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PREPAREDNESS AND RESPONSE FOR A NUCLEAR OR RADIOLOGICAL EMERGENCY

GENERAL SAFETY REQUIREMENTS

JOINTLY SPONSORED BY THE
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1. INTRODUCTION

BACKGROUND

1.1. This IAEA Safety Requirements publication is governed by the fundamental safety objective and the fundamental safety principles established in the IAEA Safety Fundamentals [1]. In particular, this publication addresses Principle 9, which is concerned with the arrangements that must be made for preparedness and response for a nuclear or radiological emergency [1].

1.2. This publication also allows for consistency with essential element No. 11 of the IAEA Nuclear Security Fundamentals [2] which is concerned with the planning for, preparedness for, and response to a nuclear security event. It therefore addresses the emergency arrangements that must be in place 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.

1.3. In 2002, the IAEA published the Safety Requirements publication, Preparedness and Response for a Nuclear or Radiological Emergency, jointly sponsored by seven international organizations (FAO, IAEA, ILO, OECD/NEA, PAHO, OCHA and WHO)[1]. The present Safety Requirements publication is a revised edition of IAEA Safety Standards Series No. GS-R-2, updated to take into account developments and experience gained since 2002. In the revision process, due consideration has been given to — but was not limited to — experience gained from the response to the accident at the Fukushima Daiichi nuclear power plant and to recommendations of the International Commission on Radiological Protection (ICRP) [3]. IAEA Safety Guides [4, 5] elaborate on the requirements established in GS-R-2 and provide recommendations and guidance on their implementation. In addition, Ref. [6] provides guidance on planning and preparing for emergency response to transport accidents involving radioactive material.

1.4. This Safety Requirements publication addresses the requirements for preparedness and response for a nuclear or radiological emergency (including requirements for the transition to an existing exposure situation). Other Safety Requirements publications refer to and are consistent with these requirements in relation to emergency preparedness and response.

1.5. The response to a nuclear or radiological emergency may involve many national organizations (e.g. the operating organization and response organizations at the local, regional and national levels) as well as international organizations. The functions of many of these organizations may be the same for

[1] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-R-2, IAEA, Vienna (2002).

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the response to a nuclear or radiological emergency as for the response to a conventional emergency. However, the response to a nuclear or radiological emergency might also involve specialized agencies and technical experts. Therefore, in order to be effective, the response to a nuclear or radiological emergency has to be well coordinated and emergency arrangements have to be appropriately integrated with arrangements for the response to a conventional emergency and with the response measures for a nuclear security event.

1.6. Safety measures and security measures have in common the aim of protecting human life and health and the environment. Paragraph 1.10 of Ref. [1] states that "Safety 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". This emphasizes the importance of effective coordination between safety measures and security measures in relation to the response to a nuclear or radiological emergency.

1.7. This publication also provides guidance for (1) preparedness and response for a nuclear or radiological emergency by the relevant international organizations and (2) the inter-agency coordination performed through the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE).

1.8. It is assumed that States applying these requirements have in place an infrastructure for the purpose of regulating the safety of facilities and activities that could pose radiation risks. This includes laws and regulations governing the safe operation of facilities and the safe conduct of activities, and an independent regulatory body with responsibilities for establishing and enforcing rules for safe operation and safe conduct. In this context, the IAEA has issued General Safety Requirements publications on the governmental, legal and regulatory framework for safety [7] and on radiation protection and safety of radiation sources [8].

1.9. In addition, it is assumed that States applying these requirements have in place an infrastructure for the purpose of regulating the nuclear security of nuclear material and other radioactive material, associated facilities and associated activities, as well as nuclear security measures for nuclear material and other radioactive material out of regulatory control. This also includes an independent regulatory body as well as other competent authorities with responsibilities for regulating nuclear security. In this context, IAEA Nuclear Security Series publications [9–11] provide recommendations.

OBJECTIVE

1.10. The present publication establishes the requirements for an adequate level of preparedness and response for a nuclear or radiological emergency. The application of these requirements is also intended to mitigate the consequences of a nuclear or radiological emergency if such an emergency arises despite all efforts made to prevent it.

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1.11. The fulfilment of these requirements will contribute to the harmonization worldwide of arrangements for preparedness and response for a nuclear or radiological emergency.

1.12. These requirements are intended to be applied by the government at the national level by means of adopting legislation and establishing regulations, and by making other arrangements, including assigning responsibilities (e.g. to the operating organization or the operating personnel of a facility or an activity, local or national officials, response organizations or the regulatory body) and verifying their effective fulfilment.

1.13. The requirements are also intended for use by response organizations, operating organizations and the regulatory body with regard to preparedness and response for a nuclear or radiological emergency, as well as by authorities with responsibilities in emergency preparedness and response at the local and regional level and, as appropriate, by relevant international organizations at the international level.

SCOPE

1.14. The requirements apply for preparedness and response for a nuclear or radiological emergency in relation to all those facilities and activities, as well as sources, with the potential for causing radiation exposure, environmental contamination or concern on the part of the public warranting protective actions and other response actions.

1.15. The requirements also apply to preparedness and response for a nuclear or radiological emergency in relation to off-site jurisdictions that may need to take protective actions and other response actions.

1.16. The requirements apply for preparedness and response for a nuclear or radiological emergency irrespective of the initiator of the emergency, whether the emergency follows a natural event, a human error, a mechanical or other failure, or a nuclear security event[2]. The requirements do not cover preparedness for, or response measures that are specific to, nuclear security events, for which recommendations are provided in Refs [9–11]. Such response measures include activities for the identification, collection, packaging and transport of evidence contaminated with radionuclides, nuclear forensics and related actions in the context of investigation into the circumstances surrounding a nuclear security event. The requirements established here do provide for a coordinated and integrated approach to preparedness and response for a nuclear or radiological emergency arising from a nuclear security event that necessitates protective actions and other response actions to be taken for

[2] A ‘nuclear security event’ is an event that has potential or actual implications for nuclear security that must be addressed. Such events include criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities or associated activities. A nuclear security event, for example sabotage of a nuclear facility or detonation of a radiological dispersal device, may give rise to a nuclear or radiological emergency.

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protection of members of the public, workers and emergency workers, helpers in an emergency and patients.

STRUCTURE

1.17. This publication comprises six sections. Section 2 provides for the interpretation and entry into force of the requirements. Section 3 establishes the goals of emergency preparedness and response. Section 4 establishes the general requirements that are required to be met before effective emergency arrangements can be made, defines by using a graded approach the emergency preparedness categories for which the requirements have been established and elaborates on the development of a protection strategy on the basis of the hazards assessed. Section 5 establishes the requirements to be met for performing the functions critical for an effective emergency response. Section 6 establishes requirements for the infrastructure necessary to develop and maintain adequate arrangements for preparedness. Guidance values for restricting exposure of emergency workers in a nuclear or radiological emergency are provided in Appendix I. Generic criteria for use in emergency preparedness and response are provided in Appendix II. Annex I presents the applicability of paragraphs in the text for each emergency preparedness category.

2. INTERPRETATION, RESOLUTION OF CONFLICTS AND ENTRY INTO FORCE

DEFINITIONS

2.1. Terms used in this publication have the meanings given under Definitions. Unless otherwise stated under Definitions, terms are used as defined in the IAEA Safety Glossary (2007) [22].

INTERPRETATION

2.2. Except as specifically authorized by the statutory governing body of a Sponsoring Organization, no interpretation of this standard by any officer or employee of the Sponsoring Organization other than a written interpretation by the Director General of the Sponsoring Organization shall be binding on the Sponsoring Organization.

RESOLUTION OF CONFLICTS

2.3. The requirements of this standard are established in addition to and not in place of other applicable requirements, such as those of relevant binding conventions and national laws and regulations.

2.4. In cases of conflict between the requirements of this standard and other applicable requirements, the government or the regulatory body, as appropriate, shall determine which requirements are to be enforced.

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2.5. Nothing in this standard shall be construed as restricting any actions that may otherwise be necessary for protection and safety or as relieving the parties referred to in this standard from complying with applicable laws and regulations.

ENTRY INTO FORCE

2.6. The Secretariat envisages that, for the IAEA's own operations and for those operations assisted by the IAEA, arrangements will be made to meet these requirements within a period of no more than one year from the date of publication of this standard.

2.7. These standards shall come into force within a period of no more than one year from the date of publication of this standard for all the Sponsoring Organizations in accordance with their respective mandates.

2.8. If a State decides to adopt this standard, this standard shall come into force at the time indicated in the formal adoption by that State, and preferably within a period of no more than one year from the date of its publication.

3. GOALS OF EMERGENCY PREPAREDNESS AND RESPONSE

GOAL OF EMERGENCY PREPAREDNESS

3.1. The goal of emergency preparedness is to ensure that an adequate capability is in place at the operating organization and at local, regional and national levels and, where appropriate, at the international level for an effective response in a nuclear or radiological emergency. This capability relates to an integrated set of infrastructural elements that include, but are not limited to: authority and responsibilities; organization and staffing; coordination; plans and procedures; tools, equipment and facilities; training, drills and exercises; and a management system.

GOALS OF EMERGENCY RESPONSE

3.2. In a nuclear or radiological emergency, the goals of emergency response are:

(a) To regain control of the situation and to mitigate consequences;

(b) To save lives;

(c) To avoid or to minimize severe deterministic effects;

(d) To render first aid, to provide critical medical treatment and to manage the treatment of radiation injuries;

(e) To reduce the risk of stochastic effects;

(f) To keep the public informed and to maintain public trust;

(g) To mitigate, to the extent practicable, non-radiological consequences;

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(h) To protect, to the extent practicable, property and the environment;

(i) To prepare, to the extent practicable, for the resumption of normal social and economic activity.

4. GENERAL REQUIREMENTS

Requirement 1: The emergency management system

The government shall ensure that an integrated and coordinated emergency management system for preparedness and response for a nuclear or radiological emergency is established and maintained.

4.1. The government shall ensure that an emergency management system is established and maintained on the territories and within the jurisdiction of the State for the purposes of emergency response to protect human life, health, property and the environment in the event of a nuclear or radiological emergency.

4.2. The emergency management system shall be designed to be commensurate with the results of the hazard assessment (see paras 4.18–4.26) and shall enable an effective emergency response to reasonably foreseeable events (including very low probability events).

4.3. The emergency management system shall be integrated, to the extent practicable, into an all-hazards emergency management system (see para. 5.7).

4.4. The government shall ensure the coordination of and consistency of national emergency arrangements with the relevant international emergency arrangements[3].

Requirement 2: Roles and responsibilities in emergency preparedness and response

The government shall make provisions to ensure that roles and responsibilities for preparedness and response for a nuclear or radiological emergency are clearly specified and clearly assigned.

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4.5. 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. These preparations shall include adopting legislation and establishing regulations for effectively governing the preparedness and response for a nuclear or radiological emergency at all levels (see para. 1.12).

4.6. The government shall ensure that arrangements are in place for effectively governing the provision of prompt and adequate compensation for victims of damage due to a nuclear or radiological emergency.

[3] Arrangements set under the Assistance Convention and under the Early Notification Convention [12] are examples of international emergency arrangements that are relevant for States Parties to these Conventions.

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4.7. The government shall ensure that all roles and responsibilities for preparedness and response for a nuclear or radiological emergency are clearly allocated in advance among operating organizations, the regulatory body and response organizations[4].

4.8. The government shall ensure that response organizations, operating organizations and the regulatory body have the necessary human, financial and other resources, in view of their expected roles and responsibilities and the assessed hazards, to prepare for and to deal with both radiological and non-radiological consequences of a nuclear or radiological emergency, whether the emergency occurs within or beyond national borders.

4.9. The government shall ensure that operating organizations, response organizations and the regulatory body establish, maintain and demonstrate leadership in relation to preparedness and response for a nuclear or radiological emergency [13].

COORDINATING MECHANISM

4.10. The government shall establish a national coordinating mechanism[5] to be functional at the preparedness stage, consistent with its emergency management system, with the following functions:

(a) to ensure that roles and responsibilities are clearly specified and are understood by operating organizations, response organizations and the regulatory body (see para. 4.7);

(b) to coordinate the hazard assessment within the State (see paras 4.18–4.26) and periodic reviews of the assessed hazards (see para. 4.25);

(c) to coordinate and ensure consistency among the emergency arrangements of the various response organizations, operating organizations and the regulatory body at local, regional and national levels under the all-hazards approach, including those arrangements for response to relevant nuclear security events, and, as appropriate, those arrangements of other States and of international organizations;

(d) to ensure consistency among requirements for emergency arrangements, contingency plans and security plans of operating organizations specified by the regulatory body and by other competent authorities with responsibilities for regulating nuclear security, as relevant, and to ensure that these arrangements and plans are integrated (see para. 4.14(b));

(e) to ensure that appropriate emergency arrangements are in place, both on the site and off the site, as appropriate, in relation to facilities and activities under regulatory control, both within the

[4] This also includes the allocation of roles and responsibilities, as appropriate, among members of the government.

[5] The mechanism for ensuring coordination may differ for different tasks. It may involve an existing body or a newly established body (e.g. a committee consisting of representatives from different organizations and bodies) that has been given the authority to ensure the necessary coordination.

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State and, as relevant, beyond its borders, and also for sources that are not under regulatory control[6];

(f) to coordinate arrangements made for enforcing compliance with the national requirements for emergency preparedness and response as established by legislation and regulations (see paras 1.12, 4.5 and 4.12);

(g) to coordinate a subsequent analysis of an emergency, including analysis of the emergency response (see para. 5.102);

(h) to ensure that appropriate and coordinated programmes of training and exercises are in place and implemented, and that training and exercises are systematically evaluated;

(i) to coordinate effective communication with the public in preparedness for a nuclear or radiological emergency.

REGULATORY BODY

4.11. The government shall ensure that arrangements for preparedness and response to a nuclear or radiological emergency for facilities and activities under the responsibility of the operating organization are dealt with through the regulatory process.

4.12. The regulatory body is required to establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based [7]. These regulations and guides shall include principles, requirements and associated criteria for emergency preparedness and response for the operating organization (see also paras 1.12 and 4.5).

4.13. The regulatory body shall require that arrangements for preparedness and response for a nuclear or radiological emergency be in place for the on-site area for any regulated facility or activity that could necessitate emergency response actions. Appropriate emergency arrangements shall be established by the time the source is brought to the site, and complete emergency arrangements shall be in place before the commencement of operation of the facility or commencement of the activity. The regulatory body shall verify compliance with the requirements for such arrangements.

4.14. Before commencement of operation of the facility or commencement of the activity, the regulatory body shall ensure, for all facilities and activities under regulatory control that could necessitate emergency response actions, that the on-site emergency arrangements:

(a) are integrated with those of other response organizations as appropriate;

[6] Examples of sources not under regulatory control are sources that have been abandoned, lost or stolen and sources under governmental control but not under regulatory control. Examples also include radioactive material that is out of regulatory control as discussed in Ref. [11].

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(b) are integrated with contingency plans in the context of Ref. [9] and with security plans in the context of Ref. [10];

(c) provide, to the extent practicable, assurance of an effective response to a nuclear or radiological emergency.

4.15. The regulatory body shall ensure that the operating organization is given sufficient authority to promptly take necessary protective actions on the site in response to a nuclear or radiological emergency that could result in off-site consequences.

OPERATING ORGANIZATION

4.16. The operating organization shall establish and maintain arrangements for on-site preparedness and response for a nuclear or radiological emergency for facilities or activities under its responsibility, in accordance with the applicable requirements (see paras 1.12, 4.5 and 4.12).

4.17. The operating organization shall demonstrate that, and shall provide the regulatory body with an assurance that, emergency arrangements are in place for an effective response on the site to a nuclear or radiological emergency in relation to the facility or the activity under its responsibility.

Requirement 3: Responsibilities of international organizations in emergency preparedness and response

Relevant international organizations shall coordinate their arrangements in preparedness for a nuclear or radiological emergency and their emergency response actions.[7]

Requirement 4: Hazard assessment

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.

4.18. Hazards identified and potential consequences of an emergency shall be assessed to provide a basis for establishing arrangements for preparedness and response for a nuclear or radiological emergency. These arrangements shall be commensurate with the hazards identified and the potential consequences of an emergency.

4.19. For the purposes of these safety requirements, assessed hazards are grouped in accordance with the emergency preparedness categories shown in Table I. The five emergency preparedness categories (hereinafter referred to as ‘categories’) in Table I establish the basis for a graded approach to the application of these requirements and for developing generically justified and optimized arrangements for preparedness and response for a nuclear or radiological emergency.

[7] The Inter-Agency Committee on Radiological and Nuclear Emergencies and its Joint Radiation Emergency Management Plan of the International Organizations are examples of such coordination.

