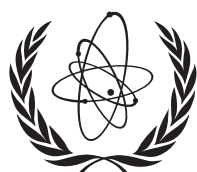


Preparedness and Response for a Nuclear or Radiological Emergency Combined with Other Incidents or Emergencies



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PREPAREDNESS AND RESPONSE
FOR A NUCLEAR OR RADIOLOGICAL
EMERGENCY COMBINED WITH OTHER
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EPR-COMBINED EMERGENCIES (2020)

PREPAREDNESS AND RESPONSE
FOR A NUCLEAR OR RADIOLOGICAL
EMERGENCY COMBINED WITH OTHER
INCIDENTS OR EMERGENCIES

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2020

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PREPAREDNESS AND RESPONSE FOR A NUCLEAR OR RADIOLOGICAL
EMERGENCY COMBINED WITH OTHER INCIDENTS OR EMERGENCIES

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FOREWORD

According to para. 4.20 of IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency:

“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...[e]vents 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”.

This publication supports IAEA Member States in preparing for and responding to a nuclear or radiological emergency combined with other incidents or emergencies, such as a nuclear or radiological emergency initiated and/or affected by conventional emergencies, natural events and/or security events (referred to as a ‘combined emergency’), by describing possible challenges in meeting the emergency preparedness and response requirements established in GSR Part 7 for such circumstances.

The IAEA officers responsible for this publication were R. De La Vega and P. Vilar Welter of the Incident and Emergency Centre.

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1. INTRODUCTION

1.1. Background

Governed by the safety objective and the fundamental safety principles established in the IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles [1], IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency [2], addresses the requirements for preparedness and response for a nuclear or radiological emergency. Recommendations and guidance on how to comply with the safety requirements on nuclear or radiological emergency preparedness and response (EPR) are provided in Refs [3–5].¹

Past experience shows that a nuclear or radiological emergency can have serious consequences for life, health, the environment and society over a wide geographical area [6–10]. Experience also shows that these consequences can be even more severe if the nuclear or radiological incident or emergency^{2,3} is combined with other incidents or emergencies, i.e. a nuclear or radiological emergency initiated and/or affected by conventional emergencies⁴, natural events⁵, security events⁶ and/or big national or global health crisis (hereafter referred to as a ‘combined emergency’⁷). For example, as observed in the 2011 Fukushima Daiichi accident [8–10], a nuclear or radiological emergency can be initiated and/or affected in a complex manner by other incidents or emergencies, severely challenging the response capabilities and possibly exceeding the resources of any State.

Other incidents or emergencies might initiate the nuclear or radiological emergency. In addition, other incidents or emergencies might have a negative effect on any of the components of the response to the nuclear or radiological emergency, including the management of the response, the identification and notification of the nuclear or radiological emergency, the activation of the response to the nuclear or radiological emergency, the implementation of mitigatory actions, the implementation of protective actions and other response actions, the provision of instructions, warnings and relevant information to the public, the protection of emergency workers and helpers, management

¹ Further information regarding nuclear or radiological EPR can be found in the IAEA EPR Series publications, in the IAEA TECDOC Series publications and in IAEA reports on nuclear or radiological emergencies.

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

³ Hereinafter, the term ‘nuclear or radiological emergency’ is used instead of ‘nuclear or radiological incident or emergency’. It should be noted that an incident can be caused intentionally; therefore, the term ‘nuclear or radiological emergency’ is appropriate, as nuclear or radiological emergencies include events caused intentionally (i.e. nuclear security events).

⁴ Conventional emergencies include fires, chemicals, explosion (non-security related), aircraft crash and any other not related to radiation emergencies, which are included in the national all-hazards emergency plans.

⁵ Examples of natural events are severe weather, earthquake, volcanic eruption, tsunami, floods or mudslides.

⁶ This includes only conventional security events (i.e. events involving criminal or illegal activities in which the target is not related to nuclear or radioactive materials, as well as to nuclear and radiological facilities or activities). Response to nuclear security events which may trigger nuclear or radiological emergencies are covered within the response to nuclear or radiological emergencies.

⁷ Beyond the simple correlation of emergencies, in this publication ‘combined’ refers to those cases where there is a causality between the emergencies (i.e. an influence or effect) that challenges the nuclear or radiological EPR capabilities.

of the medical response, communication with the public, the management of radioactive waste, the mitigation of non-radiological consequences, the request, provision and receipt of international assistance, the termination of the emergency and the analysis of the emergency and of the response.

States are responsible for establishing and maintaining appropriate nuclear or radiological emergency preparedness and response arrangements to protect life, health, the environment and society based on their laws, legislation and international legal instruments on the territories of and within the jurisdiction of the State, including arrangements agreed with neighbouring States and the international community (e.g. the Convention on Early Notification of a Nuclear Accident [11] or the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [12]).

1.2. Scope

The scope is covering nuclear and radiological EPR. This publication:

- Addresses the preparedness and response for a nuclear or radiological emergency initiated and/or affected by conventional emergencies⁴, natural events⁵, security events⁶ and/or big national or global health crisis (hereafter referred to as a ‘combined emergency’⁷);
- Describes potential challenges in meeting each of the requirements established in GSR Part 7 [2] in a combined emergency;
- Covers the preparedness stage and the response phases, including the urgent response phase, early response phase and transition phase of the emergency [2].

This publication does not:

- Address the preparedness and response for a conventional emergency or natural events initiating and/or affecting a nuclear or radiological emergency;
- Provide guidance on response measures that are specific to nuclear security events, as indicated in para. 1.16 of GSR Part 7 [2]. These measures are addressed in publications in the IAEA Nuclear Security Series [13–15];
- Address the effects of conventional emergencies, natural events and/or security events on the site evaluation for nuclear installations (which is addressed in Ref. [16]).

1.3. Objective

This publication supports IAEA Member States in preparing for and responding to a combined emergency (as defined above), by describing possible challenges in meeting the EPR requirements established in GSR Part 7 [2]. The information provided in this publication is relevant to those responsible for establishing, maintaining and implementing nuclear or radiological EPR arrangements for a combined emergency, at all levels (i.e. international, national, regional, local and at the facility) and within all relevant organizations (e.g. operating organizations, regulatory bodies, technical support organizations, responders).

The information provided here is intended to complement and not to replace existing guidance and information provided in other IAEA publications for the preparedness and response to nuclear or radiological emergencies initiated by different causes.

1.4. Structure

Section 2 addresses the basic information and key concepts needed to use the publication and put its information into context. Section 3 describes the possible challenges in meeting the requirements established in GSR Part 7 [2].

2. KEY CONCEPTS

This section provides a general description of selected elements necessary for effective preparedness and response for a combined emergency. Further details of the principles and arrangements to respond effectively to a nuclear or radiological emergency can be found in the Fundamental Safety Principles [1] and other IAEA safety standards [2–5]. The IAEA Safety Glossary [16] defines and explains technical terms used in IAEA safety standards and other safety related IAEA publications, and provides information on their usage.

2.1. Introduction

Effective preparedness and response arrangements are a necessity to protect human life, health, property and the environment in any nuclear or radiological emergency. In the case of a combined emergency the impacts on the facilities and activities, on the community and its infrastructure, and on the overall response to the nuclear or radiological emergency can be severe and can challenge the ability of all response organizations (operating, local, national and international) to effectively perform their response functions. Additional arrangements are needed to ensure an effective preparedness and response for nuclear or radiological emergency combined with other incidents or emergencies.

The first step in developing EPR arrangements for combined emergencies is to perform a hazard assessment [2]. The hazard assessment needs to include the identification of all hazards and their potential consequences from events such as those:

- Involving a combination of a nuclear or radiological emergency and/or a conventional emergency, natural event or security event (especially including those that can trigger the nuclear or radiological emergency);
- That could occur at a facility, operation or activity, including those of low probability or otherwise not considered in the design basis;
- Affecting several facilities and activities simultaneously, and their interactions;
- That affect wide areas and/or impair capabilities to support the emergency response;
- At nuclear facilities, operations and/or activities that might affect other States;
- At nuclear facilities, operations and/or activities in other States that might affect the territories or jurisdiction of the State;

- From the results of relevant threat and/or risk assessments.

The results of the hazard assessment enable a graded approach to the preparation of arrangements that are commensurate with the types of hazard identified and their potential consequences [2]. Additionally, based on the hazards and potential consequences, protection strategies can be developed, justified and optimized for taking effective protective actions and other response actions.

Thus, the hazard assessment is a necessary building block for developing, maintaining and coordinating arrangements for preparedness and response to combined emergencies, along with arrangements for preparedness and response to other types of incidents or emergencies.

Ensuring effective preparedness and response for a combined emergency requires the development and maintenance of an all-hazard national emergency management system (EMS) that includes communications, coordination, cooperation and integration of operating, local, regional and national emergency response organizations.⁸ An all-hazard national EMS provides the foundation for an effective and efficient State response to any emergency and harmonization of arrangements with neighbouring States and the international community.

A necessary element for an all-hazard national EMS is establishment of a Unified Command and Control System (UCCS)⁹ [2]. The UCCS provides a means for effective communications, coordination and decision making within the command and control structure, between levels, and includes all relevant organizations. The communication arrangements within and between each level of the UCCS ensure coordination, communications, information exchange and knowledge between the different organizations, resources, capabilities and teams during a response. A UCCS typically consist of three levels (see Section 2.5 for further details). These are:

- Operational/Tactical Level (on-scene/on-site);
- Strategic Level (off-scene/off-site, local and/or regional);
- Policy Level (national).

The UCCS is also scalable to enable the increase, reduction, addition and/or deletion of relevant organizations into the command and control structure. The UCCS ensures effective communication within each level, between levels and relevant organizations of the UCCS as well as communications with other States, international organizations and the public, which is critical to effectively managing operations in an emergency response.

⁸ Effective nuclear or radiological EPR not only involves communication, coordination, cooperation and integration within a State, but also among States and with international intergovernmental organizations [2].

⁹ Examples of Unified Command and Control Systems (UCCS) are the Incident Command System (ICS) used in the United States of America, Canada and the United Kingdom, the Australasian Inter-Service Incident Management System (AIIMS) used in Australia, the Coordinated Incident Management System (CIMS) used in New Zealand or the Gestion Opérationnelle et Commandement (GOC) used in France.

Finally, an all-hazard national EMS needs to be documented in the ‘national emergency plan’ or ‘national response framework’, which needs to incorporate the preparedness and response plans and procedures developed for conventional emergencies, natural events, security events¹⁰ and nuclear or radiological emergencies¹¹, and/or other State specific special response situations.

2.2. Goals of preparedness and response for a nuclear or radiological emergency

Paragraph 3.1 of GSR Part 7 [2] states:

“The goal of emergency preparedness is to ensure that an adequate capability is in place within 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.”

Paragraph 3.2 of GSR Part 7 [2] states:

“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;
- (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.”

2.3. All-hazard national emergency management system

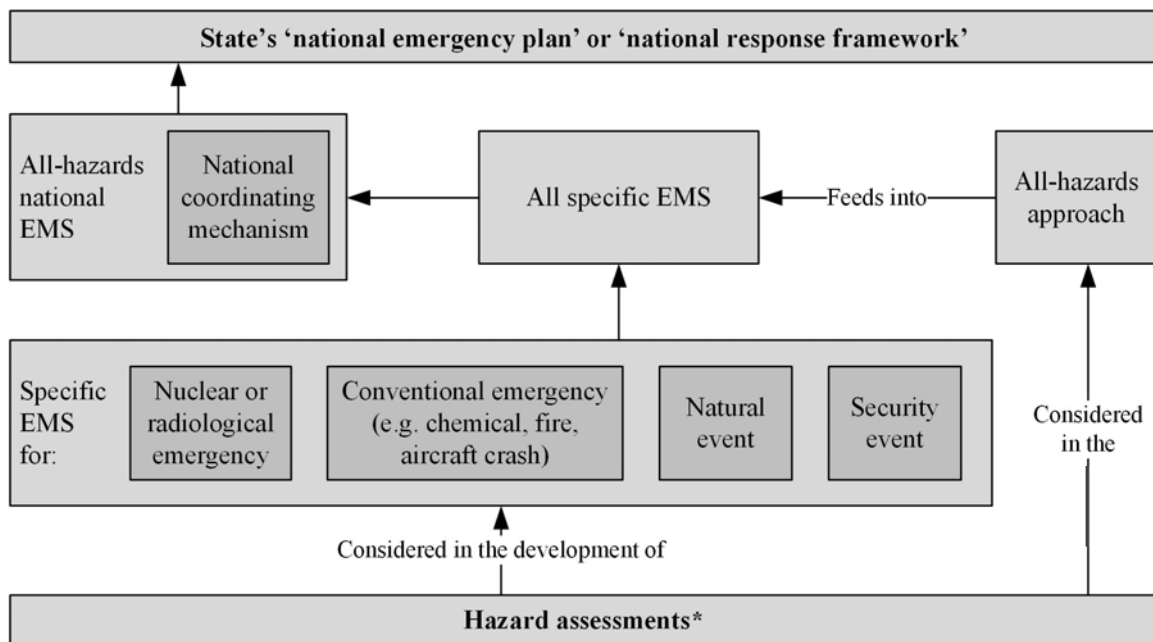
A key component of effective nuclear or radiological EPR arrangements for combined emergencies is the establishment and maintenance of an all-hazard national EMS, which needs to be established to address all emergencies that can be expected. The specific EMS developed for the various types of emergencies identified through the hazard assessments needs to be integrated and documented in a State’s ‘national emergency plan’ or ‘national

¹⁰ Events involving criminal or illegal activities in which the target is not related to nuclear or radioactive materials, as well as to nuclear and radiological facilities or activities).

¹¹ Response to nuclear security events which may trigger nuclear or radiological emergencies are covered within the response to nuclear or radiological emergencies.

response framework'¹² (as described in Fig. 1). The State's national emergency plan or response framework document needs to ensure an integrated all-hazard approach that is coordinated with all organizations at all levels (operating, local, national) that could have a role in the response to any type of emergency or a combination of these emergencies.

The all-hazard national EMS as documented in the national emergency plan needs to be established and maintained to enable a State to effectively and efficiently respond to any type of emergency, either individually or combined. The State's all-hazard national EMS provides the foundation necessary for developing, maintaining and coordinating the arrangements for preparedness and response for a nuclear or radiological emergency irrespective of its initiating event, along with the arrangements for preparedness and response to other types of incidents or emergencies. This foundation supplemented with necessary and appropriate details for each type of emergency anticipated would provide the elements necessary for development and maintenance of an integrated and coordinated all-hazard national EMS for response to all emergencies, either individually or, when combined, with other incidents or emergencies.



* The term 'hazard' may vary, e.g. 'risk' assessment is used in the chemical industry.

FIG. 1. Relationship between the national emergency plan, the EMS and the hazard assessments.

As any other management system, the nuclear or radiological EMS, needs to integrate the operating, local, and national level emergency response arrangements into a single system to enable effective and efficient preparedness and response for a nuclear or radiological emergency irrespective of its initiating event. This integration needs to include: plans and procedures; authorities, roles and responsibilities; organizational structure; logistics and resources (financial, personnel, equipment, facilities); coordination; training, drills and

¹² This terminology is used here as an example and it can differ between States.

exercises; quality management; and cultural considerations. The State's national emergency plan needs to ensure through the National Coordinating Mechanism an integrated and coordinated all-hazard national EMS for preparedness and response for a nuclear or radiological, including combined, emergencies. The nuclear or radiological EMS needs to be commensurate with the results of the hazard assessment; integrated into an all-hazard national EMS; and coordinated and consistent with national emergency arrangements and relevant international emergency arrangements.

The specific nuclear or radiological EMS needs to be developed based on an all-hazard approach. The hazard assessment needs to identify all potential hazards, including any from conventional emergencies, natural events and security events associated with the nuclear and radiological activities and assess their potential consequences that could be expected from all identified hazards. The national emergency plan (see Fig. 1) needs to ensure that arrangements exist for integration and coordination of the nuclear and radiological EMS through an all-hazards national EMS, to facilitate a response to any combinations of conventional emergencies, natural events, security events and nuclear or radiological emergencies.

Further information on the EMS can be found in Refs [17, 18].

2.4. Hazard assessment

Fundamental to the arrangements for preparedness and response for a nuclear or radiological emergency is the identification of the relevant hazards that could impact a State and its jurisdictions, and an assessment of the possible consequences associated with the identified hazards (i.e. a hazard assessment). The hazard assessment identifies the relevant hazards associated with nuclear or radiological emergencies by identifying those events and the associated areas for which protective actions and other response actions may be required within the State and actions that would be effective in mitigating the consequences of such events. It is a prerequisite to an adequate development of emergency response capabilities.

The hazard assessment enables a graded approach to be applied to ensure that the nuclear or radiological EPR arrangements are commensurate with the identified hazards and their potential consequences. A hazard assessment is central to ensuring adequate preparedness and thus a successful response to a nuclear or radiological emergency, even when it is combined with other incidents or emergencies.

Any hazard that has the potential to impair or diminish the ability to protect human life, health, property and the environment in the event of a nuclear or radiological emergency needs to be identified. The first step in the hazard assessment is to identify all facilities, operations and activities, locations and conditions that could cause a nuclear or radiological emergency that could warrant protective actions and other response actions within the State and its jurisdictions. This identification step includes the full range of all possible conventional incidents and emergencies¹³, and natural or security events¹⁴

¹³ See footnote 3.

¹⁴ See footnotes 4 and 5.

including those of a very low estimated probability of occurrence and those not considered in the design of a facility. The 2011 Fukushima Daiichi accident has shown the need to consider all incidents, emergencies and events that might initiate and/or affect the nuclear or radiological emergency, including those of very low probability.

The hazard assessment process for nuclear or radiological emergencies includes the following:

- Identify and characterize postulated emergency situations within the limits of uncertainties;
- Evaluate the radionuclide inventory (including the radionuclide mix and the nature of any chemical or other hazards) and possible release and exposure pathways;
- Assess the distribution or dispersion of nuclear or radioactive material and any other materials that could be released, when appropriate;
- Assess the radiological exposures and non-radiological consequences;
- Assess the need for protective actions and other response actions and their effectiveness;
- If necessary, revise the initial emergency preparedness category.

As part of the first step of characterization of postulated emergency situations, credible events (including those that may result in the failure of all safety systems or nuclear security measures caused unintentionally or maliciously) need to be identified and their dynamics and evolution need to be characterized. Such events include a combination of a nuclear or radiological emergency (including emergencies triggered by nuclear security events) with other conventional emergencies, natural events or security events (which may be the cause of the nuclear or radiological emergency but not necessarily) such as an emergency following an earthquake, a volcanic eruption, a tropical cyclone, severe weather, a tsunami, an aircraft crash or civil disturbances that may affect wide areas and/or impair capabilities to provide support in the emergency response. To ensure these events and associated consequences are adequately assessed in the hazard assessment, the application of an all-hazard approach is necessary (see Fig. 1). Application of an all-hazards approach to the assessment is necessary to identify and consider resources, including personnel, needed for responding to other hazards that could also be included in the response to a nuclear or radiological emergency, especially in the case of a combined emergency, e.g. a nuclear or radiological emergency combined with security events, natural events and/or conventional emergencies. The hazard assessment needs to consider pandemic conditions or hazards which might affect health status of workers (e.g. availability, fitness for duty), emergency workers (e.g. availability, fitness for duty) and/or the public. The hazard assessments for nuclear or radiological emergencies¹⁵ and any resources for responding to any given hazard that are identified, need to be coordinated with other organizations responsible for response to other incidents or emergencies that may have similar needs for resources.

¹⁵ This includes utilization of results of the threat assessment for the purpose of nuclear security to ensure all nuclear or radiological hazards and nuclear security threats that can affect nuclear or radiological EPR are identified and assessed, and that arrangements are coordinated.

