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Strategic Aspects of Nuclear and Radiological Emergency Management

Planning for Effective Decision Making

Consequence Management and Transition to Recovery

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Foreword

Since the early 1990s, the OECD Nuclear Energy Agency has offered its member countries a forum, through the Committee on Radiation Protection and Public Health (CRPPH) Working Party on Nuclear Emergency Matters (WPNEM), for improving efficiency and effectiveness in nuclear emergency management. One of the main pillars of the WPNEM work programme is the development, conduct, evaluation and follow-up of the International Nuclear Emergency Exercise (INEX) series. Since 1993, these exercises have focused on national and international decision-making processes, primarily in the early phase of an emergency response, but since the INEX-3 exercise (2005-2006), placing increasing focus on later-phase consequence management and the transition to recovery.

In order to draw lessons for decision making in nuclear and radiological emergency management from this knowledge base, the WPNEM established an expert group to review the full INEX series experience, supplemented by lessons from the emergency management programmes on member countries. The intent was to use this experience to develop a strategy for national emergency management authorities aimed at facilitating timely, effective, optimal and compatible decision making by response organisations at every level within the emergency management structure and between countries. With this in mind, the Expert Group on Considerations for Decision Making developed a planning framework that brings together the key elements of the decision-making process in order to facilitate a coherent and effective approach to decision making as part of emergency management, from preparedness to the transition to recovery.

Additionally, experience from the INEX-3 exercise has shown that longer-term consequence management of a nuclear or radiological emergency and the transition to recovery remain difficult challenges. To address identified issues, the WPNEM also launched activities focusing on the development of strategies for countermeasures that could be considered when managing longer-term consequences. Two expert groups – the Expert Group on Recovery, Food and Agriculture, and the Expert Group on Countermeasures – dealt with different but complementary aspects of strategies for countermeasures in the post-crisis phases of an emergency situation.

Since decision making is at the core of emergency management, these expert groups worked in close co-operation in order to develop consistent strategies for decision making and for approaches to countermeasures for consequence management and the transition to recovery. The outcomes of the work of these two expert groups are presented in Parts A and B of this publication.

Recognising that detailed approaches on “how” to prepare emergency plans are provided in other publications, this report continues to use the approach adopted by the WPNEM to elaborate strategies aimed at improving emergency management. It therefore provides an understanding, basis and framework to improve decision-making effectiveness – as part of detailed preparedness – both in its general sense, and as specifically focused on countermeasures strategies for consequence management and the transition to recovery.

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Executive summary

The collective experience of the CRPPH Working Party on Nuclear Emergency Matters (WPNEM), and in particular, the experience from the WPNEM International Nuclear Emergency Exercise (INEX) series, has shown that it is important to plan and implement emergency response actions based on a guiding strategic vision. Such a guiding vision is particularly valuable with respect to decision making and the development and implementation of protection strategies.

Within this context, this report presents a framework of strategic planning elements to be considered by national emergency management authorities when establishing or enhancing processes for decision making, and when developing or implementing protection strategies. The focus of the work has been on those emergency situations leading to complex preparedness and response conditions, involving multiple jurisdictions and significant international interfaces.

The intent of this report is to provide an additional contribution to emergency management authorities by offering insights on decision-making processes, based on the WPNEM experience, within existing emergency planning arrangements. The report does not present a detailed approach to developing emergency response plans. Rather, it highlights and addresses common areas of good practice in decision making for consideration during planning in order to assist decision making during emergency response. Some specific areas for improvement, identified during the INEX 3 consequence management exercise (NEA, 2007a), are included, particularly in support of decision making for countermeasures for consequence management and the transition to recovery.

Note to the reader

This report is aimed at national emergency management authorities, international organisations and those who are seeking to improve the effectiveness of emergency management. By providing a framework of key considerations for decision making, it is intended to be used by emergency planners as part of emergency preparedness, in order to support the development of decision-making processes and improve the arrangements that will be used during emergency response. The framework has been developed based on the WPNEM collective experience and considers a broad range of international and national experience from exercises, actual response activities and existing documents and projects of relevance to the topics addressed.

The report is not intended to provide a detailed approach to emergency planning and preparedness, for which other documents exist at the national and international levels, in particular those published by the International Atomic Energy Agency (IAEA) on arrangements for response to nuclear or radiological emergency situations (IAEA, 2002, 2003, 2007a). It is also not intended to provide a detailed exploration of the new ICRP guidance for emergency exposure situations (ICRP, 2009), which had not yet been formally released at the time of drafting of this report.[1]

Part A: Planning for effective decision making

The elaboration of a generic strategic approach to decision making can facilitate timely, effective and compatible decision making by response organisations at every level within the emergency management structure and between countries, helping to ensure optimal protection of health, environment, and society during an emergency situation. Within this context, the first part of this report provides a framework of seven key strategic elements for decision making which cover the entire

1. In 2010, the WPNEM created an expert group to investigate issues in, and approaches to, the implementation of new international guidance for emergency exposure situations, including guidance from the ICRP.

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emergency management timeline and help to identify and frame the relevant aspects that should be considered in formulating a decision. These elements include:

- Planning for decision making within the emergency management cycle: *strategic decision making is at the core of the emergency management cycle.*
- Depth of preparedness: *threat and risk assessment inform the depth to which planning must be prepared.*
- The emergency management structure and co-ordination of decision making: *compatibility in approaches to decision making, and in the decisions taken, is needed across the spectrum of the response to ensure the optimal protection of health, environment and society.*
- Identifying and characterising key decision-making points: *anticipating when a decision will be necessary along an emergency management timeline and the information needed to support the decision is critical to emergency planning.*
- Co-ordinated communications: *co-ordination of decision making, both nationally and internationally, amongst all parties in the emergency response is a critical component of effective decision making.*
- Appropriate and timely decision making: *decision-making processes need to be responsive to the situation and specific to the actual emergency encountered.*
- Stakeholder involvement (including international implications): *planners and decisions makers need to take into account the involvement of stakeholders in the implementation of protection strategies, particularly the international implications.*

This framework is intended to provide an understanding and strategic basis for decision making as an integral and essential part of emergency management. Such a guiding strategic view, applied during preparedness, will enhance the management of a complex emergency situation involving many different organisations and stakeholders at the local, national and international levels.

Part B: Consequence management and transition to recovery

The second part of this report provides a strategic framework for planning and implementing protection strategies as part of consequence management and the transition to recovery, focussing on those areas of interest as identified in the INEX 3 exercise. A key aspect of these later phases of the emergency management timeline is that the actual state of consequences may be quite difficult to predict in detail. As such, while protection strategies for the early phase of an emergency situation may be relatively straightforward to characterise and prepare for an identified scenario, protection strategies for later periods following the emergency's onset become increasingly difficult to plan in detail during the preparedness phase.

For this reason, it is important to prepare strategies, structures and tools to guide and inform actions for consequence and recovery management based on situation-specific information rather than comprehensive implementation plans for defined actions. This does not mean that detailed pre-planning is unnecessary, but rather that preparedness should focus on scoping the types of response issues and needed actions rather than their specific details. This will include approaches to decision making for later-phase conditions and mechanisms for involving relevant stakeholders, bearing in mind that the types and roles of involved organisations may change as the situation moves progressively towards long-term recovery and return to normal social and economic activity.

Additionally, the related arrangements should be understood, exercised and sufficiently flexible to allow authorities to respond appropriately if an unexpected event occurs. This is especially important for highly visible areas such as populations and urban environments, agriculture, food production and water supplies. Also important are considerations for actions regarding events in other countries, and for travel, trade and tourism to and from affected areas.

Part B of this report provides a framework of the key areas where preparedness should focus in order to assure that an appropriate strategy has been developed for consequence management and transition to recovery. The most important elements include:

- Building the emergency management structure for consequence management and for recovery: *establish the national structure for consequence management and for recovery, build partnerships between organisations and develop processes for international co-ordination.*

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- Dealing with the consequence management phase: *in co-ordination with relevant parties, use the threat and risk assessment to develop optimised protection strategies for consequence management and the transition to recovery prior to an emergency*.
- Managing the transition to recovery: *develop a recovery plan framework as an integral part of emergency preparedness*.
- Developing and maintaining processes for stakeholder involvement: *identify and involve relevant stakeholders in emergency preparedness in order to improve the development and implementation of appropriate protection strategies*.

This framework addresses the aspects of consequence management and the transition to recovery that can most effectively be planned in advance. It is intended to find applicability amongst national emergency management authorities and international organisations by providing insights on key considerations for planning and implementing protection strategies, specifically in the development of necessary plans, procedures, arrangements and tools for protection strategies.

It is hoped that consideration by emergency planners and decision makers of the frameworks presented in Parts A and B of this report will facilitate compatible and/or consistent approaches to consequence management and recovery amongst the multiple layers of organisations and entities, nationally and internationally, involved in responding to emergency situations.

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Part A.

Planning for effective decision making

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1. Introduction

Emergency situations demand that actions be taken by responsible organisations in a timely and effective manner to mitigate consequences on populations, infrastructure and environment, and support the return of affected areas to normal social and economic activity to the extent possible. To deliver an effective response over the emergency management timeline, it is necessary to make, maintain and exercise adequate plans and arrangements in advance of an emergency situation. These must contain appropriate elements and resources for preparedness, response and assistance to identified threats, recognise and include all implicated partners, and take account of international interfaces. Effective management of complex emergency situations that can lead to a wide range of consequences and involve multiple organisations at the local, national and international levels also requires anticipation of the range of decision-making needs, an understanding of the interactions between response organisations and a model for their co-ordination.

Experience arising from the management of emergency situations has shown that the integration of these various factors into emergency preparedness and response arrangements should be based on a guiding strategic vision. Emergency response is a dynamic process that develops in time from a situation of little information to one of potentially overwhelming information. Within this context, emergency response organisations must be able to respond in an appropriate and timely manner at any point along the emergency management timeline. This will be facilitated by developing and implementing an overarching framework to guide the decision-making process. Decision making is at the core of emergency management, and such a framework will help emergency planners put in place arrangements that facilitate timely, effective and compatible decision making by response organisations at every level within the integrated response.

As a contribution to this area, the WPNEM launched in 2007 a review of its collective emergency management experience in order to extract key themes that could form a strategy for improving decision making in emergency management. This review, as undertaken by the WPNEM Expert Group on Decision Making (EGDM), considered all aspects of national and international exercises and the extensive understanding gained to date in terms of key strategies for decision making. It has focused on the experience gained by the NEA, participating countries and the broader emergency planning community through the NEA International Nuclear Emergency Exercise – INEX – series, (NEA, 2001, 2005, 2007a) as well as experience from national and international emergency management programmes. The outcome of this work is a broadly applicable strategic framework for decision making in emergency management.

The WPNEM has previously provided strategic views on issues of international interest in emergency management, including exercise planning and conduct (NEA, 2007b), data management (NEA, 2000, 1996b) and agricultural countermeasures (NEA, 1996a). This report continues this approach by providing those responsible for developing plans, procedures, arrangements and decision-support tools with a generic framework for improving the effectiveness of decision making. It elaborates the strategic considerations associated with each of the framework elements in order to provide an understanding, basis and approach for decision making within the emergency management cycle, from preparedness to the transition to recovery. By addressing these elements in the preparedness phase, associated processes, procedures and resources can be developed and implemented, facilitating effective and coherent decision making during an emergency. Experience has shown that the investment of time, effort and resources to plan for the types of decisions that will be required for identified emergency situations is worthwhile. Part A of this report provides details on this framework, with the objective of providing emergency planners with practical guidance on customising the framework within their own emergency management programme.

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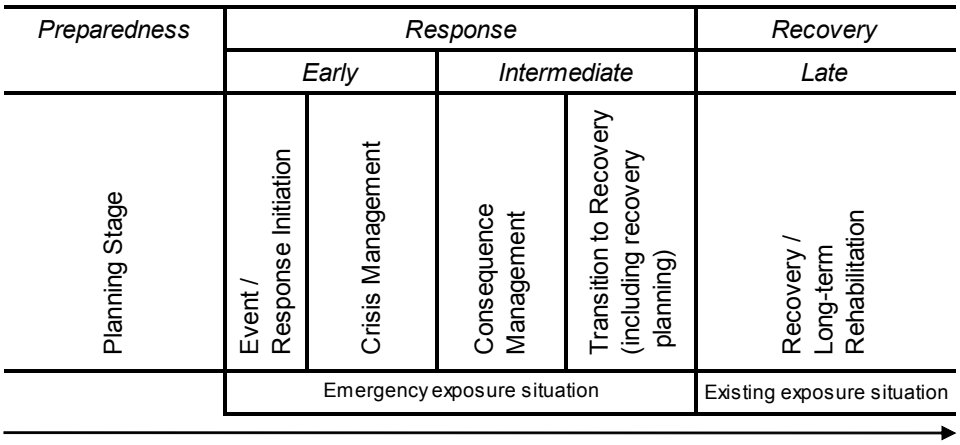
2. Overview of the emergency management timeline

To elaborate a decision-making strategy that coherently addresses the evolution of an emergency situation and that will be broadly applicable to any emergency management structure, it is important to have a common understanding of the emergency management timeline. Recognising that different terminology is used within the emergency management community to describe the evolution of an emergency situation, this report adopts the approach illustrated in Figure 1. Readers should be able to relate their particular terminology to the concepts described below.

Figure 1. **A view of the emergency management timeline and emergency phases**



In this scheme, the overall emergency management view includes three broad aspects, namely the pre-emergency preparedness, response to a given emergency situation and recovery from the situation. In this case, the "response" and "recovery" elements correspond to the ICRP (2007) definitions of emergency and existing exposure situations, respectively, as noted below:

- Emergency exposure situation: situations that may occur during the operation of a planned situation, or from a malicious act, or from any other unexpected situation and require urgent action in order to avoid or reduce undesirable consequences.
- Existing exposure situation: exposure situations that already exist when a decision on control has to be taken, including prolonged exposure situations after emergencies.

The second row elements (early, intermediate and late) identify the progression of the situation management timeline: the "early" and "intermediate" phases comprise the emergency response, whereas the "late" phase is associated with long-term recovery.

The detailed elements in the middle of the chart identify the various stages and types of activities taking place along the timeline. The "planning stage" is comprised of all activities undertaken in advance of an emergency situation, in co-operation with relevant stakeholders, to build, maintain and improve the response capabilities at all levels (local, national, international). The "early" phase response comprises i) "event/response initiation", including recognition of an emergency situation and initiation of the response, and ii) "crisis management", including efforts to characterise and gain control over the source and implementation of any urgent protective measures that must be taken promptly in order to be effective. Management of this part of the response is typically undertaken in a top-down manner, with little or no input from stakeholders beyond the emergency response authorities themselves.

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In the intermediate phase, "consequence management" is identified as the period of time after control over the source has been regained or the release has been terminated and radioactive contamination is in the environment. Response efforts will focus on mitigating the consequences on populations, infrastructure, environment and socio-economic structures through actions such as population protection measures, agricultural and food countermeasures, decontamination, etc. During this time, characterisation of the contamination (including measurement and analyse), review or lifting of initial countermeasures and consideration of new countermeasures are ongoing. Urban and/or agricultural countermeasures, stakeholder involvement mechanisms and international co-ordination become increasingly important and activities addressing the transition to recovery will begin. During the "transition to recovery", efforts are made to ramp down the emergency response and put specific plans in place to begin the late-phase "recovery/long-term rehabilitation" of affected areas and support the return to normal social and economic activity, as far as possible.

It is important to note that while the above diagram presents these phases and activities as distinct elements for the sake of clarity, this will rarely be the case in practice, and for large scale, complex events, different geographic areas may be in different stages of the response at the same time. Additionally, there are considerable linkages between the types and timelines of decisions and information inputs/outputs required over the emergency timeline. Thus, while phases are often identified in the emergency arrangements, the decision-making process should be viewed as a continuum, for which an overarching strategic approach will increase its effectiveness.

