commensurate with the result of the hazard assessment and consistent with the national radiation emergency plan of States in which radioactive material is transported.

2.48. Additional plans and procedures may be developed for specific shipments that occur so infrequently that they are not considered in the national hazard assessment. This will depend primarily on the material being transported. Any such additional plans and procedures should be consistent with the existing plans and procedures, to the extent practicable.

2.49. In accordance with para. 5.6 of GSR Part 7 [2], emergency arrangements are required to be coordinated and integrated with the arrangements for response

¹² An inner cordoned off area is “An area established by first responders in an emergency around a potential radiation hazard, within which protective actions and other emergency response actions are taken to protect first responders and members of the public from possible exposure and contamination” [2].

to a nuclear security event during the transport of radioactive material (see Refs [12, 13]).

2.50. All response organizations should ensure that their plans are consistent and compatible with those of other response organizations. A process to ensure that any changes to existing plans are communicated to affected organizations should be developed and implemented.

National plans

2.51. There does not need to be a separate national plan for a transport emergency. In some States, the national radiation emergency plan is part of the all-hazards national emergency plan [14].

2.52. The emergency arrangements relating to transport should address all the relevant topics for the national radiation emergency plan. These topics include the following:

- (a) Planning basis and hazard assessment;
- (b) Authorities, responsibilities, capabilities and roles of the organizations involved;
- (c) Procedures for alerting and notifying key organizations and persons;
- (d) Methods of providing public information, including warning and informing;
- (e) Generic criteria, emergency action levels (if appropriate), operational intervention levels, and observables and indicators;
- (f) Protective actions and other response actions for the protection of people, property and the environment;
- (g) Protection of emergency workers¹³ and helpers;
- (h) Resources for medical support;
- (i) Training, drills and exercise programmes;
- (j) Procedures for reviewing and updating plans and procedures;
- (k) Procedures for response actions involving the recovery of a package;
- (l) Conditions for terminating the emergency;
- (m) Analysis of the emergency and the emergency response, including implementing actions to address identified gaps.

¹³ An emergency worker is “A person having specified duties as a worker in response to an emergency” [2].

Local plans

2.53. Local authorities that have a role in responding to a transport emergency should develop a plan to enable emergency response functions to be performed. These local emergency plans relating to the transport of radioactive material should address all the necessary topics, including the following:

- (a) A list of emergency response facilities in the local area, consistent with the national hazard assessment and planning basis;
- (b) Responsibilities, capabilities and roles of the organizations involved, including the allocation of tasks and responsibilities during the response, and the responsibility for management of local operations;
- (c) Procedures for requesting information and support from the consignor and the carrier in order to effectively respond to the emergency;
- (d) Procedures for alerting and notifying key organizations and persons, including the fire brigade, police, emergency medical services, radiological assessors and other experts;
- (e) Provision of public information, including warning and informing the public, and links with the media [9];
- (f) Procedures for response actions, including the means of communicating with organizations involved in the response, and the conditions for terminating an emergency [7];
- (g) Resources for medical support and for managing the medical response;
- (h) Procedures for training, drills and exercises (see paras 3.43–3.53);
- (i) Maintenance of the emergency plan.

Consignor and carrier plans

2.54. At the operating organization level, emergency plans for responding to a nuclear or radiological emergency involving the transport of radioactive material should conform, as closely as possible, to the plans for emergencies involving the transport of other dangerous goods. The plans for an emergency involving the transport of radioactive material should be integrated with the plans for other emergencies and for conventional emergencies, as appropriate.

2.55. Consignors and carriers conducting international shipments should ensure that their emergency arrangements comply with the regulatory requirements of each State through which they conduct shipments.

2.56. The emergency arrangements of consignors and carriers should be regularly reviewed and updated, as necessary, within a defined frequency, to take into