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TABLE I. EMERGENCY PREPAREDNESS CATEGORIES

Category	Description
I	Facilities, such as nuclear power plants, for which on-site events[a, b] (including those not considered in the design[c]) are postulated that could give rise to severe deterministic effects[d] off the site that warrant precautionary urgent protective actions, urgent protective actions or early protective actions, and other response actions to achieve the goals of emergency response in accordance with international standards[e], or for which such events have occurred in similar facilities.
II	Facilities, such as some types of research reactor and nuclear reactors used to provide power for the propulsion of vessels (e.g. ships and submarines), for which on-site events[a, b] are postulated that could give rise to doses to people off the site that warrant urgent protective actions or early protective actions and other response actions to achieve the goals of emergency response in accordance with international standards[e], or for which such events have occurred in similar facilities. Category II (as opposed to category I) does not include facilities for which on-site events (including those not considered in the design) are postulated that could give rise to severe deterministic effects off the site, or for which such events have occurred in similar facilities.
III	Facilities, such as industrial irradiation facilities or some hospitals, for which on-site events[b] are postulated that could warrant protective actions and other response actions on the site to achieve the goals of emergency response in accordance with international standards[e], or for which such events have occurred in similar facilities. Category III (as opposed to category II) does not include facilities for which events are postulated that could warrant urgent protective actions or early protective actions off the site, or for which such events have occurred in similar facilities.
IV	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[e] 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[f]. 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.
V	Areas within emergency planning zones and emergency planning distances[g] in a State for a facility in category I or II located in another State.

[a] That is, on-site events involving an atmospheric or aquatic release of radioactive material, or external exposure (due, for example, to a loss of shielding or a criticality event), that originates from a location on the site.

[b] Such events include nuclear security events.

[c] This includes events that are beyond the design basis accidents and, as appropriate, conditions that are beyond design extension conditions.

[d] See ‘deterministic effect’ under Definitions.

[e] See the goals of emergency response in para. 3.2 and the generic criteria in Appendix II.

[f] A radiological dispersal device is a device to spread radioactive material using conventional explosives or other means. A radiation exposure device is a device with radioactive material designed to intentionally expose members of the public to radiation. They could be fabricated, modified or improvised devices.

[g] See para. 5.38.

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4.20. The government shall ensure that for facilities and activities, a hazard assessment on the basis of a graded approach is performed. The hazard assessment shall include consideration of:

(a) events that could affect the facility or activity, including events of very low probability and events not considered in the design;

(b) events involving a combination of a nuclear or radiological emergency with a conventional emergency such as an emergency following an earthquake, a volcanic eruption, a tropical cyclone, severe weather, a tsunami, an aircraft crash or civil disturbances that could affect wide areas and/or could impair capabilities to provide support in the emergency response;

(c) events that could affect several facilities and activities concurrently, as well as of the interactions among the facilities and activities affected;

(d) events at facilities in other States or events involving activities in other States.

4.21. The government shall ensure that the hazard assessment identifies those facilities and locations at which there is a significant likelihood of encountering a dangerous source that is not under control[8].

4.22. The government shall ensure that the hazard assessment includes consideration of the results of threat assessments made for nuclear security purposes[9] [9–11].

4.23. In the hazard assessment, facilities and activities, on-site areas, off-site areas and locations shall be identified for which a nuclear or radiological emergency could — with account taken of the uncertainties in and limitations of the information available — warrant:

(a) precautionary urgent protective actions to avoid or to minimize severe deterministic effects by keeping doses below levels approaching the generic criteria at which urgent protective actions and other response actions are required to be undertaken under any circumstances, with account taken of Appendix II;

(b) urgent protective actions and other response actions to avoid or to minimize severe deterministic effects and to reduce the risk of stochastic effects, with account taken of Appendix II;

(c) early protective actions and other response actions, with account taken of Appendix II;

(d) other emergency response actions such as longer term medical actions, with account taken of Appendix II, and emergency response actions aimed at enabling the termination of the emergency (see Requirement 18); or

[8] Examples of such facilities and locations are: scrap metal processing facilities, border crossing points, seaports, airports and abandoned military facilities or other facilities where dangerous sources might have been used in the past.

[9] This includes consideration of ‘strategic locations’, i.e. locations of high security interest in the State which are potential targets for attacks using nuclear and other radioactive material and locations for detection of nuclear and other radioactive material that is out of regulatory control, in line with Ref. [11].

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(e) protection of emergency workers in accordance with paras 5.49–5.61 and with account taken of Appendix I.

4.24. The government shall ensure that the hazard assessment also identifies non-radiation-related hazards[10] to people on the site and off the site that are associated with the facility or activity and that may impair the effectiveness of the response actions to be taken.

4.25. The government shall ensure that a review of the hazard assessment is performed periodically with the aims of: (a) ensuring that all facilities and activities, on-site areas, off-site areas and locations where events could occur that would necessitate protective actions and other response actions are identified, and (b) taking into account any changes in the hazards within the State and beyond its borders, any changes in assessments of threats for nuclear security purposes, the experience and lessons from research, operation and emergency exercises, and technological developments (see paras 6.30, 6.36 and 6.38). The results of this review shall be used to revise the emergency arrangements as necessary.

4.26. The government through the regulatory body shall ensure that operating organizations review appropriately and as necessary revise the emergency arrangements (a) prior to any changes in the facility or activity that affect the existing hazard assessment and (b) when new information becomes available that provides insights into the adequacy of the existing arrangements[11].

Requirement 5: Protection strategy for an emergency

The government shall ensure that 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.

4.27. 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 emergency preparedness stage for taking protective actions and other response actions effectively in a nuclear or radiological emergency to achieve the goals of emergency response.

4.28. Development of a protection strategy shall include, but shall not be limited to, the following:

(1) Consideration shall be given to actions to be taken to avoid or to minimize severe deterministic effects and to reduce the risk of stochastic effects. Deterministic effects shall be evaluated on the basis of relative biological effectiveness (RBE) weighted absorbed dose to a tissue or organ. Stochastic effects in a tissue or organ shall be evaluated on the basis of equivalent dose to the

[10] Examples of non-radiation-related hazards are the release of toxic chemicals, e.g. uranium hexafluoride (UF_6), fires, explosions and floods.

[11] Examples of such changes and available information include the movement of irradiated nuclear fuel to a new location, projected flooding, and information on storms or other meteorological hazards.

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tissue or organ. The detriment associated with the occurrence of stochastic effects in individuals in an exposed population shall be evaluated on the basis of the effective dose.

(2) A reference level expressed in terms of residual dose shall be set, typically as an effective dose in the range 20–100 mSv, acute or annual, that includes dose contributions via all exposure pathways. This reference level shall be used in conjunction with the goals of emergency response (see para. 3.2) and the specific time frame in which particular goals are to be achieved[12];

(3) On the basis of the outcome of the justification and the optimization of the protection strategy, national generic criteria for taking protective actions and other response actions, expressed in terms of projected dose or of dose that has been received, shall be developed with account taken of the generic criteria in Appendix II. If the national generic criteria for projected dose or received dose are exceeded, protective actions and other response actions, either individually or in combination, shall be implemented;

(4) Once the protection strategy has been justified and optimized and a set of national generic criteria has been developed, pre-established operational criteria (conditions on the site, emergency action levels (EALs) and operational intervention levels (OILs)) for initiating the different parts of an emergency plan and for taking protective actions and other response actions shall be derived from the generic criteria[13]. Arrangements shall be established in advance to revise these operational criteria, as appropriate, in the course of a nuclear or radiological emergency, with account taken of the prevailing conditions as they evolve.

4.29. Each protective action, in the context of the protection strategy, and the protection strategy itself shall be demonstrated to be justified (i.e. to do more good than harm), with account taken not only of

[12] The application solely of the reference level for effective dose would not be sufficient to develop the protection strategy. Consideration needs to be given to the particular goal to be met in the response, the time to allow for actions to be taken effectively, and the appropriate dose quantity to be used to ensure that organ doses will be kept below those at which protective actions and other response actions are justified (see para. 4.28 (1)). For example, actions to avoid or to minimize severe deterministic effects are to be taken urgently when projected doses expected to be received within a short period of time exceed those given in Table II.1 of Appendix II for the RBE weighted absorbed dose to a tissue or organ. In this case, if such doses are received, then prompt and appropriate medical actions are necessary. Moreover, selection of a particular value (to be used for optimization purposes and for retrospective assessment of the effectiveness of actions and strategy taken) within the proposed range of 20–100 mSv acute or annual effective dose would depend on the phase of the emergency, the practicality of reducing or preventing exposures, and other factors. While in the urgent phase of an emergency, an effective dose of 100 mSv, acute or annual, might be justified as one of the dosimetric bases for implementing and optimizing a protection strategy, in the later phases, such as during the transition, an effective dose of 20 mSv per year may be justified as one of the dosimetric bases for implementing and optimizing a protection strategy to enable the transition to an existing exposure situation to be made.

[13] The operational criteria (i.e. operational intervention levels) need to be derived for a representative person with account taken of those members of the public that are most vulnerable to radiation exposure (i.e. pregnant women and children).

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those detriments that are associated with radiation exposure but also of those detriments associated with impacts of the actions taken on public health[14], economy, society and the environment.

4.30. The government shall ensure that interested parties are involved and are consulted, as appropriate, in the development of the protection strategy.

4.31. The government shall ensure that the protection strategy is implemented safely and effectively in an emergency response through the implementation of emergency arrangements, including but not limited to:

(a) promptly taking urgent protective actions and other response actions with account taken of Appendix II to avoid or to minimize severe deterministic effects, if possible, on the basis of observed conditions and before any exposure occurs;

(b) taking early protective actions and other response actions to reduce the risk of stochastic effects with account taken of Appendix II;

(c) providing for registration, health screening and longer term medical follow-up, as appropriate, with account taken of Appendix II;

(d) taking actions to protect emergency workers, with account taken of guidance values provided in Appendix I;

(e) taking actions to mitigate non-radiological consequences, with account taken of Appendix II;

(f) assessing the effectiveness of the actions taken and adjusting them as appropriate on the basis of prevailing conditions and available information as well as the reference level expressed in terms of residual dose;

(g) revising the protection strategy as necessary and its further implementation;

(h) discontinuing protective actions and other response actions when they are no longer justified.

5. FUNCTIONAL REQUIREMENTS

GENERAL

5.1. The requirements established in this Section address the functions that are critical for the emergency response in a nuclear or radiological emergency to be effective and for achieving the goals of emergency response (see para. 3.2).

[14] Examples of such impacts include possible deaths among patients evacuated without the necessary medical care and possible reduced life expectancy due to resettlement.

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Requirement 6: Managing operations in an emergency response

The government shall ensure that arrangements are in place for operations in response to a nuclear or radiological emergency to be appropriately managed.

5.2. For facilities in categories I, II and III, arrangements shall be made for the on-site emergency response to be promptly executed and managed without impairing the performance of the continuing operational safety and security functions both at the facility and at any other facilities on the same site. The transition from normal operations to operations under emergency conditions on the site shall be clearly specified and shall be effectively made. The responsibilities of all personnel who would be on the site in an emergency shall be designated as part of the arrangements for this transition. It shall be ensured that the transition to the emergency response and the performance of initial response actions do not impair the ability of operating personnel (such as operating personnel in the control room) to ensure safe and secure operation while taking mitigatory actions.

5.3. For facilities in categories I, II and III, and, where appropriate, for activities in category IV, arrangements shall be made for an off-site emergency response to be promptly executed, effectively managed and coordinated with an on-site emergency response.

5.4. For a site where several facilities in categories I and II are collocated, adequate arrangements shall be made to manage the emergency response at all the facilities if each of them is under emergency conditions simultaneously. This shall include arrangements to manage the deployment of and the protection of personnel responding on and off the site (see paras 5.49–5.61).

5.5. For facilities and activities in categories I, II, III and IV, arrangements have to be made, as far as practicable, so that the facility or activity has a nuclear security system or systems [9–11] that would be functional in a nuclear or radiological emergency.

5.6. Arrangements for response to a nuclear or radiological emergency shall be coordinated and integrated with arrangements at the local, regional and national levels for response to a conventional emergency and to a nuclear security event[15]. These arrangements shall take into consideration the fact that the initiator of the nuclear or radiological emergency may not be known early in the response.

5.7. Arrangements shall be made for the establishment and use of a clearly specified and unified command and control system for emergency response under the all-hazards approach as part of the emergency management system (see paras 4.1–4.3). The command and control system shall provide sufficient assurance for effective coordination of the on-site and off-site response. The authority and

[15] The coordination and integration of arrangements for response to a nuclear or radiological emergency with arrangements for response to a nuclear security event includes coordination with and integration of arrangements for response measures such as identification, collection, packaging and transport of evidence contaminated with radionuclides, nuclear forensics and related activities in the context of an investigation into the circumstances surrounding a nuclear security event.

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responsibility for directing the emergency response and for making decisions on emergency response actions to be taken shall be clearly designated. The responsibility for directing the emergency response and for decision making on emergency response actions to be taken shall be promptly discharged following a notification of an emergency.

5.8. Arrangements shall be made for obtaining and assessing the information necessary for making decisions on the allocation of resources for all response organizations throughout a nuclear or radiological emergency.

5.9. For facilities in category I or II and areas in category V, arrangements shall be made for coordinating the emergency response between response organizations (including those of other States) within the emergency planning zones and emergency planning distances (see para. 5.38) and for providing mutual support.

5.10. Arrangements shall be made with other States, as appropriate, for coordinated response to a radiological emergency.

Requirement 7: Identifying and notifying an emergency and activating an emergency response

The government shall ensure that arrangements are in place for the prompt identification and notification of a nuclear or radiological emergency and for the activation of an emergency response.

5.11. Off-site notification point(s)[16] shall be established to receive notification of an actual or potential nuclear or radiological emergency. The notification point(s) shall be maintained continuously available to receive any notification or request for support and to respond promptly, or to initiate a preplanned and coordinated off-site response appropriate to the emergency class or the level of emergency response. The notification point(s) shall be able to initiate immediate communication by suitable, reliable and diverse means with the response organizations that are providing support.

5.12. For facilities in categories I and II and for areas in category V, the notification point shall be able to initiate immediate communication with the authority that has been assigned the responsibility to decide on and to initiate precautionary urgent protective actions and urgent protective actions off the site (see also para. 5.7).

5.13. For facilities and locations at which there is a significant likelihood of encountering a dangerous source that is not under control (see para. 4.21), arrangements shall be made to ensure that the on-site managers of operations and other personnel are aware of the indicators of a potential radiological emergency, the appropriate notification, and protective actions and other response actions warranted immediately in an emergency. For facilities and locations for which there is a significant likelihood of

[16] This may be the notification point used to receive notification of and to initiate an off-site emergency response to an emergency of any type (conventional, or nuclear or radiological).

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encountering a dangerous source that is not under control and for an emergency at an unforeseen location, arrangements shall be made to ensure that the local officials responsible for the response and first responders are aware of the indicators of a potential radiological emergency, the appropriate notification, and protective actions and other response actions warranted immediately in an emergency.

5.14. The operating organization of a facility or activity in category I, II, III or IV shall make arrangements for promptly classifying, on the basis of the hazard assessment, a nuclear or radiological emergency warranting protective actions and other response actions to protect workers, emergency workers, members of the public and, as relevant, patients and helpers in an emergency, in accordance with the protection strategy (see Req. 5). This shall include a system for classifying all types of nuclear or radiological emergency[17] as follows:

(a) *General emergency* at facilities in category I or II for an emergency that warrants taking precautionary urgent protective actions, urgent protective actions, and early protective actions and other response actions on the site and off the site. Upon declaration of this emergency class, appropriate actions shall promptly be taken, on the basis of the available information relating to the emergency, to mitigate the consequences of the emergency on the site and to protect people on the site and off the site.

(b) *Site area emergency* at facilities in category I or II for an emergency that warrants taking protective actions and other response actions on the site and in the vicinity of the site. Upon declaration of this emergency class, actions shall promptly be taken: (i) to mitigate the consequences of the emergency on the site and to protect people on the site; (ii) to increase the readiness to take protective actions and other response actions off the site if this becomes necessary on the basis of observable conditions, reliable assessments and/or results of monitoring; and (iii) to conduct off-site monitoring, sampling and analysis.

(c) *Facility emergency* at facilities in category I, II or III for an emergency that warrants taking protective actions and other response actions at the facility and on the site but does not warrant taking protective actions off the site. Upon declaration of this emergency class, actions shall promptly be taken to mitigate the consequences of the emergency and to protect people at the facility and on the site. Emergencies in this class do not present an off-site hazard.

(d) *Alert* at facilities in category I, II or III for an event that warrants taking actions to assess and to mitigate the potential consequences at the facility. Upon declaration of this emergency class, actions shall promptly be taken to assess and to mitigate the potential consequences of the event and to increase the readiness of the on-site response organizations.

[17] The emergency classes may differ from those specified in (a)–(e) provided that emergencies of all these types are included.

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(e) *Other nuclear or radiological emergency*[18] for an emergency in category IV that warrants taking protective actions and other response actions at any location. Upon declaration of this emergency class and the level of emergency response, actions shall promptly be taken to mitigate the consequences of the emergency on the site, to protect those in the vicinity (e.g. workers and emergency workers and the public) and to determine where and for whom protective actions and other response actions are warranted.

5.15. For facilities in category I, II or III and for category IV, arrangements shall be made to review the declared emergency class in the light of any new information and, as appropriate, to revise it.