During the planning stage, it is desirable to prepare relatively detailed response arrangements for the early phase of the identified emergency scenarios. However, this becomes increasingly impractical for arrangements addressing later periods following the emergency's onset, as many situation-specific factors will come into play. For these later periods, it is nonetheless important to plan in advance the structures and strategies that will be used in an event to formulate appropriate actions, rather than define specific actions. In this context, it is essential that roles and responsibilities are clearly organised and understood by the relevant organisations that will be managing the response.

In addition to the planning undertaken as part of emergency preparedness, subsequent planning of actions will take place later in the response (in this case, as part of the transition to recovery) as detailed recovery arrangements can only be undertaken in response to a specific event. Emergency planners should also anticipate that decisions made during one phase may have impacts later in the response, including impacts on future decisions. Finally, as actual events often deviate from the planned scenarios, it is important that arrangements are understood, exercised and sufficiently flexible to allow response authorities to respond appropriately if an unexpected event occurs.

Table 1 provides some basic actions and types of criteria that could characterise the likely evolution of the emergency management timeline, recognising that the development of plans and processes is a "multi-step iterative process that includes assessment, planning, resource allocation, training, exercises, audit, and revision" (ICRP, 2007). Each of these actions, including the development of protection strategies, will have many associated activities that will need to be considered. The following section of the report provides details on how these may be integrated into an overarching decision-making framework.

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Table 1. **Basic actions associated with the emergency management timeline**

Phase	Stage	Basic actions
Preparedness	Planning stage	• Assess potential threats and risks (internal, external to country). • Identify scenarios for detailed planning and their potential impacts (people, infrastructure, environment, socio-economic, etc.); identify preparedness goals and objectives. • Identify persons and organisations having a role in emergency management arrangements and allocate responsibilities. • Identify and involve all relevant partners/stakeholders. • Identify possible countermeasures and develop protection strategies for crisis, consequence management and transition to recovery. • Indentify resources needed to characterise the emergency situation and support decisions on countermeasures. • Develop related plans, procedures and capabilities and integrate these with all-hazards approaches to the extent feasible. • Allocate adequate resources. • Educate and train all persons involved in preparedness and response, with special attention to first responders (fire, police, and medical rescue services, etc.). • Identify strengths and weaknesses in the existing management system, and test effectiveness of planning arrangements (drills, exercises and audits). • Use feedback from actual events and exercises to refine arrangements. • Maintain ongoing communication with stakeholders.
Early	Response initiation	• Identify type of emergency situation. • Activate response structure. • Adapt and integrate plans and protection strategies according to the situation. • Implement the adopted protection strategies and pre-determined countermeasures according to the situation. • Communicate and co-ordinate within the emergency structure (including internationally). • Communicate with the public. • Interact with stakeholders as appropriate. • Undertake ongoing characterisation, analysis, prediction (information gathering, assessment, decision making). • Adjust the response as needed, including adding, modifying, terminating of protection strategies. • Develop recovery priorities and actions. • Implement recovery plan. • Review effectiveness of recovery actions and adjust as needed. • Capture lessons learned.
	Crisis management	
Intermediate	Consequence management	
	Transition to recovery	
Late	Recovery	
	Long-term rehabilitation	

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3. The decision-making framework

Due to the potential scope of impacts on populations, infrastructure, environment and socio-economic structures, the decision-making process required to manage a nuclear or radiological emergency is complex. To assist emergency planners and decision makers in handling this complexity, it is important to plan and implement emergency response actions based on a guiding strategic vision. Such an approach should view emergency management as a continuum of decisions that fit together in a coherent manner, ensuring that appropriate actions are taken in a timely manner.

While decision-making processes will be specific to each country and emergency management structure, a review of experience from exercises and emergency response has shown that there are approaches and practices in decision making that are broadly applicable to any emergency management programme. Based on this, the following planning framework for decision making has been developed. Taken as a whole, the framework provides a guiding vision for emergency management authorities and will help to identify and frame the specific aspects that should be considered in the national decision-making processes and addressed in emergency preparedness. Such a framework is important from the preparedness perspective because many different organisations and stakeholders are implicated in emergency management. Effective co-ordination and compatible decision making between these implicated parties can only be achieved through proper planning.

Table 2 presents the elements of this framework, which are discussed in more detail in Sections 3.1 through 3.7. Emergency management authorities are encouraged to fully consider these when elaborating specific national emergency arrangements.

To assist the reader in understanding the role of stakeholders within the presented framework, it is noted that "stakeholders" as used in this report refer to organisations and individuals that will be affected by the emergency situation and will be involved in or affected by its management, including governmental and non-governmental organisations and civil society (industry, public, etc.). A broad range of stakeholders may be implicated in the decision-making framework in terms of providing inputs, outputs, information, needs and perspectives, with the intent of facilitating decisions better suited to a particular situation. However, while stakeholders' interaction provides input into the decision-framing process, the responsibility for decision-taking in preparedness and response rests with the relevant decision makers. These may exist at multiple layers, depending on the issue.

Table 2. **Key elements of a decision-making framework**[2]

Planning for decision making within the emergency management cycle Decision making lies at the core of emergency management. Therefore, any strategy for decision-making needs to be placed coherently within the overall emergency management cycle: from preparedness through response, recovery and post-event feedback.
Depth of preparedness The types of credible scenarios for which detailed planning and preparedness should be undertaken are derived from a comprehensive threat and risk assessment that looks at all possible nuclear and radiological emergencies in terms of their origin, likelihood and magnitude of impacts. The outcomes of these assessments will provide an indication to emergency planners of the level of detail to which each scenario should be planned, either in whole or at different points in the timeline.
The emergency management structure and co-ordination of decision making Different organisations/entities in different jurisdictions will have a role in the emergency management cycle. An important aspect of decision making for nuclear or radiological events is therefore the co-ordination of the decision-making processes among all the involved organisations and entities at the local, national and international levels. Co-ordination of arrangements and responsibilities for decision making across jurisdictions for different scenarios is therefore important. The goal is to have the approaches to decision making, and the decisions, as compatible as practical across the spectrum of the response to ensure the optimal approach to protecting health, environment, and society.

2. The key strategic elements are supported by the detailed emergency planning and response functions as elaborated in national and international documents (*e.g.*, IAEA 2002, 2003, 2007a).

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Table 2. **Key elements of a decision-making framework** (Cont'd)

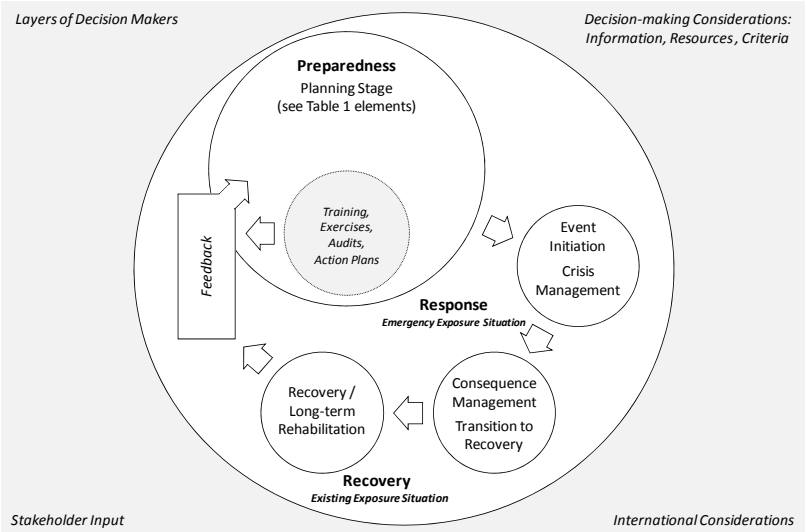
Identifying and characterising key decision-making points Anticipating, identifying and characterising the key decision-making points along the emergency management timeline are critical to successful planning for response to and recovery from nuclear and radiological emergencies. These include the types and timelines of likely decisions, and their characteristics such as the inputs necessary for establishing an initial technical basis for recommendations, the outputs and the linkages to other response partners and stakeholders.
Co-ordinated communications The co-ordination of decision making both nationally and internationally, amongst all parties implicated in the emergency response is a critical component of effective decision making. Effective communications and co-ordination will facilitate compatible decision making.
Appropriate and timely decision making While the threat and risk assessment will identify the types of scenarios for which detailed plans should be elaborated, each emergency situation will have its own unique characteristics. Decisions must match the timeline and characteristics of the particular emergency situation. Decision-making processes that facilitate the development of situation-specific recommendations are critical, because an appropriate decision for one emergency may be different in another situation.
Stakeholder involvement (including international implications) Complex emergency situations require the involvement of a broad range of stakeholders to facilitate their effective management. Emergency planners and decision makers should identify the range of relevant stakeholders and how their involvement may impact the effectiveness of decisions and the implementation of protection strategies. Relevant stakeholders, either directly or through their representatives, should be included in the emergency planning arrangements.

3.1 Planning for decision making within the emergency management cycle

Decision making lies at the core of emergency management. Therefore, any strategy for decision making needs to be placed coherently within the overall emergency management cycle: from preparedness through response, recovery and post-event feedback.

Preparedness begins at the most general levels, namely assessing threats and risks, establishing the goals to protect health, infrastructure and environment on a country's territories and within its jurisdiction, and proceeds to specific levels of planning as shown in Table 1. A representation of the emergency management cycle, including influencing parameters, is provided in Figure 2.

Figure 2. **Overview of the emergency management cycle**



To ensure effective management of an emergency situation, and to understand the scope of decisions that may be required, planning must begin with an understanding of the threats and risks that could arise both within and external to a country, and an identification of the scenarios for which detailed plans and capabilities should be elaborated. Based on possible countermeasures to limit the potential consequences of the identified scenarios, protection strategies can be developed according to the general response objectives. Implementing procedures and capabilities should then be developed that address the protection strategies and functional requirements along the emergency management

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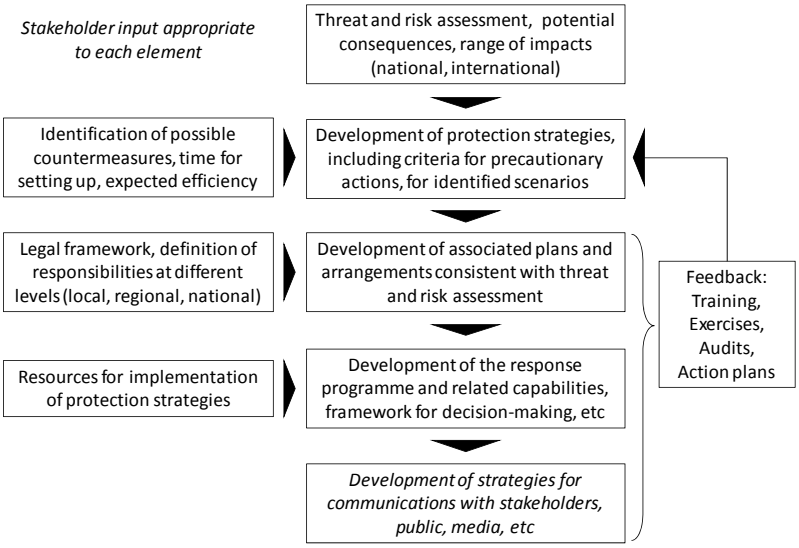
timeline (IAEA, 2002). These procedures and capabilities are used to develop training and exercise programmes based on discrete and measurable performance objectives for each function within the emergency organisation, and their interfaces and linkages within the broader emergency management structure (NEA, 2007b). The potential consequences identified in the threat and risk assessment, the range of impacts that may occur (within a country and abroad), the parties affected by these impacts both nationally and internationally and any anticipated response actions make up the technical planning basis for the crisis and consequence management. This process is illustrated in Figure 3.

Figure 3. **Overview of the general planning process**



Emergency management programmes are evaluated in detail through assessments, exercises and audits to assure an adequate level of readiness to respond to identified scenarios based on the threat and risk assessment. Results and feedback are used to continuously improve the programme through implementation of improvements and corrective actions in the planning cycle. When developing plans and procedures, it is important to review actual event or exercise outcomes and incorporate the lessons learned into the planning process. Event timelines from past emergency situations also provide an example of actual key decision points that can be used during the risk assessment process.

The general model for the emergency management cycle has important implications for improving decision making. Any strategy, including supporting processes and resources, developed by emergency planners to improve the effectiveness of decision making needs to be consistent with the various stages of the cycle. These strategies are developed as part of emergency preparedness, with particular focus on the requirements for response to an emergency situation: the anticipated scenarios and their potential impacts, response objectives, possible countermeasures and related response resources, information requirements (inputs and outputs), response timelines and interfaces with other stakeholders (both government and non government), including how such interfaces may change as the situation shifts from crisis to consequence to recovery management. An understanding of these elements and their characteristics allows planners to identify and anticipate the types of decisions that will be required and their implications, and prepare in advance to address these to the extent possible.

A requirement in assuring that preparedness for low-probability events such as radiological or nuclear emergencies is sufficient to ensure timely and appropriate decisions throughout an actual emergency situation is that sufficient time, effort and resources are devoted to all planning stage elements. Experience has shown that nuclear and radiological emergencies are unique. Therefore, preparedness must be sufficiently robust, flexible, understood and exercised to allow decision makers and supporting staff to use and synthesise the required knowledge and experience "on the spot" in response to each emergency situation.

3.2 Depth of preparedness

The types of credible scenarios for which detailed planning and preparedness should be undertaken are derived from a comprehensive threat and risk assessment that looks at all possible nuclear and radiological emergencies

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in terms of their origin, likelihood and magnitude of impacts. The outcomes of these assessments will provide an indication to emergency planners of the level of detail to which each scenario should be planned, either in whole or at different points in the timeline.

Emergency preparedness seeks to build and maintain emergency management programmes fit-for-purpose, recognising that nuclear and radiological emergencies are unexpected and low probability events and that their occurrence and consequences cannot be precisely quantified in advance deterministically. Response to such events may require actions that are not standard for other types of emergencies, and therefore may require consideration of additional actors, interfaces and resources.

With respect to nuclear facilities, all accidents considered (including low probability events) should be taken into account in the design, and all reasonably practical measures should be taken to prevent accidents and to mitigate their consequences should they occur. Despite this, it is prudent to plan for the protection of people and the environment under postulated accident conditions. Additionally, emergencies could arise from other situations, such as transportation, industry and hospitals, malicious use of radioactive materials, events in other countries that may impact national territories and/or national responsibilities abroad (embassies or national citizens resident or travelling in other countries, etc.), and other events such as a potential satellite crash. The types of credible scenarios for which detailed planning and preparedness should be undertaken are derived from a comprehensive threat and risk assessment[3] that looks at all possible nuclear and radiological emergencies in terms of their origin, likelihood and magnitude of impacts (*e.g.*, IAEA, 2007a).

The depth of preparedness and level of detail within a plan will depend on the identified level of threat posed and the degree to which the circumstances of the emergency can be determined and planned in advance. The outcomes of the threat and risk assessment will provide an indication to emergency planners of the level of detail to which each credible scenario should be planned, either in whole or at different points in the timeline. In general, events with higher likelihood or risk will be planned to a greater level of detail, particularly when addressing emergencies arising from licensed activities. However, the threat and risk assessment may also indicate the need to provide detailed planning for other high risk areas with respect to malicious acts or other initiating events.

It is the responsibility of the relevant authorities to determine the depth of preparedness for the different identified scenarios. However, even basic generic plans should indicate the responsibilities within the emergency management structure, methods for situation characterisation, communication and co-ordination and a framework for guiding decision making. Regardless of the extent of planning, preparedness and decision-making frameworks should reflect the threat and risk assessment, include all key elements (even if generically), be flexible, recognise the need to identify key decision points and linkages/interfaces and include protection strategies to prevent deterministic health effects (early phase) and optimise the level of protection.