Civil disturbance by a mass act of disobedience such as strikes or demonstrations, could lead to a nuclear or radiological emergency if it occurred in a vulnerable location where nuclear material or radioactive sources exist. Cases vary whether this act is demonstrated at a nuclear facility, near a radioactive waste storage or mid a mission for the transport of radioactive material. A strike by security workers at a nuclear facility where all the security system measures are suspended, could expose the whole facility to malicious acts leading to a combined emergency. An act of civil disobedience from protests and demonstrations at or close to nuclear facilities could lead to destruction of property and disruption of operations or activities and even the whole infrastructure causing a nuclear emergency. In preparedness for a nuclear or radiological emergency, it is necessary to ensure that the hazard assessment includes the results of the threat assessments¹⁶ (including civil disturbances) and the protection strategy identifies potential influences of civil disturbances and similar situations to safe and secure implementation of the necessary protective actions. The all-hazard approach needs to ensure that an overarching picture of the effects that all relevant hazards could have on nuclear or radiological emergencies, and on emergency response is obtained. The probability of events involving a combined emergency, including those that might affect wide areas and/or impair capabilities to support the response, are also assessed.

Hazard assessments need to be regularly reviewed and, as necessary, updated. To ensure all hazards are considered, this on-going process will require coordination with all relevant authorities or organizations within a State that are involved with preparing for and responding to a radiological or nuclear emergency, and also with other authorities or organizations involved in the preparedness and response to incidents or emergencies (i.e. an all-hazard approach).

Note that the term ‘hazard assessments’ is called differently in other areas, such as ‘chemical risk assessment’ for chemical emergencies. Requirements, recommendations and further information on the hazard assessment and the all-hazard approach can be found in Refs [2, 4, 19–21].

2.5. Unified Command and Control System

A UCCS enables effective management, decision making and coordination in any emergency response (nuclear, radiological or other). Use of a UCCS provides effective communications, coordination and decision making within the command and control structure; between levels; and includes all relevant organizations. The UCCS is also scalable to enable the increase, reduction, addition and/or deletion of relevant organizations into the command and control structure.

A UCCS typically consist of three levels (as displayed in Fig. 2). These are:

- (a) Operational/Tactical Level (on-scene/on-site): The operational level is the on-scene/on-site level and needs to be comprised of teams of individuals responsible

¹⁶ Threat assessment is an evaluation of the threats, based on available intelligence, law enforcement and open source information that describe the motivations, intentions and capabilities of these threats, where threat refers to a person or group of persons with motivation, intention and capability to commit a malicious act.

for performing specific on-scene/on-site response actions. Depending on the classification of the emergency and the potential consequences, the operational level needs:

- To establish a command post with a single individual (on-scene commander/incident commander) in charge and responsible for all on-scene/on-site response action decisions including mitigatory actions, protective actions and other response actions;
- To ensure the command post staffed by the multidisciplinary experts (technical, fire, medical, safety, security, public information, environmental assessment, logistics, etc.) necessary to ensure an effective response;
- To allocate necessary resources and provide on-scene/on-site direction to response personnel;
- To provide protective action and other response action recommendations to off-scene/off-site authorities;
- To ensure coordination and information and data exchange with other levels (strategic and policy levels) of the unified command and control structure;
- To ensure coordination of public information.

(b) Strategic Level (local and/or regional): The strategic level is the local and/or regional level and needs to be comprised of teams of individuals responsible for performing specific off-scene/off-site response actions. Depending on the classification of the emergency and the potential impact to off-scene/off-site health and safety, the strategic level needs:

- To establish a strategic command post with a single individual (strategic commander) in charge and responsible for all off-scene/off-site response action decisions including mitigatory actions, protective actions and other response actions;
- To ensure the strategic command post and any other local or regional off-scene/off-site centres are staffed by the multidisciplinary experts (technical, fire, medical, safety, security, public information, environmental assessment, logistics, etc.) from the local and regional authorities necessary to ensure an effective off-scene/off-site response;
- To ensure an appropriate command, control and coordination structure and effective communications between the strategic command post and other local and regional established off-scene/off-site centres;
- To allocate necessary resources and provide off-scene/off-site direction to response personnel;
- To provide response recommendations to local and national authorities;
- To ensure coordination and information and data exchange with other levels (Operational and Policy levels) of the UCCS;
- To ensure coordination of public information.

(c) Policy Level (national): The policy level is the off-scene/off-site national level and needs to comprise individuals at the highest level of national organizations with overall responsibility for national level policy decisions. Depending on the

classification of the emergency and the potential impact to human life, health, property and the environment, the policy level needs:

- To establish a national command post with a single individual (national policy coordinator) in charge and responsible for providing national level policy and response action decisions including off-scene/off-site mitigatory actions, protective actions and other response actions and interactions with neighbouring States and international organizations;
- To ensure the national command post and other ministry and authority response centres are staffed by the senior leaders and experts of the relevant ministries and authorities that have a role in the emergency response;
- To ensure an appropriate command, control and coordination structure and effective communications between the various national command post and other ministry and authority response centres;
- To allocate necessary resources for effective response to off-scene/off-site and, as necessary, to on-scene/on-site authorities;
- To ensure coordination and information and data exchange with other levels (operational and strategic levels) of the UCCS;
- To ensure coordination of public information;
- To provide international coordination of the emergency with neighbouring States and international organizations, to include request for, and offers of, assistance.

The roles and responsibilities of the relevant organizations involved in the UCCS need to be clearly defined. This can be accomplished through legislation or formal arrangements such as, written agreements or memoranda of understanding between the various organizations. The extent and complexity of these arrangements need to be flexible to allow for the escalation or de-escalation of any and all levels of the UCCS.

Effective and well defined communication arrangements within and between each level of the UCCS ensure coordination, communications, information exchange and knowledge between the different organizations, resources, capabilities and teams during a response. Effective communication within each level of the UCCS, between levels and relevant organizations as well as all authorities and the public are critical to effectively managing operations in an emergency response.

Further information on the UCCS can be found in US Federal Emergency Management Agency's (FEMA) National Incident Management System (NIMS) Training Program on the Incident Command System (ICS) [22].

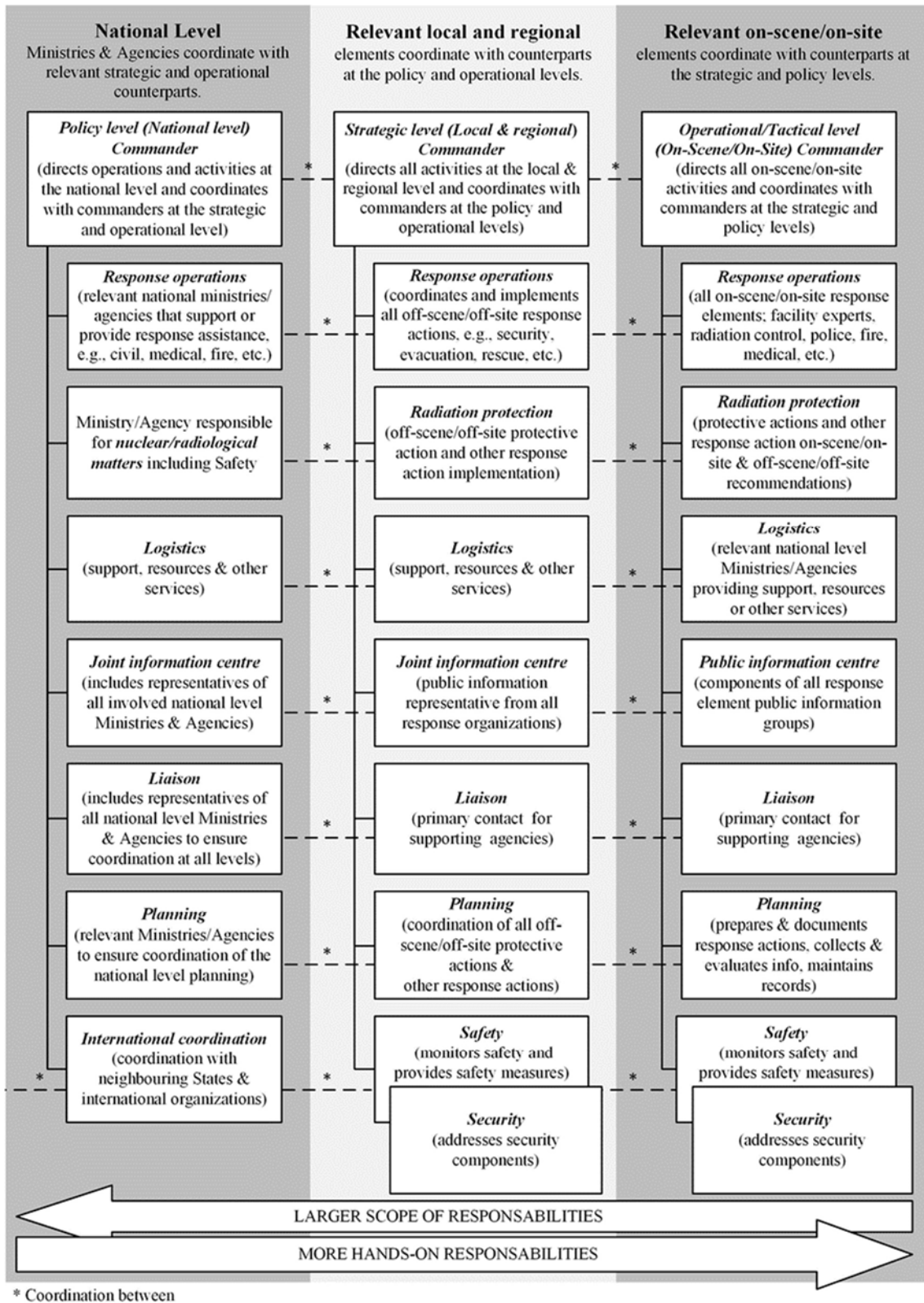


FIG. 2. Schematic representation of a typical unified command and control system.

2.6. Self-assessment

A self-assessment is a comprehensive evaluation of the strengths and weaknesses of any particular programme that is observed by individuals working within the programme and/or in partnership with individuals working in other organizations within the programme. The self-assessment typically involves gathering information about all aspects of the programme to assess the level of compliance with established programme requirements. A comprehensive self-assessment evaluation provides information and data on areas of the programme's strengths and weaknesses and enables the programme to develop a system to address and strengthen weaknesses and overall programme capabilities.

For the self-assessment to be effective, individuals conducting the assessment need to be un-biased and truthful in their assessment of the programme. The self-assessment needs to identify:

- Programme strengths;
- Programme areas that meet requirements but can be improved;
- Programme areas that do not meet requirements.

Based on the results of the self-assessment, a corrective action plan needs to be developed to address areas requiring improvements and that do not meet the requirements. The corrective action plan will identify short and long term actions; milestones for each action; entity (organization and person) responsible for the action; estimated date for achieving each milestone and completing the action; and necessary budgetary, equipment and personnel needs, including training.

2.6.1. EMS self-assessment

2.6.1.1. *All-hazard national EMS self-assessment*

To ensure an effective self-assessment of the all-hazard national EMS, the self-assessment needs to be:

- Organized, and preferably lead, by the State's designated National Coordinating Mechanism or Authority;
- In accordance with the State's laws and regulations;
- Based on hazards identified in the hazard assessment, including those from security events, conventional emergencies and natural events;
- Composed of all organizations (operating, local, regional and national levels) identified in the national emergency plan or national response framework as having a role in, and responsibilities for, the all-hazard national EMS;
- Based on objectives and questions from approved national and organizational plans and procedures;
- Based on scenarios and identified resulting consequences that can be expected from the all-hazard national EMS, including those of very low probability;

- Conducted by individuals working within the various organizations identified in the national emergency plan or national response framework.

2.6.1.2. *Nuclear or radiological EMS self-assessment*

To ensure an effective self-assessment of the nuclear or radiological EMS, the self-assessment needs to be:

- Organized in coordination with the State’s designated National Coordinating Mechanism or Authority;
- In accordance with the State’s nuclear laws, regulations and standards;
- Based on hazards identified in the nuclear and/or radiological all-hazard assessment;
- Composed of all organizations (operating, local, regional and national levels) identified in the national emergency plan or national response framework as having a role in, and responsibilities for, responding to a nuclear or radiological emergency as identified in the all-hazard national EMS;
- Based on objectives and questions from approved national and organizational plans and procedures;
- Based on nuclear and/or radiological scenarios and identified resulting consequences that can be expected from all hazards, including those of very low probability and combined with other incidents or emergencies;
- Conducted by individuals working within the various organizations identified in the national emergency plan or national response framework as having a role and responsibilities for a nuclear or radiological emergency.

The National Coordinating Mechanism or Authority; or organization conducting the self-assessment in coordination with the National Coordinating Mechanism or Authority; as well as all other organizations involved in the self-assessment need to develop a corrective action plan to address areas requiring improvements and that do not meet the requirements.

3. CHALLENGES IN MEETING THE REQUIREMENTS OF GSR PART 7

This section addresses how to meet the requirements provided in GSR Part 7 [2] for a nuclear or radiological emergency initiated and/or affected by a conventional emergency, natural event and/or security event (referred to as a ‘combined emergency’).

The general structure of this section closely follows the structure of GSR Part 7 [2], in that all overarching and associated requirements¹⁷ are addressed in the same sequence. For each overarching requirement, this section provides:

- A quote of the overarching requirement (as a reminder).

¹⁷ Overarching requirements emphasize the topic. The associated requirements provide detailed arrangements associated with the overarching requirement topic.

- General guidance on the overarching requirement.
- Guidance for each paragraph associated to the overarching requirement. The individual paragraphs are not quoted here and need to be consulted in GSR Part 7 [2]. The guidance is structured into:
 - A description of the potential difficulties in meeting the requirements;
 - Examples to clarify the potential difficulties;
 - The challenges that need to be overcome to meet the requirements provided in the specific paragraph for a combined emergency.

Those interested only in the arrangements for preparedness and response for a specific emergency preparedness category, as defined in GSR Part 7 [2], will need to read only those paragraphs as indicated in Table 1.

TABLE 1. APPLICABILITY OF PARAGRAPHS IN GSR PART 7 BY EMERGENCY PREPAREDNESS CATEGORY (*Table A-1 of GSR Part 7 [2]*)

Category	Applicable paragraphs in GSR Part 7 [2]				
I	1.1–1.17			5.4, 5.9, 5.12,	6.25
II	2.1–2.8			5.21, 5.38–	
	3.1–3.2		5.2, 5.25,	5.40,	
II	4.1–4.10, 4.18–		5.27,	5.45–5.46,	
	4.20,	4.11–4.17,	5.32–5.34,	5.66,	
	4.22–4.25, 4.27–	4.26	5.41–5.43,	5.76–5.77	
III	4.31	5.3, 5.5,	5.65	6.11, 6.15,	
	5.1, 5.6–5.8, 5.11,	5.14–5.17,	6.29	6.23	
IV	5.18–5.20, 5.22,	5.23–5.24,		5.10, 5.47	
	5.31, 5.36–5.37,	5.26	4.21		
IV	5.48–5.61, 5.64,	6.19	5.13, 5.28–		
	5.67–5.75, 5.78–		5.30,		
	5.80,		5.35, 5.44,		
V	5.82–5.105		5.62–5.63,		
	6.1–6.10, 6.12–		5.81		
	6.14,				
V	6.16–6.18, 6.20–	5.9, 5.12, 5.21, 5.39–5.40, 5.45–5.46, 5.66,			
	6.22,	5.76–5.77			
	6.24, 6.26–6.28,	6.15			
	6.30–6.39				

3.1. General Requirements of GSR Part 7

Requirement 1 of GSR Part 7: 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.”

A key component of effective nuclear or radiological EPR arrangements is the establishment and maintenance of an all-hazard national EMS. An all-hazard national EMS needs to be established to address all emergencies (nuclear, radiological and other) that can be expected based on the implementation of an integrated all-hazard approach. The nuclear or radiological EMS needs to be: commensurate with the results of the hazard assessment; integrated into an all-hazard national EMS; and coordinated and consistent with national and relevant international arrangements. The all-hazard national EMS needs to provide the foundation and building blocks necessary for developing and maintaining arrangements for preparedness and response to a nuclear or radiological emergency, as well as arrangements for other types of emergencies. The specific EMS developed for the various types of emergencies identified through the State’s hazard assessment needs to be integrated and documented in a State’s ‘national emergency plan’ or ‘national response framework’. The State’s national plan or framework document needs to ensure an integrated all-hazard approach that is coordinated with all organizations (operating, local, national, international) that could have a role in the response to a nuclear or radiological emergency or other incident or emergency. More details are provided in Section 2.3.

Observations for para. 4.1 of GSR Part 7 [2]

Potential difficulties: Since many response organizations are required to establish and maintain capabilities to respond to any and all emergencies (nuclear, radiological and others), multiple EMS can be in place to address the various identified situations and hazards. An ineffective response to the situation or hazard can occur if coordination, integration and cooperation between the various response organizations is not achieved during the development of the EMS.

Clarifying real example: The Great East Japan Earthquake, Tsunami and Fukushima Daiichi Accident of March 2011 identified a lack of effective coordination and integration between response organization for natural events (e.g. Great East Japan Earthquake and Tsunami) and nuclear or radiological emergencies (e.g. 2011 Fukushima Daiichi accident). As a result, coordination, integration and cooperation between the various response organizations was limited during the early stages of the multiple emergencies leading to confusion amongst response organizations at all levels (operating, local, national and international) and amongst the public [8, 10].

Challenges in meeting the requirements in para. 4.1 of GSR Part 7 [2]: It needs to be ensured that all EMS addressing the different types of emergencies are identified and integrated into an all-hazard national EMS. This will enable an efficient response to any and all combinations of conventional emergencies, natural events, security events and nuclear or radiological emergencies. The integration needs to ensure the coordination of

response capabilities and responding organizations at the operating, local, national and international levels are documented in the State's national emergency plan or national response framework and known by all responding organizations.

Observations for para. 4.2 of GSR Part 7 [2]

Potential difficulties: The nuclear and radiological EMS: (i) might not be commensurate with the results of hazard assessment; (ii) might not include scenarios with very low probability events; (iii) might not consider nuclear or radiological emergencies combined with other incidents or emergencies; or (iv) might not consider the implications of the threat assessment or the results of the chemical risk assessments in the hazard assessment.

Clarifying real example:¹⁸ The 2006 ²¹⁰Po incident in London [23] involved a very small quantity of ²¹⁰Po that led to a lethal dose to an individual and involved the contamination of public areas (including a restaurant, private home, two hotels, a hospital and two airplanes). This was an unexpected, very low probability event, with a security component, that was likely not considered in many national hazard assessments, but that nonetheless required a significant response and international coordination.

Challenges in meeting the requirements in para. 4.2 of GSR Part 7 [2]: The hazard assessment needs to consider the hazards associated with all relevant types of emergencies, including those of very low probability, for example events involving radiological exposures devices (RED). The nuclear and radiological EMS then needs to be developed to be commensurate with hazard assessment and consequences that can be expected from the identified scenarios.

Observations for para. 4.3 of GSR Part 7 [2]

Potential difficulties: The nuclear and radiological EMS might not be integrated into an all-hazard national EMS and thus, response operations might be deficient when responding to emergencies since all relevant and necessary response capabilities and operations might not be included in the response. This is especially important and necessary for an effective and efficient response to a nuclear or radiological emergency combined with other incidents or emergencies.

Clarifying real example:¹⁸ Hurricane Katrina struck the Gulf Coast of the United States of America on 29 August 2005. When the storm made landfall, it had a Category 3 rating with sustained winds of approximately 160–230 km/h on the Saffir–Simpson Hurricane Scale and stretched approximately 650 km across. The storm itself did a great damage, but its aftermath was catastrophic with levee breaches causing massive flooding. The combined storm and flooding damaged several medical and other facilities that used licensed radioactive sources, and as a result of the evacuations, in some cases radiological sources were left unattended. This situation caused concern of possible radiological exposure and health hazards for rescue workers and residents since some sources were dislodged and unshielded. This could also be an attractive target for a potential malicious

¹⁸ Some of the clarifying examples provided in this publication are not combined emergencies but are nonetheless relevant to the preparedness for and response to combined emergencies.

act that could trigger a nuclear or radiological emergency which would add more challenges to the EMS in achieving an effective and efficient response.