5.16. The emergency classification system for facilities and activities in categories I, II, III and IV shall take into account all postulated emergencies, including those arising from events of very low probability. The operational criteria for classification shall include emergency action levels and other observable conditions (i.e. 'observables') and indicators of the conditions at the facility and/or on the site or off the site. The emergency classification system shall be established with the aim of allowing for the prompt initiation of an effective response in recognition of the uncertainty of the available information. It shall be ensured that any process for rating an event on the International Nuclear and Radiological Event Scale (INES) [14] does not delay the emergency classification or emergency response actions[19].

5.17. For facilities and activities in categories I, II and III, and for category IV, arrangements shall be made: (1) to promptly recognize and classify a nuclear or radiological emergency; (2) upon classification, to promptly declare the emergency class and to initiate a coordinated and preplanned on-site response; (3) to notify the appropriate notification point (see para. 5.11) and to provide sufficient information for an effective off-site response; and (4) upon notification, to initiate a coordinated and preplanned off-site response, as appropriate, in accordance with the protection strategy. These arrangements shall include suitable, reliable and diverse means of warning persons on the site, of notifying the notification point (see paras 5.41, 5.42, 5.43, 6.22 and 6.34) and of communication among response organizations.

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[18] This class covers broad types of emergency (see Table I and paras 4.21 and 4.22). A graded approach may need to be taken when postulating emergencies and expected consequences within the class in order to determine the level of emergency response warranted.

[19] The emergency classification system is not to be confused with the International Nuclear and Radiological Event Scale (INES). INES is a scale developed for use by States only for the purpose of communicating with the public on the safety significance of events associated with sources of radiation. INES is not to be used as a basis for emergency response actions.

5.18. In the event of a transnational emergency, the notifying State shall promptly notify[20,21] the IAEA of the emergency and, either directly or through the IAEA, those States that could be affected by it. The notifying State shall provide information on the nature of the emergency and on its potential transnational consequences, and shall respond to requests from other States and from the IAEA for information for the purposes of mitigating any consequences.

5.19. The State shall make known to the IAEA and to other States, directly or through the IAEA, its single warning point responsible for receiving emergency notifications and information from other States and information from the IAEA. This warning point shall be maintained continuously available to receive any notification, request for assistance or request for verification and to initiate promptly a response or verification. The State shall promptly inform the IAEA and shall inform other States, directly or through the IAEA, of any changes that occur in respect of the warning point. The State shall make arrangements for promptly notifying and for providing relevant information, directly or through the IAEA, to those States that could be affected by a transnational emergency.

5.20. The notifying State shall have arrangements in place for promptly responding to requests from other States or from the IAEA for information in respect of a transnational emergency, in particular with regard to minimizing any consequences. These arrangements shall include making known to the IAEA and to other States, directly or through the IAEA, the notifying State's designated organization(s) for so doing.

5.21. Arrangements shall be made for promptly and directly notifying any State within the emergency planning zones and emergency planning distances (see para. 5.38) in which urgent protective actions and early protective actions and other response actions could be required to be taken.

5.22. Appropriate emergency response actions shall be initiated in a timely manner upon the receipt of a notification from another State or of information from the IAEA on a notification relating to an actual or potential transnational emergency that could have impacts on the State or its nationals.

Requirement 8: Taking mitigatory actions

The government shall ensure that arrangements are in place for taking mitigatory actions in a nuclear or radiological emergency.

[20] Such a notification is in accordance with the State's obligations under the general principles and rules of international law and, for the case of a transboundary release that could be of radiological safety significance for another State, it is in accordance with the Early Notification Convention [12].

[21] A transnational emergency that is considered to represent a public health emergency of international concern may also be expected to be notified in accordance with the International Health Regulations [15].

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5.23. The operating organization of a facility or activity in category I, II, III or IV shall promptly decide on and take actions[22] on the site that are necessary to mitigate the consequences of a nuclear or radiological emergency involving a facility or an activity under its responsibility.

5.24. Off-site emergency services shall be made available for the purpose of, and shall be capable of, supporting the on-site response at facilities and activities in category I, II, III or IV.[23]

5.25. For facilities in category I, II or III, arrangements shall be made for mitigatory actions to be taken by the operating personnel, in particular:

(a) to prevent escalation of an emergency;

(b) to return the facility to a safe and stable state;

(c) to reduce the potential for, and to mitigate the consequences of, radioactive releases or exposures.

These arrangements shall take into account the full range of possible conditions affecting the emergency response, including those resulting from conditions in the facility and those resulting from impacts of postulated natural, human induced or other events and affecting regional infrastructure or affecting several facilities simultaneously. Arrangements shall include emergency operating procedures and guidance for operating personnel on mitigatory actions for severe conditions (for a nuclear power plant, as part of the accident management programme [16]) and for the full range of postulated emergencies, including accidents that are not considered in the design and associated conditions. As far as practicable, the continued functionality of nuclear security system(s) (see Refs [9–11]) needs to be considered in these arrangements.

5.26. The operating organization of a facility or activity in category I, II, III or IV shall assess and determine, at the preparedness stage, when and under what conditions assistance from off-site emergency services may need to be provided on the site, consistent with the hazard assessment and the protection strategy.[23]

5.27. For facilities in category I, II or III, arrangements shall be made, in particular by the operating organization, to provide technical assistance to the operating personnel. On-site teams for mitigating the consequences of an emergency (e.g. damage control, firefighting) shall be available and shall be prepared to perform actions at the facility. Paragraph 5.15 of Ref. [17] states that “Any equipment that is necessary for actions to be taken in manual response and recovery processes shall be placed at the most suitable location to ensure its availability at the time of need and to allow safe access to it under the environmental conditions anticipated”. The operating personnel directing mitigatory actions shall

[22] Such actions may include actions with off-site consequences such as discharge of radioactive material to the environment, provided that the appropriate off-site organizations are notified in advance.

[23] This is not to be understood as reducing the responsibility of the operating organization to have adequate capabilities to respond to an emergency arising in the facility or activity under its responsibility.

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be provided with information and technical assistance that allows them to take actions effectively to mitigate the consequences of the emergency. Arrangements shall be made to obtain support promptly from the emergency services (e.g. law enforcement agencies, medical services and firefighting services) off the site. Off-site emergency services shall be afforded prompt access to the facility, and shall be informed of on-site conditions and provided with instructions and with means for protecting themselves as emergency workers.

5.28. Arrangements shall be made for the operating organization of an activity in category IV, first responders in an emergency at an unforeseen location, and those personnel at locations where there is a significant likelihood of encountering a dangerous source that is not under control (see para. 4.21) to take promptly all practicable and appropriate actions to mitigate the consequences of a nuclear or radiological emergency. These arrangements shall include providing basic instructions and training in the means of mitigating the potential consequences of a nuclear or radiological emergency (see para. 5.41).

5.29. Arrangements shall be made to provide expertise and services in radiation protection promptly to local officials, first responders in an emergency at an unforeseen location and specialized services (e.g. law enforcement agencies) responding to emergencies involving activities in category IV, and to those personnel at locations where there is a significant likelihood of encountering a dangerous source that is not under control (see para. 4.21). This shall include arrangements for on-call advice or other appropriate mechanisms and arrangements to dispatch onto the site an emergency team capable of assessing radiation hazards, mitigating radiological consequences and managing the exposure of emergency workers. In addition, arrangements shall be made to determine whether and when additional assistance is necessary and to determine how to obtain such assistance (see paras 5.24 and 5.94).

5.30. Arrangements shall be made to initiate a prompt search in the event that a dangerous source could possibly be in the public domain as a result of its loss or unauthorized removal (see para. 5.46).

Requirement 9: Taking urgent protective actions and other response actions

The government shall ensure that arrangements are in place to assess emergency conditions and to take urgent protective actions and other response actions effectively in a nuclear or radiological emergency.

5.31. Arrangements shall be made so that the magnitudes of hazards and the possible development of hazardous conditions are assessed initially and throughout a nuclear or radiological emergency in order to promptly identify, characterize or anticipate, as appropriate, new hazards or the extent of hazards and to revise the protection strategy.

5.32. The operating organization of a facility in category I, II or III shall make arrangements to promptly assess and anticipate:

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(a) abnormal conditions at the facility;
(b) exposures and radioactive releases and releases of other hazardous material;
(c) radiological conditions on the site and, as appropriate, off the site;
(d) any exposures or potential exposures of workers and emergency workers, the public and, as relevant, patients and helpers in an emergency.

5.33. These assessments as stated in para. 5.32shall be used:

(a) for deciding on mitigatory actions to be taken by the operating personnel;

(b) as a basis for emergency classification (see para. 5.14);

(c) for deciding on protective actions and other response actions to be taken on the site, including those for the protection of workers and emergency workers;

(d) for deciding on protective actions and other response actions to be taken off the site;

(e) where appropriate, to identify those individuals who could potentially have been exposed on the site at levels requiring appropriate medical attention in accordance with Appendix II.

5.34. These arrangements as stated in para. 5.32 shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)) and provision for access to instruments displaying or measuring those parameters that can readily be measured or observed in a nuclear or radiological emergency. In these arrangements, the expected response of instrumentation and structures, systems and components at the facility under emergency conditions shall be taken into account.

5.35. The operating organization for activities in category IV shall make arrangements to assess promptly the extent and/or the significance of any abnormal conditions on the site, any exposures or any contamination. These assessments shall be used:

(a) for initiating the mitigatory actions;

(b) as a basis for protective actions and other response actions to be taken on the site; and

(c) for determining the level for emergency response and for communicating the extent of the hazards to the appropriate off-site response organizations.

These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).

5.36. Arrangements shall be made such that information on emergency conditions, assessments and protective actions and other response actions that have been recommended and have been taken is promptly made available, as appropriate, to all relevant response organizations and to the IAEA throughout the emergency.

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5.37. Arrangements shall be made for actions to save human life or to prevent serious injury to be taken without any delay on grounds of the possible presence of radioactive material (see paras 5.39 and 5.64). These arrangements shall include providing first responders in an emergency at an unforeseen location with information on the precautions to take in giving first aid or in transporting an individual with possible contamination.

5.38. For facilities in category I or II, arrangements shall be made for effectively making decisions on and taking urgent protective actions, early[24] protective actions and other response actions off the site in order to achieve the goals of emergency response, on the basis of a graded approach and in accordance with the protection strategy. The arrangements shall be made with account taken of the uncertainties in and limitations of the information available when protective actions and other response actions have to be taken to be effective, and shall include the following:

(a) The specification of off-site emergency planning zones and emergency planning distances[25] for which arrangements shall be made at the preparedness stage for taking protective actions and other response actions effectively. These emergency planning zones and emergency planning distances shall be contiguous across national borders, where appropriate, and shall include:

(i) A precautionary action zone (PAZ), for facilities in category I, for which arrangements shall be made for taking urgent protective actions and other response actions, before any significant release[26] of radioactive material occurs, on the basis of conditions at the facility (i.e. conditions leading to the declaration of a general emergency; see para. 5.14), in order to avoid or to minimize severe deterministic effects.

(ii) An urgent protective action planning zone (UPZ), for facilities in category I or II, for which arrangements shall be made to initiate urgent protective actions and other response actions, if possible before any significant release of radioactive material occurs, on the basis of conditions at the facility (i.e. conditions leading to the declaration of a general emergency; see para. 5.14), and after a release occurs, on the basis of monitoring and assessment of the radiological situation off the site, in order to reduce the risk of

[24] Although defined under this overarching requirement, emergency planning zones and emergency planning distances are applicable for both urgent protective actions and early protective actions and other response actions. Within emergency planning zones the main focus is on taking precautionary urgent protective actions, urgent protective actions and other response actions. However, within emergency planning distances, urgent decisions may be warranted, as a precaution, to prevent inadvertent ingestion and to restrict the consumption of food, milk and drinking water that could be directly contaminated following a significant release of radioactive material to the environment and consumed.

[25] The off-site emergency planning zones and emergency planning distances may differ from those specified provided that, at the preparedness stage, such areas and distances are designated and arrangements are made to effectively take precautionary urgent protective actions, urgent protective actions and early protective actions and other response actions within these areas and distances in order to achieve the goals of emergency response.

[26] A significant release of radioactive material is a radioactive release that could lead to severe deterministic effects off the site and thus warrants taking protective actions or other response actions off the site.

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stochastic effects[27]. Any such actions shall be taken in such a way as not to delay the implementation of precautionary urgent protective actions and other response actions within the precautionary action zone.

(iii) An extended planning distance (EPD) from the facility, for facilities in category I or II (beyond the urgent protective action planning zone), for which arrangements shall be made to conduct monitoring and assessment of the radiological situation off the site in order to identify areas within a period of time that would allow the risk of stochastic effects in the areas to be effectively reduced by taking protective actions and other response actions within a day to a week or to weeks following a significant radioactive release.

(iv) An ingestion and commodities planning distance (ICPD) from the facility, for facilities in category I or II (beyond the extended planning distance), for which arrangements shall be made to take response actions (1) for protecting the food chain and water supply[28] as well as for protecting commodities other than food from contamination following a significant radioactive release and (2) for protecting the public from the ingestion of food, milk and drinking water and from the use of commodities other than food with possible contamination following a significant radioactive release.

(b) Criteria, based on the emergency classification and on conditions at the facility and off the site (see paras 4.28(3), 4.28(4), 5.14 and 5.15), for initiating and for adjusting urgent protective actions and other response actions within the emergency planning zones and emergency planning distances, in accordance with the protection strategy.

(c) Authority and responsibility to provide sufficient and updated information to the notification point at any time to allow for an effective off-site emergency response.

5.39. Within the emergency planning zones and emergency planning distances, arrangements shall be made for taking appropriate protective actions and other response actions effectively, as necessary, promptly upon the notification of a nuclear or radiological emergency. These arrangements shall include arrangements for:

(a) prompt execution of authority and discharge of responsibility for making decisions to initiate protective actions and other response actions upon notification of an emergency (see para. 5.12);

[27] Taking actions within the urgent protective action planning zone in order to reduce the risk of stochastic effects would not mean that no severe deterministic effects could possibly be observed within the urgent protective action planning zone. However, any severe deterministic effects are most likely to occur within the precautionary action zone.

[28] 'Water supply' refers to water supplies that use rainwater or other untreated surface water.

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(b) warning the permanent population, transient population groups and special population groups or those responsible for them and warning special facilities;

(c) taking urgent protective actions and other response actions such as evacuation, restrictions on the food chain and on water supply, prevention of inadvertent ingestion, restrictions on the consumption of food, milk and drinking water and on the use of commodities, decontamination of evacuees, control of access and traffic restrictions; and

(d) protection of emergency workers and helpers in an emergency.

The arrangements shall be coordinated with all jurisdictions (including, to the extent practicable, jurisdictions beyond national borders, where relevant) within any emergency planning zone or distance. These arrangements shall ensure that services necessary for ensuring public safety (e.g. rescue services and health services for the care of critically ill patients) are provided continuously throughout the emergency, including while protective actions and other response actions are being taken.

5.40. Within emergency planning zones and emergency planning distances, arrangements shall be made for the timely monitoring and assessment of contamination, radioactive releases and exposures doses for the purpose of deciding on or adjusting the protective actions and other response actions that have to be taken or that are being taken. These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).

5.41. The operating organization of a facility in category I, II or III shall make arrangements to ensure protection and safety for all persons on the site in a nuclear or radiological emergency. These shall include arrangements to do the following:

(a) to notify all persons on the site of an emergency on the site;

(b) for all persons on the site to take appropriate actions immediately upon notification of an emergency;

(c) to account for those persons on the site and to locate and recover those persons unaccounted for;

(d) to provide immediate first aid;

(e) to take urgent protective actions.

5.42. Arrangements as stated in para. 5.41 shall also include ensuring the provision, for all persons present in the facility and on the site, of:

(a) suitable assembly points, provided with continuous radiation monitoring;

(b) a sufficient number of suitable escape routes;

(c) suitable and reliable alarm systems and other means for warning and instructing all persons present under the full range of emergency conditions.

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5.43. The operating organization of a facility in category I, II or III shall ensure that suitable, reliable and diverse means of communication are available at all times, under the full range of emergency conditions, for use in taking protective actions and other response actions on the site and for communication with off-site officials responsible for taking protective actions and other response actions off the site or within any emergency planning zones or emergency planning distances.

5.44. Operating personnel for activities in category IV, first responders in an emergency at an unforeseen location and those personnel at locations where there is a significant likelihood of encountering a dangerous source that is not under control (see para. 4.21) shall be provided with guidance and training on taking urgent protective actions and other response actions. This shall include guidance and training on the approximate radius of the inner cordoned off area in which urgent protective actions and other response actions would initially be taken and on the adjustment of this area on the basis of observed or assessed conditions on the site.

Requirement 10: Providing instructions, warnings and relevant information to the public for emergency preparedness and response

The government shall ensure that arrangements are in place to provide the public who are affected or are potentially affected by a nuclear or radiological emergency with information that is necessary for their protection, to warn them promptly and to instruct them on actions to be taken.