Early phase response should be well-planned in all cases, additionally indicating types of strategies and actions to be implemented or considered. Planning for later stages may focus on management and co-ordination mechanisms rather than a list of detailed actions. Preparedness at the national level should also include arrangements to manage the impacts of an out-of-country emergency on areas of national responsibility abroad, for example embassies and citizens resident in another country. Embassies may receive requests for assistance or information from citizens visiting a country affected by an emergency situation. They should also serve as an official channel of information within the emergency response structure on an emergency situation in another country.

3.3 The emergency management structure and co-ordination of decision making

Different organisations/entities in different jurisdictions will have a role in the emergency management cycle. An important aspect of decision making for nuclear or radiological events is therefore the co-ordination of the decision-making processes among all the involved organisations and entities at the local, national and international levels. Co-ordination of arrangements and responsibilities for decision making across jurisdictions for different scenarios is therefore important. The goal is to have the approaches to decision making, and the decisions, as compatible as practical across the spectrum of the response to ensure the optimal approach to protecting health, environment, and society.

3. Recognising that various approaches and terminologies are used in different countries for threat and risk, in this report these refer to broadly complementary components for identifying and assessing the types of events and possible consequences on health, environment, etc., to be considered in emergency planning arrangements. The manner in which this is done is not addressed here.

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Because of the complex nature of emergencies and the potential scope of their consequences, preparedness and response arrangements for their management will likely involve multiple organisations and entities (governmental, non-governmental) in different jurisdictions (local, regional, national). Interfaces with other countries and international organisations will also be significant. Each of these will have their own mandates, responsibilities and processes, including any obligations under relevant international conventions (such as the Convention on Early Notification of a Nuclear Accident, IAEA, 1986) or bilateral arrangements between countries. As a result, the decision making in such situations will be complex, involving multiple layers of actors within the overall emergency management structure with various roles and authorities. The possible change in the relationship between these organisations or inclusion of different partners for the different types of scenarios considered (licensed facility, malicious act, out-of-country events), as well as the increasing level of stakeholder interaction as the event moves from crisis to consequence to recovery management adds further complexity. The emergency management structure needs to integrate these in a manner that ensures co-ordination within a country and with the international community.

One of the most important aspects of decision making is therefore the co-ordination of the related authorities and processes, including the supporting technical assessments, among all the involved organisations and entities: governmental, inter-governmental and non-governmental organisations and other stakeholders at the local, regional, national and international levels, as appropriate. Strategic and tactical decision making will be aided by a management structure that integrates these aspects in a clear, unambiguous and co-ordinated manner. Its characteristics will depend on the approach adopted within a particular country, but in all cases the objective is to ensure a coherent, consistent and compatible approach within the country to the emergency. A related objective is to ensure that decisions taken by other countries in response to the emergency are as compatible as practical.

While the approach to overall co-ordination will depend on the type of emergency management structure adopted, any structure should clearly elaborate how organisations at all levels will interact, where the decision-making authorities reside and if and how these will change depending on the type of event or its severity. In support of this, each organisation or entity implicated in the emergency plan should have arrangements addressing their own roles, responsibilities and authorities that are co-ordinated with the overall emergency management structure.

Such a structure needs to be documented, exercised and supported by all implicated parties. High priority should be given to bringing together the planning teams of organisations that have a role in emergency management, including those supporting, making or implementing decisions. Mechanisms for involving stakeholders in this process, as appropriate, should be included. The members of the integrated planning team should understand the overall emergency management structure, the roles and responsibilities of their individual organisations and their relation to other organisations and jurisdictions within the management structure, including international obligations and interfaces.

Based on this, the integrated planning team can develop an approach that allows different response teams to work together during the emergency response so that decision makers at all levels have compatible approaches and/or knowledge of the decision choices and outcomes. The planning team should identify key decision points intersecting multiple organisations, where co-ordination is critical to successful response management or areas where additional information or preparedness efforts should be focused. Procedures and protocols defining the interfaces between emergency teams with respect to data exchange formats and timelines should be given high priority. A list of some areas requiring common understanding and/or co-ordination is elaborated below:

- *Threat and risk assessment:* a common understanding of the magnitude and likelihood of possible events and consequences, and the scenarios for which detailed planning is required.
- *Decision-making authority*: a common understanding of how organisations and decision makers will co-ordinate within the emergency management structure, and how the strategic and tactical decision-making authority is allocated for the identified scenarios.
- *Protection strategies and countermeasures:* development of protection strategies to meet the response objectives (see Part B of this report). Considerations include identification of:
  - Implicated stakeholders, and an understanding of the roles and responsibilities of the various response organisations for specific response actions.
  - Possible protective actions and their timeframes.
  - Inputs and outputs for formulating or verifying decisions on protection strategies, needed resources for monitoring, assessment and characterisation and their availability.

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- *Communications and co-ordination:* development of common or compatible arrangements, agreements, protocols and capabilities for information exchange at all levels, including through official channels and internationally.
- *International co-ordination:* a common approach to ensuring compatibility of decision-making approaches between countries, for example neighbouring countries dealing with impacts from an emergency in another neighbouring country, or countries supporting their own citizens in another country affected by an emergency situation.

Once the co-ordination process has begun, planning team members from the various organisations, including those external to the formal emergency management structure, can address these common areas with specific lines of inquiry to help identify and prepare for the key decision points which intersect multiple organisations and/or jurisdictions. This will also include identifying and preparing for the inputs, outputs and linkages needed to support timely and effective decisions.

Understanding and co-ordinating the approaches to emergency management among and between all implicated parties are a critical component of a practical decision-making strategy. Another consideration is to clearly identify during planning the chain of command within the overall emergency structure, and within individual organisations and entities. This will minimise confusion if different levels are brought into the emergency management, if authorities change when moving from response to recovery management, or if there are unplanned decision maker changes during an event. Drills and exercises should periodically test both planned and unplanned successions of authorities.

3.4 Identifying and characterising key decision-making points

Anticipating, identifying and characterising the key decision-making points along the emergency management timeline is critical to successful planning for response to and recovery from nuclear and radiological emergencies. These include the types and timelines of likely decisions, and their characteristics such as the inputs necessary for establishing an initial technical basis for recommendations, the outputs and the linkages to other response partners and stakeholders.

Identifying key decision points

Decision making for emergency management is a continuous activity aimed at ensuring public safety, optimising protection and supporting the return of affected areas to normal social and economic activity to the extent possible. To reach this outcome, decision makers must make appropriate and timely decisions at multiple points along the emergency management timeline, beginning with an analysis of the situation and formulation of recommendations on a course of action appropriate to the issues presented at the local, national or international level, and ending with a decision implemented by the designated parties. This process is supported by arrangements undertaken during preparedness.

As such, the objective of a decision-making framework is to facilitate timely, effective and compatible decision making by response organisations at every level within the emergency management structure. Anticipating decision-making requirements in a comprehensive and coherent manner through identification and analysis of potential decision points is an important aspect of this framework. Once these are identified, they can then be planned for in greater detail based on their characteristics, thereby providing a focus on where to direct strategic and operational planning efforts.

In addition to the organisational framework discussed previously, the emergency management structure requires an agreed working process to provide the operational framework that supports effective decision making in relation to the response objectives. An example is provided in Figure 4. Defining the working process in terms of its constituent steps, related objectives, actions and tasks facilitates the identification of key decision points and their associated characteristics, such as types, timelines, inputs, outputs and linkages to other responding organisations that should be involved.

Once defined, it can be analysed by emergency planners to identify the major decision points that can be expected over the duration of an emergency situation, from which related protocols, interfaces, resources, training and exercise objectives can be developed. This analysis should be undertaken in co-operation with relevant stakeholders who may have specific roles and responsibilities with respect to taking or supporting a decision, or who may have different experience, perspectives or priorities with respect to possible actions. Types of questions that should be asked as part of planning in order to identify decision points and their characteristic are given in Table 3.

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Figure 4. **Working process for emergency response**

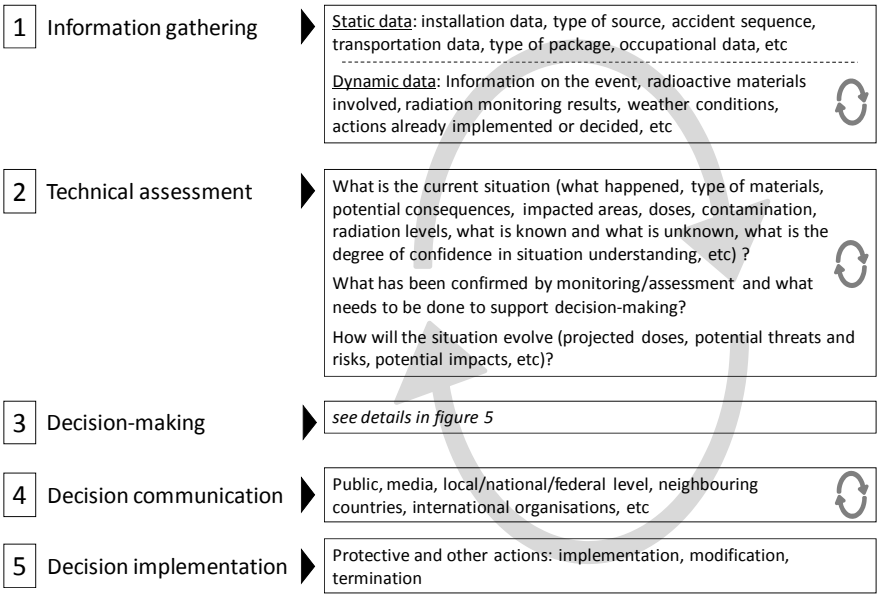

Table 3. **Identification and characterisation of decision points**

Types and timeliness of decisions	• What types of scenarios need to be considered? • What types of decision may be required? • Who is responsible for making these decisions i) in planning and ii) in response? • What is the priority of the types of decisions, including those that need to be made as a first priority? Is there a common understanding of the timeline? • How long will implementation of the decision take once it is made? • How will delays in implementing a decision impact the response?
Linkages and interfaces	• What are the relationships between decision makers and how will this change with the scenario? • Who is affected by the decision? • Who should be consulted/co-ordinated with prior to making a given decision (local, national and international level)? • What information is needed to support the decision and who supplies it? • Who should be informed of a given decision (local, national and international)? • What is the effect of decisions made by others not part of this process?
Assessment	• What types of protection strategies need to be developed to support the response (including types of individual countermeasures or actions)? • What inputs are needed or desired to support decision making? What resources, capabilities or infrastructure are required to obtain these? What impacts can be expected if inputs are missing or incomplete? What contingencies can be developed to deal with missing or uncertain information? • What decision support tools are needed to support decision making? To what extent will decisions at each stage of the response be based on modelled or actual data? • What resources, capabilities or infrastructures are needed to support implementation of a decision, including assessing its effectiveness? • What type of assistance may be required? What enabling arrangements need to be put in place? • What is the effect of uncertainty in the decision process?
Impacts	• What is the impact on other organisations, and have they been included/accounted for in the planning process? • What previous decisions impact or inform the present decision? • What is the impact of the decision on later actions or choices (crisis, consequence management, recovery)? • How might a decision conflict with another decision made by someone else? • What processes are needed to ensure continuous review of impacts? • What contingencies can be put in place to deal with unplanned impacts of earlier decisions? • What is the penalty for "not" making a decision?

Characteristics of key decision points: criteria and considerations

In addition to identifying the types and timelines of decisions that are likely to be required for the various credible scenarios, the planning process should also identify their characteristics. Based on

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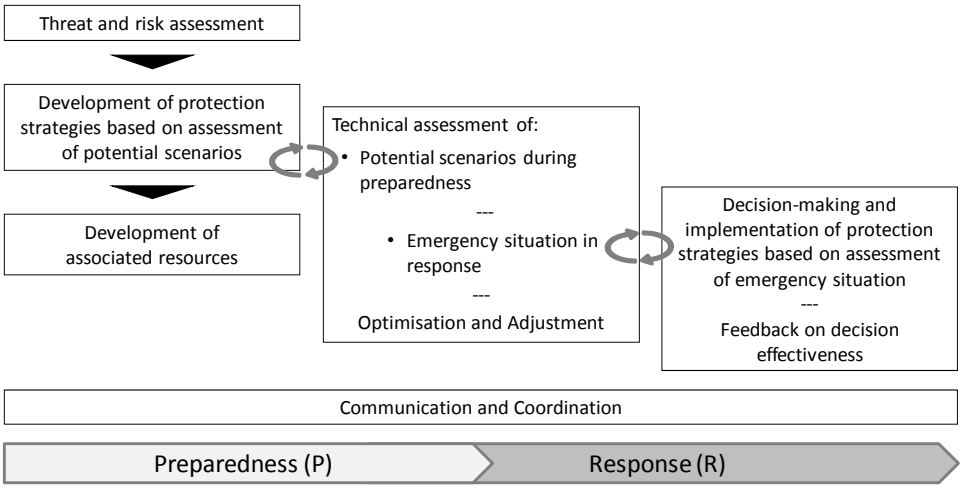
these characteristics, emergency planners can construct a roadmap for the development of necessary processes, procedures and resources. These characteristics will include the:

- Responsible decision makers and supporting organisations, and how they are linked.
- Assessment needs.
- Types of inputs, who supplies them and the associated timelines for their reception.
- Types of outputs, who needs them and the associated timelines for their distribution.
- Interfaces to other associated activities.

Emergency planners should further characterise the needed inputs in terms of their availability *i*) during the planning stage, and/or *ii*) during the emergency response, and how this data will be incorporated into the decision-making process. In planning, technical assessments based on a prognosis of what may happen as the scenario evolves will provide information on the potential timeline of the scenario. In an emergency, the assessment will be based on analysis and diagnosis of the actual situation and prognosis of its evolution based on the specific characteristics of the emergency. This information will feed the decision-making process.

Table 4 lists key elements for identifying decision points and where and/or when related detailed information is likely to be available; some of these will have information components throughout the emergency timeline. Characteristics include inputs necessary for establishing and updating the technical basis for a recommendation as well as interactions with other response partners as part of optimisation of protection and risk management. These characteristics may be used to develop supporting plans, procedures and resources, identify where decision-making interactions may occur and where operational arrangements with implicated organisations/jurisdictions need to be developed and co-ordinated as part of emergency preparedness.