It is important that the natural event EMS considers radioactive sources in its hazard assessment, and the radiological EMS includes the very low probability impact of a hurricane on the radioactive sources in the hazard assessment. Emergency planning needs to include consideration of the feasibility for searching, locating and securing of radiation sources during a natural event.

Challenges in meeting the requirements in para. 4.3 of GSR Part 7 [2]: The integration of all-hazard in local, regional and national arrangements with the UCCS needs to be ensured. Ensuring an all-hazard approach will enable integration of all EMS arrangements (operating, local and national) in the State's national emergency plan or national response framework. Additionally, use of a UCCSs ensures integration of all-hazard and operating, local and national response levels.

Failure to establish coordinating mechanisms and a UCCS beforehand may result in conflicts during the response. Teams that may have never worked together before will be under increased pressure and possibly overwhelmed during response to the combined emergency. Conflicts may arise about who is responsible for which actions, this will cost time and hinder the response. Considerations should be given at the preparedness stage to distribution of roles and responsibilities, as well as to whether and how they change during response to a combined emergency.

Integrating the emergency management system, to the extent practicable, into an all-hazards emergency management system would involve, in a first approach and among other considerations, that when actions in response to other hazards are taken, the impact of these hazards and associated response actions on nuclear or radiological emergencies should be considered.

Observations for para. 4.4 of GSR Part 7 [2]

Potential difficulties: Individual national organizational emergency management systems might not be coordinated at the State's national level and therefore, international emergency arrangements would be with individual national organizational systems rather than with the State's national system. Lack of coordination at a State's national system can lead to uncoordinated, inconsistent response at the national and international levels.

Clarifying real example: Often, international organizations have close relationships with a State's equivalent national organization counterpart (such as the IAEA with a State's nuclear regulator, the World Health Organization (WHO) with a State's national health authority, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) with a State's civil protection organization) and as a result there may be inadequate coordination at the State's national level with the international level leading to the different uncoordinated organizational responses.

Challenges in meeting the requirements in para. 4.4 of GSR Part 7 [2]: To ensure that the national emergency plan or national response framework is integrated and coordinated

with the international response arrangements for nuclear or radiological emergencies and other incidents or emergencies at all levels and amongst all response organizations. Individual EMS as well as the national emergency plan or national response framework need to identify the responsible national and international coordinator and how coordination is achieved at the national and international levels to ensure that all parties are knowledgeable of the coordinator contact points and coordination process.

Requirement 2 of GSR Part 7: 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.”

One prerequisite for effective response to nuclear or radiological emergencies is for the government to ensure that clear specification and assignment of responsibilities for both the preparedness and response stages are made and understood by all involved roles at all levels. This is especially important for scenarios involving nuclear or radiological EPR arrangements combined with arrangements for other incidents or emergencies. For these cases, the assignment and awareness of roles and responsibilities at all levels of an emergency organization are critical to achieving a successful response.

Arrangements in the national emergency plan need to ensure clear integration of roles during a response to a combined emergency, including all response organizations (also those not usually responding to a nuclear or radiological emergency but that might be responding during a combined emergency). Additionally, in the UCCS a single decision maker needs to have authority for the response at each level (operational/tactical ‘on-scene/on-site’, strategic ‘off-site, local and/or regional’, and policy ‘national’) of the UCCS.

Observations for para. 4.5 of GSR Part 7 [2]

Potential difficulties: Efforts to deal with combined emergencies can be inadequate if there is a lack of established governmental legislation and regulations that ensure well defined and designated roles and responsibilities for all phases of the preparedness and response, and at all levels, i.e. at the operating, local, regional, national and, when appropriate, at the international level (e.g. conventions, treaties, standards, etc.). The legislative procedure is often a lengthy and an overwhelming process that risks delaying creation and assignment of coherent and well defined roles and responsibilities.

Clarifying example: If well defined roles or responsibilities have not been identified or assigned for coordinating rescue efforts in a combined emergency, for example such as one involving a radioactive discharge from a nuclear facility occurring at the same time as a nearby chemical plant discharge, then deciding and making priorities on the most effective protection strategy to deal simultaneously with each of the rescue efforts can be compromised.

Challenges in meeting the requirements in para. 4.5 of GSR Part 7 [2]: A national emergency plan or national response framework needs to be in place that integrates all relevant EMS for different types of emergencies and clearly designates roles and responsibilities at all levels. Efforts need to be made to streamline the process of adopting legislation and regulations relevant to the national emergency plan, with attention given to roles and responsibilities at all levels. The legislation needs to consider the entire spectrum of scenarios that have resulted from an all-hazard assessment, including combined emergencies. Where the adoption of legislation or regulations takes long lead times, the organizations need to develop interim agreements (i.e. memorandum of understanding or agreements) to clearly designate roles and responsibilities amongst the organization(s) pending issuance of legislation or regulations.

Observations for para. 4.6 of GSR Part 7 [2]

Potential difficulties: It might not be possible to promptly and adequately provide compensation if the governing legislation does not exist or does not adequately cover aspects of combined emergencies, i.e. when compensation is needed as a result of the different emergencies.

Clarifying example: As an example, consider a general emergency in a single nuclear reactor resulting in the need to relocate a large inhabited area at the same time as a hurricane occurs that also causes severe damage both to the same area and to a larger surrounding area. This is a case involving one group of people needing to relocate due to two different emergencies plus another group of people needing to relocate because of the hurricane. Legislation for compensation that considers this special case for a combined event would need to have been in place before the events occurred.

Challenges in meeting the requirements in para. 4.6 of GSR Part 7 [2]: To ensure arrangements are in place for compensating victims that include coverage for any type of nuclear or radiological emergency, including combined emergencies. This might require an analysis of how to integrate the compensation that could be warranted for the scenarios involving combined emergencies that have been identified in the all-hazard assessment.

Observations for para. 4.7 of GSR Part 7 [2]

Potential difficulties: The absence of clear lines of responsibility and authority for combined emergencies could make integration of local, regional and national arrangements difficult or unachievable.

Clarifying example: Multiple decision makers resulting from the involvement of different response organizations can lead to the implementation of inconsistent response actions. This could be due to an unclear mandate regarding the provision of public information during a combined emergency leading to contradictory and/or delayed information, e.g. conflict or inconsistency in, or lack of understanding of the mandate between the health authority and the nuclear regulator, or any other regulator involved in the incident or emergency. For example, in a radiological emergency involving severe weather conditions, the public is instructed to evacuate by the nuclear or radiological response organization and to shelter by the conventional response organization.

Clarifying real example: There were delays in the decision making due to the unavailability of high level decision makers during the Great East Japan Earthquake, Tsunami and 2011 Fukushima Daiichi accident [8].

Challenges in meeting the requirements in para. 4.7 of GSR Part 7 [2]: To ensure an integration of the EPR arrangements for all types of emergencies and hazards, at the local, regional and national levels (as described in Section 2.5). This means that clear lines of responsibility and decision making are established at all levels of the UCCS.

Observations for para. 4.8 of GSR Part 7 [2]

Potential difficulties: Human, financial and other resources are necessary prerequisites for effectively preparing for and responding to both the radiological and non-radiological consequences of combined emergencies. The demand for shared resources between on-site and off-site entities can be significantly increased during a combined emergency. In a nuclear or radiological emergency being a nuclear security event, security component could bring out in the community additional fear and anxiety, while victims and witnesses may be subject to trauma and subsequent psychological stress. If such emergency is combined with another emergency, these factors will increase and develop further in the community as people process their grief and misfortune. This may lead to mass panic breaking out, as the public demands information on why nothing was done to prevent such emergencies, and if things will ever return to normal. Eventually, this will increase the occurrence of non-radiological consequences and put additional burdens on available resources and services.

Clarifying example: The availability of vehicles and medical support might be challenged during a combined emergency because several response organizations are making use of them.

Challenges in meeting the requirements in para. 4.8 of GSR Part 7 [2]: To ensure that scenarios include combined emergencies to prepare for the heightened demands on resources, including maintenance. To ensure that arrangements are in place for ensuring appropriate human resources for a nuclear or radiological emergency consistent with the assessed hazards.

Observations for para. 4.9 of GSR Part 7 [2]

Potential difficulties: Establishing, maintaining and demonstrating leadership in both the preparation and response phases of a nuclear or radiological emergency combined with other incidents or emergencies can be difficult without (a) a National Coordinating Mechanism that leads to coherent and efficient preparedness activities for establishing leadership roles and responsibilities regarding combined emergencies, and (b) a well prepared UCCS that leads to clear response leadership roles and effective use of response capabilities.

Clarifying example: No clear governmental decision on allocation of responsibilities between different response organizations could lead to confusion and conflicting or redundant response actions. For example, in a radiological emergency involving severe

weather conditions, the public is instructed to evacuate by the nuclear or radiological response organization and to shelter by the conventional response organization.

Challenges in meeting the requirements in para. 4.9 of GSR Part 7 [2]: To ensure that a National Coordinating Mechanism for roles and responsibilities during preparedness activities, and a UCCS for clear decision making during response provides the conditions for leadership and accountability during scenarios involving combined emergencies. Prepare all participants in the response organization through education, training and exercises to ensure leadership and decision making roles as well as other response roles are clear.

Observations for para. 4.10 of GSR Part 7 [2]

Potential difficulties: The absence of an adequate National Coordinating Mechanism for directing and coordinating preparedness activities for combined emergencies will impede a successful planning for arrangements to respond to a combined emergency.

Clarifying example: See the example provided in observations for para. 4.9 of GSR Part 7 [2].

Challenges in meeting the requirements in para. 4.10 of GSR Part 7 [2]: To ensure that a National Coordinating Mechanism is established during preparedness that has been authorized to guarantee necessary and proper distribution of responsibilities and accountability in all scenarios from the all-hazard assessment that include combined emergencies. A combined emergency calls for the establishment of a multi-agency response that will utilize the coordination between, and integration of all, agencies. This may be especially challenging for a nuclear or radiological emergency triggered by a nuclear security event considering the number of agencies that could be involved and the potential complexity of the scenario.

Observations for para. 4.11 of GSR Part 7 [2]

Potential difficulties: The government might not ensure that arrangements for preparedness and response for facilities and activities under the responsibility of an operating organization are part of a regulatory process that includes considerations of combined emergencies. Thus, inadequate regulations, or an inadequate regulatory process regarding combined emergencies might lead to deficiencies in the preparedness process and ultimately to a lack of accountability in the event of combined emergencies.

Clarifying example: If the regulatory process has not included consideration of any combined emergencies that result from an all-hazard approach, then the regulator has no means for enforcing regulations or verifying arrangements for responding to a combined emergency.

Clarifying real example: During the Great East Japan Earthquake, Tsunami and 2011 Fukushima Daiichi accident, no regulations were in place to cover combined emergencies. The regulations for nuclear or radiological emergencies and for natural

emergencies were available but the application of both regulations at the same time and their interdependencies had not been considered.

Challenges in meeting the requirements in para. 4.11 of GSR Part 7 [2]: To ensure that the regulatory arrangements for combined emergencies are established by the government. The regulations for the individual emergencies might already exist, but might require further coordination between them.

Observations for para. 4.12 of GSR Part 7 [2]

Potential difficulties: If the regulations and guides for operating organizations that specify principles, requirements and associated criteria for safety do not include consideration of scenarios for combined emergencies, ineffective decision making and response activities in the event of a combined emergency could result.

Clarifying example: For example, existing regulations do not include the need for hardened or redundant communication capabilities where consideration has addressed the hazards occurring in scenarios that include combined emergencies. This can lead to uncoordinated decision making if a facility cannot communicate with off-site authorities (e.g. due to severe storm damage) and thus decision making will not be coordinated or will be poorly substantiated.

Challenges in meeting the requirements in para. 4.12 of GSR Part 7 [2]: To formulate and adopt regulations and guides that include consideration of the effects of combined emergencies, which will enhance accountability and decision making.

Observations for para. 4.13 of GSR Part 7 [2]

Potential difficulties: Full compliance with the regulation for on-site preparedness and response arrangements with regards to a combined emergency might not have been fully verified. This can lead to deficiencies in the preparation and/or response arrangements and lead to a variety of problems in a response to a combined emergency, such as for example increasing the severity of an emergency by the lack of appropriate coordinated actions.

Clarifying real example: Regulations and guides did not consider the effects of large tsunamis and the consequences that the subsequent flooding would have on the backup generators of the Fukushima Daiichi nuclear power plant [8].

Challenges in meeting the requirements in para. 4.13 of GSR Part 7 [2]: To ensure continued verified compliance with the regulation governing the arrangements for combined emergencies. The regulations cover all cases involving combined emergencies with attention given to the results of the all-hazard assessment.

Observations for para. 4.14 of GSR Part 7 [2]

Potential difficulties: The regulatory oversight of the operator's compliance might be insufficient resulting in on-site emergency arrangements for the facility, activity or

operation lacking integration and coordination with other response organizations relevant for combined emergencies.

Clarifying example: This could occur if the regulator is complacent regarding oversight of the operator's capabilities for responding to a combined emergency. For example, a regulator not questioning a response plan that does not consider the interaction with local response organizations for natural events or for security events.

Challenges in meeting the requirements in para. 4.14: To ensure integration of on-site emergency arrangements with other relevant emergency plans, with special attention paid to combined emergencies that have been identified in the all-hazard assessment. In case of a nuclear security event, the state of emergency may also put in place special circumstances (such as the inclusion of the military, the national guard, or similar) that may not have been considered in the original emergency plans.

Observations for para. 4.15 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.15 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 4.16 of GSR Part 7 [2]

Potential difficulties: The operating organization's emergency plans might not detail adequate roles and responsibilities and their accompanying arrangements in their scenarios for combined emergencies.

Clarifying example: The operating organization has not designated an assigned role with the responsibility to ensure the integrity of the facility or other structures needed for the response during the impact of a hurricane.

Challenges in meeting the requirements in para. 4.16 of GSR Part 7 [2]: To ensure an adequate assignment of roles and responsibilities in the operating organization for preparedness and response that includes all relevant aspects of the consequences and implications of combined emergencies.

Observations for para. 4.17 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.17 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The operator needs to ensure that emergency arrangements cover all credible scenarios including combined emergencies.

Requirement 3 of GSR Part 7: 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.”

As previously noted, combined emergencies can stretch the limits of any State’s resources and lead to complex situations, requiring a coordinated and integrated response at all levels. International organizations established under the umbrella of the United Nations or through intergovernmental mechanisms (e.g. European Commission, NATO, OECD/NEA, INTERPOL) have capabilities to assist in the response to a nuclear or radiological emergency as well as combined emergencies. International organizations and intergovernmental organizations, hereafter referred to as international organizations, have designated roles under their statutes and legally assigned functions as well as conventions and other international instruments related to the international exchange of information, assistance or other aspects of nuclear or radiological EPR.

Observations for Requirement 3

Potential difficulties: EPR arrangements for responding to nuclear and radiological emergencies, irrespective of the initiating cause, amongst relevant international organizations exist and are coordinated through the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) and documented in the Joint Radiation Emergency Management Plan of the International Organizations (JPLAN) [24]. However, this mechanism does not address arrangements for coordination amongst the international organizations participating in the JPLAN and international organizations that are mandated to respond to other incidents and emergencies (as displayed in Fig. 3).

Challenges in meeting the requirement 3: To ensure that relevant international organizations have integrated and coordinated arrangements for preparedness and response to combined emergencies. All such arrangements need to be coordinated and integrated at the international and national levels to ensure an effective and efficient response to all emergencies.

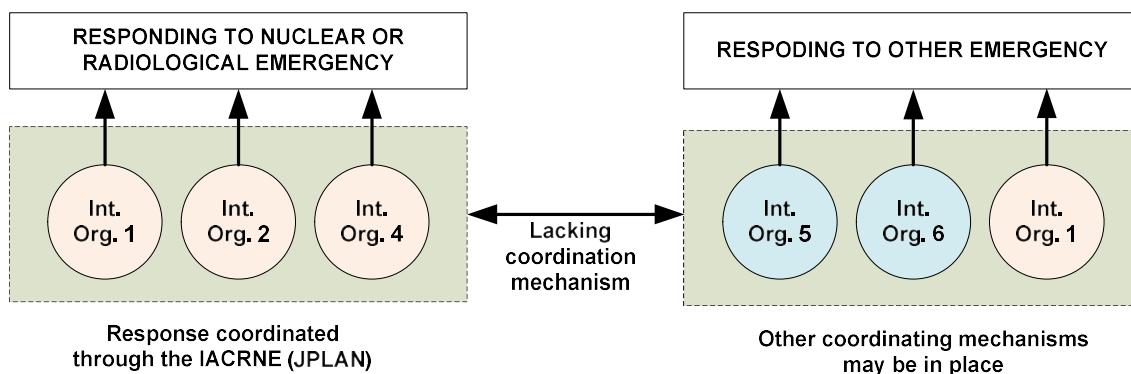


FIG. 3. Coordination between international organizations in a combined emergency.

Requirement 4 of GSR Part 7: 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.”

Fundamental to all arrangements for nuclear and radiological EPR is the identification of existing hazards (to include those from potential conventional emergencies, natural events, security events and nuclear or radiological emergencies) and an understanding of the severity of their associated consequences. A properly executed hazard assessment will identify, within reasonable constraints of uncertainties, all hazards along with the variety of consequences that could possibly occur from the nuclear or radiological activities relevant to the country in question. This includes any challenges to the nuclear or radiological EPR arrangements that could occur from other incidents or emergencies occurring simultaneously (i.e. the results of a hazard assessment). The hazard assessment needs to include events of very low probability and events not considered in the design. Therefore, it should also include the results of the threat assessment that include a review of potential threats induced by a combined emergency. A natural event may damage key components of national infrastructure and leave society more vulnerable to threats. This may create new types of threats that may not be foreseen without considering combined emergencies. For example, an emergency might significantly damage the economy, and leave people in a desperate financial and psychological situation that may lead them to commit criminal acts. The inclusion of the results of such threat assessment will thereby increase the broadness of the hazard assessment to cover all hazards linked to combined emergencies involving nuclear security events.

Results of the hazard assessment will aid in formulating a graded approach in developing a protection strategy for preparedness and response to a nuclear or radiological emergency, including those combined with other incidents or emergencies.

Observations for para. 4.18 of GSR Part 7 [2]

Potential difficulties: Hazards from other incidents or emergencies that could initiate and/or affect response to nuclear or radiological emergencies, and their full impact and consequences might not be included in the hazard assessment, which might lead to nuclear and/or radiological EPR arrangements not commensurate with the actual hazards or the potential consequences. Considerations of consequences of natural events, which may impact radiation detection equipment, need to be included in the emergency planning.

Clarifying example: Consider for example response to a natural event (e.g. hurricane, flooding or earthquake) when due to the occurred damage, radiotherapy sources and other strong radioactive sources used for industrial purposes might remain stored in the buildings located in the affected areas. This could lead to sources being lost or stolen, which would lead to the potential exposure of the public and responders, if sources are not properly located and recovered.

Consider another example when a natural event (i.e. volcano eruption) affects functioning of radiation monitoring equipment, as they are being activated from the atmospheric dispersion of natural radiation by the eruption, and they are being saturated and clogged by volcanic ash.

Challenges in meeting the requirements in para. 4.18 of GSR Part 7 [2]: The National Coordinating Mechanism ensures that the hazard assessment considers all hazards and resulting consequences, including those resulting from combined emergencies and very low probability events. It also ensures that redundant monitoring capabilities are available in case the main capabilities are damaged by such event. A natural disaster could open up vulnerabilities to the security of nuclear or radiological facilities and activities. The hazards arising from such vulnerability should be included in the hazard assessment, even for events of low probability. This includes abandoned sources that could be stolen, incapacitated nuclear security personnel, damaged security equipment, and others.