5.45. For facilities in category I or II and areas in category V, arrangements shall be made to provide the permanent population, transient population groups and special population groups or those responsible for them and special facilities within the emergency planning zones and emergency planning distances (see para. 5.38), before operation and throughout the lifetime of the facility, with information on the response to a nuclear or radiological emergency. This information shall include information on the potential for a nuclear or radiological emergency, on the nature of the hazards, on how people would be warned or notified, and on the actions to be taken in such an emergency. The information shall be provided in the languages mainly spoken by the population residing within the emergency planning zones and emergency planning distances. The effectiveness of these arrangements for public information shall be periodically assessed.

5.46. For facilities in category I or II and in areas in category V, arrangements shall be made to register those members of the public in special population groups and, as appropriate, those responsible for them, and to promptly issue them and the permanent population and transient population groups, as well as special facilities in the emergency planning zones and emergency planning distances, with a warning and instructions upon declaration of a general emergency (see para. 5.14). This shall include providing instructions on the actions to be taken, in the languages mainly spoken by the population residing within these emergency planning zones and emergency planning distances (see para. 5.38).

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5.47. For facilities in category III and category IV, arrangements shall be made to provide the public with information and instructions in order to identify and locate people who may have been affected by a nuclear or radiological emergency and who may need response actions such as decontamination, medical examination or health screening. These arrangements shall include arrangements for issuing a warning to the public and providing information in the event that a dangerous source could be in the public domain as a consequence of its loss or unauthorized removal.

5.48. Arrangements shall be made by response organizations in a State to promptly provide information and advice to its nationals and to those people with interests in other States[29] in a nuclear or radiological emergency declared beyond national borders, with due account taken of the response actions recommended in the State in which the emergency occurs as well as in the State(s) affected by that emergency (see paras 5.73 and 6.14).

Requirement 11: Protecting emergency workers and helpers in an emergency

The government shall ensure that arrangements are in place to protect emergency workers and to protect helpers in a nuclear or radiological emergency.

5.49. Arrangements shall be made to ensure that emergency workers are, to the extent practicable, designated in advance and are fit for the intended duty. These arrangements shall include health surveillance for emergency workers for the purpose of assessing their initial fitness and continuing fitness for their intended duties (see also Ref. [8]).

5.50. Arrangements shall be made to register and to integrate into operations in an emergency response those emergency workers who were not designated as such in advance of a nuclear or radiological emergency and helpers in an emergency. This shall include designation of the response organization(s) responsible for ensuring protection of emergency workers and protection of helpers in an emergency.

5.51. The operating organization and response organizations shall determine the anticipated hazardous conditions, both on the site and off the site, in which emergency workers might have to perform response functions in a nuclear or radiological emergency in accordance with the hazard assessment and the protection strategy.

5.52. The operating organization and response organizations shall ensure that arrangements are in place for the protection of emergency workers and protection of helpers in an emergency for the range of anticipated hazardous conditions in which they might have to perform response functions. These arrangements, as a minimum, shall include:

(a) training those emergency workers designated as such in advance;

[29] Examples of people with interests in other States include people travelling, people working and/or living abroad, importers and exporters, and people working in companies operating abroad.

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(b) providing emergency workers not designated in advance and helpers in an emergency immediately before the conduct of their specified duties with instructions on how to perform the duties under emergency conditions (‘just in time’ training);

(c) managing, controlling and recording the doses received;

(d) provision of appropriate specialized protective equipment and monitoring equipment;

(e) provision of iodine thyroid blocking, as appropriate, if exposure due to radioactive iodine is possible;

(f) obtaining informed consent to perform specified duties, when appropriate;

(g) medical examination, longer term medical actions and psychological counselling, as appropriate.

5.53. The operating organization and response organizations shall ensure that all practicable means are used to minimize exposures of emergency workers and helpers in an emergency in the response to a nuclear or radiological emergency (see para. I.2 of Appendix I) and to optimize their protection.

5.54. In a nuclear or radiological emergency, the relevant requirements for occupational exposure in planned exposure situations established in Ref. [8] shall be applied, on the basis of a graded approach, for emergency workers, except as required in para. 5.55.

5.55. The operating organization and response organizations shall ensure that no emergency worker is subject to an exposure in an emergency that could give rise to an effective dose in excess of 50 mSv other than:

(1) for the purposes of saving human life or preventing serious injury;

(2) when taking actions to prevent severe deterministic effects or actions to prevent the development of catastrophic conditions that could significantly affect people and the environment;

(3) when taking actions to avert a large collective dose.

5.56. For the exceptional circumstances of para. 5.55, national guidance values shall be established for restricting the exposures of emergency workers, in accordance with Appendix I.

5.57. The operating organization and response organizations shall ensure that emergency workers who undertake emergency response actions in which doses received might exceed an effective dose of 50 mSv do so voluntarily[30]; that they have been clearly and comprehensively informed in advance of associated health risks as well as of available protective measures; and that they are, to the extent possible, trained in the actions that they might be required to take. Emergency workers not designated as such in advance shall not be the first emergency workers chosen for taking actions that could result

[30] The voluntary basis for response actions by emergency workers is usually covered in the emergency arrangements.

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in their doses exceeding the guidance values of dose for life saving actions, as given in Appendix I. Helpers in an emergency shall not be allowed to take actions that could result in their receiving doses in excess of an effective dose of 50 mSv.

5.58. Arrangements shall be made to assess as soon as practicable the individual doses received in a response to a nuclear or radiological emergency by emergency workers and helpers in an emergency and, as appropriate, to restrict further exposures in the response to the emergency (see Appendix I).

5.59. Emergency workers and helpers in an emergency shall be given appropriate medical attention for doses received in a response to a nuclear or radiological emergency (see Appendix II) or at their request.

5.60. Emergency workers who receive doses in a response to a nuclear or radiological emergency shall normally not be precluded from incurring further occupational exposure. However, qualified medical advice[31] shall be obtained before any further occupational exposure occurs if an emergency worker has received an effective dose exceeding 200 mSv or at the request of the emergency worker.

5.61. Information on the doses received in the response to a nuclear or radiological emergency and information on any consequent health risks shall be communicated, as soon as practicable, to emergency workers and to helpers in an emergency.

Requirement 12: Managing the medical response in a nuclear or radiological emergency

The government shall ensure that arrangements are in place for the provision of appropriate medical screening and triage, medical treatment and longer term medical actions for those people who could be affected in a nuclear or radiological emergency.

5.62. On the presentation by an individual of clinical symptoms of radiation exposure or other indications associated with a possible nuclear or radiological emergency, the medical personnel or other responsible parties who identify the clinical symptoms or other indications shall notify the appropriate local or national officials and shall take response actions as appropriate.

5.63. Arrangements shall be made for medical personnel, both general practitioners and emergency medical staff, to be made aware of the clinical symptoms of radiation exposure, and of the appropriate notification procedures and other emergency response actions to be taken if a nuclear or radiological emergency arises or is suspected.

[31] Such qualified medical advice is intended for assessing the continuing fitness of workers for their intended tasks involving occupational exposure in line with Ref. [8]. In line with para. 5.59, any emergency worker is to be given appropriate medical attention for dose received. To illustrate this, the generic criterion for dose that is received (100 mSv effective dose in a month), as provided in Table II.2 of Appendix II, will indicate that an emergency worker receiving such a dose needs to be registered and subjected to health screening and that the emergency worker needs appropriate longer term medical follow-up in order to detect radiation induced health effects early and to treat them effectively.

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5.64. Arrangements shall be made so that, in a nuclear or radiological emergency, individuals with possible contamination can promptly be given appropriate medical attention. These arrangements shall include ensuring that transport services are provided where needed and providing instructions[32] to medical personnel on the precautions to take.

5.65. For facilities in categories I, II and III, arrangements shall be made to manage an adequate number of any individuals with contamination or having been overexposed to radiation, including arrangements for first aid, the estimation of doses, medical transport and initial medical treatment in predesignated medical facilities.

5.66. For areas within emergency planning zones (see para. 5.38), arrangements shall be made for performing medical screening and triage and for assigning to a predesignated medical facility any individual exposed at levels exceeding the criteria in Table II.1 of Appendix II. These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).

5.67. Arrangements shall be made to identify people with possible contamination or possibly having been exposed sufficiently to result in radiation induced health effects and to provide them with appropriate medical attention, including longer term medical follow-up. These arrangements shall include:

(a) guidelines for effective diagnosis and treatment;

(b) designation of medical personnel trained in clinical management of radiation injuries;

(c) designation of institutions for evaluating radiation exposure (external and internal), for providing specialized medical treatment and for longer term medical actions.

This shall also include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)) and arrangements for medical consultation on treatment following any exposure that could result in severe deterministic effects (see Appendix II) with medical personnel experienced in dealing with such injuries[33].

5.68. Arrangements shall be made for the identification of individuals in those population groups that are at risk of sustaining increases in the incidence of cancers as a result of radiation exposure in a nuclear or radiological emergency. Arrangements shall be made to take longer term medical actions to detect radiation induced health effects among such population groups in time to allow for their

[32] This includes advice that universal precautions in health care against infection (e.g. surgical masks and gloves) generally provide medical personnel with adequate protection when treating individuals possibly having contamination.

[33] Such arrangements for medical consultation on treatment could include international assistance to be provided through or to be coordinated by the IAEA and by WHO; for example, under the Assistance Convention [12].

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effective treatment. These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).

Requirement 13: Communicating with the public throughout an emergency

The government shall ensure that arrangements are in place for communication with the public throughout a nuclear or radiological emergency.

5.69. Arrangements shall be made for providing useful, timely, true, clear and appropriate information to the public in a nuclear or radiological emergency, with account taken of the possibility that the usual means of communication might be damaged in the emergency or by its initiating event (e.g. by an earthquake or by flooding) or overburdened by demand for its use. These arrangements shall also include arrangements for keeping the international community informed, as appropriate. These arrangements shall take into account the need to protect sensitive information in circumstances when a nuclear or radiological emergency is initiated by a nuclear security event. Communication with the public in a nuclear or radiological emergency shall be carried out on the basis of a strategy to be developed at the preparedness stage as part of the protection strategy. Arrangements shall be made to adjust this strategy in the emergency response on the basis of prevailing conditions.

5.70. Arrangements shall be made to ensure that information provided to the public by response organizations, operating organizations, the regulatory body, international organizations and others in a nuclear or radiological emergency is coordinated and consistent, with due recognition of the evolutionary nature of an emergency.

5.71. Arrangements shall be made so that information is provided to the public in a nuclear or radiological emergency in plain and understandable language.

5.72. The government shall ensure that a system for putting radiological health hazards in perspective in a nuclear or radiological emergency is developed and implemented with the following aim:

- To support informed decision making concerning protective actions and other response actions to be taken;
- To help in ensuring that actions taken do more good than harm;
- To address public concerns regarding potential health effects.

In the development of such a system, due consideration shall be given to pregnant women and children as individuals who are most vulnerable following radiation exposure.

5.73. Arrangements shall be made to explain to the public any changes in the protective actions and other response actions recommended in the State and any differences from those recommended in other States (see paras 6.13–6.15).

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5.74. Arrangements shall be made to identify and address, to the extent practicable, misconceptions, rumours and incorrect and misleading information that might be circulating widely in a nuclear or radiological emergency, in particular those that might result in actions[34] being taken beyond those emergency response actions that are warranted (see Req. 16).

5.75. Arrangements shall be made to respond to enquiries from the public and from news media, both national and international, including enquiries received from or through the IAEA. These arrangements shall recognize the evolutionary nature of emergencies and the need to respond in a timely manner to enquiries even when information requested is not yet available.

Requirement 14: Taking early protective actions and other response actions

The government shall ensure that arrangements are in place to take early protective actions and other response actions effectively in a nuclear or radiological emergency.

5.76. Within the extended planning distance (see para. 5.38), arrangements shall be made for effective relocation that may be required following a significant radioactive release and for the prevention of inadvertent ingestion, in accordance with the protection strategy (see Req. 5). These arrangements shall include:

(a) provision of instructions and advice to prevent inadvertent ingestion;

(b) prompt monitoring and assessment;

(c) use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4));

(d) the means for accomplishing relocation and for assisting those persons who have been relocated;

(e) provisions to extend monitoring and assessment and actions beyond the extended planning distance if necessary.

5.77. For areas within the ingestion and commodities planning distance (see para. 5.38), arrangements shall be made for prompt protection in relation to, and for restriction of, non-essential local produce, forest products (e.g. wild berries, wild mushrooms), milk from grazing animals, drinking water supplies, animal feed and commodities with or possibly with contamination following a significant radioactive release, in accordance with the protection strategy (see Req. 5). These arrangements shall include:

[34] Actions beyond those emergency response actions that are warranted include, but are not limited to: actions that interfere with prompt implementation of protective actions, such as self-evacuation from inside and from outside areas from which evacuation is ordered; actions that unnecessarily burden the health care system; actions that shun or otherwise discriminate against people or products from an area affected by a nuclear or radiological emergency; elective terminations of pregnancy that are not radiologically informed; and cancellations of commercial flights that are not radiologically informed.

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(a) provision of instructions and advice:

(i) to protect the food chain, water supply and commodities from contamination;

(ii) to prevent ingestion of food, milk and drinking water with or possibly with contamination;

(iii) to prevent use of commodities with or possibly with contamination;

(b) prompt monitoring, sampling and analysis;

(c) use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4));

(d) the means to enforce the restrictions;

(e) provisions to expand monitoring and assessment and actions beyond this distance if necessary.

5.78. Within the emergency planning zones and the inner cordoned off area, arrangements shall be made for monitoring the levels of contamination of people, vehicles and goods moving out of areas with contamination, in order to control the spread of contamination and, as applicable, for the purposes of decontamination in accordance with the protection strategy (see Req. 5). These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)) and shall take into consideration that some vehicles and items potentially with contamination as well as members of the public and emergency workers might have left these areas before the establishment of contamination control points and boundaries.

5.79. Arrangements shall be made for access control and enforcing of restrictions for areas in which evacuations and relocations are carried out within emergency planning zones, the extended planning distance and the inner cordoned off area, in accordance with the protection strategy (see Req. 5). Returns to these areas for short periods of time shall be permitted if justified (e.g. to feed animals left behind) and provided that those individuals entering the area are:

(a) subject to controls and to dose assessment while in the area;

(b) instructed on how to protect themselves; and

(c) briefed on the associated health hazards.

5.80. Arrangements shall be made to test methods of decontamination before their general use and to assess their effectiveness in terms of dose reduction.

5.81. For a transnational emergency in category IV, arrangements shall be made for taking early protective actions and other response actions as appropriate for areas beyond category V, including promptly conducting monitoring and assessment of contamination (a) of food, milk and drinking water and, as appropriate, of commodities other than food, and (b) of vehicles and cargoes that are likely to have contamination, with the aim of mitigating the consequences of a nuclear or radiological

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emergency and reassurance of the public. These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).

5.82. Monitoring in response to a nuclear or radiological emergency shall be carried out on the basis of a strategy to be developed at the preparedness stage as part of the protection strategy. Arrangements shall be made to adjust the monitoring in the emergency response on the basis of prevailing conditions.

5.83. Arrangements shall be made to carry out retrospective assessment of exposure of members of the public in a nuclear or radiological emergency, and to make the results of these assessments publicly available. The assessments shall be based on the best available information, shall be put into perspective in terms of the associated health hazards (see para. 5.72) and shall be promptly updated in the light of information that would yield substantially more accurate results.

Requirement 15: Managing radioactive waste in an emergency

The government shall ensure that radioactive waste is managed safely and effectively in a nuclear or radiological emergency.

5.84. The national policy and strategy for radioactive waste management [18] shall apply for radioactive waste generated in a nuclear or radiological emergency, with account taken of these requirements.

5.85. The protection strategy (see Req. 5) shall take into account radioactive waste that might arise from protective actions and other response actions that are to be taken.

5.86. Radioactive waste arising in a nuclear or radiological emergency, including radioactive waste arising from associated protective actions and other response actions taken, shall be identified, characterized and categorized in due time and shall be managed in a manner that does not compromise the protection strategy, with account taken of prevailing conditions as these evolve.

5.87. Arrangements shall be made for radioactive waste to be managed safely and effectively. These arrangements shall include:

(a) a plan to characterize waste, including in situ measurements and analysis of samples;

(b) criteria for categorization of waste;

(c) avoiding, to the extent possible, the mixing of waste of different categories;

(d) minimizing the amount of material unduly declared as radioactive waste;

(e) a method for determining appropriate options for predisposal management of radioactive waste (including processing, storage and transport), with account taken of the interdependences between all steps as well as impacts on the anticipated end points (clearance, authorized discharge, reuse, recycling, disposal) [18, 19];

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(f) a method of identifying appropriate storage options and sites;

(g) consideration of non-radiological aspects of waste (e.g. chemical properties such as toxicity, biological properties).

5.88. Consideration shall be given to the management of human remains and animal remains with contamination as a result of a nuclear or radiological emergency, with due account taken of religious practices and cultural practices.

Requirement 16: Mitigating non-radiological consequences of an emergency and of an emergency response

The government shall ensure that arrangements are in place for mitigation of non-radiological consequences of a nuclear or radiological emergency and of an emergency response.

5.89. Non-radiological consequences of a nuclear or radiological emergency and of an emergency response shall be taken into consideration in deciding on the protective actions and other response actions to be taken in the context of the protection strategy (see Req. 5).