Table 4. **Criteria and considerations for identifying decision points**



P: Detailed information available during preparedness
R: Detailed information available only during response
P/R: Relevant information available during preparedness/response (taken into conside-ration in planning)

P	**Threat and risk assessment: Identification of scenarios for which detailed planning is deemed appropriate** • Systematic evaluation of the magnitude and likelihood of possible events that could create consequences that should be assessed and for which detailed response arrangements should be developed (plans, capabilities, protection strategies, etc.)
P	**Development of protection strategies** • Identification of potential emergency consequences for planning scenarios • Identification of implicated entities and stakeholders • Identification of possible countermeasures addressing the main exposure pathways • Consideration of national/international guidance and experience, including feedback from events and exercises • Development of optimised protection strategies

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Table 4. **Criteria and considerations for identifying decision points** (Cont'd)

P/R	***Technical assessment of situation:*** In preparedness: assessment of potential scenarios according to threat and risk assessment; assuring the resources necessary to characterise the situation; In response: assessment of actual situation. *Criteria, factors and considerations for protection strategy recommendations and decisions* • Legal requirements (according to the specific situation) • Justification (basis used for decision making) • Radiological protection criteria, intervention levels, health-economic-social factors – Population groups: Emergency responders/workers/public – Responsibilities for assessing different elements of radiological protection • Feasibility of protection strategies, including Identification of possible individual countermeasures within the overall strategy – Timeframe for action – Resources available: equipment; personnel – Cost and impacts of the countermeasure – Technical criteria for characterising the potential or actual situation and supporting decision making: Source/scenario characteristics; modelling/monitoring results; conditions such as time, weather conditions, traffic (see details in Part B, Table 10 – Modelling and monitoring results) – Previously implemented actions, and possible impacts on future decisions – Waste management aspects • International implications – International agreements: pre-defined bi-/multi-lateral preparedness arrangements – Decisions taken by own country: Within accident/event country; Decisions for responsibilities abroad (event in another country); Impacts and implications of decisions on/by other countries • Decisions taken by other countries that may affect one's own country • Impact of decisions on/by stakeholders (authority and non-authority decision makers) – Linkages between: on-site and off-site decision; impacted/non-impacted areas – Amount of information available (compared to info needed) and its level of uncertainty – Forensics – Security
P/R	***Optimisation of protection strategies:*** • Formulation of protection strategies for precautionary actions, consequence management, dealing with citizens abroad in another affected country, etc. Elements include: – necessary inputs/outputs – identification of possible countermeasures addressing the main exposure pathways – criteria for precautionary actions – reference level of residual dose – input from stakeholders • Optimisation of the protection strategy, taking into consideration the available criteria, including stakeholders' input • Optimisation of the overall response process
P	**Development of associated resources: plans, arrangements and capabilities consistent with the risk assessment and related protection strategies** • Identification of all organisations/entities implicated in the emergency response and how they are linked in terms of the key decision points • Development of operational partnerships, mutually agreeable plans and communication processes, in consultation with relevant stakeholders • Implementation or identification of needed resources, capabilities and associated operational arrangements • Flexibility to account for changing situations, input of real-time data during response, etc. • Communications strategy and arrangements for communication nationally and internationally • Exercises and feedback on lessons learned • Knowledge management
R	**Technical assessment of actual situation and formulation of recommendations for protection strategies** • Identification of emergency situation and initiation of response: assessment of the specific known or potential threat and risk based on the actual event information • Data, analysis and information gathering – Prediction model results, environmental monitoring, facility data, off-site data, and/or data from other countries (if event happens elsewhere) – Initial and ongoing technical assessment of current situation and prognosis • Criteria, factors and considerations for protection strategy recommendations and decisions (see above)

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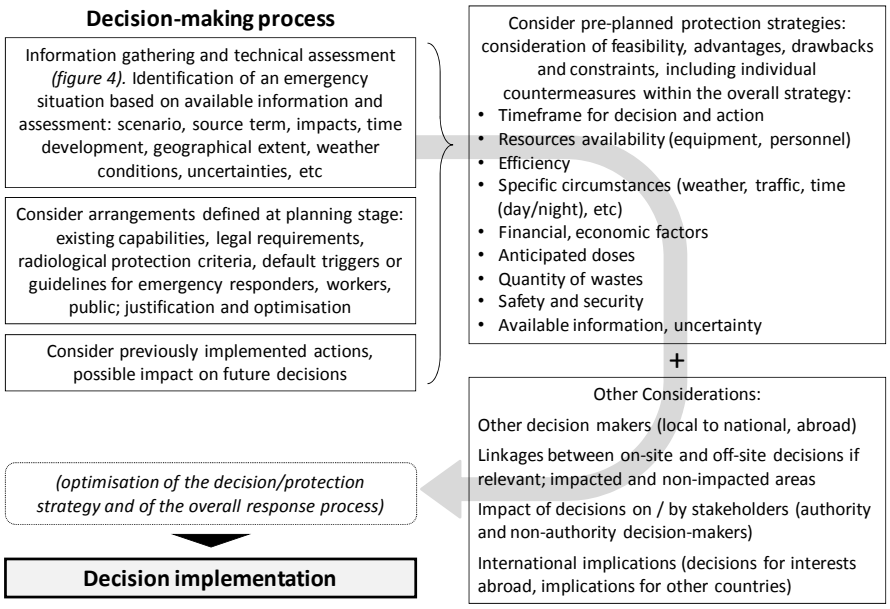
Table 4. **Criteria and considerations for identifying decision points** (Cont'd)

R	**Decision making and implementation of protection strategies** • Reflex/pre-cautionary protective actions based on the situation • Protection strategies for other longer-term actions • Timeline for subsequent decisions and actions • Implementation of actions • Increasing input from stakeholders • Termination and withdrawal of protective measures
R	**Feedback on decision/action effectiveness** • Monitoring of Situation • Evaluation of effectiveness • Adjustment or further optimisation of protection strategies; termination
P/R	**Communications and co-ordination** • Data and information exchange at local, national, international levels using formal arrangements: incorporation in planning arrangements, operational and used • Development of new, specific formal arrangements and agreements • Public and media Information

A graphical view of the different factors to be considered in the decision-making process is presented in Figure 5. Starting from a technical situation assessment (diagnoses and prognoses), and considering the existing response capabilities, legal requirements, radiological protection guidance and actions already taken, an appropriate protection strategy can be recommended. This is typically developed during the response phase by multi-disciplinary expert teams co-ordinated through an assessment centre. The recommendation is based on the combined input of the consequence assessment team using data from various partners and represents their best efforts to propose a course that balances the risks being weighed. In addition, decisions on actions to mitigate consequences to populations and environment will also include such considerations as the social and economic benefit and costs, stakeholders' input and the availability of resources needed to implement the countermeasure.

Figure 5. **Different factors to consider in decision making**



Once a recommendation on a protective strategy is reached, it will be provided to the responsible decision-making authority, bearing in mind that there may be multiple levels of decisions-makers dealing with issues that may be impacted by the decision, for example within government or industry. This process is complicated within a single country but when country boundaries are involved there will be many more decision makers to take into consideration for each of the steps discussed.

Decision makers should consider the feasibility of the strategy in light of the situation specificities. Different options may be proposed to make the process more efficient and reactive. Advantages and drawbacks of the different options should be clearly expressed to decision makers, for example, the impact for the management of following phases of the emergency, expected efficiency, doses to

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emergency responders, quantities of waste generated, etc. This should include the expected impact on stakeholders (especially in the transition and late phase), and on other potential decisions to be made at different levels in the country or abroad. If the emergency situation has occurred at a nuclear facility, the linkages between on-site and off-site decisions should also be considered.

3.5 Co-ordinated communications

The co-ordination of decision making both nationally and internationally, amongst all parties implicated in the emergency response is a critical component of effective decision making. Effective communications and co-ordination will facilitate compatible decision making.

Effective emergency management will not occur without the co-ordination of decision making amongst all parties implicated in the emergency response, both nationally and internationally. As the number of participating organisations and decision makers increases, the ability to co-ordinate communication and consultation becomes more complex, but also becomes more critical for ensuring consistent and compatible decisions, especially if the response involves multiple jurisdictions.

In order for the organisational and operational emergency management frameworks to work effectively and support the decision-making process, they must be integrated with a comprehensive communications strategy designed to facilitate:

- An effective and co-ordinated response amongst the participating organisations within a country.
- Compatible decision making between countries on possible countermeasures (taken with a country or to address responsibilities abroad).
- Communication of a consistent message to stakeholders, nationally and internationally.

Specific objectives of a communication strategy supporting the decision-making process include:

- Facilitating the co-ordination and linkages between different response organisations at the local, national and international levels.
- Enhancing the sharing of preparedness information.
- Enhancing the timely exchange of response information to facilitate understanding of the emergency situation.
- Exchanging recommendations on response actions, including their technical basis/rationale.
- Exchanging decisions taken, including their rationale.
- Exchanging information concerning the implementation of protection strategies.
- Capturing lessons learned, sharing experience to better inform all interested partners.
- Integrating with broader knowledge management strategies to ensure the preservation and utilisation of experience.

Decision-making processes should recognise that national decisions may affect other countries, and that decisions made by the international community may impact the decision making in one's own country, for example in terms of possible harmonisation, public reaction, impact on commerce, etc. Decisions made by another country affected by an emergency may also impact one's own citizens in that country (*e.g.*, embassy staff, residents abroad). Effective planning can ensure that decision makers have an understanding of the broad impacts of their decisions. This understanding will be facilitated by communication and co-ordination prior to the taking of a decision, to the extent feasible.

Efforts to co-ordinate communication among and between national and international jurisdictions should focus on the development, integration and exercising of mechanisms, procedures and platforms that facilitate a common understanding of the emergency situation amongst decision makers, and that seek to avoid or minimise the potential for conflicting decisions. While such mechanisms are not specific to nuclear or radiological emergencies, they are particularly important due to the potentially widespread impacts (radiological, non-radiological) of such emergencies. Preparedness arrangements should ensure that communication plans, procedures and processes clearly state how, when and what information will be exchanged between partners and communicated to stakeholders. A process should be established for responding to conflicting decisions, misinformation and rumours, and for determining communications effectiveness. The communications strategy should ensure that timely, accurate information and clear, understandable advice is made available to stakeholders early in the response and routinely repeated and updated throughout the emergency management timeline.

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The basic information required by national response organisations and international organisations includes *i*) actual and forecast technical data allowing an assessment of the emergency and its likely progression, and *ii*) actions being considered or having been taken. In addition to this basic data, supporting information may be useful to allow the actions considered, taken or not taken to be understood and properly compared across countries. This includes monitoring data, intervention levels, considerations of other technical and non-technical input used in the decision process and information on any pertinent aspects of the particular country, including social, economic or political factors (see Table 4). When information is exchanged, methods of accessing supplemental data should be indicated. As this information should be accessible to organisations in many different countries, it is important that common or compatible mechanisms and formatting of information are used to minimise language barriers. It is suggested that the information be exchanged using internationally-compatible communication systems or protocols.

The use of a national secure website allowing all responding organisations within a country to share information such as technical assessment data, rolling briefs and press releases is an important approach. As such websites will be used by response authorities, it is important that the information be organised to allow the decision makers to readily access the overview information but still facilitate the exchange of large amounts of detailed information between technical experts. More detailed information on the types of information that could be exchanged is presented in Part B of this report.

Importantly, internationally-agreed and established communications platforms, standards and data formats need to be developed, implemented, maintained, exercised and utilised to allow this process to function effectively. Such platforms and standards supporting the communications strategy should be easy to use, and should not present an undue burden on users; they should support both national and international needs; and they should be taken up by the larger international community for their long-term maintenance and development. An example of a communications standard is the International Radiation Information eXchange (IRIX) standard, developed under the framework of the IAEA International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies (IAEA, 2004). Additionally, national planning arrangements, including national level websites, should ensure co-ordination and compatibility with these international information exchange mechanisms and include appropriate arrangements for their implementation at the national level. This will facilitate the ability to access and exchange accurate and current information between countries.

3.6 Appropriate and timely decision making

While the threat and risk assessment will identify the types of scenarios for which detailed plans should be elaborated, each emergency situation will have its own unique characteristics. Decisions must match the timeline and characteristics of the particular emergency situation. Decision-making processes that facilitate the development of situation-specific recommendations are critical, because an appropriate decision for one emergency may be different in another situation.

While the threat and risk assessment will identify the types of scenarios for which detailed plans should be elaborated, each emergency situation will have its own unique characteristics. The decision-making process should thus be designed to respond in an appropriate and timely manner to the characteristics of the situation, including the type of event, its consequences and the characteristics of the potentially impacted areas. For example, during the release of radioactive material the decision may be made to evacuate people within a specific area; however, that same event during adverse weather conditions may result in the decision to shelter.

In addition to ensuring, to the extent possible, that information needed for decision making is received in a timely manner, preparedness arrangements should include processes for timely information transfer to those that need it for their emergency management requirements. Procedures should ensure that all of the information needed for formulating recommendations and for taking a decision is included along with the recommendation so that decision makers will understand why a particular action is being recommended. Efforts should also made to communicate information on recommendations (prior to decisions) as well as the decisions themselves to local, national and international authorities, in order to facilitate compatible decision making at all levels.

Additionally, emergency planners and decision makers need to be aware that some decisions, particularly during the early emergency response, may need to be made with little or no confirmed data and varying degrees of uncertainty. It is important to ensure that the decision-making process is

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flexible and can manage uncertainty with respect to the inputs and as well as requests for additional information, recommendations or decisions with respect to outputs. A basis for these decisions can be planned for by looking at the scenario timeline for the identified decision points, analysing their characteristics and developing possible protection strategies appropriate to the considered scenarios. Decisions that require immediate action should be identified during the planning process and predetermined actions established so decision makers at all levels are aware of and understand the importance of their timely implementation. Planning should also identify where either gaps in input of information, decision making, or co-ordination or communications can severely impact the ongoing response or recovery operation, and develop contingencies for dealing with such situations.

As decisions must match the timeline and characteristics of the particular emergency situation, decision makers should not simply apply what was specifically done during an exercise or a previous emergency response. The decision-making framework should facilitate the development of situation-specific recommendations and allow pre-planned protection strategies to be appropriately modified according to progress of the emergency situation. Alternative decisions should be considered during the planning process. In this case, each recommended action should be included in procedures along with the back-up information that provides justification for the recommendation.

The response arrangements must ensure that the type of scenario is properly identified should it occur so that appropriate actions can be initiated, even if these need to be modified as the scenario unfolds and more information is made available. A decision maker can then make appropriate initial decisions in the absence of confirmed data when it is based on an in-depth risk assessment of possible scenarios, including estimation of possible source terms. Follow-up actions that are consistent with the initial decisions can be based on actual data and results of previous decisions. Short comings in the planning arrangements can lead to lack of timeliness or to actions which are not optimal or appropriate for the emergency situation. Appropriate and timely decision making will follow from the elements identified in the previous sections, and which have been properly planned.

3.7 Stakeholder involvement (including international implications)

Complex emergency situations require the involvement of a broad range of stakeholders to facilitate their effective management. Emergency planners and decision makers should identify the range of relevant stakeholders and how their involvement may impact the effectiveness of decisions and the implementation of protection strategies. Relevant stakeholders, either directly or through their representatives, should be included in the emergency planning arrangements.

Lessons in emergency management, identified through emergency situations and exercises, have led to improvements in emergency arrangements nationally and internationally. Amongst these lessons has been the recognition that the effective management of the complex situations created by an emergency requires the involvement of a broad range of stakeholders. These include organisations and individuals that will be affected by the emergency situation or will be involved in or affected by its management, including governmental and non-governmental organisations and civil society.

The scale of stakeholder involvement can be generally characterised by the emergency management timeline. Early in the emergency, urgent protective measures will be implemented using a top-down management approach, with little or no stakeholder involvement beyond the emergency response authorities. However, as various parties will be involved in the implementation of these actions, for example evacuation or sheltering of the public or agricultural countermeasures, it is important that these parties be involved as part of planning. As the emergency exposure situation progresses into consequence management and the transition to recovery, it will become increasingly important to move to a bottom-up process, involving stakeholders in discussions leading to protection decisions in order to improve their acceptance and effectiveness. As a result, emergency preparedness activities should include processes to support the involvement of stakeholders, both in the preparedness phase and to an increasing degree following the crisis management phase.