Observations for para. 4.19 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.19 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The use of the emergency preparedness categories enables the establishment of a graded approach and justified and optimized arrangements for nuclear and radiological EPR.

Observations for para. 4.20 of GSR Part 7 [2]

Potential difficulties: The hazard assessment might not consider the severity or type of consequences that could result from nuclear or radiological emergencies combined with other incidents or emergencies and as a result, the consequences from these combined events can be either over- or underestimated. This can lead to inadequate emergency arrangements and, in the event of an actual combined emergency, an inadequate response.

Clarifying example: Consider for example an emergency preparedness category I nuclear power facility in a country with a climate that can experience severe winter weather conditions such as ice storms, which were not considered in the hazard assessment. These weather conditions can lead to severe conditions such as loss of off-site power, loss of off-site support due to limited transport or loss of communications, which could worsen or trigger an accident and compromise the emergency response.

Consider another example, of a situation that affects human resources. Such a situation can be a pandemic or other disease outbreak in a population around a nuclear power facility, which would potentially influence the health status of workers and affect the operating organization's ability to safely operate the facility, which would potentially influence the health of emergency workers and/or the public and affect the ability to respond to a nuclear or radiological emergency, as well as infrastructure (e.g. hospitals) and processes (e.g. restriction of access to the facilities).

Challenges in meeting the requirements in para. 4.20 of GSR Part 7 [2]: To ensure that the hazard assessment integrates the consequences of all hazards identified for

nuclear or radiological emergencies with those of other incidents or emergencies that could initiate and/or affect nuclear or radiological facilities, operations or activities. To ensure that the hazard assessment considers aspects (e.g. disease outbreaks or pandemics) upon which resources (including human resources) are determined and upon which preparations and arrangements for nuclear or radiological emergency response are established.

Observations for para. 4.21 of GSR Part 7 [2]

Potential difficulties: The hazard assessment might not identify nor include facilities and locations where radioactive material that are not under control might have been used in the past, including abandoned and/or discarded dangerous radioactive sources or radioactive waste.

Clarifying example: Consider an example when flooding affects a radioactive waste site, which becomes an area of concern because the flooding un-earthed appropriately discarded and buried drums of radioactive waste. If such situation was not considered in the hazard assessment, then there are no arrangements in place to deal with the situation at the time of the flood.

Challenges in meeting the requirements in para. 4.21 of GSR Part 7 [2]: To ensure that the hazard assessment identifies and includes facilities and locations where radioactive material might have been used in the past (e.g. abandoned and/or discarded dangerous radioactive sources or radioactive waste) to prevent the possibility of encountering the material as a result of a natural event, such as flooding or other severe weather, nuclear security event, as well as a result of a discovery of a lost or abandoned source.

Observations for para. 4.22 of GSR Part 7 [2]

Potential difficulties: The results of the threat assessments conducted for nuclear security purposes might not be considered in the hazard assessment for nuclear or radiological emergencies, resulting in conflicting security and emergency response and failure of emergency response coordination in implementation of nuclear safety and nuclear security aspects of the response, possibly leading to the emergency response not being adequate.

Clarifying real example: The Hanford Plutonium Finishing Plant explosion led to security forces locking down the site for an extended period without conferring with workers in the Plutonium Finishing Plant facility to possibly determine the cause or to determine if there were any injuries. It was preventing the emergency responders from operating (i.e. firefighters, medical personnel, etc.) [25].

Challenges in meeting the requirements in para. 4.22 of GSR Part 7 [2]: It needs to be ensured that the results of the threat assessments conducted for security purposes that might affect preparedness for nuclear or radiological emergencies or emergency response are included in the hazard assessment for the purpose of emergency preparedness and

response and that the consequences from these combined events are addressed in the EMS, to prevent or minimize conflicts between the security and emergency response.

Observations for para. 4.23 of GSR Part 7 [2]

Potential difficulties: As part of the hazard assessment process, identification of facilities and activities, on-site areas, off-site areas and, in general, locations where protective actions and other response actions would be implemented is performed. Not considering combined emergencies during this process can lead to unwarranted or inadequate response actions being implemented during the response, or to not implementing response actions that are warranted.

Clarifying example: One example is not to consider in hazard assessment process the impact of possible severe weather conditions (e.g. a hurricane) that might limit the ability to evacuate the public from a precautionary action zone (PAZ) or lead to response actions being implemented in a different manner (e.g. initial sheltering being prioritized over immediate evacuation in certain areas).

Challenges in meeting the requirements in para. 4.23 of GSR Part 7 [2]: It needs to be ensured that impacts of combined emergencies are considered in the process when identifying facilities and activities, on-site areas, off-site areas and, in general, locations where protective actions and other response actions could be implemented.

Observations for para. 4.24 of GSR Part 7 [2]

Potential difficulties: The hazard assessment might not consider all non-radiation hazards that can impair or impact the effectiveness of the response.

Clarifying example: Not considering uranium hexafluoride (UF₆), chlorine or other chemicals used in the nuclear fuel cycle in the hazard assessment on the site. For example, UF₆ is a greater concern from a chemical than from a radiological point of view and therefore might be overlooked in the hazard assessment if the all-hazard approach is not followed. In preparedness for a nuclear or radiological emergency, it is necessary to ensure that the hazard assessments include the potential for fires ignited off-site impacting on-site operations and activities.

On 29 September 1957, the Fissile Material Storage Facility (FMSF) at Mayak plant in the former Soviet Union exploded due to a failure of the cooling system. At the time of the explosion, the tank stored tens of thousands of tonnes of dissolved nuclear waste. The explosion was a chemical (non-nuclear) explosion having an energy estimated at about 75 t of TNT (310 GJ). This explosion, although non-nuclear, released 740 PBq of fission products, of which 74 PBq drifted off the site, creating a contaminated region of 15 000–20 000 km² called the East Urals Radioactive trace [26].

Challenges in meeting the requirements in para. 4.24 of GSR Part 7 [2]: To ensure that non-radiation hazards resulting from combined emergencies are considered in the hazard assessment (i.e. all-hazard approach). To ensure that emergency plans are based on the all-hazard approach and that scenarios are developed to address all types of

situations including very low probability situations (i.e. chemical explosion of radioactive waste storage tank due to loss of coolant).

Observations for para. 4.25 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.25 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. It is important to remember the necessity of periodic reviews that could consider any changes to the hazard assessment that might warrant the revision of the nuclear and radiological EPR arrangements.

Observations for para. 4.26 of GSR Part 7 [2]

Potential difficulties: New or additional information that has become available regarding hazards that can impact or change emergency response or emergency arrangements relevant to nuclear or radiological emergencies combined with other incidents or emergencies might not be considered.

Clarifying example: An example is the possibility of an extremely severe storm, which would completely damage all infrastructure and make impossible a call for assistance, not being considered in the nuclear and radiological EPR arrangements, so that an emergency could occur that might have been prevented (e.g. resulting from storm damage), or the needed mitigatory actions might not be implemented in order to diminish the severity of the consequences (e.g. emergency core cooling system cannot be operated due to the effects of the storm).

Challenges in meeting the requirements in para. 4.26 of GSR Part 7 [2]: To ensure that new and/or additional information that might be related to hazards linked to a nuclear or radiological emergency combined with other incidents or emergencies are brought to the attention of appropriate personnel and that appropriate nuclear and radiological EPR arrangements are revised based on the new or additional information.

Requirement 5 of GSR Part 7: Protection strategy for a nuclear or radiological 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.”

A protection strategy needs to be developed, based on an all-hazard approach to ensure it includes all relevant combinations of a conventional emergency, a natural event and/or a security event with a nuclear or radiological emergency.

A protection strategy for nuclear or radiological emergencies that is developed during the preparedness stage provides the framework for applying effective protective actions and other response actions during a response. The application of protective actions and other response actions are guided by the principles of justification and optimization to ensure

more good than harm is done and the best results are achieved under the given circumstances. This is particularly relevant for a combined emergency. Namely, the circumstances associated with the other incidents or emergencies can render justified actions unsafe or give different weighting to available options to be considered in the protection strategy, in comparison to those to be taken into account on radiation protection grounds only.

Observations for para. 4.27 of GSR Part 7 [2]

Potential difficulties: The protection strategy development, justification and optimization might not take into account all consequences from scenarios involving a nuclear or radiological emergency combined with other incidents or emergencies leading to a reduced efficiency of the response.

Clarifying example: The evacuation or sheltering of the public during a nuclear or radiological emergency which is occurring under severe adverse conditions due to a natural catastrophe happening at the same time, might be unsafe and thus result in more harm than good.

Clarifying real example: The strategy to protect the public during the 2011 Fukushima Daiichi accident did not consider the limitations imposed by damaged infrastructure to the provision of off-site support to the on-site response (i.e. off-site support needed for the implementation of on-site mitigatory actions was significantly delayed due to roads not being usable because of the earthquake and tsunami).

Challenges in meeting the requirements in para. 4.27 of GSR Part 7 [2]: To ensure that the impact by external events identified in the hazard assessment are considered during the protection strategy development, and that flexibility is built in the strategy to apply under the range of circumstances that might be imposed by the other incidents or emergencies.

Observations for para. 4.28 of GSR Part 7 [2]

Potential difficulties: The implementation of response actions based solely on dosimetric criteria (i.e. reference level and generic criteria) and operational criteria (i.e. observables, emergency action levels and operational intervention levels), which are developed based on radiation protection grounds, without the justification and optimization of the actions within a protection strategy, can lead to response actions that might not be justified and/or optimized in a combined emergency.

Clarifying example: Following the declaration of a general emergency at a nuclear power plant affected by severe snow storms, some response actions are being implemented based on operational intervention levels, which are developed based on radiation protection grounds, without further justification and optimization of the actions within a protection strategy, e.g. without considering the potential complications in the implementation of response actions such as evacuation during a snow storm. If evacuation is implemented based on these operational intervention levels, without considering the

non-radiation hazards resulting from the snow storm, the public might be put at an unnecessary risk.

Challenges in meeting the requirements in para. 4.28 of GSR Part 7 [2]: The impact of other incidents or emergencies need to be considered in the development, justification and optimization of the protection strategy [27].

Observations for para. 4.29 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.29 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Take note to not forget consideration of all hazards, including those resulting from events, other than nuclear or radiological emergencies, in developing the protection strategy.

Observations for para. 4.30 of GSR Part 7 [2]

Potential difficulties: Not all interested parties related to the other incidents or emergencies that could be combined with a nuclear or radiological emergency might be involved during the development of the protection strategy, leading to a protection strategy that might not reflect the interests of all the parties.

Clarifying example: Consider, for example, that the local civil protection was not involved in the development of the protection strategy. As a result, the possible limitation of civil protection resources due to the response to other (non-radiological) incidents or emergencies was not considered in the response to the nuclear or radiological emergency and in the optimization of the protection strategy.

Challenges in meeting the requirements in para. 4.30 of GSR Part 7 [2]: The National Coordinating Mechanism ensures that all relevant parties, including all response organizations (e.g. civil protection), the public and other relevant facilities (e.g. chemical plants) that would be involved in a response to a nuclear or radiological emergency combined with other incidents and emergencies, are involved and are consulted, as appropriate, during the development of the protection strategy. Especially the public, needs to understand the implications that the combined emergencies can have on the strategy and the flexibility built in it.

Observations for para. 4.31 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 4.31 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. To ensure that a safe and effective protection strategy is implemented, the hazards resulting from the other incidents and emergencies need to be considered in an all-hazard approach.

3.2. Functional Requirements of GSR Part 7

Requirement 6 of GSR Part 7: 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.”

Effective management of operations in response to a nuclear or radiological emergency requires the development of preparedness arrangements to appropriately plan the operations necessary for the response to a nuclear or radiological emergency. The preparedness arrangements are based on the all-hazard approach and protection strategy developed considering each specific postulated incident or emergency, including consideration of national, local and site specific circumstances. The preparedness arrangements need to include use of a single command and control system for the response to:

- Any potential nuclear or radiological emergency regardless of the number of involved facilities (e.g. fuel cycle facility or nuclear power plant) or activities (e.g. transport or storage of highly radioactive waste), including those at the same location or nearby;
- Other incidents or emergencies that might initiate and/or affect the nuclear or radiological emergency.

Effective management of the response to a combined emergency with a command and control system enables prompt execution and effective coordination of on-site and off-site (local, regional, national and, as appropriate, international) response operations. A UCCS, ensures prompt and effective decision making, coordination, communications and appropriate implementation of actions at all levels (site/facility, local, regional and national) and with neighbouring States and the international community from the onset of any emergency, including a nuclear or radiological emergency combined with other incidents or emergencies. The UCCS includes all relevant response organizations and provides effective communications and decision making within the command, control and coordination structure and between levels. While managing the response, safety and security functions must remain operational, and mitigatory actions should not hinder these functions.

Observations for para. 5.2 of GSR Part 7 [2]

Potential difficulties: Combined emergencies present challenges to the overall response command and control since different organizations at the local, regional and national levels are incorporated into the on-site (i.e. the operational level described in Section 2.5) command and control response structure. The adding and/or removing of the different response organizations to the command and control structure requires extensive interaction, integration and coordination to ensure all appropriate response organizations and relevant infrastructure necessary for effective management of on-site response operations (e.g. personnel, communication, equipment) are fully integrated and involved during the transition from normal operations to emergency operations. During a combined

emergency, those responsible for security on-scene/on-site may no longer be able to perform their duties, making a nuclear security event more likely to occur. They may be having to deal with another event elsewhere (flooding, fire, cyber or other malicious attack), or be physically unable to perform their duties (by falling ill, injured, or being unable to come in due to failing infrastructure). Accordingly, plans should be in place to consider the transfer of responsibilities when certain personnel are no longer available to ensure the continued functionality of the security systems.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the Japanese Cabinet Office and Fukushima Prefecture were responding to the earthquake and tsunami emergencies, which affected the initial Cabinet Office and Fukushima Prefecture responses to the Fukushima Daiichi accident. Additionally, the tsunami devastated the infrastructure (power, communications, roads, emergency facilities, other response equipment) near the Fukushima Daiichi nuclear power plant making the transition from normal operations to emergency operations extremely difficult and time consuming [8].

Challenges in meeting the requirements in para. 5.2 of GSR Part 7 [2]: To ensure the effective development and use of a UCCS capable of integrating and coordinating all necessary response organizations and capabilities (including off-site response personnel and capabilities needed for an effective on-site response), even when these capabilities are responding to other off-site incidents or emergencies, during the transition from normal operations to emergency operations is paramount for efficient management of response operations.

Observations for para. 5.3 of GSR Part 7 [2]

Potential difficulties: Combined emergencies present challenges to the overall response command and control since a multitude of different off-site response organizations at the local, regional and national levels need to be promptly executed, effectively managed and coordinated with the on-site nuclear or radiological emergency response. Again, the adding and/or removing of the different response organizations to the command and control structure requires extensive interaction, integration and coordination to ensure all appropriate response organizations and relevant infrastructure necessary for prompt execution and effective management of the off-site response as well as coordination with the on-site nuclear or radiological response operations.

Clarifying example: Necessary command and control decision makers are unavailable due to the response to the other incident or emergency resulting in necessary decisions not being made and/or delayed.

Challenges in meeting the requirements in para. 5.3 of GSR Part 7 [2]: To ensure the effective development and use of a UCCS that provides prompt execution and effective management of the off-site response (local, regional and national levels) and is fully coordinated and integrated with the on-site response.

Observations for para. 5.4 of GSR Part 7 [2]

Potential difficulties: The nuclear or radiological emergency might simultaneously involve emergencies at multiple collocated nuclear activities combined with other incidents or emergencies which provides challenges to on-site and off-site command and control. The on-site command and control might be compromised since a single on-site command and control structure is not being used and thus, off-site response organizations would be receiving data from multiple on-site response entities that appear misleading and cause confusion.

Clarifying real example: The 2011 Fukushima Daiichi accident involved emergencies at four of the six nuclear power plants and all six spent nuclear fuel pools combined with the earthquake and tsunami causing multiple challenges for the management of the overall emergency response (both on-site and off-site) [8].

Challenges in meeting the requirements in para. 5.4 of GSR Part 7 [2]: To ensure the establishment and use of a UCCS that has the multiple on-site nuclear emergency response entities reporting to a single on-site command and control entity, who has the sole responsibility to provide information and data to the off-site command and control entity. The single on-site command and control entity needs to be staffed with expertise necessary to provide effective decision making regarding the various types of nuclear, radiological emergencies or other incidents or emergencies (e.g. natural events) that could occur on-site.

Observations for para. 5.5 of GSR Part 7 [2]

Potential difficulties: The nuclear or radiological security arrangements in place during normal operations might not be functional or equivalent alternate security measures might not be in place during a combined emergency.

Clarifying real example: During the 2011 Fukushima Daiichi accident, on-site, off-site and emergency power were knocked out by the tsunami rendering the security alarm system inoperable. Security staff were evacuated due to the increased radiation levels and anticipated additional radiation hazards from the multiple nuclear power plant units and spent nuclear fuel pools on-site resulting in no operating or backup security systems in place for fresh fuel on-site for refuelling operations ongoing at Reactors 5 and 6 prior to the earthquake and tsunami or to ensure security protection at the site.

Challenges in meeting the requirements in para. 5.5 of GSR Part 7 [2]: Contingency plans need to be developed to ensure security protection and integrity for all possible impacts and consequences identified in the hazard assessments including those resulting from the other incidents or emergencies and made available as appropriate for use during a nuclear or radiological emergency, as well as to avoid or minimize conflict with the emergency response.

Observations for para. 5.6 of GSR Part 7 [2]

Potential difficulties: Coordination and integration of a nuclear or radiological emergency with arrangements at the local, regional and national levels, when the response is combined with other incidents or emergencies, presents challenges to the overall

response command and control since different organizations at the local, regional and national levels are incorporated into the on-site (operational level as described in Section 2.5), off-site local and regional (strategic level as described in Section 2.5) and national (policy level as described in Section 2.5) command and control response structure. The adding and/or removing of the different on-site, off-site and national level response organizations to the command and control structure requires extensive interaction, integration and coordination to ensure effective management of all response operations (e.g. on-site, off-site and national).

Clarifying real example: Prior to the 2011 Fukushima Daiichi accident, nuclear or radiological emergency response arrangements in Japan were not coordinated with response arrangements to natural disasters. Thus, the Japanese Cabinet Office (national level) and Fukushima villages, cities and Prefecture (off-site local and regional levels) were initially busy with the response to the earthquake and tsunami emergencies and, since no arrangements for integration and coordination of the response to a conventional incident or emergency with a nuclear or radiological emergency had been developed, this affected integration and coordination of their initial responses to the Fukushima Daiichi accident.

During the response to Hurricane Katrina a lack of a coordinated and integrated command and control structure between the on-site (city of New Orleans), local (county and state) and national level response organizations resulted in many challenges between the city, local, regional and national command and control elements.

Challenges in meeting the requirements in para. 5.6 of GSR Part 7 [2]: To ensure the effective development and use of a UCCS capable of integrating, coordinating and managing all necessary response organizations and capabilities including on-site, off-site, national and international response capabilities necessary for an effective response to a combined emergency. Arrangements for response, including nuclear security response, should be integrated and coordinated even when the initiator of the event is not yet known. To determine whether a nuclear or radiological emergency is a nuclear security event, external experts and facilities may be needed, such as nuclear forensics and nuclear security experts. Consideration should be given to the availability of special facilities and teams during a combined emergency. External laboratories and experts may not be reachable during an emergency due to failures in infrastructure or communication. Plans for coordination and communication at the local and national level should be considered, even during extreme conditions. This may necessitate additional communications equipment, procedures for travel under emergency conditions, and plans for response to a nuclear or radiological emergency triggered by a nuclear security event without the use of external facilities and expertise.

Observations for para. 5.7 of GSR Part 7 [2]

Potential difficulties: There might be a lack of an established and clearly specified UCCS for emergency response as a part of the all-hazard national EMS under the all-hazard approach that provides sufficient assurance for effective coordination of on-site and off-site response, authority and responsibility for decision making and directing the response, and prompt discharge of responsibilities upon notification of a combined emergency.