5.90. Arrangements shall be made for mitigating the non-radiological consequences of an emergency and those of an emergency response and for responding to public concern in a nuclear or radiological emergency. These arrangements shall include arrangements for providing the people affected with:

(a) information on any associated health hazards and clear instructions on the actions to be taken (see Req. 10 and Req. 13);

(b) medical and psychological counselling, as appropriate;

(c) adequate social support, as appropriate.

5.91. Arrangements shall be made to mitigate the impacts on international trade of a nuclear or radiological emergency and associated protective actions and other response actions, with account taken of the generic criteria in Appendix II. These arrangements shall provide for information of the public and interested parties (such as importing States) on controls put in place in relation to traded commodities, including food, and on vehicles and cargoes being shipped, and on any revisions of the relevant national criteria.

5.92. Arrangements shall be put in place for any actions taken, beyond those emergency response actions that are warranted, by members of the public and by commercial, industrial, infrastructural or other governmental or non-governmental bodies to be, to the extent practicable, promptly identified and appropriately addressed. This shall include the designation of organization(s) with the responsibility for monitoring for, identifying and addressing such actions.

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Requirement 17: Requesting, providing and receiving international assistance for emergency preparedness and response

The government shall ensure that adequate arrangements are in place to benefit from, and to contribute to the provision of, international assistance for preparedness and response for a nuclear or radiological emergency.

5.93. Governments and international organizations shall put in place and shall maintain arrangements to respond in a timely manner to a request made by a State, in accordance with established mechanisms and respective mandates, for assistance in preparedness and response for a nuclear or radiological emergency.

5.94. Arrangements shall be put in place and maintained for requesting and obtaining international assistance from States or international organizations and for providing assistance to States (either directly or through the IAEA) in preparedness and response for a nuclear or radiological emergency, on the basis of international instruments (e.g. the Assistance Convention [12]), bilateral agreements or other mechanisms. These arrangements shall take due account of compatibility requirements for the capabilities to be obtained from and to be rendered to different States so as to ensure the usefulness of these capabilities.

Requirement 18: Terminating an emergency

The government shall ensure that arrangements are in place and are implemented for the termination of a nuclear or radiological emergency, with account taken of the need for the resumption of social and economic activity.

5.95. Adjustment of protective actions and other response actions and of other arrangements that are aimed at enabling the termination of an emergency shall be made by a formal process that includes consultation of interested parties.

5.96. Arrangements for communication with the public in a nuclear or radiological emergency (see Req. 13) shall include arrangements for communication on the basis for any adjustment of protective actions and other response actions and other arrangements aimed at enabling the termination of the emergency. This shall include providing the public with information on the need for any continuing protective actions following termination of the emergency and on any necessary modifications to their personal behaviour. Arrangements shall be made, during this period, to closely monitor public opinion and the reaction in news media in order to ensure that any concerns can be promptly addressed. These arrangements shall ensure that any information provided to the public puts health hazards in perspective (see para. 5.72).

5.97. The termination of a nuclear or radiological emergency shall be based on a formal decision that is made public and shall include prior consultation with interested parties, as appropriate.

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5.98. Both radiological consequences and non-radiological consequences shall be considered in deciding on the termination of an emergency as well as in the justification and optimization of further protection strategies as necessary.

5.99. The transition to an existing exposure situation and the return to a planned exposure situation shall be made in a coordinated and orderly manner, by making any necessary transfer of responsibilities and with the increased involvement of relevant authorities and interested parties.

5.100. The government shall ensure that, as part of its emergency preparedness, arrangements are in place for the termination of a nuclear or radiological emergency. The arrangements shall take into account that the termination of an emergency might be at different times in different geographical areas. The planning process shall include as appropriate:

(a) the roles and functions of organizations;

(b) methods of transferring information;

(c) means for assessing radiological consequences and non-radiological consequences;

(d) conditions, criteria and objectives to be met for enabling the termination (see Appendix II);

(e) review of the hazard assessment and of the emergency arrangements;

(f) establishment of national guidelines for termination of an emergency;

(g) arrangements for continued communication with the public, and for monitoring of public opinion and the reaction in the news media;

(h) arrangements for consultation of interested parties.

5.101. Once the emergency is terminated, all workers undertaking relevant work shall be subject to the relevant requirements for occupational exposure in planned exposure situations [8], and individual monitoring, environmental monitoring and health surveillance shall be conducted subject to the requirements for planned exposure situations or existing exposure situations, as appropriate [8].

Requirement 19: Analysing the emergency and the emergency response

The government shall ensure that the nuclear or radiological emergency and the emergency response are analysed in order to identify actions to be taken to avoid other emergencies and to improve emergency arrangements.

5.102. Arrangements shall be made to document, protect and preserve, to the extent practicable, in an emergency response, data and information important for an analysis of the nuclear or radiological emergency and the emergency response. Arrangements shall be made to undertake a timely and comprehensive analysis of the nuclear or radiological emergency and the emergency response with the involvement of interested parties. These arrangements shall give due consideration to the need for

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making contributions to relevant internationally coordinated analyses and for sharing the findings of the analysis with relevant response organizations. The analysis shall give due consideration to:

(a) reconstruction of the circumstances of the emergency;

(b) root causes of the emergency;

(c) regulatory controls including regulations and regulatory oversight;

(d) general implications for safety, including the possible involvement of other sources or devices (including those in other States);

(e) general implications for nuclear security, as appropriate;

(f) necessary improvements to emergency arrangements;

(g) necessary improvements to regulatory control.

5.103. Arrangements shall be made to enable comprehensive interviews on the circumstances of the nuclear or radiological emergency to be conducted with those involved.

5.104. Arrangements shall be made to acquire (e.g. from the IAEA, from another State or from the manufacturer of relevant equipment) the expertise necessary to conduct an analysis of the circumstances of the nuclear or radiological emergency.

5.105. Arrangements shall be made to take actions promptly on the basis of an analysis to avoid other emergencies, including analysis of information from other operating organizations as relevant or from other States through the IAEA.

6. REQUIREMENTS FOR INFRASTRUCTURE

GENERAL

6.1. This section establishes the requirements for infrastructural elements that are essential to providing the capability for fulfilling the requirements established in Section 5 in accordance with the hazard assessment and the protection strategy.

Requirement 20: Authorities for emergency preparedness and response

The government shall ensure that authorities for preparedness and response for a nuclear or radiological emergency are clearly established.

6.2. The authorities for developing, maintaining and regulating arrangements, both on the site and off the site, for preparedness and response for a nuclear or radiological emergency shall be established by means of acts, legal codes or statutes.

6.3. All of the functions specified in Section 5 shall be assigned to the appropriate operating organizations and to local, regional and national organizations. The involvement of all these

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organizations in the performance of these functions, or in support of their performance, shall be documented[35]. The documentation shall specify their roles, functions, authorities and responsibilities in emergency preparedness and response and shall assent to the authorities, roles and responsibilities of other response organizations. Conflicting or potentially conflicting and overlapping roles and responsibilities shall be identified and conflicts shall be resolved at the preparedness stage through the national coordinating mechanism (see para. 4.10).

6.4. The authority and responsibility for making decisions on response actions to be taken on the site and off the site (see para. 5.7) and for communication with the public shall be clearly assigned for each phase of the response.

6.5. The emergency arrangements shall include clear allocation of responsibilities and authorities and shall provide for coordination and for communication in all phases of the response. These arrangements shall include:

- ensuring that for each response organization a position in the response hierarchy has the authority and responsibility to direct and to coordinate its response actions;
- clearly assigning the authority and responsibility for the direction and coordination of the entire response (see para. 5.7) and for the prevention and resolution of conflicts between response organizations;
- assigning to an on-site position the authority and responsibility for notifying the appropriate organization(s) of an emergency and for taking immediate on-site actions;
- assigning to an on-site position the responsibility for directing the entire on-site response (see paras 5.3 and 5.7).

These arrangements shall be such as to ensure that those personnel with authority and responsibility to perform critical response functions[36] in an emergency response are not assigned any other responsibilities in an emergency that would interfere with the prompt performance of the specified functions.

6.6. The arrangements for delegation and/or transfer of authority shall be specified in the relevant emergency plans, together with arrangements for notifying all appropriate parties of the transfer.

[35] Typically the involvement of operating organizations and local, regional and national organizations is documented as part of the appropriate local, regional and national emergency plans.

[36] Critical response functions are functions that must be performed promptly and correctly in order to classify, declare and notify an emergency, to activate an emergency response, to manage the response, to take mitigatory actions, to protect emergency workers and to take urgent protective actions on and off the site.

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Requirement 21: Organization and staffing for emergency preparedness and response

The government shall ensure that overall organization for preparedness and response for a nuclear or radiological emergency is clearly specified and staffed with sufficient personnel who are qualified and are assessed for their fitness for their intended duties.

6.7. The organizational relationships for preparedness and response for a nuclear or radiological emergency and interfaces between all the response organizations shall be established.

6.8. The positions responsible within each operating organization and response organization for performance of the response functions specified in Section 5 shall be assigned in the emergency plans and procedures. The positions responsible in each operating organization, in each response organization and in the regulatory body for the performance of activities at the preparedness stage, in accordance with these requirements, shall be assigned as part of the routine organizational structures and shall be specified, as appropriate, in the emergency plans and procedures.

6.9. Personnel who are assigned to positions in all operating organizations and response organizations to perform the functions necessary to meet the requirements established in Section 5 shall be qualified and shall be assessed for their initial fitness and continuing fitness for their intended duties.

6.10. Appropriate numbers of suitably qualified personnel shall be available at all times (including during 24 hour a day operations) so that appropriate positions can be promptly staffed as necessary following the declaration and notification of a nuclear or radiological emergency. Appropriate numbers of suitably qualified personnel shall be available for the long term to staff the various positions necessary to take mitigatory actions, protective actions and other response actions.

6.11. For a site where multiple facilities in category I or II are collocated, an appropriate number of suitably qualified personnel shall be available to manage an emergency response at all facilities if each of the facilities is under emergency conditions simultaneously (see para. 5.4).

Requirement 22: Coordination of emergency preparedness and response

The government shall ensure that arrangements are in place for the coordination of preparedness and response for a nuclear or radiological emergency between the operating organization and response organizations at the local, regional, and national levels, and, where appropriate, at the international level.

6.12. Arrangements shall be developed, as appropriate, for the coordination of emergency preparedness and response and of protocols for operational interfaces among operating organizations and authorities at the local, regional and national levels, including those organizations and authorities responsible for the response to conventional emergencies and to nuclear security events (see paras 4.4, 4.10, 6.3 and Req. 6). The arrangements shall be clearly documented and the documentation shall be

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made available to all relevant parties. Arrangements shall be put in place to ensure effective working relationships among these organizations, both at the preparedness stage and in an emergency.

6.13. When several different organizations of the State or of other States are expected to have or to develop tools, procedures or criteria for use in the response to an emergency, arrangements for coordination shall be put in place to improve consistency of the assessments of the situation, including assessments of contamination, doses and radiation induced health effects and any other relevant assessments made in a nuclear or radiological emergency, so as not to give rise to confusion.

6.14. Arrangements shall be made to coordinate with other States in the event of a transnational emergency any protective actions and other response actions that are recommended to their citizens and to their embassies in order either to ensure that they are consistent with those recommended in other States, or to provide an opportunity for them to explain to the public the basis for any differences (see para. 5.73).

6.15. Arrangements shall be made to ensure that States with areas in category V are provided with appropriate information for developing their own preparedness to respond to a transboundary emergency and that appropriate coordination across national borders is in place. These arrangements shall include:

(a) agreements and protocols to provide information necessary to develop a coordinated means for notification, classification schemes and criteria for taking and for adjusting protective actions and other response actions;

(b) arrangements for communication with the public;

(c) arrangements for the exchange of information between decision making authorities.

Requirement 23: Plans and procedures for emergency response

The government shall ensure that plans and procedures necessary for effective response to a nuclear or radiological emergency are established.

6.16. Plans, procedures and other arrangements for effective emergency response, including coordinating mechanisms, letters of agreement or legal instruments, shall be made for coordinating a national emergency response. The arrangements for a coordinated national emergency response:

- shall specify the organization responsible for the development and maintenance of the arrangements;
- shall describe the responsibilities of operating organizations and other response organizations;
- shall describe the coordination effected between these arrangements and the arrangements for response to a conventional emergency and to a nuclear security event.

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Consideration shall be given in these plans, procedures and other arrangements to the need to protect information that might be confidential.

6.17. Each response organization shall prepare an emergency plan or plans for coordinating and performing their assigned functions as specified in Section 5 and in accordance with the hazard assessment and the protection strategy. An emergency plan shall be developed at the national level that integrates all relevant plans for emergency response in a coordinated manner and consistently with an all hazards approach. Emergency plans shall specify how responsibilities for managing operations in an emergency response are to be discharged on the site, off the site and across national borders, as appropriate. The emergency plans shall be coordinated with other plans and procedures that may be implemented in a nuclear or radiological emergency, to ensure that the simultaneous implementation of the plans would not reduce their effectiveness or cause conflicts. Such other plans and procedures include:

(a) emergency plans for facilities in category I and for areas in category V;

(b) security plans and contingency plans [9, 10];

(c) procedures for the investigation of a nuclear security event, including identification, collection, packaging and transport of evidence contaminated with radionuclides, nuclear forensics and related activities [11];

(d) evacuation plans; and

(e) plans for firefighting.

6.18. The appropriate responsible authorities shall ensure that:

(a) a 'concept of operations'[37] for emergency response is developed at the beginning of the preparedness stage;

(b) emergency plans and procedures are prepared and, as appropriate, approved for any facility or activity, areas and locations that could give rise to an emergency warranting protective actions and other response actions;

(c) response organizations and operating organizations, as appropriate, are involved in the preparation of emergency plans and procedures, as appropriate;

(d) account is taken in the content, features and extent of emergency plans of the results of any hazard assessment and any lessons from operating experience and from past emergencies, including conventional emergencies (see paras 4.18–4.26);

(e) emergency plans and procedures are periodically reviewed and updated (see paras 6.36 and 6.38).

[37] A 'concept of operations' is a brief description of an ideal response to a postulated nuclear or radiological emergency, used to ensure that all those personnel and organizations involved in the development of a capability for emergency response share a common understanding.

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6.19. The operating organization of a facility or for an activity in category I, II, III or IV shall prepare an emergency plan. This emergency plan shall be coordinated with those of all other bodies having responsibilities in a nuclear or radiological emergency, including public authorities, and shall be submitted to the regulatory body for approval.

6.20. The operating organization and response organizations shall develop the necessary procedures and analytical tools to be able to perform the functions specified in Section 5 for the goals of emergency response to be achieved and for an emergency response to be effective.

6.21. Procedures and analytical tools shall be tested under simulated emergency conditions and shall be validated prior to initial use. Any arrangements for the use of analytical tools early in an emergency response for supporting decision making on protective actions and other response actions shall be made in due recognition of the limitations[38] of such analytical tools and in a way that would not reduce the effectiveness of response actions. These limitations shall be made clear to, and shall be recognized by, those responsible for decision making.

Requirement 24: Logistical support and facilities for emergency response

The government shall ensure that adequate logistical support and facilities are provided to enable emergency response functions to be performed effectively in a nuclear or radiological emergency.

6.22. Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation (such as documentation of procedures, checklists, manuals, telephone numbers and email addresses) shall be provided for performing the functions specified in Section 5. These items and facilities shall be selected or designed to be operational under the conditions (such as radiological conditions, working conditions and environmental conditions) that could be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (e.g. compatible with the communication frequencies used by other response organizations), as appropriate. These support items shall be located or provided in a manner that allows their effective use under the emergency conditions postulated.

6.23. For facilities in categories I and II, as contingency measures, alternative supplies for taking on-site mitigatory actions, such as an alternative supply of water and an alternative electrical power supply, including any necessary equipment, shall be ensured. This equipment shall be located and maintained so that it can be functional and readily accessible when needed (see also Ref. [16]).

[38] An example of such limitations is that the timing and magnitude of radioactive releases in an emergency at a nuclear power plant that would warrant taking precautionary urgent protective actions and urgent protective actions off the site before, or shortly after, a radioactive release may not be predictable. In addition, the radioactive release could occur over several days, resulting in complex deposition patterns off the site.

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6.24. Emergency response facilities or locations to support an emergency response under the full range of postulated hazardous conditions shall be designated and shall be assigned the following functions, as appropriate:

(a) receiving notifications and initiating the response;

(b) coordination and direction of on-site response actions;

(c) providing technical and operational support to those personnel performing tasks at a facility and those personnel responding off the site;

(d) direction of off-site response actions and coordination with on-site response actions;

(e) coordination of national response actions;

(f) coordination of communication with the public;

(g) coordination of monitoring, sampling and analysis;

(h) managing those people who have been evacuated (including reception, registration, monitoring and decontamination, as well as provision for meeting their personal needs, including for housing, feeding and sanitation);

(i) managing the storage of necessary resources;

(j) providing individuals who have undergone exposure or contamination with appropriate medical attention including medical treatment.