While the nature and extent of such processes will vary from country to country, stakeholder involvement should be viewed as an important component in the development and optimisation of protection strategies for emergency situations, as well as in the education and training of the stakeholders themselves with respect to the planning arrangements. Stakeholder involvement covers a wide range of issues and approaches. Emergency planners should identify the range of relevant stakeholders and how their involvement may impact the effectiveness of decisions and the implementation of protection strategies. Stakeholders, either directly or through their representatives

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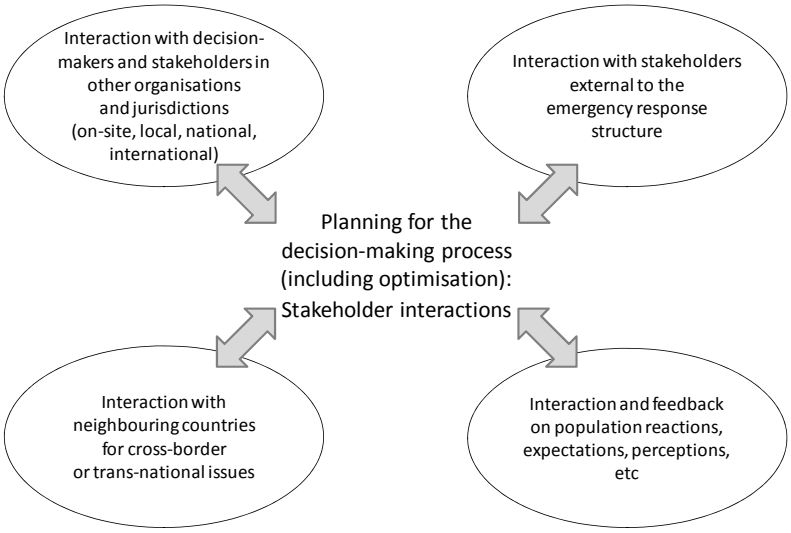
(for example, industrial or agricultural) should be included in the emergency planning arrangements. This implies at least two-way communication between the most obvious stakeholders directly involved in the response (response authorities, expert advisors, neighbouring countries) and those not usually involved, particularly non-governmental organisations, industry and the public. Their role and degree of involvement will depend on the type of stakeholder, and how they may be affected by an emergency situation, including possible preparedness and response roles.

Figure 6 identifies some of the stakeholder interactions that will influence the decision-making process. Stakeholders including response organisations, populations, neighbouring countries and decision-makers in other jurisdictions can impact the emergency management. Decision-making and optimisation processes that favour co-ordination require an understanding of these interactions, how they may affect decision makers within all jurisdictions, and what aspects need to be considered along the event timeline. Decision-making processes therefore need to be designed to accommodate this interaction. This is discussed further in Part B of this report.

Figure 6. **Interactions with stakeholders**



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4. Summary

Decision making is at the core of emergency management and should be planned for in advance to the extent feasible in order to minimise the potential consequences of emergency situations on health, infrastructure, environment and society. Practical emergency management experience has shown that such planning should be based on a guiding strategic vision. Within this context, Part A of this report has elaborated a generic framework of broadly applicable key elements for decision making that should be considered by national emergency management authorities when establishing or enhancing processes for decision making, and when developing or implementing protection strategies.

Decision making is a complex process involving layers of decision makers within and between local, regional and international jurisdictions. Co-ordination of decision-making approaches, clearly defined support information, and well-understood roles and responsibilities for each decision maker are critical to effective emergency management and transition to recovery.

Key considerations in decision making include elaborating the planning and response objectives, identifying the types of scenarios for which detailed plans should be developed, understanding the types of decisions that may be required during emergency management, identifying and characterising required information, interfaces and potential stakeholders, and establishing the required linkages with national and international partners. In addition, each emergency situation will have its own unique characteristics. Decision-making processes that facilitate the development of situation-specific recommendations are critical because a decision appropriate for one emergency may be different in another situation. Finally, although threat and risk assessments will identify scenarios for which emergency arrangements should be prepared, actual events often deviate from the planned scenarios. It is therefore necessary that arrangements are understood, exercised and sufficiently flexible to allow response authorities to respond appropriately if an unexpected event occurs.

Part A of this report has recommended that these considerations be addressed up front in the planning process in order to put all required operational arrangements in place, to facilitate appropriate and timely decisions, and to effectively manage resources. By addressing these elements in the preparedness phase, associated processes, procedures and resources can be developed and implemented. This will facilitate effective and coherent decision making during an emergency by response organisations at every level within the integrated response, and between countries.

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Part B.

Consequence management and transition to recovery

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1. Introduction

Experience from the NEA International Nuclear Emergency Exercise (INEX) series, and in particular the INEX 3 consequence management exercise (NEA, 2007a), has shown that while significant advances have been made in planning for early phase management of nuclear and radiological emergencies, the consequence management and transition to recovery phases remain a difficult challenge for emergency planners and decision makers.

The INEX 3 exercise series, conducted throughout 2005 and early 2006 was developed by the NEA Working Party on Nuclear Emergency Matters (WPNEM) to investigate national and international arrangements for responding to widespread radiological contamination of the environment and the consequence management issues likely to be raised in the medium to long term after such an event. Areas of particular focus included agricultural and food countermeasures, decision making with respect to travel, trade, tourism and other matters associated with the interfaces between countries (so-called "soft" countermeasures), recovery management and public information. The INEX 3 evaluation workshop concluded with a set of identified key needs for which the participants felt that the WPNEM could usefully contribute.

In 2007, the WPNEM established an Expert Group on Recovery, Agricultural and Food Countermeasures (EGR) and an Expert Group on Countermeasures (EGCM) to develop strategies for actions that could be considered by emergency management authorities and decision makers when managing the longer-term consequences of a nuclear or radiological emergency. The groups dealt with different but complementary aspects of strategies for countermeasures in the post-crisis stages of an emergency response.

In addition to mitigating the impacts on populations, infrastructure and environment, planning for the response to a nuclear or radiological emergency includes the ultimate goal of returning affected areas to normal social and economic activity to the extent possible. This goal will present significant challenges not only to affected populations and other segments of society, but also to the organisations responsible for the emergency management and recovery activities in countries either directly or indirectly affected by the emergency. The fulfilment of this goal will be facilitated by effective and co-ordinated management of the consequences and the transition to recovery, which will set the context (including social, economic and political aspects) for the long-term recovery actions to be undertaken. Management strategies that are developed and implemented as part of the emergency preparedness phase will improve decision making throughout the emergency response. Additionally, the change from an emergency exposure situation to an existing exposure situation[4] will likely involve a transfer of responsibilities between authorities, or at least from crisis management to recovery and restoration management groups within the same authority. To ensure its effectiveness, planning for this change should also be undertaken as part of overall emergency preparedness and involve all relevant stakeholders (ICRP, 2007).

Whereas Part A of this report presents a generic framework for decision making over the emergency management timeline, Part B presents a framework, building on Part A, for addressing issues in consequence management and the transition to recovery as identified from the INEX 3 exercise. Due to the general applicability of this strategic framework, other issues in consequence management (such as population protection measures) have also been included as far as appropriate.

The Part B framework includes key elements and issues to consider in developing, implementing and managing protection strategies for consequence management, including a view of the types of actions that could be considered and relevant criteria for the related decision process. It is intended to

4. Exposure situations that already exist when a decision on control has to be taken, including prolonged exposure situations after emergencies.

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find applicability amongst national emergency management authorities and international organisations by providing strategies and insights on key considerations for consequence management and the transition to recovery to be addressed as part of emergency preparedness, specifically in the development of necessary plans, procedures, arrangements and tools. It is hoped that consideration of this strategy by emergency planners and decision makers will facilitate compatible and/or consistent approaches to consequence management and recovery amongst the multiple layers of organisations and entities involved in responding to emergency situations as well as between different countries.

Note to the reader

The strategy for countermeasures is not intended to provide a detailed approach to emergency preparedness, for which other documents exist at the national and international levels. Long-term rehabilitation is not addressed in detail in this strategy but the reader may be able to use aspects of the framework described in this document to facilitate development of their own related plans and approaches.

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2. General considerations for developing planning frameworks

To ensure a common understanding of the emergency management timeline, Figure 7 (from Part A) presents the emergency management timeline, from pre-event preparedness to post-event recovery and rehabilitation used throughout this report.

Figure 7. **A view of the emergency management timeline and emergency phases**

Preparedness	*Response*				*Recovery*
	Early		*Intermediate*		*Late*
Planning Stage	Event / Response Initiation	Crisis Management	Consequence Management	Transition to Recovery (including recovery planning)	Recovery / Long-term Rehabilitation
	Emergency exposure situation				Existing exposure situation

Within the timeline, "consequence management" is identified as the period of time after control over the source has been regained or the release has been terminated, and any urgent actions have been undertaken. The crisis phase has passed and radioactive contamination has been released into the environment; however its characterisation may not be fully complete. Authorities will be focused on mitigating the consequences of the emergency on populations, infrastructure, environment and socio-economic structures and on returning to normal social and economic activity. During this time, characterisation of the contamination, review or lifting of initial countermeasures and consideration of new countermeasures will be ongoing. Urban and/or agricultural countermeasures, dietary aspects, stakeholder involvement mechanisms and international co-ordination become increasingly important, and activities addressing the transition to recovery will begin. During the "transition to recovery", efforts are made to ramp down the emergency response and put specific arrangements in place to begin the late-phase "recovery/long-term rehabilitation" to support the return of affected areas to normal social and economic activity, as far as possible.

A multitude of practical questions are expected to arise during this period, and policy, structural and procedural aspects of consequence and recovery management must be in place for governments and other stakeholders to appropriately respond. The complexity of the emergency management is compounded by the involvement of numerous response organisations across multiple jurisdictions and an increasing level of stakeholder involvement.

As noted in Part A, while the timeline presents these phases and activities as distinct elements for the sake of clarity, this will rarely be the case in practice, and for large scale, complex events, different geographic areas may be in different stages of the response at the same time. Additionally, some recovery actions will begin before a formal recovery phase is initiated, for example, establishing a recovery management team early in the response to identify issues relevant to long-term recovery as they arise, and to begin developing a plan for their resolution.

The INEX 3 exercise has shown that in order for authorities and other implicated stakeholders to adequately respond to the multitude of challenges in post-crisis management, strategies and structures for response and recovery should be elaborated, understood and exercised during the emergency preparedness phase (NEA, 2007a). The goal of such strategies and structures is to facilitate the implementation of a coherent and efficient framework for managing, in consultation with stakeholders, radioactively-contaminated areas and for moving towards their recovery and rehabilitation.

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A key aspect of consequence and recovery management is that the characteristics of an actual emergency situation will be difficult to predict in detail in advance. As such, while protection strategies for the early phase of an emergency, such as pre-defined urgent actions and associated criteria for their implementation, may be relatively straightforward to develop in detail in advance of an emergency, they become increasingly difficult to plan and characterise in detail for later periods following the emergency's onset. It is thus important to prepare strategies, structures and tools to guide and inform actions for consequence and recovery management based on situation-specific information rather than comprehensive implementation plans for defined actions. A planning framework that provides key common elements in the management process will allow consequence management to be specified and carried out in a coherent manner during an emergency, and facilitate the elaboration of recovery plans when required. Such a framework should recognise the important role of social, economic, environmental and political factors in the recovery management.

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3. A planning framework for countermeasures for consequence management and the transition to recovery

It is possible and desirable to plan detailed pre-defined protection strategies and implementation criteria for crisis management. However, the uncertainties in predicting the characteristics of the post-crisis situation, the impact that decisions implemented early in the response may have on subsequent decisions and actions, and the increasing requirement to incorporate stakeholders' feedback into the decision-making process renders impractical such a detailed approach for many later-phase countermeasures. Consequently, while generic protection strategies can and should be planned for later periods, generally these cannot be elaborated in detail for implementation. Such generic strategies should therefore be supported by decision-making processes, structures and tools that will allow them to be adjusted, optimised, implemented and terminated as required. In addition, any planning framework for post-crisis countermeasures should be consistent and integrated with the overall decision-making framework adopted in the emergency management structure. The planning framework elaborated here builds on the generic decision-making framework presented in Part A, and specifically addresses the issues relevant to protection strategies for the intermediate and late phases.

For emergency situations with international implications, often referred to as transnational emergencies (IAEA, 2002), national authorities will be concerned with a spectrum of possible countermeasures to address impacts on their own territories, international interactions with affected areas (travel, trade, tourism, etc.) or responsibilities in another affected country (such as embassies, national citizens abroad). This spectrum of countermeasures ranges from early-phase actions based primarily on radiological protection considerations to a broader range of consequence management issues for which social, economic and political factors are also important considerations. For a majority of these countermeasures, there will be no standard approach for their formulation, nor pre-defined criteria for their implementation.

While most countries will advise their citizens in these situations, such advice may not be consistent or harmonised between countries for several reasons, such as differing legal bases for the response, lack of standard approaches, variations in the availability of information and its assessment, or different prioritisations in the development of optimised protection strategies, including stakeholders' expectations. Part A discussed the importance of co-ordination and communication as part of decision making in facilitating an understanding of the basis for such differences, and reducing unwarranted discrepancies. This is particularly important for understanding the approaches that might be taken in the longer-term response. A generic planning framework for countermeasures should therefore aim to not only assist emergency managers in planning appropriate protection strategies and supporting structures to deal with consequence management and the transition to recovery within a country, but facilitate compatible decision making between different countries.

The key elements of a generic planning framework, as identified through an analysis of experience arising from national emergency management programmes, are presented in Table 5. As with Part A, emergency planners can use this framework to identify specific topics for inclusion in supporting plans, procedures and resources, particularly with respect to the development of protection strategies and recovery plans, in co-operation with relevant parties and stakeholders. These considerations are discussed in more detail in Sections 3.1 through 3.4

3.1 Building the emergency management structure for consequence management and for recovery

As part of preparedness, identify, co-ordinate and define roles and responsibilities of the national emergency management structure for consequence management and for recovery. Build partnerships with identified organisations and jurisdictions for planning and implementing a co-ordinated response, including the development and implementation of protection strategies, and co-ordination of recovery objectives and strategies. Implement co-ordinated strategies for international communication to facilitate compatible decision making.

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Table 5. **Framework of key considerations for consequence management and the transition to recovery**

Building the emergency management structure for consequence management and recovery • Organise the national emergency management structure. • Develop arrangements for international communications and co-ordination. As part of preparedness, identify, co-ordinate and define roles and responsibilities of the national emergency management structure for consequence management and for recovery. Build partnerships with identified organisations and jurisdictions for planning and implementing a co-ordinated response, including development and implementation of protection strategies, and co-ordination of recovery objectives and strategies. Implement co-ordinated strategies for international communication to facilitate compatible decision making.
Dealing with the consequence management phase • Identify potential impacts and possible countermeasures. • Develop protection strategies and decision support structures. • Implement and terminate protection strategies. During preparedness, use the threat and risk assessment to identify potential impacts and possible countermeasures for each scenario. In co-ordination with all relevant parties, develop optimised protection strategies for consequence management and the transition to recovery prior to an emergency. During an emergency, advise decision makers on appropriate courses of actions throughout the consequence management and transition to recovery phases. Terminate countermeasures when successfully implemented, no longer applicable, or when event changes indicate the need for different approaches or countermeasures.
Managing the transition to recovery • Develop a recovery plan framework as part of preparedness. • Identify potential issues for recovery management. Identify potential issues that will need to be addressed during the long-term recovery and rehabilitation. Develop a framework recovery plan as part of preparedness with basic common issues to facilitate the recovery operations, for detailed elaboration in response to a specific emergency and include a description of roles, responsibilities, priorities, timeline and financial implications.
Developing and maintaining processes for stakeholder involvement Identify and involve relevant stakeholders in emergency preparedness in order to improve the development and implementation of appropriate protection strategies and the transition to recovery.

Organise the national emergency management structure

A range of organisations and entities across different jurisdictions will have responsibilities in the emergency management cycle. While the emergency management structure provides the overall roadmap for organisational co-ordination (Part A, Section 2.3), the specific organisations involved in the response at any point during the emergency may change. For example, as the response moves from the initial crisis stage to the consequence management stage, the involved parties may shift from largely local authorities to a multitude of parties and stakeholders dealing with different aspects of the emergency at the local, national and international levels. The organisational relationship between these parties may also depend upon the type of emergency situation being addressed, according to the specific national legal basis and emergency management structure. Identifying and co-ordinating all involved parties will be a key requirement of the consequence management phase due to the breadth of issues concerning populations, infrastructure, environment, and socio-economic structures that will need to be managed in an effective, co-ordinated and timely manner.