Clarifying real example: The 2011 Fukushima Daiichi accident highlighted the need for an established and clearly specified all-hazard UCCS documented in an all-hazard national EMS. The initial response to the 2011 Fukushima Daiichi accident lacked a unified command and control for the individual emergencies (natural disaster and nuclear accident), resulting in decision and direction being provided individually at the site, off-site and nationally for the individual emergencies rather than through a coordinated and integrated command and control to address the combined emergencies on-site, off-site and nationally.

Challenges in meeting the requirements in para. 5.7 of GSR Part 7 [2]: To ensure the establishment and use of a clearly specified UCCS for emergency response under the all-hazard approach that provides sufficient assurance for effective coordination of on-site and off-site response, authority and responsibility for decision making and directing the response, and prompt discharge of responsibilities upon notification of a combined emergency. Ensuring the UCCS is documented in an all-hazard national EMS (see Requirements 1, 2 and 4 for additional details regarding the EMS (Requirement 1), roles and responsibilities (Requirement 2) and hazard assessment (Requirement 4)).

Observations for para. 5.8 of GSR Part 7 [2]

Potential difficulties: Arrangements might not have been made for obtaining and assessing information necessary for decision making regarding allocation of resources for effective and efficient response to the emergency for all response organizations involved in a combined emergency.

Clarifying example: If the resource needs of the conventional and radiological response organizations and vice versa are not considered in the planning, the resources might not be available during the emergency.

Challenges in meeting the requirements in para. 5.8 of GSR Part 7 [2]: To ensure that the all-hazard national EMS has an established and clearly specified all-hazard UCCS for effective coordination, integration and assessment of information necessary for effective decision making regarding allocation of all response organization resources to address the emergency.

Observations for paras 5.9 and 5.10 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.9 and 5.10 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Arrangements for international coordination of response between response organizations of other States within the emergency planning zones (EPZs) and emergency planning distances (EPDs) needs to be established. Ensuring effective development and use of arrangements, such as a UCCS, that provides for prompt execution and effective management of the on-site and off-site (local, regional, national, neighbouring States and international levels) that is fully coordinated and integrated amongst all parties, is needed to prevent confusion and sometimes conflicting protective actions and other response actions between the accident State, neighbouring States and the international community.

Requirement 7 of GSR Part 7: Identifying and notifying a nuclear or radiological 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.”

Critical for ensuring an effective response to a nuclear or radiological emergency is ensuring that arrangements and systems exist for prompt identification and notification of a nuclear or radiological emergency and for activation of an emergency response. The procedures need to include means and methods to ensure identification, classification, notification and communication of the emergency; and arrangements in place for authorities to ensure activation of response capabilities. Procedures also need to ensure capabilities to ensure awareness and warning for first responders, local officials and initiation of a coordinated pre-planned on-site and off-site response. Additionally, systems need to be robust, reliable and diverse to enable prompt recognition, classification, declaration and notification of the emergency including warning systems and effective communications systems amongst all response organizations. Continuously available notification points need to be identified to receive notifications and activate pre-planned response actions that have been coordinated between all response organizations involved in the combined emergency during the preparedness stage.

Observations for para. 5.11 of GSR Part 7 [2]

Potential difficulties: There might be instances where:

- (1) The emergency is initiated by other events (e.g. security events, natural disasters) which results in the notification being made to a 24-hour notification point other than 24-hour notification point for nuclear or radiological emergencies and this notification point is unaware of the 24-hour notification point for nuclear or radiological emergencies resulting in the 24-hour notification point for nuclear or radiological emergencies not receiving an initial notification of the nuclear or radiological emergency.
- (2) The notification point, because of other incidents or emergencies, might not have continuous availability for notification updates, to receive requests for support, to respond promptly or to initiate pre-planned and coordinated off-site response.
- (3) Communications equipment becomes unavailable or in-operable jeopardizing notifications and updates, requests for support and initiation of prompt response.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the tsunami devastated the communications capabilities in the local community near the nuclear power plant hindering prompt notification and updates of the situation and requests for support. Additionally, since notification points for natural events was different than the notification point for nuclear and radiological emergencies, coordination between the responding elements was uncoordinated initially resulting in delayed decision making [8].

Other examples include: (i) during the TMI nuclear accident communications between on-site and off-site entities was lost due to an unrelated off-site repair work that severed

communication lines causing confusion, concern and conflicting reports between on-site and off-site (local, state and national authorities) regarding the accident; and (ii) during Hurricane Katrina in the United States of America, communications capabilities became unavailable in the initial phase of the hurricane making communications between the city, state and national levels difficult resulting in confusion and lack of prompt response decisions [6, 28].

Challenges in meeting the requirements in para. 5.11 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes: (i) established and documented procedures that ensure actions are taken for notification of all relevant organizations and for initiation of a prompt response; (ii) coordination between the multiple relevant notification points and response organizations regardless of type of emergency or initiating event; and (iii) robust and redundant communications systems to ensure communication during and throughout any emergency, including combined emergencies.

Observations for para. 5.12 of GSR Part 7 [2]

Potential difficulties: It might be challenging to establish, maintain and empower a notification point to be able to immediately communicate with authorities responsible for deciding and initiating precautionary urgent protective actions and urgent protective actions off-site, as well as other response actions.

Clarifying real example: Over the years numerous emergencies; such as: the 2011 Fukushima Daiichi accident, Chernobyl nuclear power plant accident, TMI accident, Tokai-Mura JCO Fuel Fabrication Plant accident, Hurricane Katrina, accidents involving radioactive sources in Brazil (Goiânia) and Georgia all had deficiencies noted with regards to deciding and initiating protective actions and other response actions [6].

Challenges in meeting the requirements in para. 5.12 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes established and documented procedures for notification of identified and empowered authorities responsible for deciding and initiating precautionary urgent protective actions and urgent off-site protective actions and other response actions.

Observations for para. 5.13 of GSR Part 7 [2]

Potential difficulties: To establish and maintain a process and system that provides awareness for local officials and first responders of the indicators of a potential radiological emergency, who needs to be notified, and who need to take immediate protective actions and other response actions.

Clarifying real example: The 1987 radioactive source accident in Goiânia, Brazil in which an abandon source was stolen and then mishandled resulting in 4 deaths and 249 people exposed to significant levels of radioactive material and extensive environmental contamination. Rescue workers were unable to identify the initial hazard resulting in additional exposures. Additionally, fear of radiation due to a lack of detailed information could result in first responders refusing to respond due to radiation hazard.

Challenges in meeting the requirements in para. 5.13 of GSR Part 7 [2]: Development of plain language basic instructions and training programmes for responders to provide an effective initial response to all emergencies regardless of the initiating event (e.g. CBRNE training and arrangements in place [29]).

Observations for para. 5.14 of GSR Part 7 [2]

Potential difficulties: Different emergency classification systems might exist for differing types of emergencies (e.g. nuclear or radiological emergency, security event, hurricanes, earthquakes, terrorism alert levels, chemical, fires, floods, etc.) which can lead to confusion during combined emergencies or amongst organizations that do not normally provide a response to incidents or emergencies outside their area of emergency expertise. This confusion could lead to delayed or misclassification of a combined emergency, resulting in protective actions and other response action being delayed or not implemented.

Clarifying example: The hazards resulting from a neighbouring chemical plant are not considered in the emergency classification (e.g. release of toxic gases resulting from a conventional emergency might be a reason for a higher classification of the situation).

Challenges in meeting the requirements in para. 5.14 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes established and documented procedures for classification of all emergencies identified and anticipated from the hazard assessment and a system for notification of identified emergencies and classification level of the emergency. The procedures need to identify the response expected based on the classification and, if it is a combined emergency, the coordinated response expected from each identified classification system.

Observations for para. 5.15 of GSR Part 7 [2]

Potential difficulties: Establishing the necessary arrangements for the conduct of periodic reviews of the declared emergency classification when updated or as additional information becomes available.

Clarifying example: As new information or data becomes available, the emergency classification might change resulting in a higher emergency classification.

Challenges in meeting the requirements in para. 5.15 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes established and documented procedures for periodic reviews of the emergency classification as new or revised information and data becomes available for all emergencies.

Observations for para. 5.16 of GSR Part 7 [2]

Potential difficulties: Different emergency classification systems for differing types of emergencies or events (e.g. nuclear or radiological emergency, security event, hurricanes, earthquakes, terrorism alert levels, chemical, fires, floods, etc.) often do not:

- (1) Include all postulated emergencies, especially those arising from events of very low probability;
- (2) Include emergency action levels and other observable conditions and indicators in the operational criteria;
- (3) Enable prompt initiation of an effective response in recognition of uncertainty of information;
- (4) Address emergency classification, emergency response and emergency rating delays caused by other incidents or emergencies.

Clarifying real example: Not developing operational criteria for external events such as tsunami (e.g. height of waves above a certain value), hurricanes (e.g. wind speed above a certain value), severe weather (e.g. snow height exceeding a certain value) and other effects from natural events or other incidents or emergencies included in the overall emergency classification system.

Examples include Hurricane Andrew in the United States of America, which knocked out communication lines and caused concern at the Turkey Point nuclear power plants in the United States of America or the tsunami effects on the Fukushima Daiichi nuclear power plant.

Challenges in meeting the requirements in para. 5.16 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes established and documented procedures that incorporates emergency classifications for all postulated events including those of very low probability; emergency action levels and other observable conditions and indicators in the operational criteria; provisions for prompt initiation of an effective response in recognition of uncertainty of information; and a process to address emergency classification, emergency response and delays in rating for public communication purposes (e.g. through INES [30]).

Observations for para. 5.17 of GSR Part 7 [2]

Potential difficulties: To establish and maintain an all-hazard national EMS that includes suitable, reliable and diverse means for prompt recognition and classification of the emergency; prompt declaration of the emergency classification and initiation of on-site response; notification to the appropriate notification points with sufficient information and data for an effective off-site response; initiation of a coordinated pre-planned on-site and off-site response in accordance with the approved protection strategy; and warning persons on the site, notification to the notification point and communications between response organizations.

Clarifying real example: On-site and off-site warning and/or communications systems become inoperable due to tsunami, hurricanes, severe weather (e.g. Great East Japan Earthquake, Tsunami and Fukushima Daiichi accident of March 2011, Hurricane Andrew and the Turkey Point Nuclear Power Plant, TMI communications loss. Additionally, communications have been affected due to different radio communication frequencies/equipment between different response organizations).

Challenges in meeting the requirements in para. 5.17 of GSR Part 7 [2]: To ensure that the all-hazard national EMS includes established and documented procedures that provide for robust, reliable and diverse means for prompt recognition, classification, declaration and notification of the emergency and initiation of a coordinated and pre-planned on-site and off-site response including warning systems and effective communications systems amongst all response organizations.

Note that a well developed, established and documented all-hazard national EMS supported by a UCCS will ensure an effective and efficient system and process for identification, notification and activating an emergency response.

Observations for paras 5.18–5.22 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.18–5.22 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. These sections refer to arrangements for interactions with other States and the international community which are specifically addressed in Requirements 3 and 17 as well as under specific sub-requirements for dealing with neighbouring States and the international community in Requirement 6.

Requirement 8 of GSR Part 7: Taking mitigatory actions

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

Mitigatory actions often need to be implemented early in a developing emergency and continuously as the emergency develops. This requires that proper arrangements be developed during the preparedness stage by all relevant operating organizations, response organizations and off-site emergency services and that they are in place for taking mitigatory actions to reduce the consequences or prevent escalation of a nuclear or radiological emergency, including when it is combined with other incidents and emergencies. Arrangements need to be in place to ensure that clearly assigned roles and responsibilities provide details of who is responsible for taking the required mitigatory actions to address the combined emergency.

Observations for para. 5.23 of GSR Part 7 [2]

Potential difficulties: The operating organization (of a facility or activity in emergency preparedness categories I, II, III or IV) might be impaired in its ability to take (or implement) mitigatory actions due to the other incident or emergency.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the tsunami caused a loss of onsite power after the diesel generators became inoperable due to flooding. In addition, large amounts of rubble hindered the responders. The operating organization was therefore unable to take mitigatory actions, e.g. to prevent the reactor meltdowns.

Challenges in meeting the requirements in para. 5.23 of GSR Part 7 [2]: To ensure that all nuclear or radiological emergencies that can reasonably occur combined with other incidents or emergencies are identified in the hazard assessment, as well as justified and optimized in the arrangements for implementation of mitigatory actions by the operator.

Observations for para. 5.24 of GSR Part 7 [2]

Potential difficulties: The off-site emergency services might be significantly challenged in a nuclear or radiological emergency combined with other incidents or emergencies and might give priority to the other incident or emergency (e.g. a non-radiological emergency or an emergency causing the loss of infrastructure for support), and thus not be able to support the on-site emergency response.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the earthquake and tsunami caused a loss of conventional infrastructure for transportation (e.g. roads), which hindered the off-site emergency services from assisting the on-site emergency response.

Challenges in meeting the requirements in para. 5.24 of GSR Part 7 [2]: The need to consider arrangements for effective mutual support when planning for the provision of off-site support from emergency services to the on-site emergency response.

Observations for para. 5.25 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.25 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. This is the same as para. 5.23 of GSR Part 7 [2] with the addition that the functionality of security systems needs to be considered in the arrangements.

Potential difficulties: Though continued functionality of security systems should be considered in the arrangements for mitigatory actions as far as practicable, this may become very challenging in a combined emergency. Broken equipment, overwhelmed personnel, and disrupted environments, caused by an emergency, may all contribute to a less than functioning security systems that could facilitate the occurrence of a nuclear security event.

Clarifying example: Consider an example when in the aftermath of a hurricane, a cyberattack is launched at a nuclear power plant. The IT security team is running on the bare minimum of staff since the hurricane has cut down all cell communication towers, and the debris on the roads make it impossible for a new team to come in. In dealing with the cyberattack, major IT security functions, such as access to the site, are neglected, causing further security concerns putting the whole system under risk. With the access systems now compromised, an organization (or an insider) gains access to the inventory and steals nuclear material.

Challenges in meeting the requirements in para. 5.25 of GSR Part 7 [2]: The combined emergency will also impact the effectiveness of mitigatory actions, for example attempting to search for a lost source in the middle of a hurricane. Compromises may need to be made in the short term on the benefit of certain mitigatory actions since one emergency may need to be prioritized over others. However, these situations should not be neglected in the long term, and mitigatory actions should be taken as soon as practicable to prevent the escalation of another emergency, such as the lost source being stolen and potentially used in a radiation exposure device (RDD).

Observations for para. 5.26 of GSR Part 7 [2]

Potential difficulties: In a nuclear or radiological emergency combined with other incidents or emergencies, the demand for off-site assistance could exceed existing capabilities.

Clarifying real example: During the response to the 2011 Fukushima Daiichi accident there was an initial lack of medical support during the response due to the combination of the nuclear or radiological emergency with the natural event (earthquake and tsunami) [8].

Challenges in meeting the requirements in para. 5.26 of GSR Part 7 [2]: To ensure that the planning, prioritizing, arranging and agreeing on mutual assistance are completed at the preparedness stage. The operating organization need to include other incidents or emergencies in its assessment of what assistance might be needed.

Observations for para. 5.27 of GSR Part 7 [2]

Potential difficulties: Combined emergencies might not have sufficient support staff near critical locations during the response, or access to the location could be hindered, which would affect the arrangements that have been made to provide technical assistance to the operating personnel. Other effects could be that mitigation equipment might be unavailable because it is in a wrong or compromised location, or information and technical assistance for assisting operating personnel might be unavailable.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the off-site emergency centre was located in the area affected by the earthquake and tsunami, which rendered it inhabitable. In addition, the centre fell within the evacuation areas established during the Fukushima Daiichi emergency response. When responders arrived, no information was available regarding current accident status, protective actions or other response actions or to where the off-site emergency centre might have been relocated.

Challenges in meeting the requirements in para. 5.27 of GSR Part 7 [2]: To ensure that the all-hazard national EMS has arrangements for backup and alternate systems and locations and that it prescribes the use of a UCCS to ensure effective management of response operations. This is closely related to Requirement 6 and managing the response (see that section and explanations under the UCCS).

Observations for para. 5.28 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.28 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Basic instructions and training for first responders for all emergencies (e.g. CBRNE training) that could be combined with nuclear or radiological emergencies, in order to take prompt and appropriate actions (for emergency preparedness category IV activities), needs to be part of the preparedness arrangements (see Ref. [29]).

Observations for para. 5.29 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.29 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Basic instructions need to be prepared and training of first responders needs to be carried out for all emergencies identified in the hazard assessment.

Observations for para. 5.30 of GSR Part 7 [2]

Potential difficulties: If a dangerous source is suspected to be in the public domain, the ability to promptly search and recover the source could be impaired by other incidents or emergencies.

Clarifying real example:¹⁸ During Hurricane Katrina in the United States of America, massive flooding caused the potential for licensed radioactive sources to be washed away and possibly lead to radiation exposures. Pre-existing response plans for mitigating such risks had to be adapted to account for the challenges posed by the flood conditions. To support responders, the United States of America mapped the affected area using its Aerial Measuring System, which could detect sources that – by being unshielded – would pose an immediate health hazard.

Challenges in meeting the requirements in para. 5.30 of GSR Part 7 [2]: To ensure that procedures exist and have been tested and that training is provided for how to search for radioactive sources in severe conditions associated with other incidents and emergencies identified in the hazard assessment.

Requirement 9 of GSR Part 7: 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.”

Arrangements need to be in place to ensure criteria are established based on the hazard assessment within the all-hazard approach and documented in the protection strategy for combined emergency events. These arrangements need to ensure that assessments of the magnitude of all of the hazards from all relevant conventional emergencies, natural events, security events, as well as nuclear or radiological emergencies are assessed

initially and throughout the emergency and that the protection strategy is revised accordingly to address the evolving emergency situation based on these assessments.

Assessment of emergency conditions to support decision-making regarding urgent protective actions and other response actions needs to be performed quickly in a developing nuclear or radiological incident or emergency to be effective, and continuously as the emergency progresses. This requires development during the preparedness stage of relevant procedures for taking urgent protective actions and other response actions early in a developing incident or emergency when not much information is available, such as automatic triggers that initiate pre-planned urgent protective actions. During the preparedness stage when these procedures are developed, for both the urgent response phase of an emergency and as the emergency progresses, hazards and possible consequences of other incidents and emergencies that can affect the implementation of protective actions and other response actions during a nuclear or radiological emergency need to be considered.

Observations for para. 5.31 of GSR Part 7 [2]

Potential difficulties: The continuous re-evaluation of the protection strategy during a combined emergency might not consider the hazards from events, other than nuclear or radiological emergencies, thus possibly leading to an inadequate protection strategy.

Clarifying example: A decision is made to evacuate the public due to the expected consequences from the hazards of an ongoing nuclear or radiological emergency. However, other adverse conditions prevail that result from another natural event occurring simultaneously (e.g. a severe earthquake) that were not considered in the re-evaluation of the protection strategy (e.g. transport infrastructure damage).

Challenges in meeting the requirements in para. 5.31 of GSR Part 7 [2]: To ensure that the hazards from events, other than nuclear or radiological emergencies are considered in the initial and continuous re-evaluation of the hazards and subsequent revision of the protection strategy during an on-going emergency.

Observations for para. 5.32 of GSR Part 7 [2]

Potential difficulties: The assessment and anticipation of other incidents or emergencies that could affect the response to a nuclear or radiological emergency might not be part of the operating organizations' response arrangements.

Clarifying example: Consider a chemical plant that is experiencing an emergency involving a chemical release, while an emergency is occurring at a nearby nuclear facility, which belong to an emergency preparedness category I, II or III. The hazards associated with the chemical release are not anticipated and not included in the prompt assessment of the operating organization at the nuclear facility, which belong to an emergency preparedness category I, II or III, and might lead to the ineffective protection of on-site personnel from the chemical hazard.