6.25. For facilities in category I, emergency response facilities[39] and locations separate from the control room and supplementary control room shall be provided so that:

(a) technical support can be provided to the operating personnel in the control room in an emergency (from a technical support centre);

(b) operational control by personnel performing tasks at or near the facility can be maintained (from an operational support centre);

(c) the on-site emergency response is managed (from an emergency centre).

These emergency response facilities shall operate as an integrated system in support of the emergency response, without conflicting with each other's functions, and shall provide reasonable assurance of being operable and habitable under a range of postulated hazardous conditions, including conditions not considered in the design.

[39] Emergency response facilities may be collocated (i.e. these functions may be performed from a single emergency response facility or location) provided that it is ensured that they do not conflict with each other in performing their specified functions and provided that they are separated from the control rooms.

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6.26. Arrangements shall be made for performing appropriate and reliable analyses of samples[40] and measurements of internal contamination for the purposes of emergency response and of health screening, as appropriate. Such arrangements shall include the designation of laboratories that would be operational under postulated emergency conditions.

6.27. Arrangements shall be made to obtain appropriate support from organizations responsible for providing support in conventional emergencies for logistics and communication, for social welfare and in other areas.

Requirement 25: Training, drills and exercises for emergency preparedness and response

The government shall ensure that personnel relevant for emergency response shall take part in regular training, drills and exercises to ensure that they are able to perform their assigned response functions effectively in a nuclear or radiological emergency.

6.28. The operating organization and response organizations shall identify the knowledge, skills and abilities necessary to perform the functions specified in Section 5. The operating organization and response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel selected have the requisite knowledge, skills and abilities to perform their assigned response functions. The arrangements shall include arrangements for continuing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities in an emergency response undergo the specified training.

6.29. For facilities in category I, II or III, all personnel and all other persons on the site shall be instructed in the arrangements for them to be notified of an emergency and of their actions if notified of an emergency.

6.30. Exercise programmes shall be developed and implemented to ensure that all specified functions required to be performed for emergency response, all organizational interfaces for facilities in category I, II or III, and the national level programmes for category IV or V are tested at suitable intervals. These programmes shall include the participation in some exercises of, as appropriate and feasible, all the organizations concerned, people who are potentially affected and representatives of news media. The exercises shall be systematically evaluated (see para. 4.10(h)) and some exercises shall be evaluated by the regulatory body. Programmes shall be subject to review and revision in the light of experience gained (see paras 6.36 and 6.38).

6.31. The personnel responsible for critical response functions shall participate in drills and exercises on a regular basis so as to ensure their ability to take their actions effectively.

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[40] Arrangements for analyses could include, for example, arrangements for performing analyses of environmental and biological samples as well as analyses of other samples taken from the facility for the purpose of assessing its operational status.

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6.32. Officials off the site who are responsible for making decisions on protective actions and other response actions shall be trained and shall regularly participate in exercises. Officials off the site who are responsible for communication with the public in a nuclear or radiological emergency shall regularly participate in exercises.

6.33. The conduct of exercises shall be evaluated against pre-established objectives of emergency response to demonstrate that identification, notification, activation and response actions can be performed effectively to achieve the goals of emergency response (see para. 3.2).

Requirement 26: Quality management programme for emergency preparedness and response

The government shall ensure that a programme is established within an integrated management system to ensure the availability and reliability of all supplies, equipment, communication systems and facilities, plans, procedures and other arrangements necessary for effective response in a nuclear or radiological emergency.

6.34. The operating organization, as part of its management system (see Ref. [13]), and response organizations, as part of their emergency management system, shall establish a programme to ensure the availability and reliability of all supplies, equipment, communication systems and facilities, plans, procedures and other arrangements necessary to perform functions in a nuclear or radiological emergency as specified in Section 5 (see para. 6.22). The programme shall include arrangements for inventories, resupply, tests and calibrations, to ensure that these are continuously available and are functional for use in a nuclear or radiological emergency.

6.35. The programme shall also include periodic and independent appraisals against functions as specified in Section 5, including participation in international appraisals[41].

6.36. Arrangements shall be made to maintain, review and update emergency plans, procedures and other arrangements and to incorporate lessons from research, operating experience (such as in the response to emergencies) and emergency exercises.

6.37. The operating organization and response organizations shall establish and maintain adequate records in relation to both emergency arrangements and the response to a nuclear or radiological emergency, to include dose assessments, results of monitoring and inventory of radioactive waste managed, in order to allow for their review and evaluation. These records shall also provide for the identification of those persons requiring longer term medical actions, as necessary, and shall provide for the long term management of radioactive waste.

[41] Examples of international appraisals include those organized by the IAEA, such as Emergency Preparedness Review (EPREV) missions.

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6.38. The operating organization and response organizations shall make arrangements to review and evaluate responses in actual events and in exercises, in order to record the areas in which improvements are necessary and to ensure that the necessary improvements are made (see Req. 19).

6.39. Relevant international organizations shall review and update their applicable standards and guidelines and their relevant arrangements in emergency preparedness and response on the basis of research and lessons from the response to actual emergencies and in emergency exercises.

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Appendix I

GUIDANCE VALUES FOR RESTRICTING EXPOSURE OF EMERGENCY WORKERS

I.1. This Appendix provides guidance values as a basis for operational guidance for restricting the exposure of emergency workers.

I.2. Table I.1 provides guidance values for restricting the exposure of emergency workers in an emergency response in terms of personal dose equivalent $H_p(10)$ from external exposure to strongly penetrating radiation The values for $H_p(10)$ in Table I.1 assume that every effort has been made for protection against external exposure to weakly penetrating radiation and against exposure due to intakes or skin contamination (see para. 5.53).

I.3. The total effective dose and the relative biological effectiveness (RBE) weighted absorbed dose to a tissue or organ via all exposure pathways (i.e. both dose from external exposure and committed dose from intakes) need to be estimated as early as possible in a nuclear or radiological emergency. Table I.1 also provides guidance on the effective dose and the RBE weighted absorbed dose to a tissue or organ for consideration in restricting further exposure in the response to a nuclear or radiological emergency once these doses have been estimated.

I.4. Severe deterministic effects to a fetus could possibly occur following an equivalent dose to the fetus of greater than 100 mSv. Consequently, in the response to a nuclear or radiological emergency, female workers who are aware that they are pregnant or who might be pregnant need to be (1) informed of this risk and (2) excluded from taking actions that might result in an equivalent dose to the embryo and fetus exceeding 50 mSv for the full period of in utero development of the embryo and fetus.

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TABLE I.1. GUIDANCE VALUES FOR RESTRICTING EXPOSURE OF EMERGENCY WORKERS

Tasks	**Guidance value**[a]		
	$H_p(10)$[b]	E[c]	AD_T[d]
Life saving actions	< 500 mSv	< 500 mSv	$< \frac{1}{2} AD_{T,\ Table\ II.1}$[e]
	This value may be exceeded — with due consideration of the generic criteria in Table II.1 of Appendix II — under circumstances in which the expected benefits to others clearly outweigh the emergency worker's own health risks, and the emergency worker volunteers to take the action and understands and accepts these health risks		
Actions to prevent severe deterministic effects and actions to prevent the development of catastrophic conditions that could significantly affect people and the environment	< 500 mSv	< 500 mSv	$< \frac{1}{2} AD_{T,\ Table\ II.1}$
Actions to avert a large collective dose	< 100 mSv	E < 100 mSv	$< \frac{1}{10} AD_{T,\ Table\ II.1}$

[a] These values are set to be two to ten times lower than the generic criteria in Table II.1 of Appendix II and they apply for:

(a) the dose from external exposure to strongly penetrating radiation for $H_p(10)$. Doses from external exposure to weakly penetrating radiation and from intake or skin contamination need to be prevented by all possible means. If this is not feasible, the effective dose and the RBE weighted absorbed dose to a tissue or organ have to be limited to minimize the health risk to the individual in line with the risk associated with the guidance values given here; and
(b) the total dose E (effective dose) and the RBE weighted absorbed dose to an a tissue or organ AD_T via all exposure pathways (i.e. both dose from external exposure and committed dose from intakes) which are to be estimated as early as possible in order to enable any further exposure to be restricted as appropriate.

[b] Personal dose equivalent $H_p(d)$ where d = 10 mm.

[c] Effective dose.

[d] RBE weighted absorbed dose to a tissue or organ.

[e] Values of RBE weighted absorbed dose to a tissue or organ given in Table II.1 of Appendix II.

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Appendix II

GENERIC CRITERIA FOR USE IN EMERGENCY PREPAREDNESS AND RESPONSE

II.1. This Appendix provides generic criteria:

(a) for doses for which protective actions and other response actions are expected to be undertaken under any circumstances in a nuclear or radiological emergency to avoid or to minimize severe deterministic effects;

(b) for doses for which protective actions and other response actions are expected to be taken, if they can be taken safely, in a nuclear or radiological emergency to reasonably reduce the risk of stochastic effects;

(c) for doses for which restriction of international trade is warranted in a nuclear or radiological emergency, with due consideration of non-radiological consequences;

(d) for doses for use as a target dose for the transition to an existing exposure situation.

Appendix II includes examples of associated protective actions and other response actions. These generic criteria and associated protective actions and other response actions shall be taken into account in the development of the protection strategy, including national generic criteria in accordance with Req. 5. If protective actions in the context of the protection strategy are to be taken when doses are below the generic criteria given in this Appendix, careful consideration is necessary to ensure that such actions are justified (i.e. that they do more good than harm) and that they are optimized in accordance with Req. 5.

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GENERIC CRITERIA FOR DOSES RECEIVED WITHIN A SHORT PERIOD OF TIME FOR WHICH RESPONSE ACTIONS ARE EXPECTED TO BE TAKEN UNDER ANY CIRCUMSTANCES IN AN EMERGENCY RESPONSE

II.2. Table II.1 provides generic criteria for doses received within a short period of time for which protective actions and other response actions are expected to be taken under any circumstances in a nuclear or radiological emergency to avoid or to minimize severe deterministic effects.

TABLE II.1. GENERIC CRITERIA FOR DOSES RECEIVED WITHIN A SHORT PERIOD OF TIME FOR WHICH PROTECTIVE ACTIONS AND OTHER RESPONSE ACTIONS ARE EXPECTED TO BE TAKEN UNDER ANY CIRCUMSTANCES TO AVOID OR TO MINIMIZE SEVERE DETERMINISTIC EFFECTS

Acute external exposure (< 10 h)		If the dose is projected: – Take precautionary urgent protective actions immediately (even under difficult conditions) to keep doses below the generic criteria; – Provide public information and warnings; – Carry out urgent decontamination. If the dose has been received: – Perform immediate medical examination, medical consultation and indicated medical treatment; – Carry out contamination control; – Carry out immediate decorporation[g] (if applicable); – Conduct registration for longer term medical follow-up; – Provide comprehensive psychological counselling.
$AD_{\text{red marrow}}$[a]	1 Gy	
AD_{fetus}	0.1[b] Gy	
AD_{tissue}[c]	25 Gy at 0.5 cm	
AD_{skin}[d]	10 Gy to 100 cm^2	
Acute internal exposure due to an acute intake (Δ = 30 d[e])		
$AD(\Delta)_{\text{red marrow}}$	0.2 Gy for radionuclides with atomic number $Z \geq 90$[f] 2 Gy for radionuclides with atomic number $Z \leq 89$[f]	
$AD(\Delta)_{\text{thyroid}}$	2 Gy	
$AD(\Delta)_{\text{lung}}$[h]	30 Gy	
$AD(\Delta)_{\text{colon}}$	20 Gy	
$AD(\Delta')_{\text{fetus}}$[i]	0.1[b] Gy	

[a] $AD_{\text{red marrow}}$ represents the average RBE weighted absorbed dose to internal tissues or organs (e.g. red marrow, lung, small intestine, gonads, thyroid) and to the lens of the eye from exposure in a uniform field of strongly penetrating radiation.

[b] At 0.1 Gy there would be only a very small probability of severe deterministic effects to the fetus and only during certain periods post-conception (e.g. between 8 and 15 weeks of gestation age), and only if the dose is received at high dose rates. During other periods post-conception and for lower dose rates, the fetus is less sensitive. There is a high probability of severe deterministic effects at 1 Gy. Therefore, 1 Gy is used as the generic criterion for doses to the fetus received within a short period of time: (i) in the hazard assessment (see para. 4.23), to identify facilities and activities, on-site areas, off-site areas and locations for which a nuclear

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or radiological emergency could warrant precautionary urgent protective actions to avoid or to minimize severe deterministic effects; (ii) for identifying situations in which exposure is 'dangerous to health'; and (iii) for making arrangements (see para. 5.38) for applying decisions on urgent protective actions and other response actions to be taken off the site to avoid or to minimize the occurrence of severe deterministic effects (e.g. establishing a precautionary action zone).

[c] Dose delivered to 100 cm^2 at a depth of 0.5 cm under the body surface in tissue due to close contact with a radioactive source (e.g. source carried in the hand or pocket).

[d] The dose is to the 100 cm^2 dermis (skin structures at a depth of 40 mg/cm^2 (or 0.4 mm) below the surface).

[e] $AD(\Delta)$ is the RBE weighted absorbed dose delivered over a period of time Δ by the intake (I_{05}) that will result in a severe deterministic effect in 5% of exposed individuals. This dose is calculated as described in Appendix I of Ref. [20].

[f] Different generic criteria are used to take account of the significant difference in RBE weighted absorbed dose from exposure at the intake threshold values specific for these two groups of radionuclides.

[g] Decorporation is the action of the biological processes, facilitated by chemical or biological agents, by means of which incorporated radionuclides are removed from the human body. The generic criterion for decorporation is based on the projected dose without decorporation.

[h] For the purposes of these generic criteria, 'lung' means the alveolar–interstitial region of the respiratory tract.

[i] For this particular case, 'Δ' means the period of in utero development of the embryo and fetus.

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GENERIC CRITERIA FOR PROTECTIVE ACTIONS AND OTHER RESPONSE ACTIONS TO REDUCE THE RISK OF STOCHASTIC EFFECTS

II.3. Table II.2 provides generic criteria for taking protective actions and other response actions in a nuclear or radiological emergency to reduce the risk of stochastic effects.

TABLE II.2. GENERIC CRITERIA FOR PROTECTIVE ACTIONS AND OTHER RESPONSE ACTIONS IN AN EMERGENCY TO REDUCE THE RISK OF STOCHASTIC EFFECTS

Generic criteria		**Examples of protective actions and other response actions**[a]
Projected dose that exceeds the following generic criteria: Take urgent protective actions and other response actions		
$H_{thyroid}$	50 mSv[b] in the first 7 days	Iodine thyroid blocking[c]
E[d] H_{fetus}[e]	100 mSv in the first 7 days 100 mSv in the first 7 days	Sheltering[f]; evacuation; prevention of inadvertent ingestion; restrictions on food, milk and drinking water[g] and restrictions on the food chain and water supply; restrictions on commodities other than food; contamination control; decontamination; registration; reassurance of the public
Projected dose that exceeds the following generic criteria: Take early protective actions and other response actions		
E[d] H_{fetus}[e]	100 mSv in the first year 100 mSv for the full period of in utero development	Temporary relocation; prevention of inadvertent ingestion; restrictions on food, milk and drinking water[g] and restrictions on the food chain and water supply; restrictions on commodities other than food; contamination control; decontamination; registration; reassurance of the public
Dose that has been received and that exceeds the following generic criteria: Take longer term medical actions to detect and to effectively treat radiation induced health effects		
E[d]	100 mSv in a month	Health screening based on equivalent doses to specific radiosensitive organs (as a basis for longer term medical follow-up)[h], registration, counselling
H_{fetus}[e]	100 mSv for the full period of in utero development	Counselling to allow informed decisions to be made in individual circumstances

[a] These examples are neither exhaustive nor grouped in a mutually exclusive way.

[b] This generic criterion applies only for administration of iodine thyroid blocking. For the thyroid, iodine thyroid blocking is an urgent protective action that is prescribed: (a) if exposure due to radioactive iodine is involved, (b) before or shortly after a release of radioactive iodine, and (c) within only a short period before or after the intake of radioactive iodine.

[c] The equivalent dose to the thyroid ($H_{thyroid}$) only due to exposure to radioiodine.

[d] Effective dose.

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[e] H_{fetus} is the equivalent dose to the fetus, derived as the sum of the dose from external exposure and the maximum committed equivalent dose to any organ from intake to the embryo or fetus for different chemical compounds and different times relative to conception.

[f] As a less disruptive protective action, sheltering may be ordered at lower doses as long as justified and optimized in accordance with Req. 5 with due consideration of the reference level in para. 4.28(2).

[g] Restrictions on food, milk and drinking water using these generic criteria are to be applied before sampling and analysis of food, milk and drinking water are carried out. Such restrictions apply as long as replacements of food, milk and drinking water or other alternatives are available to ensure they would not result in severe malnutrition, dehydration or other severe health impacts.

[h] When results of the health screening indicate that the criteria in Table II.1 are exceeded, then appropriate medical attention on the basis of Appendix II (see Table II.1) is necessary.

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GENERIC CRITERIA FOR FOOD, MILK AND DRINKING WATER AND OTHER COMMODITIES TO REDUCE THE RISK OF STOCHASTIC EFFECTS

II.4. Table II.3 provides generic criteria for taking protective actions and other response actions to reduce the risk of stochastic effects from the ingestion of food, milk and drinking water and from the use of other commodities in a nuclear or radiological emergency.