The organisation of the emergency management structure and the fostering of required interfaces and linkages will be an iterative approach best undertaken by the integrated planning teams identified in Part A. During initial planning, it will be possible to identify and co-ordinate with the main response organisations that will be involved in consequence management and recovery for domestic emergencies or for emergencies abroad. Specific aspects of the national organisation should address:

- The identification of the different organisations and the manner of interaction.
- Mechanisms and processes, including training and exercising, for co-ordination and communication within the emergency management structure.
- Mechanisms and processes for interaction between technical experts and decision makers, including identification of the types of information to be exchanged to support decision making for consequence management.
- Linkages to the international community, including bi/multi-national arrangements and established international arrangements (*e.g.* IAEA, 1986) for co-ordination and communication, and for requesting or providing assistance.

Depending on the scenarios and expected consequences arising from the threat and risk assessment, other governmental and non-governmental organisations (embassies, industry groups,

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agricultural groups, transportation companies, etc.), should be brought into the planning process as appropriate. The identification, involvement and co-ordination of all involved parties should bear in mind the role of the various stakeholders in identifying impacts and developing or implementing protection strategies. Partnerships with these parties can be built and linkages established and integrated into preparedness activities as appropriate. Mechanisms to support an increasing level of stakeholder involvement should also be developed, implemented and co-ordinated with the emergency management structure (Part B, Section 3.4).

As the emergency situation transitions from consequence management to recovery, organisations and teams involved in the response may change, including the designated lead organisation, depending on national arrangements and on the specific scenario. Issues with respect to the organisational structure for recovery will begin before the emergency situation has ended, particularly if there are significant spatial variations in the characteristics of the situation, or if the national response has not included an crisis phase response (*e.g.*, if the event is from or in another country). However, regardless of possible changes in response structure, organisations involved in the initial emergency response will have a key role in ensuring a successful transition to a modified recovery structure. Where a response involves interaction with other countries or international organisations, it is also important to remember that different countries may take different approaches to recovery management, including the criteria for initiating the transition from an emergency to an existing situation.

A well-planned and timely transition from emergency management to recovery is critical for building public confidence and enabling the return to a stable situation. While the details of how and when this transition is achieved will depend on the national arrangements and specific characteristics of the emergency, it is important that procedures for activating and co-ordinating the recovery management structure and for hand-over of responsibilities be addressed as part of emergency preparedness, included in national plans, understood by all implicated parties and exercised.

Develop arrangements for international communication and co-ordination

The organisation of the national emergency management structure and its linkages into international arrangements will be strengthened if effective and co-ordinated communications arrangements are adopted. As part of preparedness, communications between relevant organisations and groups in the management structure should enable a common understanding of, and co-ordinated approach to, the planning basis. The communications arrangements should also facilitate co-ordination and compatible decision making between different countries to the extent feasible.

Any communications and information management strategy addressing these goals should enable systematic and appropriate information exchange between response authorities at all levels and at all points along the emergency management timeline, including both preparedness and response. Such a strategy should enable timely consultation between authorities and support their ability to make and communicate decisions to deal with the consequences of an emergency situation.

At a minimum, an overarching communications strategy supporting post-crisis management should include the generic elements and consideration shown in Table 6. These should be addressed both during preparedness to build the base for compatibility, and during response for the exchange of emergency information and co-ordination of decision making for consequence-management. The framework provides key elements and issues to be considered when elaborating specific national and international arrangements. Details of what should be communicated and by what means should be discussed and agreed by all involved parties. For international communications, this should be carried out at the international level. This will be aided by drawing on international standards, guidance and experience (*e.g.*, EC, 1999; NEA, 2000; IAEA, 2007b), including the International Radiation Information eXchange (IRIX) communications standard, developed under the framework of the IAEA International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies (IAEA, 2004). IRIX provides standards for a data set, data format and communications protocol that, when consistently adopted, will facilitate the setup of an effective internationally harmonised communications system and standardised information exchange, and minimise the need for countries to develop independent systems.

Table 7 supplements this strategy by providing an overview of the types of information that should be exchanged between organisations to support decision making. This list should not be considered definitive, and should be customised to particular national arrangements during the preparation of communication arrangements.

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Table 6: **Elements and considerations in a strategy for national and international communications**

Communication channels	Identification and formalisation of channels for exchanging reliable information within a country and with other countries, including through official channels such as: • Inter-governmental communications from event country to other countries via: – Ministry of foreign affairs to embassies of foreign governments in the host country. – Government to government: Bilateral arrangements, official websites. – IAEA and other international organisations. • Inter-governmental communications between other countries, including between: – Embassies in an affected country concerning information related to national responsibilities in that country (citizens residing in affected country, tourists, industry). – Other parts of the response organisations concerning information on the emergency situation, technical assessment, etc. – Other national routes (*e.g.*, information received directly from industry, etc.). • Media.
Consultation mechanisms	Development and implementation of agreements and procedures for inter-agency communications and consultation within the emergency management structure and internationally. This should aim to: • Achieve a common, timely information base and consistent understanding of the emergency situation. • Facilitate consultation between organisations on possible actions and communication of decisions taken, to the extent feasible.
Areas for co-ordination	Identification of areas where information should be exchanged as part of the preparedness phase, and where decision making addressing consequences within a country and for responsibilities abroad should be co-ordinated amongst identified partners.
Decision-points	Identification of decision-points and criteria related to the areas for co-ordination. Considerations include the partners to be consulted or informed, the types and timeliness of information to be exchanged, and how information and decisional needs may vary for near-field or far-field countries or for dealing with responsibilities abroad.
Basis for recommendations	Exchange and comparison of information related to the basis for recommendations, to facilitate consistency or compatibility of decision making nationally and internationally: • *During preparedness*: information on approaches for formulating optimised protection strategies to improve compatibility of decisions. This will be facilitated by an understanding of the technical basis, criteria for formulating recommendations, understanding of other input considered, including input from stakeholders, expected benefits and risks. This should include identification and communication of the types of countermeasures that can be considered within a protection strategy, as well as criteria or considerations for their optimisation, implementation and termination. • *During response*: exchange and consultation on situation-specific information using the arrangements put in place as part of preparedness.
Basis for recommendations	Elements to be addressed in the strategy include: 1. *Technical assessment/understanding the emergency situation.* Development of procedures for information exchange to support a common understanding of the emergency situation, including: • Agreement on the types, content and timing of technical and non-technical information exchange communicated through the established communication mechanisms (see Table 7). • Compatible procedures, protocols, and platforms for timely exchange of information. • Mechanisms for consultation between authorities on the understanding of the emergency based on information *i*) received through official channels, and *ii*) processed by the response authorities. 2. *Recommendations for protection strategies.* Development of agreements and procedures for national and international communication and consultation on recommendations considered for countermeasures in the consequence management phase prior to formal approval by decision makers, including: • Identification of types of stakeholders to be informed. • Channels and mechanisms for information exchange and consultation. • Types of information to be exchanged with respect to recommendations for protection strategies: – What, when, where and why (including expected benefit). – Criteria used for formulating the recommendations, including pre-defined or ad hoc criteria (such as reference levels, intervention levels, or other criteria/considerations), stakeholders' input, analysis of feasibility, arrangements for implementation. – Consideration of recommendations or decisions on protective actions to be taken by neighbouring countries and the international community. 3. *Communication of decisions for protective actions.* Development of common agreements, procedures and mechanisms for communicating decisions on protection strategies to be implemented. This should consider communication within a country, to national citizens abroad in another affected country, and between countries.

In order for a generic framework to provide operational benefit, it needs to be implemented and adapted within a specific country, and adopted internationally to the extent feasible. This includes development and implementation of standardised or compatible communications protocols and

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procedures for the exchange of emergency information (such as the IRIX communications standard). It is recommended that the international community consider how this generic framework may be taken up and implemented internationally, with the overall goal of improving compatibility between countries regarding decisions relevant to consequence management and the transition to recovery.

Table 7. **Types of information to be exchanged between organisations to support decision making**

General information (relevant to all of the other information types given below) • Agency providing information • Date and time that information is valid at (*e.g.*, time of posting)
Overview information (summarising the information required by decision makers) • Event summary: description of the emergency including location, time, type, severity, key events • Key issues against which the response is assessed (*e.g.*, health impacts, economic impact) • Strategic aims and priorities (defined on a national level) • Countermeasures planned and already taken

Technical information
(for understanding the emergency situation and formulation of recommendations)
• Event characteristics, including release information
• Meteorology
• Extent of impacts (actual/projected)
• Protection strategies/countermeasures
• Modelling and monitoring results
 	
• Projected doses to population
• Measured dose rates/calculated doses
• Medical follow-up plans, including medical resources available/locations
• Number of people monitored
• Results of population monitoring
 	
• Sampling plans for soil, food, feed, water, environment, including agencies and resources available
• Samples collected for soil, food, feed, water, environment
• Expected date of availability of sample/analysis data
• Projected/measured concentrations in soil, food, feed, water, environment
 	
• Protection strategies/countermeasures considered and implemented (what, when, where, criteria, expected benefit)
  – Regarding impacts within the country
  – Regarding interactions with another affected country, for example
  ✓ Instructions to embassy(ies) in the affected country concerning protection of staff, national citizens abroad
  ✓ Citizens travelling to/from affected country
  ✓ Trade to/from with the affected country
  ✓ Transport to/from the affected country
• Effectiveness of protection strategies/countermeasures
• Impact of protection strategies/countermeasures, including on future management options
 	
• Foods potentially exceeding maximum permitted levels
• Foods banned (types/origin) and plans for their management
• Quantity of restricted foods to be managed
 	
• Classification of waste (total activity or activity concentration)
• Quantity of waste to be managed
• Locations/capacities of waste facilities

Public information • Public communications plan (media, timing, key messages) • Press releases issued (when, by whom, key message) • Identified stakeholder issues

3.2 Dealing with the consequence management phase

During preparedness, use the threat and risk assessment to identify potential impacts and possible countermeasures for each scenario. In co-ordination with all relevant parties, develop optimised protection strategies for consequence management and the transition to recovery prior to an emergency. During an emergency, advise decision makers on appropriate courses of actions throughout the consequence management and transition to recovery phases. Terminate countermeasures when successfully implemented, no longer applicable, or when event changes indicate the need for different approaches or countermeasures.

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Protection strategies for the crisis phase of an emergency are generally focused on urgent countermeasures that need to be implemented promptly in order to be effective, and for which the effectiveness will be markedly reduced if there is a delay. These protection strategies should be pre-planned with associated pre-defined and unambiguous triggers for their implementation.

Protection strategies for consequence management and the transition recovery should also be pre-planned to the extent feasible. However, the level of detail for each scenario of interest will depend on its likelihood and magnitude of impacts, bearing in mind the uncertainties in predicting at the planning stage the characteristics of the post-crisis situation and the associated response. For this reason, protection strategies for consequence management will be more generic in nature but should address, as a minimum, the potential impacts on populations, agricultural/food systems, infrastructure, environment, waste management and socio-economic structures. The development and optimisation of such protection strategies should aim to create a coherent approach to mitigating impacts, focusing on the combined effects of all individual countermeasures included in the strategy. The clarification of what and who may be affected by the potential emergency situation and the types of countermeasures that should be considered to address these impacts will provide additional information for identifying and co-ordinating the necessary emergency management structure.

The identification and assessment of relevant technical and non-technical considerations associated with the emergency and the related response provides the basis for possible protection strategies and supporting decision structures for their development, optimisation, implementation, modification and termination. This is a multi-step process that requires, as part of emergency preparedness, *i*) anticipation and assessment of the possible consequences of the scenarios identified in the threat and risk assessment, and *ii*) the development of generic protection strategies for consequence management and guidance for their modification based on situation-specific information (Part A, Table 4). Relevant factors include:

- Identification of dominant exposure pathways and possible consequences for a given scenario.
- Identification of types of individual countermeasures that could be considered to mitigate consequences.
- Legal, regulatory, technical, social and economic considerations and issues.
- Stakeholders' input.
- Interfaces within and between countries.
- Identification and availability of tools to support all stages of the response.

During an emergency, ongoing assessment of potential consequences coupled with relevant stakeholders' input, will provide the basis for decisions on appropriate actions.

Identify potential impacts and possible countermeasures

After the crisis response and implementation of urgent countermeasures, there will be a need to consider subsequent actions to manage the consequences of radioactive material in the environment and move towards recovery. The outcomes of the threat and risk assessment for a range of emergency situations (Part A) will have been used to identify credible scenarios and develop strategies for early phase response. In order to plan for the consequence management phase, these outcomes should also be used to identify, to the extent feasible, what and who may be affected as the scenario advances in time. This will require forecasting of the dominant exposure pathways and potential consequences of the identified credible scenarios.

Evaluation of the INEX 3 consequence management exercise identified the need for improved guidance on possible countermeasures that could be considered in consequence management and the transition to recovery, and how to integrate these into a coherent approach to response. Identification of appropriate countermeasures and development of an overall strategy for consequence management should be carried out in a manner that coherently follows from the early response, and is part of an overall response strategy. The possibility of multiple exposure pathways means that such strategies should focus on the overall exposures that may occur and the optimal level of protection to be achieved (ICRP, 2007, 2009). As such, a protection strategy will be composed of a combination of appropriate individual countermeasures addressing the total exposure from the different exposure pathways in a collective manner, with a focus on the resulting residual dose after their implementation.

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Table 8 provides a non-exhaustive list of the types of countermeasures or advice addressing the key focus areas noted above that could be considered when developing optimised protection strategies. This list is divided into i) countermeasures that could be considered by response authorities within a directly affected country, and ii) those that could be considered by national authorities to address their responsibilities in another (indirectly) affected country, focussing primarily on the areas where advice to citizens abroad could be given or requested. Examples of individual countermeasures for these various types are provided in Annex 1, Table A. It is noted that information exchange between states and international organisations that addresses these areas will facilitate compatible decision making in different countries. Table 9 provides elaboration on related issues and considerations to be taken into account in the development and optimisation of approaches for their implementation.

These tables should be interpreted by emergency planners in the context of their own national needs, and be modified or appended with additional possible countermeasures as appropriate. Supporting technical information that should be considered as part of the assessment and decision-making process is given in Part A, Table 4. Examples of this approach as applied to the management of contaminated urban and rural areas can be found in the bibliography.