Challenges in meeting the requirements in para. 5.32 of GSR Part 7 [2]: To ensure that all feasible scenarios are included in the all-hazard assessment and that all hazards are included in assessments made during a nuclear or radiological emergency.

Observations for paras 5.33–5.37 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.33–5.37 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (see observation for para. 5.32 for supportive information for paras 5.33–5.35, and Requirement 7 for supportive information for para. 5.36).

Observations for para. 5.38 of GSR Part 7 [2]

This requirement is divided into three bullet points. Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.38 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (see Requirements 2, 4, 5 and 7 for information). The effects of other incidents or emergencies needs to be considered in the hazard assessment (all-hazard approach) and thus also in the determination of the EPZs and EPDs.

Observations for para. 5.39 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.39 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (see Requirements 2 and 7 for additional information on para. 5.39(a), Requirement 10 for additional information on para. 5.39(b), Requirements 4 and 5 for additional information on para. 5.39(c) and Requirement 11 for additional information on para. 5.39(d)).

Observations for para. 5.40 of GSR Part 7 [2]

Potential difficulties: Monitoring and assessment capabilities might be limited or compromised due to other incidents or emergencies (see Requirement 5 for supportive details).

Clarifying real example: The monitoring capabilities were severely impacted by the earthquake and tsunami during the 2011 Fukushima Daiichi accident. Fixed monitoring stations were lost, monitoring resources were limited due to the response to the earthquake and tsunami (e.g. limited aerial and ground capabilities), which significantly delayed the availability of monitoring results [8, 10].

Challenges in meeting the requirements in para. 5.40 of GSR Part 7 [2]: To ensure that the impact from events, other than nuclear or radiological emergencies is considered in the protection strategy for an effective monitoring and assessment during a combined emergency.

Observations for para. 5.41 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.41 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 5.42(a) and (b) of GSR Part 7 [2]

Potential difficulties: On-site assembly points and escape routes can become unavailable or unusable or dangerous due to other incidents or emergencies.

Clarifying example: An assembly point located in an area under attack during a criminal event, or in an area that becomes flooded in a natural event.

Challenges in meeting the requirements in para. 5.42(a) and (b) of GSR Part 7 [2]: To ensure that all hazards are considered and the protection strategy addresses all consequences including those identified from events, other than nuclear or radiological emergencies.

Observations for para. 5.42(c) of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.42(c) of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 5.43 of GSR Part 7 [2]

Potential difficulties: The communication capabilities of an operating organization of a facility can be negatively affected by other incidents or emergencies.

Clarifying real example: During the 2011 Fukushima Daiichi accident the operating organization was initially unable to communicate with the local authorities because the communication infrastructure was destroyed by the tsunami. Dispatch drivers had to be used, but they also had trouble delivering information because of the damaged condition of the roads and the amount of traffic [8].

Challenges in meeting the requirements in para. 5.43 of GSR Part 7 [2]: To ensure that a reliable communications infrastructure with redundant and robust communication alternatives is established and that it considers the impact from the other incidents or emergencies.

Observations for para. 5.44 of GSR Part 7 [2]

Potential difficulties: The training of operating personnel, first responders and those personnel at locations where there is a significant likelihood of encountering a dangerous source that is not under control, might not have covered the additional types of response that could be needed in a combined emergency.

Clarifying example: Responders to a radiological emergency triggered by explosion of a radiological dispersal device have not been trained or received on-the-spot training on

the security related threats and might put themselves at unreasonable risk or might interfere with security aspects of the response.

Challenges in meeting the requirements in para. 5.44 of GSR Part 7 [2]: To ensure that training arrangements are in place to provide on-the-spot training, to provide relevant information during the response (e.g. a hotline with an expert body), and/or to provide basic nuclear and radiological emergency awareness training.

Requirement 10 of GSR Part 7: 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.”

Arrangements and systems for providing instructions, relevant information and warning to the public are necessary to ensure prompt notification about emergencies and actions to protect the public. Procedures need to provide instructions for the public regarding appropriate protective actions and other response actions. The arrangements and systems need to ensure that warning, information and instructions are provided for all response organization (including those not usually responding to a nuclear or radiological emergency but that might be responding during a combined emergency) covering all potential nuclear or radiological emergencies, including combined emergencies.

Observations for para. 5.45 of GSR Part 7 [2]

Potential difficulties: To establish, maintain and periodically update arrangements to provide all population groups within the EPZs and EPDs with warnings and notification of the actions to be taken during a nuclear or radiological emergency.

Clarifying real example: While arrangements existed to provide the population groups with information, warning and notification, and actions to be taken for a nuclear or radiological emergency, the 2011 Fukushima Daiichi accident showed that procedures can be deficient and warning systems can become inoperable in a combined emergency [8].

Challenges in meeting the requirements in para. 5.45 of GSR Part 7 [2]: To ensure that procedures contain warning and notification and instructions to the public regarding protective actions and other response actions for combined emergencies. Additionally, nuclear or radiological emergency systems need to be integrated with emergency systems for other incidents or emergencies and all systems need to be redundant to ensure prompt warning, notification and instructions to the public regardless of the initiating event.

Observations for para. 5.46 of GSR Part 7 [2]

Potential difficulties: Not considering other response actions being implemented as a result of the other incident or emergency can lead to confusion and/or conflicting information and instruction to the public.

Clarifying example: Contradictory information and data provided to the public with regard to protective actions (e.g. evacuate due to a general emergency, but shelter due to severe weather) leads to conflicting information which cause confusion and could put the public in danger.

Challenges in meeting the requirements in para. 5.46 of GSR Part 7 [2]: To ensure that an all-hazard national EMS and use of a UCCS provides coordination of all response organizations which reduces the possibility of conflicting and confusing information and instructions.

Observations for para. 5.47 of GSR Part 7 [2]

Potential difficulties: Procedures might not include provisions to provide adequate warning and instruction to other response organizations and responders (who might be responding to the non-nuclear or radiological emergency) and to the members of the public (that might be following response actions unrelated to the nuclear or radiological emergency) that they might encounter radioactive material or contamination and when and how to screen, decontaminate and receive medical attention.

Clarifying real example:¹⁸ Some responders to Hurricane Katrina as well as members of the public were unaware of potential presence of unshielded radioactive sources. Accidents in Samut Prakarn, Thailand [31], Istanbul, Turkey [32] and Yanango, Peru [33] represent other examples of situations when public encountered contact with dangerous radioactive sources, which were present in public domain.

Challenges in meeting the requirements in para. 5.47 of GSR Part 7 [2]: To ensure that other relevant conventional response organizations and responders have arrangements in place to identify when radioactive screening, decontamination and medical attention might be needed, and to locate and identify members of the public and other people who might have been affected and require screening. Additionally, use of a UCCS with documented procedures ensures a consistent process to provide continuous and necessary notification and warnings to responders and the public.

Observations for para. 5.48 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.48 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (for additional information, see the observations for paras. 5.45–5.47 of GSR Part 7 [2] above as well as Requirements 3 and 17 and associated requirements for dealing with neighbouring States and the international community in Requirement 6).

Requirement 11 of GSR Part 7: 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.”

Arrangements need to be in place to cover protection of emergency workers and helpers from all hazards including the hazards resulting from a combined emergency (such as those resulting from a natural event). Such arrangements need to include to the extent practicable, the process for designation, registration, training, integration and monitoring of all emergency workers and helpers in a combined emergency. Procedures need to state specific requirements to ensure emergency workers designated in advance of an emergency, as well as those identified and designated once an emergency started, are protected. Additionally, specific requirements need to be in place to protect helpers in emergencies. These procedures need to cover emergency workers and helpers responding to a combined emergency.

Observations for para. 5.49 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.49 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The requirement for emergency workers to be designated in advance and be fit for duty, including health surveillance for assessing initial fitness and continuing fitness for duty, is normally required for emergency workers in all areas. Arrangements for assessing fitness for duty need to include considerations for pandemic and other disease outbreaks.

Observations for para. 5.50 of GSR Part 7 [2]

Potential difficulties: Procedures to ensure that emergency workers who are not designated in advance of the emergency and helpers as they join the emergency response are registered (e.g. designation of the responsible response organization) and integrated into the overall response operation might not exist.

Clarifying real example: During the Great East Japan Earthquake, Tsunami and 2011 Fukushima Daiichi accident, many Japanese national emergency workers and helpers and non-Japanese n emergency workers (as part of international search and rescue) needed to be registered since areas being searched were in the EPZs and EPDs. Additionally, initially there were some difficulties regarding integration of these emergency workers and helpers into the overall response to the 2011 Fukushima Daiichi accident and means for registration to ensure appropriate medical radiation contamination and exposure screening.

Challenges in meeting the requirements in para. 5.50 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS supported by a UCCS will implement an effective and efficient system and process for identification, registration and integration of all emergency workers and helpers to arrange for

appropriate radiation screening during a combined emergency. These arrangements should consider that in some types of combined emergencies (such as the ones involved large number of casualties due to natural events) the number of helpers could substantially increase.

Observations for para. 5.51 of GSR Part 7 [2]

Potential difficulties: The hazard assessment might not include an all-hazard approach and hazardous conditions resulting from events, other than nuclear or radiological emergencies, are not addressed in the protection strategy. The hazard assessment might not include infectious disease outbreak or pandemic hazard, and emergency plans and procedures of the operating and response organizations would not be prepared to perform their functions amid the outbreak or pandemic hazard conditions.

Clarifying real example: Prior to Hurricane Katrina in the United States of America, the response plans to the hurricane did not include the potential of radioactive exposure from licensed radioactive sources for search and rescue personnel and other emergency workers. Pre-existing response plans for mitigating such risks had to be adapted to account for the challenges posed by the flood conditions. To assist responders, the United States of America mapped the affected area using its Aerial Measuring System, which could detect sources that – by being unshielded – would pose an immediate health hazard.

Challenges in meeting the requirements in para. 5.51 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS that considers in the protection strategy all hazardous conditions that could arise from a combined emergency. Disease outbreak or pandemic hazard need to be included in the hazard assessment, so that the operating and response organizations are prepared to perform their functions amid the outbreak or pandemic hazard condition.

Observations for para. 5.52 of GSR Part 7 [2]

Potential difficulties: Procedures to ensure that emergency workers and helpers are provided training and knowledge of the conditions, special needs and equipment for the range of anticipated hazardous conditions might not be in place.

Clarifying example: The hazards from a chemical plant located near the nuclear or radiological facility is not considered in the hazard assessment.

Challenges in meeting the requirements in para. 5.52 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS, that considers all hazardous conditions that could arise from a combined emergency, provides prepared in advanced training (including on-the-spot training) and knowledge of the conditions, special needs and equipment needed for the range of anticipated hazardous conditions identified in the optimized protection strategy.

Observations for para. 5.53 of GSR Part 7 [2]

Potential difficulties: Procedures to ensure the consequences of other incidents and emergencies are considered in the protection strategy to minimize exposures to emergency workers and helpers and to optimize their protection might not exist.

Clarifying example: Collapse of hospital from an earthquake and emergency workers exposed to radioactive sources that were in the hospital.

Challenges in meeting the requirements in para. 5.53 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS that considers the consequences of other incidents and emergencies in the protection strategy to minimize exposures to emergency workers and helpers.

Observations for para. 5.54 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.54 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Ensuring occupational exposure limits in planned exposure situations apply in a nuclear or radiological emergency (see GSR Part 3 [34] for exposure limits). Additionally, further details are presented in observations for para. 5.55 of GSR Part 7 [2] below.

Observations for para. 5.55 of GSR Part 7 [2]

Potential difficulties: Procedures to specify when it is permissible for an emergency worker to exceed 50 mSv emergency worker guidance value might not be in place, especially regarding the mitigation of conventional hazards in a nuclear or radiological emergency.

Clarifying example: Preventing other hazards to people and the environment (e.g. chemical hazard) might warrant exceeding guidance value for emergency workers when chemical hazard is combined with a nuclear or radiological emergency.

Challenges in meeting the requirements in para. 5.55 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS that specifically states the considerations and conditions for when an emergency worker is permitted to exceed the 50 mSv emergency worker guidance value.

Observations for paras 5.56 and 5.57 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.56 and 5.57 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. National guidelines for the exceptional circumstances for when an emergency worker is permitted to exceed the 50 mSv total effective dose need to be included in the nuclear/radiological section of the developed, established and documented all-hazard national EMS. Additionally, the procedures of this section of the all-hazard national EMS need to specify the requirements regarding voluntary actions and the associated health risks, as well as training, equipment and other protective measures.

Observations for para. 5.58 of GSR Part 7 [2]

Potential difficulties: Procedures to ensure that doses to emergency workers and helpers are assessed, documented and tracked and, if necessary, restricting emergency workers and helpers from further exposure might not be in place.

Clarifying example: The shielding of a radioactive source is breached as a result of an earthquake and unbeknownst to search and rescue emergency workers teams, resulting in search and rescue teams being potentially exposed or exposed and doses not tracked.

Challenges in meeting the requirements in para. 5.58 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS that specifically indicates the conditions and requirements to assess, document and track exposure of emergency workers and helpers and, if necessary, restrict, emergency worker and helper from further exposure when responding to a combined emergency.

Observations for paras 5.59–5.61 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.59–5.61 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The procedures of the nuclear/radiological section of the all-hazard national EMS needs to specify the requirements for: (i) appropriate medical attention for persons with certain doses or potential doses received (for para. 5.59); (ii) restrictions of further occupational exposure and medical advice for emergency workers responding to a combined emergency (for para. 5.60); and (iii) communicating doses received and consequent health risks to emergency workers and helpers (for para. 5.61).

Requirement 12 of GSR Part 7: 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.”

It is important for the safety of the population that the medical response in a nuclear or radiological emergency is managed responsibly and that arrangements for the medical response are prepared. Requirement 12 might be especially relevant for combined emergencies, because qualified personnel with relevant medical expertise might be involved in the response and treatment of patients injured as a result of another incident or emergency. Arrangements need to be in place to identify designated medical facilities where emergency workers, helpers and members of the public can receive necessary medical treatment for all relevant conventional emergencies, natural events, security events, as well as nuclear or radiological emergencies. The medical personnel responding in a combined emergency needs to be able to understand the differences in the symptoms and treatments that can result from the different types of emergencies that might be

occurring simultaneously, including those special to nuclear or radiological emergencies, and be able to make priorities regarding the needs of the affected people.

Observations for para. 5.62 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.62 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (see observations for para. 5.52, 5.59 and 5.60 of GSR Part 7 [2] for supportive information).

Observations for para. 5.63 of GSR Part 7 [2]

Potential difficulties: Recognizing radiation symptoms by off-site medical personnel can be difficult since experience and awareness of medical personnel to the conditions associated with radiation symptoms is often lacking. This is especially important for combined emergencies since the medical personnel arriving at the scene might be specialists in treating the patients affected by other incidents or emergencies and might not be able to recognize and respond effectively to the medical effects due to radiation.

Clarifying real example: The 21 October 1994, theft of a ^{137}Cs source from a waste repository at Tammiku, Estonia. During the theft, the source became dislodged from the metal container and one of the three men put the source in his pocket and took it to his home in the nearby village of Kiisa. The man became ill and was subsequently admitted to the hospital with severe injuries to his leg and hip and died on 2 November 1994. The injury and subsequent death were not attributed to radiation exposure and the source remained in the man's home. On 17 November, the man's son was hospitalized with severe burns on his hands which were identified as radiation induced. The remaining occupants of the man's home as well as his two brothers who were involved in the theft were hospitalized and all diagnosed as suffering from varying degrees of radiation induced injuries [35].

Challenges in meeting the requirements in para. 5.63 of GSR Part 7 [2]: To ensure that a programme is established for awareness training of radiation symptoms for all medical personnel that could provide medical assistance in a response to combined emergencies.

Observations for para. 5.64 of GSR Part 7 [2]

Potential difficulties: Challenges such as a damaged infrastructure, lack of transport, unavailability or lack of medical personnel, etc., resulting from the impact of combined emergencies might not have been considered in the preparation of arrangements for providing prompt medical attention to contaminated individuals or individuals in hospitals or nursing homes within evacuation zones.

Clarifying real example: The Great East Japan Earthquake, Tsunami and Fukushima Daiichi accident of March 2011 is an example of a situation where the effects of the earthquake and tsunami natural events rendered the prepared plans for medical hospital evacuations in the event of a nuclear power plant accident severely under-dimensioned.

This was mainly a result of the large number of patients in hospitals and nursing homes within the evacuation zone (20 km) that had not been considered in the planning. Many of these patients were seriously ill. An initial estimation (April 2011) attributed 51 deaths to the evacuations from hospitals and nursing homes mainly resulting from a lack of effective transport means, alternative hospitals, medical equipment for special needs and infrastructure (see Volume 3, pp 55–57 of Ref. [8]).

Challenges in meeting the requirements in para. 5.64 of GSR Part 7 [2]: To ensure that the impact of combined emergencies has been considered in the preparation of arrangements for providing prompt medical attention to contaminated individuals, patients in hospitals or nursing homes located within EPZs and EPDs.

Observations for para. 5.65 of GSR Part 7 [2]

Potential difficulties: Medical facilities pre-designated as treatment centres for nuclear or radiological emergencies might not be able to partially or fully operate due to the effects of other events. This risk might not be considered in the hazard assessment.

Clarifying example: A pre-designated medical facility for nuclear or radiological emergencies might be affected by a major mudslide or flooding and unable to operate.

Challenges in meeting the requirements in para. 5.65 of GSR Part 7 [2]: To ensure that medical capabilities (e.g. facilities, transport, expertise, equipment) are identified and established for continued operation under the impact of other events. Alternatively, redundant, back-up capabilities need to be identified and available.

Observations for para. 5.66 of GSR Part 7 [2]

Potential difficulties: Not having considered the impact of hazards from events, other than nuclear or radiological emergencies in the preparing of medical arrangements can result in unavailable or limited resources for medical screening or medical triage capabilities. This can also result in being unable to perform medical screening or medical triage under hazardous conditions (see Requirements 5 and 9 for additional supportive information).

Clarifying example: A wildfire might limit the ability of personnel and the public to access a pre-designated medical facility.

Challenges in meeting the requirements in para. 5.66 of GSR Part 7 [2]: To ensure that hazards resulting from events, other than nuclear or radiological emergencies are considered and ensure that the continued operation of the medical screening and triage capabilities under the impact of these events is secured or have alternative capabilities in place.

Observations for para. 5.67 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.67 of GSR Part 7 [2] that would be specific to a combined emergency,

and thus no detailed observations are made (see Requirement 5 for supportive information). Note that the challenge of training enough responders to identify possibly contaminated or overexposed individuals, (i.e. individuals who have possibly been sufficiently exposed for radiation induced health effects to result), including the responders themselves, might be multiplied in a combined emergency due to a larger number of involved responders/response organizations (e.g. involvement of firefighters, police forces and international support such as WHO and/or OCHA).

Observations for para. 5.68 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.68 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made (see Requirement 5 for supportive information).

Requirement 13 of GSR Part 7: Communicating with the public throughout a nuclear or radiological emergency

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

A response to any emergency has a primary focus on protection of the public and workers. An important part in any protection scheme is providing open, factual, coordinated and consistent communication with the public throughout an emergency and is a vital component of a successful response. In the event of a combined emergency, coordinating the information and communication arrangements between the ongoing emergencies and achieving consistency will be challenging. These issues need to be dealt with during the preparedness stage by the National Coordinating Mechanism (see Requirement 2, para. 4.10(i) of GSR Part 7 [2]). The UCCS under the ‘national emergency plan’ needs to clearly identify procedures that delineate roles and responsibilities throughout all response organizations involved in a combined emergency for coordinating the communicating with the public.

Observations for para. 5.69 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.69 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 5.70 of GSR Part 7 [2]

Potential difficulties: Not having considered the impact of hazards from events, other than nuclear or radiological emergencies in the preparedness of public communication arrangements can result in limited or lack of coordination between the multiple response organizations of the UCCS and result in deficient communications with the public. A combined emergency with a nuclear or radiological emergency being a nuclear security event will pose unique challenges in communicating with the public, notably with the

additional factor of confidentiality of sensitive information. An active investigation may be ongoing, and even in the chaos of a combined emergency confidential information should not be disclosed. Confidential information should clearly be marked as such, with well established procedures to ensure it remains confidential.