II.5. A value of 1/10 of the generic criteria given in Table II.2 for early protective actions and other response actions is established as generic criteria for restrictions on food, milk and drinking water and on other commodities to ensure that the dose via all exposure pathways, including ingestion, will not exceed the generic criteria given in Table II.2 for early protective actions and other response actions.

II.6. If restrictions on food, milk or drinking water would result in severe malnutrition or dehydration because replacements are not available, food, milk or drinking water with concentration levels of radionuclides that are projected to result in doses above the generic criteria given in Table II.3 may be consumed until replacements are available; otherwise, the people affected may be relocated, provided that this would not result in doses above the generic criteria given in Table II.1.

TABLE II.3. GENERIC CRITERIA FOR FOOD, MILK AND DRINKING WATER AND OTHER COMMODITIES TO REDUCE THE RISK OF STOCHASTIC EFFECTS

Generic criteria		**Examples of protective actions and other response actions**
Projected dose from ingestion of food, milk and drinking water and from the use of other commodities that exceeds the following generic criteria: Take protective actions and other response actions		
E[a]	10 mSv in the first year	Restrict consumption, distribution and sale of non-essential[b] food, milk and drinking water[d] and restrict the use and distribution of other commodities. Replace essential food, milk and drinking water as soon as possible or relocate the people affected if replacements are not available. Estimate the doses of those who might have consumed food, milk and drinking water or used other commodities to determine whether this may have resulted in doses warranting medical attention in accordance with Table II.2.
H_{fetus}[c]	10 mSv for the full period of in utero development	

[a] Effective dose.

[b] Restricting essential food, milk or drinking water could result in dehydration, severe malnutrition or other severe health impacts; therefore, essential food, milk and drinking water is to be restricted only if alternatives are available.

[c] H_{fetus} is the equivalent dose to the fetus derived as the sum the dose from external exposure and the maximum committed equivalent dose to any organ from intake to the embryo or fetus for different chemical compounds and different times relative to conception.

[d] These criteria for taking actions on food, milk and drinking water are applied once the sampling and analysis of food, milk and drinking water is carried out. This would also provide a basis for discontinuing restrictions imposed on food, milk and drinking water as a precaution on the basis of the generic criteria in Table II.2.

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GENERIC CRITERIA FOR VEHICLES, EQUIPMENT AND OTHER ITEMS TO REDUCE THE RISK OF STOCHASTIC EFFECTS

II.7. Table II.4 provides generic criteria for taking protective actions and other response actions to reduce the risk of stochastic effects arising from the use of vehicles, equipment and other items from an area affected by a nuclear or radiological emergency.

II.8. A value of 1/10 of the generic criteria given in Table II.2 for early protective actions and other response actions is established as a generic criterion for vehicles, equipment and other items from an affected area, to ensure that the dose via all exposure pathways, including the use of such vehicles, equipment and other items, would not exceed the generic criteria given in Table II.2 for early actions for a member of the public.

II.9. Restricting the use of vehicles, equipment and other items from an affected area could interfere with taking urgent protective actions and other response actions or with providing services essential to public health or wellbeing (e.g. restricting the use of vehicles for transferring individuals requiring critical medical treatment or preventing a ship or an aircraft that has left an affected area from reaching its final destination). Such vehicles, equipment and other items whose use would give rise to a projected dose above the generic criteria given in Table II.4 may be used until replacements are available, provided that:

(a) their use will not result in doses that exceed the generic criteria given in Table II.1 for members of the public or the guidance values given in Appendix I for restricting the exposure of emergency workers, or the restriction set in para. 5.57 for exposures of helpers in an emergency;

(b) actions are taken to manage and control the exposure of the user as an emergency worker, a helper in an emergency or a member of the public, as appropriate.

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TABLE II.4. GENERIC CRITERIA FOR VEHICLES, EQUIPMENT AND OTHER ITEMS TO REDUCE THE RISK OF STOCHASTIC EFFECTS

<table>
<tr><th colspan="2">Generic criteria</th><th>Examples of protective actions and other response actions</th></tr>
<tr><td colspan="3">Projected dose from the use of vehicles, equipment or other items from an affected area that exceed the following generic criteria: Take protective actions and other response actions.</td></tr>
<tr><td>E[a]</td><td>10 mSv in the first year</td><td rowspan="2">Restrict non-essential[b] use.

Use essential vehicles, equipment and other items from an affected area until replacements are available provided that: (a) their use will not result in doses exceeding the generic criteria given in Table II.2 for a member of the public or the guidance values given in Appendix I for restricting the exposure of emergency workers, and (b) actions are taken to control the dose to the user as an emergency worker, helper in an emergency or a member of the public, as appropriate.

Estimate doses to those emergency workers, helpers in an emergency and members of the public who may have used a vehicle, equipment and other item from an affected area to determine whether this could have resulted in a dose warranting medical attention in accordance with Table II.2.</td></tr>
<tr><td>H_{fetus}[c]</td><td>10 mSv for the full period of in utero development</td></tr>
</table>

[a] Effective dose.

[b] Restricting the use of vehicles, equipment and other items from an affected area could interfere with taking urgent protective actions and other response actions or with providing services essential to public health or wellbeing (e.g. restricting the use of vehicles for transferring individuals requiring critical medical treatment).

[c] H_{fetus} is the equivalent dose to the fetus derived as the sum of the dose from external exposure and the maximum committed equivalent dose to any organ from intake to the embryo or fetus for different chemical compounds and different times relative to conception.

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GENERIC CRITERIA FOR FOOD AND OTHER COMMODITIES TRADED INTERNATIONALLY

II.10. Table II.5 provides generic criteria aimed at the effective implementation of response actions to reduce the non-radiological consequences of a nuclear or radiological emergency by providing a basis for the continuation or the resumption of international trade.

II.11. Values that exceed the generic criteria in Table II.5 may be acceptable under emergency (temporary) conditions.

II.12 The generic criteria for food traded internationally derive from the level used by the Joint FAO/WHO Codex Alimentarius Commission [21]. These generic criteria, and generic criteria for other commodities traded internationally that could contain radionuclides following a nuclear or radiological emergency, are established at 1/100 of the generic criteria given in Table II.2 for early protective actions and other response actions to ensure that doses to the public would be a small fraction of those for which actions are warranted to reduce the risk of stochastic effects.

II.13. For food traded internationally that could contain radionuclides following a nuclear or radiological emergency, the operational criteria (i.e. guideline levels) as published by the Joint FAO/WHO Codex Alimentarius Commission [21] may ultimately be used (see para. 5.23 of Ref. [8]).

II.14. If restricting trade in food and other commodities could result in severe health impacts or other detrimental effects in another State, then the food and other commodities that would give rise to a projected dose that exceeds the generic criteria in Table II.5 may be traded — if the trade is justified — until replacements are available, provided that:

(a) trade is approved with the receiving State;

(b) trade will not result in doses that exceed the generic criteria given in Table II.2 and Table II.3 for the public;

(c) actions are taken to manage and control exposures during shipping;

(d) actions are taken to control the consumption and use of food and other commodities and to reduce the exposure of members of the public.

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TABLE II.5. GENERIC CRITERIA FOR FOOD AND OTHER COMMODITIES TRADED INTERNATIONALLY

Generic criteria		**Examples of other response actions**
Projected dose from food and other commodities that exceed the generic criteria: Take response actions to restrict international trade.		
E[a]	1 mSv per year	Restrict non-essential[b] international trade. Trade essential food and other commodities until replacements are available if: (a) trade is approved with the receiving State; (b) trade will not result in doses to the public that exceed the generic criteria given in Table II.2 for all exposure pathways and in Table II.3 for the respective pathways; (c) actions are taken to manage and control the dose during shipping; and (d) actions are taken to control the consumption and use of food and other commodities and to reduce the exposure of members of the public.
H_{fetus}[c]	1 mSv for the full period of in utero development	

a. Effective dose.

b. Restricting the trade of essential commodities and food could result in severe health impacts or other detrimental conditions in another State.

c. H_{fetus} *i*s the equivalent dose to the fetus derived as the sum of the dose from external exposure and the maximum committed equivalent dose to any organ from intake to the embryo or fetus for different chemical compounds and different times relative to conception.

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GENERIC CRITERIA FOR ENABLING A TRANSITION TO AN EXISTING EXPOSURE SITUATION

II.15. Generic criteria shall be established in terms of the projected dose for the implementation of protective actions and other actions aimed at enabling the termination of a nuclear or radiological emergency and the subsequent transition to an existing exposure situation with due consideration of, and verification of the fulfilment of, the conditions set out in para. II.16. These criteria are established to 1/5[42] of the generic criteria for the early protective actions and other response actions given in Table II.2 and are:

(a) an effective dose of 20 mSv per year; and

(b) an equivalent dose to a fetus of 20 mSv for the full period of in utero development.

II.16. The decision to terminate the nuclear or radiological emergency and the subsequent transition to an existing exposure situation is to be taken after:

(a) justified actions (see para. 4.29) have been taken to reach the generic criteria[43] for enabling the transition to an existing exposure situation and it has been confirmed that any further actions to reach these criteria would do more harm than good;

(b) confirmation that the source of exposure is fully characterized for all members of the public living as normal in the area;

(c) the situation with regard to exposure is understood and remains stable;

(d) any restrictions on normal living conditions are limited and provisions are in place to confirm compliance with such restrictions;

(e) confirmation that interested parties, including the public, have been consulted and are being kept informed about the basis for the adjustment of emergency response actions and for the transition, with the associated health hazards put into perspective (see para. 5.72).

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[42] Criteria established to 1/5 of the generic criteria for the early protective actions and other response actions given in Table II.2 are considered to be generically justified. This is of the order of the dose for which the government is required to establish an action plan to reduce activity concentrations for sources of exposure (e.g. Rn-222) for the existing exposure situation [8]. Being at the lower bound of the reference level for an emergency exposure situation (see para. 4.28), this level is also consistent with the reference levels established in Ref. [8] for both emergency exposure situations and existing exposure situations.

[43] Actions taken (see para. 4.29) to reach the generic criteria in para. II.15 need to be justified and optimized in accordance with Req. 5. However, it may not be feasible to reach these criteria for enabling the transition to an existing exposure situation. If it is not feasible or justified to reach these generic criteria, the transition may still be possible as long as the generic criteria for early protective actions and other response actions given in Table II.2 are not exceeded.

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Annex

APPLICABILITY OF PARAGRAPHS IN THIS PUBLICATION BY EMERGENCY PREPAREDNESS CATEGORY

A-1. Table A-1 presents the applicability of paragraphs in this publication by emergency preparedness category.

TABLE A-1. APPLICABILITY OF PARAGRAPHS IN THIS PUBLICATION BY EMERGENCY PREPAREDNESS CATEGORY

<table>
<tr><th>Category</th><th colspan="5">Paragraphs applicable in this publication</th></tr>
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4.1-4.10, 4.18-4.20, 4.22-4.25, 4.27-4.31
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6.19</td><td rowspan="3">5.2, 5.25, 5.27, 5.32-5.34, 5.41-5.43, 5.65
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<tr><td>II</td><td rowspan="4">/</td></tr>
<tr><td>III</td><td rowspan="2">5.10, 5.47</td></tr>
<tr><td>IV</td><td>4.21
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<tr><td>V</td><td colspan="3">5.9, 5.12, 5.21, 5.39-5.40, 5.45-5.446, 5.66, 5.76-5.77
6.15</td></tr>
</table>

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DEFINITIONS

The following definitions apply for the purposes of this safety standard.

The symbol '🛈' denotes an information note; this note is not part of the definition.

arrangements

See (emergency) arrangements.

authorization

The granting by a regulatory body or other governmental body of written permission for a person or organization (the operator) to conduct specified activities.

control

The function or power or (usually as controls) means of directing, regulating or restraining.

🛈 It should be noted that the usual meaning of the English word control in safety related contexts is somewhat 'stronger' (more active) than that of its usual translations and other similar words in some other languages. For example, 'control' typically implies not only checking or monitoring something but also ensuring that corrective or enforcement measures are taken if the results of the checking or monitoring indicate such a need. This is in contrast, for example, to the more limited usage of the equivalent word in French and Spanish.

regulatory control. Any form of control or regulation applied to facilities and activities by a regulatory body for reasons relating to nuclear safety and radiation protection or to nuclear security.

🛈 In the Nuclear Security Series [11], the phrase 'out of regulatory control' is used to describe a situation in which nuclear material or other radioactive material is present without an appropriate authorization, either because controls have failed for some reason, or because they never existed.

dangerous source

See source.

deterministic effect

A radiation induced health effect for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose.

🛈 Such an effect is described as a **severe deterministic effect** if it is fatal or life threatening or results in a permanent injury that reduces quality of life.

🛈 The level of the threshold dose is characteristic of the particular health effect but may also depend, to a limited extent, on the exposed individual. Examples of deterministic effects include erythema, damage to the haemopoietic system and acute radiation syndrome (radiation sickness).Deterministic effects are also referred to as 'harmful tissue reactions'.

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early protective actions

See protective actions.

emergency

A non-routine situation that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human life, health, property or the environment.

ⓘ This includes nuclear and radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms or earthquakes.

ⓘ This includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

nuclear or radiological emergency. An emergency in which there is, or is perceived to be, a hazard due to:

(a) The energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction; or

(b) Radiation exposure.

ⓘ When used in IAEA publications, the term radiation normally refers only to ionizing radiation. The IAEA has no statutory responsibilities in relation to non-ionizing radiation.

emergency action level (EAL)

A specific, predetermined criterion for observable conditions used to detect, recognize and determine the emergency class.

(emergency) arrangements

The integrated set of infrastructural elements, put in place at the preparedness stage, that are necessary to provide the capability for performing a specified function or task required in response to a nuclear or radiological emergency.

ⓘ These elements may include: authorities and responsibilities, organization, coordination, personnel, plans, procedures, facilities, equipment or training.

emergency class

A set of conditions that warrant a similar immediate emergency response.

ⓘ This is the term used for communicating to the response organizations and to the public the level of response needed. The events that belong to a given emergency class are defined by criteria specific to the installation, source or activities, which, if exceeded, indicate classification at the prescribed level. For each emergency class, the initial actions of the response organizations are predefined.

emergency classification

The process whereby an authorized official classifies an emergency in order to declare the applicable emergency class.

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ⓘ Upon declaration of the emergency class, the response organizations initiate the predefined emergency response actions for that emergency class.

emergency exposure situation

A situation of exposure that arises as a result of an accident, a malicious act, or other unexpected event, and requires prompt action in order to avoid or to reduce adverse consequences.

ⓘ Exposure in an emergency can be reduced only by protective actions and other response actions.

emergency plan

A description of the objectives, policy and concept of operations for the response to an emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response. The emergency plan serves as the basis for the development of other plans, procedures and checklists.

ⓘ A ***concept of operations*** is a brief description of an ideal response to a postulated nuclear or radiological emergency, used to ensure that all those personnel and organizations involved in the development of a capability for emergency response share a common understanding.

emergency planning distance

The extended planning distance (EPD) and the ingestion and commodities planning distance (ICPD).

emergency planning zone

The precautionary action zone (PAZ) and the urgent protective action planning zone (UPZ).

emergency preparedness

The capability to take actions that will effectively mitigate the consequences of an emergency for human life, health, property and the environment.

emergency procedures

A set of instructions describing in detail the actions to be taken by emergency workers in an emergency.

emergency response

The performance of actions to mitigate the consequences of an emergency for human life, health, property and the environment.

ⓘ The emergency response also provides a basis for the resumption of normal social and economic activity.

emergency (response) action

An action to be taken in response to a nuclear or radiological emergency to mitigate the consequences of an emergency for human life, health, property and the environment.

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ⓘ Emergency response actions comprise protective actions and other response actions.

Other response action. An emergency response action other than a protective action.

ⓘ The most common other response actions are: medical examination, consultation and treatment; registration and longer term medical follow-up; providing psychological counselling; and public information and other actions for mitigating non-radiological consequences and for public reassurance.

emergency response facility or location

A facility or location necessary for supporting an emergency response, for which specific functions are to be assigned at the preparedness stage, and which need to be usable under emergency conditions.

ⓘ There are two different types of emergency response facility or location: those established in advance (e.g. a technical support centre for a nuclear power plant) and those designated at the time of an emergency (e.g. a medical screening and triage area).

ⓘ For both types, advance preparations are necessary to ensure their operability under emergency conditions. Depending on the emergency preparedness category and on the nature of an emergency, an emergency response facility may be designated as an emergency response location.

emergency services

The local off-site response organizations that are generally available and that perform emergency response functions. These may include police, firefighters and rescue brigades, ambulance services and control teams for hazardous materials.

emergency worker

A person having specified duties as a worker in response to an emergency.

ⓘ Emergency workers may include workers employed, both directly and indirectly, by registrants and licensees, as well as personnel of response organizations, such as police officers, firefighters, medical personnel, and drivers and crews of vehicles used for evacuation.