Table 8. **Examples of types of countermeasures that can be considered in developing protection strategies for consequence management**

A) To be considered by the emergency managers within a directly affected country	**B) To be considered by national authorities in a country that is not directly affected***
Urgent countermeasures	
To be taken in one's own country • Evacuation • Sheltering indoors • Iodine prophylaxis • Sheltering of and/or feeding restrictions on livestock	*Advice to one's own citizens in another affected country concerning:* • Evacuation • Sheltering indoors • Iodine prophylaxis • Travel
Consequence management countermeasures	
To be taken in one's own country • Access control; travelling to, from or through contaminated areas • Relocation • Monitoring and decontamination of populations (including travellers within country and from abroad) • Response to possible health effects; Medical surveillance and reassurance monitoring • Countermeasures for agricultural and food production systems (restrictions, modifications, advice) • Countermeasures for food and drinking water; dietary aspects (including restricting distribution of locally-produced food or food importation) • Countermeasures for raw and processed materials • Trade and transport of goods to, from or through contaminated areas • Countermeasures for inhabited areas; monitoring and decontamination of inhabited areas and environment • Waste storage/disposal • Restoration of services, infrastructure, economic activity, population movement, environment • Advice/public communications • Financial/compensation	*Actions to be considered in one's own country* • Monitoring and decontamination of people and goods coming from an affected area. • Medical follow-up • Import restrictions • Advice/public communications *Advice to one's own citizens travelling to/from or staying in another affected country concerning:* • Relocation • Travelling to, from or in contaminated areas • Travelling within or from a foreign country • Monitoring and decontamination of citizens abroad • Consumption of food and water • Small scale decontamination of living area, including alteration of living conditions • A country's businesses located in affected areas • Trade and transport of goods to, from or through contaminated areas • Information and advice to citizens in one's own country concerning family members in affected areas • Advice/public communications

* This includes addressing responsibilities for one's own nationals in another affected country (in addition to advice given by the authorities of the affected country)

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Table 9. **Examples of types of consequence management countermeasures: Issues and considerations**

Note: see also Annex 1: Compendium of possible countermeasures

Type of countermeasures
Access control
Relocation
Monitoring and decontamination of populations
Response to possible health effects; Reassurance monitoring; Medical surveillance and follow-up
Countermeasures for agricultural and food production systems; Countermeasures for food and drinking water; Dietary aspects

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Table 9. **Examples of types of consequence management countermeasures: Issues and considerations**

Note: see also Annex 1: Compendium of possible countermeasures

Issues and considerations
Restricting access to contaminated areas or buildings to control dose (in conjunction with decontamination/cleanup) Considerations include: • Characteristics of contamination: radionuclides, levels, geographic extent, etc. • Areas: critical infrastructure; public/private buildings; work areas; recreational areas/green spaces; transportation routes • Populations: public, residents, workforce • Impacts on services • Public acceptance • Transport (vehicles, drivers and support staff willing to enter contaminated areas, costs, road safety, etc.) • Security for restricted locations, access for populations wishing to inspect property/remove items; procedures for clearing items as safe for removal *Linked actions:* relocation, monitoring and decontamination, restoration of services
Temporary/permanent relocation; criteria for implementation and termination Registration and census of relocated populations for traceability, reunite families, compensation Facilities at new location (housing, medical, communications, food, education, employment, social support, compensation, mechanisms for informing/consulting populations, etc.) Impacts on in-situ residents of new location (mass ingress of new population); stresses on existing facilities, competition for jobs, school places, etc. *Linked actions:* access control, monitoring and decontamination, restoration of services, financial/compensation
Identify, monitor and decontaminate affected populations, including travellers within country and from abroad Identify, gather, analyse and communicate relevant information between the various responding agencies, decision makers and stakeholders. Registration and census of affected populations for traceability, medical or epidemiological follow-up, compensation. Designing monitoring strategies – considerations include: • Development of strategies: identification of relevant populations and areas, consideration of modelling results, geographical coverage, reassurance monitoring • Maintaining equipment/resources or loan of specialised monitoring equipment and expertise • Undertaking field measurements; possible different approaches (*e.g.*, clear uncontaminated areas first then quantify contaminated areas, etc.) • Resource limitations for sampling/analysis: use of statistical methods, differing needs of various national/international agencies, use of labs not routinely monitoring radioactivity (*e.g.*, dairy labs), use of labs in other countries, quality control • Sample analysis and data interpretation • Data archiving and retrieval for compensation claims, etc. *Linked actions:* Response to possible health impacts, monitoring and decontamination of inhabited areas and environment, financial/compensation
Registration and census of affected populations; exposed population should be identified, receive an initial medical assessment and be provided with accurate and timely information regarding their exposure level and associated potential risk; process for assessing, reconstructing, record doses Procedures for dealing with anxiety, population reassurance, reassurance monitoring, trauma counselling Consider long-term health surveillance programmes of specifically identified sub-groups of the exposed population: sensitive populations, populations most at risk according to dosimetry and/or dose-reconstruction results and possibly specifically identified persons upon request; long-term medical and psychological follow-up, medical follow-up of future generations Medical professionals should receive specialised training on responding to a nuclear or radiological emergency (including psychological effects) Methods for communicating with local medical professionals in an emergency so they can provide event-specific information to their patients *Linked actions:* Monitoring and decontamination, financial/compensation
The objective is to maintain a clean or safe supply, and move towards a return to normal production/markets. Actions addressing the safety of the food and drinking water supply should be taken early in the response. Before any emergency, it is necessary to prepare public messages about food or drinking water restrictions. Considerations include: • Existing legal requirements, regulations and guidance, including standards or criteria for food, agricultural products, drinking water • Type and scale of contamination; timeframes • Monitoring capabilities • Monitoring and modelling results • Alternate supplies • Public acceptance • Maintenance of culture and traditions

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Table 9. **Examples of types of consequence management countermeasures** (Cont'd)

Type of countermeasures
Countermeasures for agricultural and food production systems; Countermeasures for food and drinking water; Dietary aspects
Monitoring and decontamination of inhabited areas and environment
Waste storage/disposal
Restoration of services, infrastructure, economic activity, population movement, environment
Financial/compensation

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Table 9. **Examples of types of consequence management countermeasures** (Cont'd)

Issues and considerations
Countermeasures for food production systems – considerations include: • Physical and/or chemical treatment of soils and water. • Changes in husbandry practices. • Provision of feed additives to livestock. • Alternative land uses; industrial scale food processing to remove contamination. • Selection of alternative drinking water supplies. Reducing exposure from ingestion to as low as reasonably achievable may involve the implementation of more complex protection strategies which apply to all levels of the food chain or drinking water supply, including: • Primary production (animals, plants). • Primary water supply. • Processing (food or water industries). • Transport and storage (warehouses). • Distribution (restaurants, super-markets). • Modification of personal behaviour. Long-term restrictions on the consumption of foods or drinking water are difficult to maintain and are, in principle, incompatible with the sustainable development of the territory. Whenever possible, countermeasures should be implemented in a manner that limits the impact on the distribution and consumption of local produce or drinking water. There may be situations where the authorities decide that a sustainable agricultural economy in the contaminated areas is not possible without allowing contaminated food to enter the market. As such foods will be subject to market forces, this will necessitate an effective communication strategy to overcome the negative reactions from consumers and the food industry.
The objective of monitoring and decontamination actions is to reduce the levels of contamination on objects, buildings, areas and lands to levels that are socially acceptable as the emergency situation moves into the recovery phase. In the long term, further reductions will depend on stakeholder discussions and on optimisation considerations, including modification of personal behaviour. Monitoring – considerations include: • Development of monitoring strategies, including identification of relevant areas, consideration of modelling results. • Maintaining equipment/resources or loan of specialised monitoring equipment and expertise. • Undertaking field measurements; techniques, effectiveness, cost, specialised equipment and expertise. • Limits on resources for sampling and analysis. • Sample analysis and data interpretation. • Data archiving and retrieval for compensation claims, etc. Decontamination actions – considerations include: • Existing legal requirements, regulations and guidance (based on dose and/or contamination levels) regarding clean-up criteria for areas, buildings or objectives, standards for consumer goods, etc. • Existing international guidance in terms of international transport/trade. • Consideration of actual levels of contamination in the environment. • Development of clean-up objectives and approaches with stakeholders, noting that different acceptable levels could be applied to different areas. • Consideration of countermeasures within an optimised protection strategy. *Linked actions:* Monitoring of populations.
Options for waste storage and disposal will depend on existing legal requirements, regulations and guidance; available/ planned facilities. Communication and explanation to stakeholders, including mechanisms for feedback on acceptability. Types of waste: Radioactive/below exemption limits, organic, building materials, chemically/biologically hazardous (*e.g.*, asbestos, biochemical oxygen demand of milk wastes, etc.). Volumes of waste to be disposed: Estimates of types, quantities for choosing appropriate countermeasures; tools, procedures for estimation. National facilities: Identification of facilities (actual/planned). Consider capacities for handling waste in choosing countermeasures and in designation of radioactive waste or below any applicable exemption limits.
The objective of restoration is to return to normal social and economic activity after an emergency to the extent possible. Considerations include: • Existing legal requirements, regulations and guidance. • Identification of types of infrastructure that may need monitoring, decontamination, etc. (power plants, distribution networks, infrastructure, transportation (roads, train, airplane, ship etc.), public spaces. • Prioritisation for restoration. *Linked actions:* access control, relocation, monitoring and decontamination.
The aftermath of an emergency may feature a number of legal considerations, as well as issues of liability, insurance, mechanisms for compensation of affected populations and financial reimbursement, tribunals of inquiry, accusations of negligence or criminal activity. Legal issues may continue for many years and, as a result, agencies will need to ensure that they have comprehensive records of all decisions, actions and expenditures. There may also be significant resource implications for agencies, which are involved in long-term inquiries and litigation. These issues are likely to start appearing as the organisations move into consequence management and the transition to recovery

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Develop protection strategies and decision support structures

Protection strategies for consequence management aim to address the identified objectives and priorities for the response (*e.g.*, protect populations, rapidly restore critical infrastructure or limit social-economic impacts) in a coherent and optimal manner. A protection strategy will be composed of individual countermeasures or packages of linked countermeasures addressing the anticipated dominant exposure pathways and response priorities. The strategy should follow from an optimisation process aimed at reducing the anticipated residual dose to as low as reasonably achievable below an established reference level of dose. The optimisation process should take into consideration all relevant legal, regulatory, technical, social and economic factors, and lead to the elaboration of appropriate considerations or criteria for its implementation.

The goal of the optimisation process is to achieve a level of protection that will be the best under the prevailing circumstances (ICRP, 2007). By addressing all countermeasures collectively, rather than individually and independently, it is possible to maximise the overall benefit of the response, bearing in mind the final residual dose, the linkages between countermeasures, their costs, detriments and how these should be managed, including their impact on other countermeasures making up the strategy. By addressing all countermeasures collectively, the dominant exposure pathways can be dealt with strategically and simultaneously, reducing possible incompatibilities between countermeasures.

The manner of implementing the countermeasures comprising the protection strategy will influence the overall net benefit achieved. Beyond legal, regulatory and technical criteria, social and economic consequences should also be considered in the optimisation process. The involvement of potential stakeholders in this process will help to ensure that the protection strategies are generally optimised, feasible and acceptable with respect to all relevant factors. In addition to individual countermeasures that should be considered (Tables 8-9), the development, optimisation and implementation of protection strategies for consequence management should also take into account the actions planned and implemented for the early phase response. This will be critical to ensuring coherency in the overall emergency management approaches (see Part A).

Once optimised, criteria or other considerations should be developed for initiating the full strategy and for individual countermeasures within the strategy based on the anticipated exposure pathways and possible doses in an actual emergency situation. In an emergency, these criteria will be useful for determining if the full strategy or only selected countermeasures should be implemented (for example, a strategy may include a particular package of actions to address an exposure pathway which turns out not to be dominant in an actual emergency due to the characteristics of the event).

ICRP (2007, 2009) has recommended optimisation be applied in a generic manner at the planning stage and then operationally adjusted, as required, during an emergency. The need to consider such adjustments will increase as the emergency exposure situation progresses. Protection strategies should therefore be supported by processes for their modification based on event characteristics, earlier decisions and an increasing amount of stakeholders' input. This will require an identification and understanding of the impacts of these factors on the countermeasures that may be included within a strategy. As the decision-making considerations associated with each countermeasure are complex, these should be accounted for when developing the strategy and then summarised in a clear and concise manner for decision makers to consider in an event. Table 10 provides a non-exhaustive list of the types of issues to be considered in the optimisation process.

It is important to note that while this approach allows the response to be considered in a coherent and integrated manner, different but legitimate prioritisations adopted by different countries in the optimisation process may lead to different consequence management options. For example, as part of the emergency management framework, authorities may establish requirements to be met (*e.g.*, guidelines for maximum permissible concentrations), but not necessarily the endpoint that might be achieved by the optimisation (*e.g.*, values lower than the guidelines). This will be determined by the priorities adopted, and may lead to justified but different values or approaches in countermeasure implementation as a result of the optimisation process. As relevant stakeholders (government, industry, public, etc.) may have different priorities, such optimisation should be undertaken beforehand with stakeholders as part of planning.

Subsequent modification of the strategies based on the characteristics of an actual event should also be undertaken, as appropriate, later in the response as the emergency management moves from an initial top-down approach (based on rapid implementation of pre-defined protection strategies

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during the crisis management) to an approach that includes stakeholders' input in the decision-framing process for consequence management and recovery. Consultation between countries on national approaches as part of preparedness will increase the compatibility of decision making by helping to identify and explain potential sources of differences.

Table 10. **Considerations in the optimisation of protection strategies**

Considerations within an iterative process of optimisation
A. Information needed • Response objectives and priorities. • Dominant exposure pathways; reference level of residual dose. • Types of individual countermeasures that should be considered to address dominant pathways. • Objectives of various countermeasures (*e.g.*, restrict access or rehabilitate). • Timeline. • Legal, regulatory, technical, social and economic considerations associated with each countermeasure (see previous tables). • Stakeholders' input. • Necessary background data (technical, demographic, etc. – should already be available). • Develop strategies and structures to adjust generic protection strategies as needed. • Implementation of a protection strategy. – Identify event. – Implement protection strategy. – Adjust as needed based on event characteristics and stakeholders' feedback. • Modelling and monitoring results (across the emergency management timeline). – Characteristics of affected areas (population, industry/agriculture land use, water supplies). – Information on time of year (*e.g.*, for growing season, harvesting time), weather (dry/wet deposition, wash off of contamination after deposition etc.). – Role of monitoring results in applying/ceasing countermeasures. – Predictions/measurements on level and extent of contamination and potential doses. – Predictions on evolution of contamination in foods, area, etc. – Understanding uncertainties and limitations of any strategy chosen – links to modeling. – Time-scale for reduction to occur. • Feedback on effectiveness of protection strategies chosen, implemented. – Countermeasure effectiveness for a given radionuclide, plant, animal, building type, soil, etc. • Acceptability of countermeasures to those responsible for their implementation and to the public. ***B. Social impacts*** • Disruption of normal social, economic, political and cultural context; feeling of loss of control. • Loss of traditional industries/agriculture; loss of international markets for goods/produce; loss of income; black-market for food/supplies. • Loss in confidence in affected area for future investment; longer-term effects of government/NGO assistance. • Population movements – social effects on both old and new communities, migration of younger and more affluent populations from "contaminated" area. • Efforts to minimise social impacts; policy and strategies for the long-term management and recovery of potentially contaminated areas with the involvement of all stakeholders.
Once a protection strategy has been optimised, criteria or considerations for implementation should be developed • Food and water: Set contamination criteria based on directly measurable levels of contamination (activity concentration). Consider guideline levels developed by the Codex Alimentarius Commission for use in international trade (FAO/WHO, 2009). • Other countermeasures: Inclusion of a process for initiating later phase protective measures appropriate to the characteristics of the evolving emergency situation, including decisions already taken and an increasing level of stakeholder involvement.

An additional consideration in the development and implementation of protection strategies will be to determine if any identified resources and capabilities will be established, maintained and resourced within the remit of the national emergency response structure, or whether they will be requested from external parties through pre-planned arrangements, including with private industry, through bi- and multi-lateral agreements or through international assistance mechanisms, such as enactment of the IAEA Response and Assistance Network (IAEA, 2006).

Implement and terminate protection strategies

In developing protection strategies, it is important to identify and plan for the types of countermeasures likely to be effective in addressing the evolving emergency situation. This includes criteria or considerations for both implementation and termination of protection strategies, and a method for

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tracking their progression and effectiveness in an actual emergency. However, in contrast to arrangements for crisis phase urgent countermeasures, the criteria and considerations for implementing and terminating protection strategies for consequence management will be generally less reliant on pre-planned triggers, since decisions on appropriate actions should generally take account of the increasing level of situation specific information and opportunities for optimisation.

Decisions to implement protection strategies for consequence management will be based on the identification of the situation and its ongoing evaluation, assessment and adjustment of previously implemented countermeasures, and recommendations to decision makers on an appropriate course of action. Considerations in the decision process include the increasing level of event-specific data, the types and effectiveness of actions already taken, an increasing level of stakeholders' input, and co-ordination of actions and information with other countries (particularly for addressing an emergency abroad). As such, processes and tools for adjusting and implementing pre-planned generic protection strategies in real-time should be developed to support emergency managers and decision makers.