Clarifying example: During a nuclear or radiological emergency initiated and/or affected by an earthquake, additional coordination on the operating, local, national and eventually international levels for the multiple emergencies are necessary to ensure the information is consistent (i.e. to achieve a single message) but through multiple voices.

Challenges in meeting the requirements in para. 5.70 of GSR Part 7 [2]: To ensure that use of an established UCCS will lead to proper and necessary coordination with the public throughout an emergency regardless of the initiating event. Additionally, proper coordination during preparedness needs to ensure an appropriate contact point within the public sector.

Observations for paras 5.71–5.75 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.71–5.75 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Requirement 14 of GSR Part 7: 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.”

Arrangements need to be in place to ensure criteria are established based on the hazard assessment from the all-hazard approach for taking early protective actions and other response actions in combined emergency events. These arrangements need to address the implementation of early protective actions and other response actions for all emergencies and as the emergency evolves. In developing the early protective actions during the preparedness stage, account needs to be taken of any expected consequences from other incidents and emergencies that can affect the implementation of early protective actions and other response actions during a nuclear or radiological emergency.

Observations for para. 5.76 of GSR Part 7 [2]

Potential difficulties: If hazards from other incidents or emergencies that could initiate and/or affect a nuclear or radiological emergency have not been considered in the assessment and determination of the extended planning distance, the number of people that might need to be relocated in an actual combined emergency might exceed the prepared relocation capabilities (see Requirement 5 and observations for para. 5.38 of GSR Part 7 [2] for further supportive information).

Clarifying real example: The number of people that needed to relocate due to the earthquake, tsunami and the nuclear accident during the event of the Japanese earthquake, tsunami and 2011 Fukushima Daiichi accident far exceeded any prepared relocation capabilities (Volume 3 of Ref. [8]).

Challenges in meeting the requirements in para. 5.76 of GSR Part 7 [2]: To ensure that the hazards from events, other than nuclear or radiological emergencies are considered in the arrangements for relocation (e.g. safe transport, safe or alternative location, sufficient alternate housing for relocation, infrastructure and assistance).

Observations for para. 5.77 of GSR Part 7 [2]

Potential difficulties: During a combined emergency, consequences caused by the event, other than nuclear or radiological emergency might not have been considered when restricting non-essential local produce, forest products, milk from grazing animals, drinking water supplies, animal feed and commodities (for discussion on problems related to monitoring within the ICPD during a combined emergency, see the discussion for Requirement 5).

Clarifying example: Water supplies might be limited after a natural event and additional restrictions due to the nuclear or radiological emergency might lead to serious shortages of water. Alternative water supplies need to be made available.

Challenges in meeting the requirements in para. 5.77 of GSR Part 7 [2]: To ensure that protective actions and other response actions are implemented only if they can be implemented safely and if they do more good than harm, considering all hazards.

Observations for para. 5.78 of GSR Part 7 [2]

Potential difficulties: Monitoring and decontamination capabilities within the EPZs and the inner cordoned-off area can be negatively affected by events, other than nuclear or radiological emergencies, due to limited resources (such as lacking human resources or damaged transport infrastructure) or due to other hazards resulting from these other events.

Clarifying example: Due to the event, other than nuclear or radiological emergency, fuel supplies could become limited so that heating the water needed for decontamination of the public being evacuated from the EPZs of a nuclear power plant accident can hinder the capability to decontaminate people in cold climates. Another example would be safely monitoring within the cordoned-off area after the detonation of a radiological dispersal device due to an ongoing security situation.

Challenges in meeting the requirements in para. 5.78 of GSR Part 7 [2]: To ensure that the decontamination capabilities and the monitoring of people, vehicles and goods can continuously operate (outside of the EPZs) even under the impact of the event, other than nuclear or radiological emergency. Alternatively, or in addition, ensure that alternative capabilities are identified and can be made available. Also, if monitoring

capabilities are exceeded due to the combined emergency, instructions can be provided for self-decontamination, considering any relevant hazards from this other event.

Observations for para. 5.79 of GSR Part 7 [2]

Potential difficulties: The arrangements for access control and restrictions to the EPZs or cordoned-off areas might not consider hazards from events, other than nuclear or radiological emergencies, possibly putting the public in danger (see Requirement 5 for additional information).

Clarifying example: Access restrictions implemented for one emergency can negatively impact the response to other incidents or emergencies. For example, in a combined emergency involving a nuclear power plant and a natural event, access controls might be established because of the natural event without coordination with the on-site response at the nuclear power plant, which might warrant ad hoc access of off-site support for urgent mitigatory actions. This can impede or delay the off-site support.

Challenges in meeting the requirements in para. 5.79 of GSR Part 7 [2]: To ensure that all hazards have been considered. Ensure that the access restrictions do not limit the provision of off-site emergency support and assistance to an accident facility. Ensure coordination between the response organizations for different incidents or emergencies (i.e. UCCS).

Observations for para. 5.80 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.80 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 5.81 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.81 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The same information given for para. 5.77 of GSR Part 7 [2] is applicable here, except with the addition of one more layer of coordination (i.e. transnational coordination; see Requirement 5 for supportive information).

Observations for para. 5.82 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.82 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

Observations for para. 5.83 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.83 of GSR Part 7 [2] that would be specific to a combined emergency,

and thus no detailed observations are made. Note that national privacy regulations need to be considered when making the results of these assessments publicly available.

Requirement 15 of GSR Part 7: Managing radioactive waste in an emergency

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

As evident from past emergencies, radioactive waste generated during an emergency poses a major problem in that it multiplies quickly, requires large amounts of sealed air tight storage containers and restricted storage areas, and poses a problem for final disposition and storage. Radioactive waste generated from a combined emergency can pose even greater hazards since mixtures of nuclear or radioactive material with chemicals are problematic, the waste can multiply even more quickly, and mixed waste disposal requirements are more complex. Arrangements need to be in place to ensure clearly assigned roles and responsibilities for waste matters as well as means to identify and characterize the waste including temporary and final disposal for all waste generated in a combined emergency.

Observations for para. 5.84 of GSR Part 7 [2]

Potential difficulties: Programmes and procedures for handling mixed waste from a combined emergency might not have been developed in advance.

Clarifying example: Mixed waste (chemical activities combined with the nuclear or radiological processes) generated at nuclear fuel cycle facilities have demonstrated the challenge and complexity in dealing with mixed radioactive and chemical waste. Mixed waste changes the characteristics of the waste and thus making the demands on disposal more complex and the techniques for safe storage and dispose more daunting.

Challenges in meeting the requirements in para. 5.84 of GSR Part 7 [2]: To ensure that the national policy and strategy for radioactive waste management is applicable for waste generated from a nuclear or radiological emergency and that provisions for this strategy is documented in the all-hazard national EMS. Additionally, the all-hazard national EMS need to identify the policy, strategy and process for dealing with the mixed waste generated from a combined emergency.

Observations for para. 5.85 of GSR Part 7 [2]

Potential difficulties: The protection strategy might not address other contaminants (e.g. chemical, biological) that could result from a combined emergency.

Clarifying example: Mixed waste can result in explosions or other sever accidents that make decontamination difficult risking health of workers and the public.

Challenges in meeting the requirements in para. 5.85 of GSR Part 7 [2]: To ensure that the justification and optimization of the protection strategy includes identification of

all mixed waste hazards and contaminants that could impact waste handling, storage and final disposal.

Observations for para. 5.86 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.86 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Waste identification, characterization and categorization are addressed in observations for paras 5.84 and 5.85 of GSR Part 7 [2] above through the all-hazard protection strategy.

Observations for para. 5.87 of GSR Part 7 [2]

Potential difficulties: A process might not have been developed to enable all parties to be aware of the procedures for the safe management of waste generated during a nuclear or radiological emergency, to include mixed waste (e.g. waste generated from other incidents or emergencies), that could ensure that the waste is being adequately characterized, categorized, disposed of and/or stored and could minimize mixing of the waste.

Clarifying example: Mixed waste can result in explosions or other severe accidents that make decontamination difficult risking health of workers and the public.

Challenges in meeting the requirements in para. 5.87 of GSR Part 7 [2]: To ensure that a well developed, established and documented all-hazard national EMS supported by a UCCS will ensure an effective and efficient system and process for characterization, categorization, disposal, storage and minimized mixing of the waste.

Observations for para. 5.88 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.88 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that the disposal of human and animal remains is addressed in the all-hazard national EMS which needs to include any religion and/or cultural practices.

Requirement 16 of GSR Part 7: Mitigating non-radiological consequences of a nuclear or radiological 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.”

Mitigation of non-radiological consequences of a nuclear or radiological emergency and of an emergency response is paramount for ensuring a coordinated, effective and efficient response. Ensuring an all-hazard national EMS supported by a UCCS provides means and methods for achieving this. A nuclear or radiological emergency being a nuclear security event also causes non-radiological consequences, such as trauma, fear and anxiety that

need to be considered in the public communication plans. This will be heightened in a combined emergency, where other triggering factors may make the community as a whole more vulnerable to the non-radiological consequences of such a nuclear or radiological emergency.

Observations for para. 5.89 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.89 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. This is addressed in Requirement 5. Additionally, the all-hazard national EMS supported by a UCCS will ensure effective and efficient implementation of protective actions and other response actions in accordance with the protection strategy.

Observations for para. 5.90 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.90 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Arrangements for mitigating the non-radiological consequences and for responding to public concerns are documented in the all-hazard national EMS supported by a UCCS for managing response operations and ensuring information and instructions to the public (see Requirements 5, 10 and 13 for specific details).

Observations for paras 5.91 and 5.92 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 5.91 and 5.92 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The all-hazard national EMS supported by a UCCS will ensure: (i) effective arrangements to mitigate the impacts on international trade; and (ii) a process to identify an organization responsible for monitoring, identifying and addressing actions taken beyond warranted emergency response actions.

Requirement 17 of GSR Part 7: 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.”

Arrangements for requesting, providing and receiving international assistance are important elements for ensuring an effective response to a nuclear or radiological emergency. Additionally, arrangements need to be made in advance to ensure that requests for assistance provide sufficient detail to ensure an effective and efficient response even when the nuclear or radiological emergency is initiated and/or affected by other incidents or emergencies. These requests can include such items as equipment needs, means to get necessary off-site supplies and personnel to the affected area, etc.

Arrangements need to take due account of compatibility requirements for capabilities to be obtained from and to be rendered so as to ensure the usefulness of these capabilities. Development and implementation of procedures for requesting, receiving and providing international assistance during the preparedness stage ensures an effective process for requesting, receiving and providing international assistance, when necessary. The procedures will enable timely requests for international assistance in accordance with established mechanisms and respective mandates and for requesting and obtaining international assistance as well as for providing international assistance. The procedures need to identify the responsible entities for requesting and receiving international assistance and when provided, how they will be integrated into the response. The procedures need to also address who is responsible for ensuring that response personnel responding to a combined emergency are aware of all possible hazards and all relevant response organizations are advised of the multiple hazards and entities associated with the response

Observations for paras 5.93 and 5.94 of GSR Part 7 [2]

Potential difficulties: Procedures for requesting, providing and receiving international assistance might not be in place nor might all response organizations (e.g. organizations responding to conventional emergencies) be aware of the process if procedures do exist, delaying timely responses to requests for international assistance and in some instances making needed assistance impossible to obtain.

Clarifying real example: Examples of difficulties in receiving and utilizing international assistance can be found in the observations of response to the Fukushima Daiichi accident [8].

Challenges in meeting the requirements in paras 5.93 and 5.94 of GSR Part 7 [2]: To ensure that procedures for requesting, obtaining and/or providing international assistance are in place and documented in the nuclear/radiological section of the all-hazard national EMS. Procedures need to be readily available for use by the UCCS to enable prompt requests for international assistance and effective receipt and use of provided international assistance in a nuclear or radiological emergency, in a coordinated and integrated manner, when combined with other incidents or emergencies. Procedures also need to be readily available for use by the UCCS to respond to request for assistance and to provide such assistance in a nuclear or radiological emergency, in a coordinated and integrated manner, when combined with other incidents or emergencies. All in-country response organizations that could provide assistance need to be aware of the procedures to enable prompt responses to requests for international assistance for a combined emergency.

Requirement 18 of GSR Part 7: Terminating a nuclear or radiological 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.”

Termination of a nuclear or radiological emergency can be challenging especially since the emergency can be terminated at different times in different geographical areas. This

can cause confusion for the public which can be further exasperated when adjustments to protective actions and other response actions are made at different times for different areas. To further challenge the situation, a combined emergency can experience delays in formally declaring it ended, due to challenges faced to provide for the well being of affected populations and to restore infrastructure and services impacted by the combined emergency. Thus, arrangements need to be in place for termination of an emergency to include combined emergencies. The arrangements need to ensure that: (i) termination decisions are based on a formal decision made public and includes prior consultation with interested parties, as appropriate; (ii) both radiological and non-radiological consequences are considered; and (iii) basic details are included for transition to recovery.

Observations for paras 5.95–5.99 of GSR Part 7 [2]

Additional guidance for these paragraphs is provided in GSG-11 [**Error! Bookmark not defined.**5], which is applicable to all nuclear and radiological emergencies, including combined emergencies.

Observations for para. 5.100 of GSR Part 7 [2]

Potential difficulties: Without sufficient involvement of all relevant response organizations and consultation with interested parties in the planning process, termination of a nuclear or radiological emergency combined with other incidents or emergencies can cause confusion when termination of one emergency (e.g. nuclear or radiological emergency) occurs while the other emergency (e.g. chemical plant emergency) is still ongoing in the same area and can lead to problems regarding the roles and functions of the involved organizations, the methods of transferring information between the involved organizations, the review of the hazard assessment and the arrangements for continued communication with the public.

Clarifying example: The termination of a nuclear or radiological emergency might lead to the withdrawal of capabilities (e.g. access control) needed for the response to the other emergency or incident, if there was no prior coordination between the response organizations.

Challenges in meeting the requirements in para. 5.100 of GSR Part 7 [2]: To ensure that the all-hazard national EMS documents a process for considering impact of the other incident or emergency prior to the termination of the nuclear or radiological emergency. The documented process needs to ensure, as a minimum, account of the roles and functions of the involved organizations, the methods of transferring information between the involved organizations, the review of the hazard assessment and the arrangements for continued communication with the public.

Observations for para. 5.101 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.101 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The all-hazard national EMS supported by a UCCS needs to ensure controls on exposure limits and monitoring and

health surveillance for all individuals (workers, emergency workers, helpers, public) who might have been exposed during the emergency. This might be challenging during a combined emergency, since the organizations involved in the response to the other incidents or emergencies might not be familiar with the individual monitoring, environmental monitoring and health surveillance required in cases of radiation exposure.

Requirement 19 of GSR Part 7: Analysing the nuclear or radiological 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.”

Despite efforts that are taken to avoid emergencies, they can occur. Once a nuclear or radiological emergency has occurred and the participating response organizations have responded, the situation provides a unique opportunity to assess emergency arrangements, gain information and learn lessons on what worked and what went wrong during both the preparedness stage and the emergency response. These lessons can be used to improve emergency arrangements, including, if appropriate, those that make the response to a combined emergency more effective.

If a nuclear or radiological emergency is initiated and/or affected by other incidents or emergencies, then the analyses of the incident or emergency includes input and participation from the different response organizations and agencies involved. This requires both preparedness before and coordination after an emergency in order to succeed. Thus, one of the requirements assigned the National Coordinating Mechanism is the responsibility for coordinating the analysis of any emergency and emergency response that might occur (see para. 4.10(g) of GSR Part 7 [2]). This is particularly relevant if there are different analyses to be performed independently by different organizations or participants that would need coordinating.

Arrangements need to be in place for the conduct of analyses at the national level of the overall combined emergency as well as at the specific EMS of the individual emergencies. The arrangements need to include, when possible, compatibility of response operations and data, and specify requirements: (i) to undertake timely and comprehensive analyses; (ii) to document, protect and preserve data and information; and (iii) to ensure the analyses include identified lessons from the combined emergency and emergency response.

This will ensure that lessons are incorporated to improve EPR arrangements for combined emergencies. In addition, arrangements need to be in place to review and evaluate the response to the combined emergency at a national and international level.

Observations for para. 5.102 of GSR Part 7 [2]

Potential difficulties: Response organizations for other incidents or emergencies that can initiate and/or affect a nuclear or radiological emergency might not be coordinated or been involved in the preparedness of procedures for analysing a nuclear or radiological

emergency in accordance with Requirement 19, and thus might not have the same procedures for documenting, protecting and preserving data and information from the emergency as the ordinary nuclear or radiological emergency response organizations. This can make it difficult to effectively reconstruct the circumstances of the emergency and response and identify root causes of the emergency and/or lessons learned. This coordination ought to have been established through the National Coordinating Mechanism and included in the national emergency plan.

Clarifying example: The National Coordinating Mechanism failed to establish similar criteria for the documentation and preservation for various response organizations involved in a combined emergency. As a result, the data documented and preserved during the emergency response might not be comparable making it difficult to identify root causes and lessons learned.

Challenges in meeting the requirements in para. 5.102 of GSR Part 7 [2]: The National Coordinating Mechanism needs to ensure that arrangements during preparedness consider the hazards resulting from other incidents or emergencies that can initiate and/or affect a nuclear or radiological emergency, and coordinate with the other relevant response organizations any preparedness activities regarding how to document, protect and preserve data and information from an emergency in order to have the basis for a thorough analysis of the emergency and response. In case of a nuclear or radiological emergency being a nuclear security event, the analysis of a combined emergency will be complex and involve many different stakeholders. Arrangements should be made to consider the implications for nuclear security, as appropriate. Due to the complicated nature of a combined emergency, the implications for nuclear security may be varied, and may not have been considered before the event occurred. It is important to learn from these lessons and apply them to subsequent reviews in arrangements.

Observations for para. 5.103 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.103 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Nothing special to add except the comment to include all response organizations in the interviews regarding the circumstances of the emergency.

Observations for para. 5.104 of GSR Part 7 [2]

Potential difficulties: The task of acquiring all expertise necessary to conduct an analysis can be made more difficult in the event of a combined emergency, i.e. critical elements of the combined emergency might be missed because only a subset of experts is analysing the emergency.

Clarifying example: The analysis of a combined emergency might be performed by only a set of nuclear or radiological experts without considering other relevant expertise from other response organizations involved in the response (e.g. civil protection experts, chemical experts, public health experts, etc.), thus leading to a biased analysis of the response.

Challenges in meeting the requirements in para. 5.104 of GSR Part 7 [2]: To ensure that expertise necessary for analysing all aspects of a combined emergency is included in the analysis. The National Coordinating Mechanism has the responsibility for coordinating the analysis of any emergency and emergency response that might occur.

Observations for para. 5.105 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 5.105 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made.

3.3. Requirements for infrastructure of GSR Part 7

Requirement 20 of GSR Part 7: 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.”

Ensuring clear lines of authority are important for ensuring an effective and efficient response to an emergency. Authorities at the operating, local, regional and national organizations as well as authorities in neighbouring States and international organizations need to fully know and understand their responsibilities and roles for effective preparedness and response to a nuclear or radiological emergency. The established authorities need to be in accordance with, and consistent with, national emergency arrangements and relevant international emergency arrangements. The all-hazard national EMS, which provides the foundation and building blocks necessary for developing and maintaining arrangements for preparedness and response to a nuclear or radiological emergency, as well as arrangements for other types of emergencies need to identify authorities responsible for all aspects of the EMS developed for the various types of emergencies identified in the State’s hazards, threat and/or risk assessments and as integrated and documented in a State’s ‘national emergency plan’ or ‘national response framework’. The State’s national emergency plan or national response framework document need to ensure clear lines of authority, delineation of roles and responsibilities and integration and coordination for a combined emergency. It needs to ensure integration and coordination between all organizations (operating, local, regional, national, international) and to ensure that all authorities are fully knowledgeable and understand their role and responsibility in response to a nuclear or radiological emergency or other incident or emergency. Additionally, all relevant authorities need to ensure prompt execution and implementation of assigned functions and capabilities during a response to a nuclear or radiological emergency or other incident or emergency.