ⓘ Emergency workers may or may not be designated as such in advance to an emergency. Emergency workers not designated as such in advance of an emergency are not necessarily workers prior to the emergency.

existing exposure situation

An existing exposure situation is a situation of exposure that already exists when a decision on the need for control needs to be taken.

ⓘ Existing exposure situations include exposure to natural background radiation that is amenable to control; exposure due to residual radioactive material that derives from past practices that were never subject to regulatory control; and exposure due to residual radioactive material deriving from a nuclear or radiological emergency after an emergency has been declared to be ended.

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extended planning distance (EPD)

Area around a facility for which emergency arrangements are made to conduct monitoring following the declaration of a general emergency and to identify areas warranting emergency response actions to be taken off the site within a period following a significant radioactive release that would allow the risk of stochastic effects among members of the public to be effectively reduced.

ⓘ The area within the extended planning distance serves for planning purposes and may not be the actual area in which monitoring is to be conducted to identify areas where early protective actions such as relocation are necessary. While efforts need to be made at the preparedness stage to prepare for taking effective early protective actions within this area, the actual area will be determined by the prevailing conditions in an emergency. As a precaution, some urgent protective actions may be warranted within EPD to reduce the risk of stochastic effects among members of the public.

facilities and activities

A general term encompassing nuclear facilities, uses of all sources of ionizing radiation, all radioactive waste management activities, transport of radioactive material and any other practice or circumstances in which people may be subject to exposure to radiation from naturally occurring or artificial sources.

ⓘ Facilities includes: nuclear facilities; irradiation installations; some mining and raw material processing facilities such as uranium mines; radioactive waste management facilities; and any other places where radioactive material is produced, processed, used, handled, stored or disposed of — or where radiation generators are installed — on such a scale that consideration of protection and safety is required.

ⓘ Activities includes: the production, use, import and export of radiation sources for industrial, research and medical purposes; the transport of radioactive material; the decommissioning of facilities; radioactive waste management activities such as the discharge of effluents; and some aspects of the remediation of sites affected by residues from past activities.

ⓘ This term is intended to provide an alternative to the terminology of sources and practices (or intervention) to refer to general categories of situations. For example, a practice may involve many different facilities and/or activities, whereas the general definition (1) of source is too broad in some cases: a facility or activity might constitute a source, or might involve the use of many sources, depending upon the interpretation used.

ⓘ The term facilities and activities is very general, and includes those for which little or no regulatory control may be necessary or achievable: the more specific terms authorized facility and authorized activity should be used to distinguish those facilities and activities for which any form of authorization has been given.

ⓘ In the Fundamental Safety Principles (Safety Fundamentals), the term ‘facilities and activities — existing and new — utilized for peaceful purposes’ is abbreviated for convenience to facilities and activities as a general term encompassing any human activity that may cause people to be exposed to radiation risks arising from naturally occurring or artificial sources (see Ref. [1], para. 1.9).

first responders

The first members of an emergency service to respond at the site of an emergency.

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generic criteria

Levels for the projected dose or the dose that has been received at which protective actions and other response actions are to be taken.

ⓘ The term generic criteria as defined here relates to emergency preparedness and response only.

graded approach

(1) For a system of control, such as a regulatory system or a safety system, a process or method in which the stringency of the control measures and conditions to be applied is commensurate, to the extent practicable, with the likelihood and possible consequences of, and the level of risk associated with, a loss of control.

(2) An application of safety requirements that is commensurate with the characteristics of the facilities and activities or the source and with the magnitude and likelihood of the exposures.

hazard assessment

Assessment of hazards associated with facilities, activities or sources within or beyond the borders of a State in order to identify:

(a) those events and the associated areas for which protective actions and other response actions may be required within the State;

(b) actions that would be effective in mitigating the consequences of such events.

helper in an emergency

Member of the public who willingly and voluntarily helps in the response to a nuclear or radiological emergency.

ⓘ Helpers in an emergency are protected and are aware that they could be exposed to radiation while helping in response to a nuclear or radiological emergency.

ingestion and commodities planning distance (ICPD)

Area around a facility within which emergency arrangements are made to take effective emergency response actions following the declaration of a general emergency in order to reduce the risk of stochastic effects among members of the public and to mitigate non-radiological consequences as a result of the distribution, sale and consumption of food, milk and drinking water and the use of commodities other than food that may have contamination from a significant radioactive release.

ⓘ The area within the ingestion and commodities planning distance serves for planning purposes to prepare for emergency response actions to monitor and control commodities, including food, either for domestic use or for international trade. The actual area will be determined on the basis of the prevailing conditions in an emergency.

ⓘ As a precaution, some urgent protective actions may be warranted within the ingestion and commodities planning distance to prevent the ingestion of food, milk or drinking water and to

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prevent the use of commodities that may have contamination following a significant radioactive release.

inner cordoned off area

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.

interested party

A person, company, etc., with a concern or interest in the activities and performance of an organization, business, system, etc.

ⓘ The term interested party is used in a broad sense to mean a person or group having an interest in the performance of an organization. Those who can influence events may effectively become interested parties — whether their 'interest' is regarded as 'genuine' or not — in the sense that their views need to be considered. Interested parties have typically included the following: customers, owners, operators, employees, suppliers, partners, trade unions; the regulated industry or professionals; scientific bodies; governmental agencies or regulatory bodies (local, regional and national) whose responsibilities may cover nuclear energy; the media; members of the public (individuals, community groups and interest groups); and other States, especially neighbouring States that have entered into agreements providing for an exchange of information concerning possible transboundary impacts, or States involved in the export or import of certain technologies or materials.

justification

The process of determining for an emergency exposure situation or an existing exposure situation whether a proposed protective action or remedial action is likely, overall, to be beneficial; i.e. whether the expected benefits to individuals and to society (including the reduction in radiation detriment) from introducing or continuing the protective action or remedial action outweigh the cost of such action and any harm or damage caused by the action.

management system

A set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner.

ⓘ The component parts of the management system include the organizational structure, resources and organizational processes. Management is defined (in ISO 9000) as coordinated activities to direct and control an organization.

ⓘ The management system integrates all elements of an organization into one coherent system to enable all of the organization's objectives to be achieved. These elements include the organizational structure, resources and processes. Personnel, equipment and organizational culture as well as the documented policies and processes are parts of the management system. The organization's processes have to address the totality of the requirements on the organization as established in, for example, IAEA safety standards and other international codes and standards.

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non-radiological consequences

Adverse psychological, societal or economic consequences of a nuclear or radiological emergency or of the response to an emergency affecting human life, health, property or the environment.

ⓘ The term non-radiological consequences as defined here relates to emergency preparedness and response only.

notification

(1) A report submitted promptly to a national or international authority providing details of an emergency or a possible emergency; for example, as required by the Convention on Early Notification of a Nuclear Accident [12].

(2) A set of actions taken upon detection of emergency conditions with the purpose of alerting all organizations with responsibility for emergency response in the event of such conditions.

notification point

A designated organization with which arrangements have been made to receive notification (meaning (2)) and to initiate promptly the predetermined actions to activate a part of the emergency response.

notifying State

The State that is responsible for notifying (see notification meaning (1)) potentially affected States and the IAEA of an event of actual, potential or perceived radiological significance for other States.

ⓘ This includes:

(1) The State Party that has jurisdiction or control over the facility or activity (including space objects) in accordance with Article 1 of the Convention on Early Notification of a Nuclear Accident [12]; or

(2) The State that initially detects or discovers evidence of a transnational emergency, for example by: detecting significant increases in atmospheric radiation levels of unknown origin; detecting contamination in transboundary shipments; discovering a dangerous source that may have originated in another State; or diagnosing clinical symptoms that may have resulted from exposure outside the State.

nuclear or radiological emergency

See emergency.

nuclear security

The prevention and detection of, and response to, criminal or intentional unauthorized acts involving nuclear material, other radioactive material, associated facilities or associated activities.

nuclear security event

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An event that has potential or actual implications for nuclear security that must be addressed [2].

off-site (area)

See site (area).

on-site (area)

See site (area).

operating personnel

Individual workers engaged in the operation of an authorized facility or the conduct of an authorized activity.

operating organization

Any organization or person applying for authorization or authorized to operate an authorized facility or to conduct an authorized activity and responsible for its safety.

- ⓘ This includes, inter alia, private individuals, governmental bodies, consignors or carriers, licensees, hospitals, self-employed persons, etc.
- ⓘ Operator includes either those who are directly in control of a facility or an activity during use of a source (such as radiographers or carriers) or, in the case of a source not under control (such as a lost or illicitly removed source or a re-entering satellite), those who were responsible for the source before control over it was lost.

operational criteria

Values of measurable quantities or observable conditions (i.e. ‘observables’) to be used in the response to a nuclear or radiological emergency in order to determine the need for appropriate protective actions and other response actions.

- ⓘ Operational criteria used in emergency preparedness and response include operational intervention levels (OILs), emergency action levels (EALs), specific observable conditions (i.e. ‘observables’) and other indicators of conditions on the site.
- ⓘ The operational criteria are sometimes referred to as triggers.

operational intervention level (OIL)

A set level of a measurable quantity that corresponds to a generic criterion.

- ⓘ Operational intervention levels are typically expressed in terms of dose rates or of activity of radioactive material released, time integrated air activity concentrations, ground or surface concentrations, or activity concentrations of radionuclides in environmental, food or water samples. An operational intervention levels is used immediately and directly (without further assessment) to determine the appropriate protective actions on the basis of an environmental measurement.

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optimization (of protection and safety)

The process of determining what level of protection and safety would result in the magnitude of individual doses, the number of individuals (workers and members of the public) subject to exposure and the likelihood of exposure being "as low as reasonably achievable, economic and social factors being taken into account" (ALARA).

planned exposure situation

A planned exposure situation is a situation of exposure that arises from the planned operation of a source or from a planned activity that results in an exposure from a source.

> ⓘ Since provision for protection and safety can be made before embarking on the activity concerned, associated exposures and their probabilities of occurrence can be restricted from the outset. The primary means of controlling exposure in planned exposure situations is by good design of installations, equipment and operating procedures. In planned exposure situations, a certain level of exposure is expected to occur.

precautionary action zone (PAZ)

An area around a facility for which emergency arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to avoid or to minimize severe deterministic effects off the site. Protective actions within this area are to be taken before or shortly after a release of radioactive material or an exposure, on the basis of prevailing conditions at the facility.

preparedness stage

The stage or phase at which arrangements for an effective emergency response are established prior to a nuclear or radiological emergency.

projected dose

The dose that would be expected to be received if planned protective actions were not taken.

protective action

An action for the purposes of avoiding or reducing doses that might otherwise be received in an emergency exposure situation or an existing exposure situation.

early protective action. A protective action in the event of a nuclear or radiological emergency that can be implemented within days to weeks and still be effective.

> ⓘ The most common early protective actions are relocation and longer term restriction of the consumption of food potentially affected by contamination.

mitigatory action. Immediate action by the operator or other party:

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(a) To reduce the potential for conditions to develop that would result in exposure or a release of radioactive material requiring emergency response actions on the site or off the site; or

(b) To mitigate source conditions that may result in *exposure* or a release of radioactive material requiring emergency response actions on the site or off the site.

***urgent protective action*.** A protective action in the event of an emergency which must be taken promptly (usually within hours to a day) in order to be effective, and the effectiveness of which will be markedly reduced if it is delayed.

- ⓘ Urgent protective actions include iodine thyroid blocking, evacuation, short term sheltering, actions to reduce inadvertent ingestion, decontamination of individuals and prevention of ingestion of food, milk or water possibly with contamination.
- ⓘ A precautionary urgent protective action is an urgent protective action taken before or shortly after a release of radioactive material, or before an exposure, on the basis of the prevailing conditions to avoid or to minimize severe deterministic effects.

radiological assessor

A person or team who in the event of a nuclear or radiological emergency assists the operator or off-site response organizations by performing radiological surveys, performing dose assessments, controlling contamination, ensuring the radiation protection of emergency workers and formulating recommendations on protective actions and other response actions.

reference level

For an emergency exposure situation or an existing exposure situation, the level of dose, risk or activity concentration above which it is not appropriate to plan to allow exposures to occur and below which optimization of protection and safety would continue to be implemented.

- ⓘ The value chosen for a reference level will depend upon the prevailing circumstances for the exposure under consideration.

regulatory body

An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

- ⓘ The national competent authority for the regulation of radioactive material transport safety is included in this description, as is the regulatory body for protection and safety.

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representative person

An individual receiving a dose that is representative of the doses to the more highly exposed individuals in the population.

ⓘ ICRP Publication 101 indicates that the dose to the representative person "is the equivalent of, and replaces, the mean dose in the 'critical group'", and provides guidance on assessing doses to the representative person. The concept of critical group remains valid.

residual dose

The dose expected to be incurred after protective actions have been terminated (or after a decision has been taken not to take protective actions).

ⓘ Residual dose applies in an emergency exposure situation or in an existing exposure situation.

response organization

An organization designated or recognized by a State as being responsible for managing or implementing any aspect of an emergency response.

ⓘ This also includes those organizations or services necessary to support the management and/or conduct of an emergency response, such as meteorological services.

site area

A geographical area that contains an authorized facility, authorized activity or source, and within which the management of the authorized facility or authorized activity or first responders may directly initiate emergency response actions.

ⓘ This is typically the area within the security perimeter fence or other designated property marker. It may also be the controlled area around a radiography source or an inner cordoned off area established by first responders around a suspected hazard.

On-site (area). (Area) within the site area.

Off-site (area). (Area) outside the site area.

source

1. Anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive substances or radioactive material — and can be treated as a single entity for purposes of protection and safety.

ⓘ For example, materials emitting radon are sources in the environment; a sterilization gamma irradiation unit is a source for the practice of irradiation preservation of food and sterilization of other products; an X ray unit may be a source for the practice of radiodiagnosis; a nuclear power plant is part of the practice of generating electricity by nuclear fission, and may be regarded as a source (e.g. with respect to discharges to the environment) or as a collection of sources (e.g. for occupational radiation protection purposes). A complex or multiple installation situated at one location or site may, as appropriate, be considered a single source for the purposes of application of safety standards.

2. Radioactive material used as a source of radiation.

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ⓘ Such as those sources used for medical applications or in industrial instruments. These are, of course, sources as defined in (1), but this usage in (2) is less general.

dangerous source. A source that could, if not under control, give rise to exposure sufficient to cause severe deterministic effects. This categorization is used for determining the need for emergency arrangements and is not to be confused with categorizations of sources for other purposes.

ⓘ The term dangerous source relates to dangerous quantities of radioactive material (D-values) recommended in Ref. [20].

radioactive source. A source containing radioactive material that is used as a source of radiation.

special facility

A facility for which predetermined facility specific actions need to be taken if urgent protective actions are ordered in its locality in the event of a nuclear or radiological emergency.

ⓘ Examples include chemical plants that cannot be evacuated until certain actions have been taken to prevent fire or explosions and telecommunications centres that must be staffed in order to maintain telephone services.

special population group

Members of the public for whom special arrangements are necessary in order for effective protective actions to be taken in the event of a nuclear or radiological emergency. Examples include disabled persons, hospital patients and prisoners.

stochastic effect

A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose.

ⓘ Stochastic effects may be somatic effects or hereditary effects, and generally occur without a threshold level of dose. Examples include solid cancers and leukaemia.

transient population group

Those members of the public who are residing for a short period of time (days to weeks) in a location (such as a camping ground) that can be identified in advance. This does not include members of the public who may be travelling through an area.

transnational emergency

A nuclear or radiological emergency of actual, potential or perceived radiological significance for more than one State.

ⓘ This may include:

(1) A significant transboundary release of radioactive material (however, a transnational emergency does not necessarily imply a significant transboundary release of radioactive material);

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(2) A general emergency at a facility or other event that could result in a significant transboundary release (atmospheric or aquatic) of radioactive material;

(3) Discovery of the loss or illicit removal of a dangerous source that has been transported across, or is suspected of having been transported across, a national border;

(4) An emergency resulting in significant disruption to international trade or travel;

(5) An emergency warranting the taking of protective actions for foreign nationals or embassies in the State in which it occurs;

(6) An emergency resulting in or potentially resulting in severe deterministic effects and involving a fault and/or problem (such as in equipment or software) that could have serious implications for safety internationally;

(7) An emergency resulting in or potentially resulting in great concern among the population of more than one State owing to the actual or perceived radiological hazard.

significant transboundary release: A release of radioactive material to the environment that may result in doses or levels of contamination beyond national borders from the release which exceed generic criteria for protective actions and other response actions, including food restrictions and restrictions on trade.

urgent protective action

See protective action.

urgent protective action planning zone (UPZ)

An area around a facility for which arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to avert doses off the site in accordance with international safety standards. Protective actions within this area are to be taken on the basis of environmental monitoring — or, as appropriate, prevailing conditions at the facility.

warning point

A designated organization to act as a point of contact that is staffed or able to be alerted at all times for promptly responding to, or initiating a response to, an incoming notification (meaning (1)) warning message, request for assistance or request for verification of a message, as appropriate, from the IAEA.

worker

Any person who works, whether full time, part time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection.

ⓘ A self-employed person is regarded as having the duties of both an employer and a worker.

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