Observations for paras 6.2–6.7 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.2–6.7 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Paragraphs 6.2–6.7 of

GSR Part 7 [2] all deal with ensuring clearly established authorities, functions, roles and responsibilities and are covered in detail in Sections 1–3, 6 and 18.

Requirement 21 of GSR Part 7: 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.”

Fundamental for an effective response to any nuclear or radiological emergency is a well defined organization for both the preparedness and the response that is understood by all participating personnel. Furthermore, in order for the overall organization to function effectively it needs to be manned with enough personnel that are also fit for their duties. The government is thus obliged through Requirement 21 to ensure sufficient and qualified personnel exist in an organization for preparedness and response for nuclear or radiological emergencies, including combined emergencies, and that relevant interfaces between all response organizations exist. The national emergency plan needs to specify the organizational and staffing arrangements necessary for ensuring an effective and efficient response to combined emergencies. Such arrangements need to include to the extent practicable, organizational relationships and interfaces between all response organizations, response functions to be performed, personnel assigned to the position, qualifications and fitness-for-duty requirements for the various emergency positions.

Observations for paras 6.7, 6.8, and 6.11 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.7, 6.8, and 6.11 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. The information for these paragraphs is covered in Requirements 1–3 and 6.

Observations for paras 6.9 and 6.10 of GSR Part 7 [2]

Potential difficulties: A conventional emergency combined with a nuclear or radiological emergency could substantially affect the continuing fitness of personnel, emergency workers and responders, of both operating organizations and offsite response organizations. Similarly, such combined emergencies could affect the ability of all organizations to provide appropriate numbers of suitably qualified personnel for response to the nuclear or radiological portion of the combined emergency.

Clarifying example: In the midst of a disease outbreak or pandemic, operating organizations may have difficulty in providing the appropriate numbers of trained personnel to meet minimum response requirements for safe operation of a nuclear facility. Similarly, off-site response organizations may have difficulty in fielding responders due to the effects of the outbreak or pandemic.

Challenges in meeting the requirements in paras 6.9 and 6.10 of GSR Part 7 [2]: To ensure that conventional hazards are included in determining continued fitness of personnel, emergency workers and responders. To ensure that appropriate numbers of personnel, emergency workers and responders are available during non-nuclear hazard conditions.

Requirement 22 of GSR Part 7: 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 authorities at the local, regional and national levels, and, where appropriate, at the international level.”

Effective coordination of preparedness arrangements based on the hazard assessment and protection strategy developed considering each specific postulated combined emergency between the operating organization and local, regional and national, and where appropriate international level provides the foundation for ensuring effective and efficient response to emergencies. The preparedness arrangements need to include use of a UCCS to ensure coordination of response arrangements to enable a response to a nuclear or radiological emergencies and/or other incidents or emergencies that could possibly be encountered. A UCCS ensures prompt and effective decision making, coordination, communications and appropriate implementation of actions at all levels (site/facility, local, regional and national) and with neighbouring States and the international community from the onset through termination of any emergency, including a nuclear or radiological emergency combined with other incidents or emergencies. The UCCS includes all relevant response organizations and provides effective coordination, communications and decision making within the command, control and coordination structure and between levels.

Observations for para. 6.12 of GSR Part 7 [2]

Potential difficulties: Coordination arrangements and operational interfaces between the operating, local, regional, national and international levels might not be clearly established and appropriately documented, leading to confusion and in some instances to a lack of coordination and integration interfaces for a combined emergency.

Clarifying real example: The 2011 Fukushima Daiichi accident is an example of where coordination and interface arrangements were lacking between the response organizations at all levels since established laws and procedures in effect at the time did not include preparedness and response for a combined emergency.

Challenges in meeting the requirements in para. 6.12 of GSR Part 7 [2]: To ensure that establishment of a national emergency plan or national response framework (all-hazard national EMS) document that includes use of a UCCS for coordination and integration of operational interfaces at all levels for preparedness and response to all emergencies. Operational interfaces will face significant challenges in the response to a

combined emergency with a nuclear or radiological emergency being a nuclear security event. Arrangements to consider include allocation of responsibilities, communication methods, and integrated response plans.

Observations for para. 6.13 of GSR Part 7 [2]

Potential difficulties: Tools, procedures or criteria for assessing emergencies might not be coordinated between the different organizations or with relevant organizations of other States who have been identified as having a role in assessing the emergency.

Clarifying real example: Both the 2011 Fukushima Daiichi accident and the Chernobyl nuclear accident are examples where tools, procedures and criteria for assessing the emergency were lacking and were not sufficiently coordinated between organizations within the accident State as well as with other States resulting in confusing protective actions and other response actions.

Challenges in meeting the requirements in para. 6.13 of GSR Part 7 [2]: To ensure that the coordination of tools, procedures and/or criteria for assessing emergencies with all organizations in a State and relevant organizations of other States in which a combined emergency could impact critical facilities or operations (e.g. necessary for human health) is necessary for effective response to any emergency.

Observations for paras 6.14 and 6.15 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.14 and 6.15 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that informing citizens and embassies in another State affected by the emergency, and coordinating protective actions and other response actions with other States to ensure consistency of actions and information is covered by Requirements 3 and 17 and in observations for paras 5.39, 5.77 and 5.81 of GSR Part 7 [2].

Requirement 23 of GSR Part 7: 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.”

The information provided for Requirements 1–3 and 6 also needs to be considered for Requirement 23.

Effective response to a nuclear or radiological emergency requires development of plans and procedures during preparedness. The plans and procedures are based on the all-hazard approach and protection strategy developed considering each specific postulated nuclear or radiological emergency, including combined emergencies, as well as considering national, regional, local and site specific circumstances. The plans and procedures need to include use of a UCCS to address coordination and direction of the response arrangements. Arrangements need to be in place to ensure integration and coordination of plans and procedures developed considering each specific emergency situation to

enable an efficient and effective response to a combined emergency. Coordinated plans and procedures ensure effective management of the response to a nuclear or radiological emergency. Plans and procedures that have a documented use of a UCCS ensures prompt and effective decision making, coordination, communications and appropriate implementation of response actions at all levels (site/facility, local, regional and national) and with neighbouring States and the international community from the onset through termination of any emergency, including a nuclear or radiological emergency combined with other incidents or emergencies. The UCCS includes all relevant response organizations and provides effective coordination, integration, communications and decision making within the command and control structure and between UCCS levels throughout the emergency.

Observations for para. 6.16 of GSR Part 7 [2]

Potential difficulties: Established plans, procedures and other arrangements might not reflect all organizations involved in the response, possibly leading to unclear allocation of responsibilities and coordination. Additionally, the improper and excessive protection of information classified as confidential may lead to absolute lack of relevant information for some involved response organizations. Creation of these barriers should be avoided by ensuring that adequate procedures or other arrangements are in place for sharing appropriately this type of information.

Clarifying example: Consider an example when those decision makers who need to know sensitive information and have all necessary clearances for having access to various type of information are not provided with such information because necessary procedures do not exist, staff in one organization do not know which information may or may not be shared with other organizations and take decision to stop sharing all sensitive information with all relevant organizations. The improper and excessive protection and absolute non-sharing of, information, considered confidential, creates barriers between response organizations making a coordinated effective and efficient response to the emergency unattainable.

Challenges in meeting the requirements in para. 6.16 of GSR Part 7 [2]: To ensure the development of an EMS, as presented in Requirements 1–19, with particular interest on Requirements 1–6, ensures development of a national emergency plan or national response framework (all-hazard national EMS) document that includes all relevant organizations in development of plans and procedures during preparedness to enable an effective and efficient response.

Observations for paras 6.17 and 6.18 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.17 and 6.18 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. However, each response organization needs to prepare an emergency plan or plans for coordinating and performing their assigned functions in accordance with the hazard assessment and the protection strategy. An emergency plan needs to be developed at the national level that integrates all relevant emergency response plans and includes use of a UCCS to ensure

responsibilities for decision making and coordination consistent with the all-hazard approach. Emergency plans need to 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 need to be coordinated with other plans and procedures implemented in a nuclear or radiological emergency, to ensure that the simultaneous implementation of the plans would not reduce their effectiveness or cause conflicts (see Requirements 1–6 for detailed information).

Observations for para. 6.19 of GSR Part 7 [2]

Potential difficulties: The plan developed by the operator might be inadequate if it does not consider the plans from other response organizations responsible for other incidents or emergencies.

Clarifying example: The operator develops a plan that conflict with other response plans (e.g. firefighters, security, conventional emergencies, etc.) and might cause mutual interference in the implementation of mitigatory actions.

Challenges in meeting the requirement: To ensure the coordination with all relevant response organizations including those responsible for the other incidents or emergencies.

Observations for paras 6.20 and 6.21 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.20 and 6.21 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that supportive information is provided under observations for para. 6.13 of GSR Part 7 [2].

Requirement 24 of GSR Part 7: 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.”

An effective response to any emergency requires that adequate facilities and necessary systems, such as communications system and other logistics support, are available for use during an emergency. All such facilities including laboratories for sample analysis, systems and support (e.g. tools, instruments, supplies, equipment and documentation) need to be readily available, in excellent working order, tested regularly and operational under extreme hazard conditions. Backup facilities, redundant communications system, laboratories for sample analyses, tools, instruments, supplies, equipment and documentation needs to be maintained in a state of readiness, updated as necessary and tested on a regular basis. Based on the hazard assessment (identified hazards and consequences from relevant conventional emergencies, natural events, security events and nuclear or radiological emergencies), arrangements need to be in place to ensure

adequate tools, instruments, supplies, equipment, communications systems, facilities and documentation are available or can be quickly made available to provide an effective and efficient response to a combined emergency. Facilities where the response will be managed (e.g. on-site and off-site emergency response centres) need to be operational under a full range of emergency conditions (radiological, working and environmental conditions), and need to be suitably located and/or protected from all hazards (including those resulting from events, other than nuclear or radiological emergencies) so as to ensure their operability and habitability under such conditions.

Observations for para. 6.22 of GSR Part 7 [2]

Potential difficulties: Tools, instruments, supplies, equipment, communication systems, facilities and documentation might be inadequate for combined emergencies and in some instances obsolete.

Clarifying real example: During the 2011 Fukushima Daiichi accident, backup diesel generators did not operate because they were located in underground pit areas which were flooded by the tsunami wave rendering the diesel generator inoperable. The design bases, as well as past reviews identified that the diesel generators would be rendered inoperable if they were flooded: however, prior to the Japan Great East earthquake and tsunami, this was considered as an impossibility because the existing tsunami wall was considered an adequate barrier to a tsunami wave.

Challenges in meeting the requirements in para. 6.22 of GSR Part 7 [2]: All items and facilities need to be designed to be operational under the conditions identified for the potential consequences resulting from the hazard assessment. All equipment and supplies need to be identified with compatibility in mind to ensure a readily available supply of items under any condition. All such facilities and items need to be coordinated with all response organizations to ensure knowledge of use and compatibility. These support items need to be located or provided in a manner that protects them from events, other than nuclear or radiological emergencies.

Observations for para. 6.23 of GSR Part 7 [2]

Potential difficulties: The alternative supplies for taking on-site mitigatory actions might not be available during the response and thus unable for use to mitigate consequences during a combined emergency.

Clarifying real example: During the 2011 Fukushima Daiichi accident, the backup diesel generators installed at facility became inoperable due to malfunction and flooding by the tsunami because of their location in underground pits and it was difficult to bring in alternative measures because of the unavailability of roads that were washed out by the tsunami.

Challenges in meeting the requirements in para. 6.23 of GSR Part 7 [2]: To ensure that alternative supplies for taking on-site mitigatory actions are available under the conditions resulting from the event, other than nuclear or radiological emergency.

Observations for para. 6.24 of GSR Part 7 [2]

Potential difficulties: managing and providing medical attention to evacuees and other populations affected by a nuclear or radiological emergency could be made more difficult by certain conventional hazards that limit the ability to co-locate large numbers of evacuees or that increase demand for medical resources.

Clarifying example: During disease outbreak or pandemic conditions, social distancing or other protective actions may severely limit the capacity of reception centres or the ability of responders to address the medical or personal needs of evacuees. Disease outbreak or pandemic conditions could also severely limit the availability of medical treatment for those affected by the nuclear or radiological emergency.

Challenges in meeting the requirements in para. 6.24 of GSR Part 7 [2]: To ensure that appropriate nuclear or radiological response actions can be taken during non-nuclear hazard conditions.

Observations for para. 6.25 of GSR Part 7 [2]

Potential difficulties: Loss of an emergency response facility due to the impact of event, other than nuclear or radiological emergencies can lead to significant problems in the response resulting inadequate and possibly loss of, tools, instruments, supplies, equipment, communication systems, facilities and documentation.

Clarifying example: A backup facility such as a technical support centre needs to be planned and located to withstand the effects of a severe earthquake if identified in the hazard assessment.

Challenges in meeting the requirements in para. 6.25 of GSR Part 7 [2]: The emergency response facility, including tools, instruments, supplies, equipment, communication systems, and items for response documentation need to be designed and built to withstand the impact from the various events and/or a backup facility designed, built and available for immediate use when needed, along with necessary tools, instruments, supplies, equipment, communication systems and documentation needs to be established.

Observations for para. 6.26 of GSR Part 7 [2]

Potential difficulties: Samples might need to be analysed for other contaminants besides radiation, and laboratory capabilities need to ensure that any sample can be analysed for all types of contaminants. Additionally, loss of laboratory capabilities due to the impact of events, other than nuclear or radiological emergencies can lead to significant delays in analyses of samples in a nuclear or radiological emergency, resulting in mitigation, protective action and other response action problems and delays.

Clarifying example: If appropriate laboratories are not identified and certified during preparedness, it might be challenging to find suitable laboratories during the response to

nuclear or radiological emergency which could compromise the response, especially if a laboratory is lost due to events, other than nuclear or radiological emergencies.

Challenges in meeting the requirements in para. 6.26 of GSR Part 7 [2]: To ensure the identification and certification of sufficient laboratory capabilities for all-hazard response including those resulting from events, other than nuclear or radiological emergencies. Additionally, laboratories need to be operational under extreme conditions as well as operational during combined emergencies and/or alternative laboratories need to be available.

Observations for para. 6.27 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.27 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that an all-hazard national EMS needs to ensure availability of all national capabilities, support and assistance for all emergencies.

Requirement 25 of GSR Part 7: 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.”

The conduct of training, drills and exercises is fundamental and important for ensuring that capabilities are in place for an effective and efficient response to emergencies. Providing regular training for all personnel, who are designated as emergency response workers, and conducting periodic drills and exercises based on postulated scenarios identified from the hazard assessments provides a measure of readiness and assurance that emergency response personnel and other response capabilities can provide an effective and efficient response to emergencies.

Observations for para. 6.28 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.28 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. However, awareness of other incidents and emergencies that could impact or be an initiator of a nuclear or radiological emergency need to be included in training, drills and exercises.

Observations for para. 6.29 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.29 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that this is covered in Requirements 2

and 7; however, if systems exist for notification of events, other than nuclear or radiological emergencies, these need to be identified during training, drills and exercises.

Observations for para. 6.30 of GSR Part 7 [2]

Potential difficulties: Not considering other incidents and emergencies in the exercise programme can lead to unrealistic and untested nuclear or radiological EPR arrangements. The testing of preparedness for combined emergencies will naturally involve training, drills and exercises featuring scenarios for combined emergencies. It is essential then that nuclear security aspects be considered in inputs and scenarios for drills and exercises.

Clarifying real example: The 2011 Fukushima Daiichi accident showed where exercises conducted only to address the nuclear or radiological aspects of an emergency were not effective in a combined emergency and thus, response exercises arrangements need to include a test of realistic scenario situations involving combined emergencies.

Challenges in meeting the requirements in para. 6.30 of GSR Part 7 [2]: To ensure that the exercise programme addresses exercises for combined emergencies and that these exercises include participation by all relevant response organizations. Additionally, the exercise programme for nuclear or radiological emergencies needs to be coordinated with the exercise programmes for other types of incidents and emergencies to enable including nuclear and radiological response exercise participation in these exercises. Exercises need to also include participation by people who may be potentially affected by the emergency and representatives of news media. The main challenges will be in designing scenarios that adequately test all aspects of the response, including nuclear security aspects, in a timely and effective manner. Insufficient detail in the security aspects of the scenario will lead the exercise to ignore them in favour of more immediate response goals. It will involve careful consideration, and input from nuclear security experts in order to make effective use of training and exercises in developing and maintaining preparedness for response to combined emergencies.

Observations for para. 6.31 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.31 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that exercises involving personnel responsible for critical response functions are normally conducted for all emergencies.

Observations for para. 6.32 of GSR Part 7 [2]

Potential difficulties: Training and exercises might not include combined emergency scenarios for decision makers and those responsible for communicating with the public and those roles might not be thoroughly tested nor forced to routinely participate in exercises.

Clarifying example: Exercising decision making for protective actions and other response actions, as well as communications with the public may work effectively in a

nuclear or radiological emergency response exercises; however, when tested in a combined emergency exercises these actions may fail due to a lack of training and exercising of the coordination of decision making and resulting in contradictions of public statements (e.g. one communicator might say it is safe to stay at home because the hazard from the hurricane is over, and another might say that it is not safe due to a general emergency at the nuclear power plant).

Challenges in meeting the requirements in para. 6.32 of GSR Part 7 [2]: To ensure that personnel responsible for decision making regarding protective actions and other response actions, as well as for communicating with the public are trained and regularly participate in exercises that test response to combined emergencies. These exercises need to include use of the UCCS to ensure appropriate lines of decision making and coordination for emergencies are tested and known by all exercise participants.

Observations for para. 6.33 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.33 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that all exercises are normally tested against pre-established objectives that demonstrate that identification, notification, activation and response actions can be effectively performed.

Requirement 26 of GSR Part 7: Quality management programme for emergency preparedness and response

“The governments 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.”

A quality management programme provides assurance that those things necessary to establish, achieve and maintain an effective and reliable programme are in place. The nuclear or radiological EMS quality management programme needs to be an integral part of the all-hazard national EMS. The programme ensures 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 and other incidents or emergencies.

Observations for paras 6.34 and 6.35 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.34 and 6.35 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that logistics support and facilities to include tools, instruments, supplies, equipment, communication systems, facilities and documentation is covered in Requirement 24 and para. 6.22 of GSR Part 7 [2] and appraisals is a normal part of all quality management systems.

Observations for para. 6.36 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for para. 6.36 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that lessons identified and learned from combined emergency exercises and combined emergencies situations needs to be factored into the quality management programme.

Observations for paras 6.37, 6.38 and 6.39 of GSR Part 7 [2]

Although the paragraph is applicable to a combined emergency, no challenges are foreseen for paras 6.37–6.39 of GSR Part 7 [2] that would be specific to a combined emergency, and thus no detailed observations are made. Note that the procedures of the nuclear/radiological section of the all-hazard national EMS will specify the requirements for regarding actions being voluntary and associated health risks as well as training, equipment and other protective measures. In addition, attention needs to be provided for maintaining good records of response actions including dose assessments, monitoring, and inventory of radioactive waste management and long term follow-up and management as well as conducting prompt after action reports of exercises and actual emergency responses and updating standards, plans, procedures and guidelines based on the after-action reports for all emergencies with emphasis on combined emergencies.

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ABBREVIATIONS

EMS	emergency management system
EPZ	emergency planning zone
EPD	emergency planning distance
EPR	emergency preparedness and response
ICPD	ingestion and commodities planning distance
INES	International Nuclear and Radiological Event Scale
PAZ	precautionary action zone
UCCS	unified command and control system

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