Similarly, decisions to terminate a protection strategy or individual countermeasures within a strategy should reflect the actual characteristics of the emergency exposure situation. Countermeasures should be terminated and withdrawn when successfully implemented, no longer applicable, or when event changes indicate the need for different approaches. When possible, the criteria and considerations for terminating countermeasures should be agreed in advance of implementing them, with relevant stakeholders, and be supported by the same processes and tools for their implementation.

3.3 Managing the transition to recovery

Identify potential issues that will need to be addressed during the long-term recovery and rehabilitation. Develop a framework recovery plan as part of preparedness with basic common issues to facilitate the recovery operations, for detailed elaboration in response to a specific emergency and including a description of roles, responsibilities, priorities, timeline and financial implications.

Develop a recovery plan framework as part of preparedness

An effective response to consequence management and the transition to recovery will prepare the groundwork for long-term recovery actions leading towards a return to normal social-economic activity. According to the ICRP (2007) philosophy, the management of public exposures in the long term following an emergency should be treated as an existing exposure situation (and related occupational exposures should be treated as part of a planned exposure situation). The change from an emergency exposure situation to an existing exposure situation will be based on a decision by the authority responsible for the overall response. However, the transition will begin before termination of the emergency situation and the potential handover of responsibilities to new organisations.

The transition will include the termination of emergency countermeasures, ramp-down of emergency response structures and preparation for new recovery structures and programmes to manage identified issues, including decontamination and waste management. To efficiently manage this transition, detailed recovery plans should address the characteristics of the post-emergency situation and the identified recovery issues. Therefore, they can only be elaborated in detail in response to the specific situation. This will be facilitated if, as part of emergency preparedness, a generic recovery framework is prepared, including the identification of all implicated organisations. By including this as a core task within emergency preparedness, planners and organisations can already begin to identify what needs to be addressed. This will further allow relevant issues, as well as what types of decisions may impact later-phase recovery issues, to be flagged early in the emergency.

A very high level of stakeholder interaction can be expected with respect to recovery issues, thus the framework should provide a mechanism for identifying and involving all relevant stakeholders in a co-ordinated manner. A planning framework for developing a recovery plan is elaborated in Table 11. As with overall emergency planning, arrangements need to remain flexible in order to match the specific emergency situation.

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Table 11. **Framework for developing a recovery plan**

Plans for recovery elaborated during the transition period should explain the link between consequence management and recovery phases, address the key issues coming out of the emergency response, and be supported by all partner organisations. These can only be developed in detail in response to an actual emergency situation, but should address as a minimum the following key elements:

- *Objectives:*
  - Elaboration of recovery objectives, including consideration of actions already taken prior to the transition to recovery.
- *Changes in organisational structure:*
  - Membership and roles of the national response co-ordination group during the various phases.
  - Basis for the proposed recovery structure and identification of recovery organisations: Roles and responsibilities.
  - Agreed process/mechanism for identifying the point at which any hand-over of responsibilities will take place. The point of transition is not defined ahead of time, but the process/mechanism to allow this to be identified in the actual situation should be described.
- *International Interfaces:*
  - Co-ordination with neighbouring countries and international organisations as appropriate.
- *Issues, actions and rationale to be addressed:*
  - Populations, infrastructure, agriculture, waste management and disposal, decontamination, etc.
  - Termination/lifting, reducing or continuing protective actions, introducing new protective actions or other actions to lead towards recovery.
  - Associated interfaces and stakeholders.
- *Recovery actions:*
  - Approaches proposed, resources, timelines for long-term recovery actions lead and undertaken by i) governments, or ii) implicated stakeholders (so-called "self-help" actions).
- *Mechanisms for stakeholder involvement.*

To ensure effective implementation of the response plan, each response agency should plan for its own involvement in the recovery

Identify potential issues for recovery management

The recovery period may be as demanding on the resources and staff of responding organisations as the emergency itself and is likely to last over a longer time period, thus it is important to develop the detailed plans for recovery as part of the transition to recovery, based on the framework developed during preparedness. The transition to recovery should focus on preparing organisations and stakeholders to address the identified recovery issues and actions. These issues (radiological protection, socio-economic) and the types of required recovery operations will depend on the characteristics of the post-emergency situation, including the response that has been undertaken to address the emergency. Stakeholders' ownership of relevant recommended long-term protective actions will also be an important consideration in ensuring their implementation and effectiveness for as long as needed. This requires identification and involvement of all organisations and stakeholders implicated in the recovery structure, including potential changes in decision-making authorities.

Recovery management will be facilitated by establishing a mechanism for identifying potential recovery issues as they arise, beginning early in the response, and assessing how recovery management may be impacted by any decisions taken over the course of the emergency situation. The need for identifying and co-ordinating recovery issues as they emerge during the emergency is one of the key elements of a recovery framework and should be part of the emergency management arrangements. As such, it may be appropriate to appoint a working group to begin recovery planning early in the response. Such groups should be cross-cutting in order to identify the broad range of potential issues, and be well-integrated into the emergency response organisation; this approach has been adopted as the default position in some countries.

In addition to ensuring an organised, agreed hand-over of responsibilities to possible new organisations as response moves to recovery, it is important to have clear arrangements to deactivate any response organisations or response teams. The decision to stand-down a function or organisation should be evaluated in the context of the actual conditions, and all organisations involved in the response should be informed of the stand-down decision. Additionally, recovery management structures are often less well-defined than the emergency management structure, with possible changes in responsibilities and lead agency and with more involvement of stakeholders from civil society in the decision-making process. To ensure that the momentum of operations is not lost and to avoid periods of uncertainty, it is important to ensure that all necessary arrangements for long-term recovery have been identified and put in place, and that organisations are ready to undertake their roles before initiating the switch from the emergency management structure to longer-term response structure.

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The financial implications of a major emergency on the government and principal response agencies will also be an important consideration. The resources for response will, by definition, not have been budgeted for, but will have had to be met upfront by the responsible agencies; significant unbudgeted costs may also arise during recovery. Additionally, the financial implications of the emergency and its management will become more evident both within the country and in other countries during the recovery phase. For this reason, it will be important to involve organisations that direct national/local finances in the recovery co-ordination group even if these organisations were not involved in the crisis committee. It may also be necessary to involve the insurance industry as part of recovery co-ordination. In situations where international liability conventions apply, it will be important to clarify, as part of planning, the mechanisms that will be used to facilitate claims and compensation for affected parties in other countries.

3.4 Developing and maintaining processes for stakeholder involvement

Identify and involve relevant stakeholders in emergency preparedness in order to improve the development and implementation of appropriate protection strategies and the transition to recovery.

Stakeholder involvement involves dialogue between affected parties – government and non-government organisations and civil society – to address common issues for which the parties are implicated in terms of experiencing and/or mitigating the impacts. The objective is to improve the decision-framing process, the sustainability of decisions taken by the responsible decision makers, and the education and training of the stakeholders themselves with respect to the planning arrangements.

Following the crisis phase of an emergency, in which little stakeholder interaction is foreseen due to the urgency of actions to prevent severe radiological harm, the degree of interaction will increase as other issues begin to be addressed and resolved. For many countermeasures foreseen for consequence management and recovery, stakeholders outside of the formal emergency management structure will play an important role, for example in protection strategies addressing agricultural production, transportation, or behaviour modification. Such actions cannot be imposed on stakeholders by response officials. Therefore, their success will depend largely on the input of stakeholders into their formulation (issues, options, feasibility, impacts) and on the acceptability of the actions proposed. For example, the input of farmers and the food industry will be critical in the development of feasible and acceptable agricultural and food countermeasures. Further, unless the public has confidence in the processes undertaken to ensure the safety of food produced and released to the marketplace, agricultural countermeasures introduced to reduce or eliminate radioactivity in foods may be ineffective and a waste of efforts and resources.

An important factor in the success of the post-crisis management will therefore be effective and meaningful processes for stakeholder involvement (NEA, 2006). To support the increasing role of stakeholders in the development of possible countermeasures, mechanisms to support their involvement during the preparedness phase should be developed and implemented. While the focus of these mechanisms is on involving all stakeholders in common dialogue, these processes will be supported through communications with the media.

Implementation and sustainability of such mechanisms may also require changes in operational structures of organisations to support stakeholder involvement. However, resource constraints on stakeholders, including radiological protection institutes, mean that a highly developed, active, long-term stakeholder involvement approach cannot be applied everywhere, all of the time. However, as far as possible, a basic transparent and open approach should be maintained (NEA, 2009).

It should be recognised that approaches for stakeholder involvement are highly dependent on the legal and cultural contexts of each country. These should therefore be developed as appropriate within each country, recognising that other countries may have adopted different approaches (see, for example, NEA, 2010). To this end, basic topics and considerations for stakeholder involvement as part of consequence management and recovery are provided in Table 12. While possible approaches to stakeholder involvement have been described elsewhere, there remains a need to continue the exchange of information at the national and international level on good practices in stakeholder involvement as part of emergency preparedness and in post-emergency management.

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Table 12. **Topics and considerations for stakeholder involvement**

Stakeholder aspects	• Existing legal requirements, regulations and guidance. • Processes for handling an increasing level of stakeholder involvement. • Identification of relevant stakeholders. • Mobilising stakeholders' interest during preparedness, maintaining involvement, balancing views of different groups. • Education of stakeholders on relevant preparedness and response issues, education of emergency preparedness experts on stakeholders' concerns. • Method and timing for stakeholder involvement after the crisis phase. • Explaining reasons for decisions following stakeholders' input .
Strategy for stakeholder dialogue	Ongoing dialogue with stakeholders in preparedness and response: • Build and maintain dialogue with stakeholders as part of preparedness; communicate with stakeholders before an emergency; provide co-ordinated, timely, accurate information and clear advice during response. • Prepare in advance information on countermeasures that may need to be applied, explaining effectiveness, side-effects if any. • Implement mechanisms for reaching the public – television, radio, internet, help-lines, advertisements, SMS messaging, etc. • Use existing channels of communication to disseminate information *e.g.*, dairies/creameries to farmers; travel companies to travellers; medical centres and pharmacies to patients and populations; local interest groups, community awareness programmes, local libraries; etc. • Target special groups – radiation protection and medical professionals, relocated populations, business owners, farmers, food producers. • In the longer-term, education of school children by visits to schools and training of local teachers can be an effective way of disseminating information in a community. Communications to the media: • Have arrangements in place for the media to carry public information notices for important messages, and to support ongoing dialogue of stakeholders, including communicating outcomes. • Provision of information via press statements, press conferences, web-sites, etc.; anticipating the main questions regarding protection strategies implemented, media monitoring to verify effectiveness of messages. • Provide access to senior management, senior experts and public representatives for interviews and ensure they are trained to deliver key messages. • Arrange visits by the media or VIPs to the site of the incident or sites where recovery actions are ongoing. Such visits can present opportunities for raising awareness, reassuring the public of ongoing vigilance by the authorities and promoting key messages.

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4. Summary

The ultimate goal of nuclear or radiological emergency management is to return affected areas to normal social and economic activity to the extent possible. While this goal will present challenges to response organisations, affected populations and other segments of society, its fulfilment will be facilitated by the co-ordinated management of the emergency consequences and the transition to recovery, as this will set the context for long-term recovery. Management strategies that are developed and implemented as part of the emergency preparedness phase will improve decision making throughout the emergency response. However, since a key aspect of the post-crisis phases of the emergency management timeline is that the actual conditions may be difficult to predict in detail in advance, it is important to plan structures and strategies for consequence and recovery management rather than specific actions. It is also essential to ensure that these are understood, exercised and sufficiently flexible to allow authorities to respond appropriately.

Building on the generic decision-making framework presented in Part A of this report, Part B has elaborated a framework for addressing issues in consequence management and the transition to recovery as identified from the INEX 3 exercise. A planning framework that provides key common elements in the management process will allow consequence management to be carried out in a coherent manner, and facilitate the efficient development of recovery plans when required. The framework proposed in this report includes key elements and issues to consider in the development, implementation and management of protection strategies for consequence management, including a view of the types of actions that could be considered and relevant criteria for the related decision process. The strategic elements address the aspects of consequence management and the transition to recovery that can most effectively be planned in advance, namely building an appropriate emergency management structure for post-crisis management, developing optimised protection strategies and a generic recovery framework, and creating conditions for stakeholder involvement. It is expected that the readers of this report should be able to use these generic elements and related considerations to develop plans, procedures and resources specific to their own national context.

As with Part A of this report, it is hoped that consideration of this framework by emergency planners and decision makers will facilitate compatible and/or consistent approaches to consequence management and recovery amongst the multiple layers of organisations and entities involved in responding to emergency situations as well as between different countries.

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Annex 1

Compendium of possible countermeasures for consequence management

The following table provides a non-exhaustive list of possible countermeasures that could be considered when developing protection strategies for consequence management and the transition to recovery, harmonised with Part B, Table 9. It has been derived from various sources, including the EURANOS, FARMING and STRATEGY projects – see Annex 2: Bibliography of related programmes.

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Table A1. **Examples of countermeasures for consideration in consequence management and the transition to recovery**

Type of countermeasures	Examples
Access control	• Prohibit access by public to affected areas • Restrict access by workforce (restrict time or personnel) to affected areas
Relocation	• Temporary relocation from residential areas • Permanent relocation from residential areas
Monitoring of populations, inhabited areas and environment	• Provision and distribution of monitoring equipment • Monitoring of populations to identify contaminated individuals • Monitoring of populations to reassure uncontaminated individuals • Monitoring of inhabited areas for dose assessments • Monitoring of infrastructure, transportation, etc. • Monitoring of goods, etc. • Monitoring of domestic animals • Environmental monitoring in potentially affected areas (see also Countermeasures for agricultural and food production systems)
Medical surveillance and follow-up	• Register of contaminated persons to allow any necessary medical follow-up • Ongoing medical surveillance of people
Countermeasures for agricultural and food production systems Countermeasures for food and drinking water Dietary aspects	• Import and/or export restrictions • Restrictions on use of contaminated water for crops/animals (irrigation/watering of livestock) • Early mowing and discarding of fodder • Greater cropping height of harvest and discarding of upper parts of plants (requires specialised combine harvesters) • Addition of ammonium-ferric-hexacyano-ferrate (AFCF) to concentrate ration (animal feed) • Administration of AFCF boli to ruminants • Distribution of saltlicks containing AFCF • Addition of calcium to concentrate ration (animal feed) • Administration of clay minerals to animal feed • Clean feeding of animals • Clean feeding of animals for appropriate period prior to slaughter • Live monitoring of animals • Change of hunting season • Manipulation of slaughter times • Keep live fish in uncontaminated water after catching • Use of decontamination techniques (*e.g.*, ion exchange) for milk • Processing of milk for subsequent human consumption (*e.g.*, production of cheese) • Selective grazing regime • Slaughtering of dairy livestock • Suppression of lactation before slaughter • Application of lime to arable soils and grassland • Application of potassium fertilisers to arable soils and grassland • Land improvement (ploughing, rolling, reseeding and application of NPK fertilisers and lime) • Processing of crops for subsequent consumption • Production of canned vegetables/mushrooms (rejecting cooking water) • Production of canned fruit (after peeling) • Production of fruit juice by mechanical extraction • Electrodialysis of clear apple juice • Treatment of fruit juice by adding bentonite or kaolin • Treatment of fruit juice using prussiate ion exchangers or zeolites • Production of wine from grapes • Treatment of wine with potassium ferrocyanide (“blue fining”) • Grinding corn • Removing the chaff on the production of bran as food • Extracting starch from corn, maize and potatoes • Extracting oil from oleaginous fruits (legumes, rape, sunflowers) • Making sugar from sugar beets • Further processing of vegetable products to alcohol • Pruning/defoliation of fruit trees and vines • Selection of edible crop that can be processed

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Table A1. **Examples of countermeasures for consideration in consequence management and the transition to recovery** (Cont'd)

Type of countermeasures	Examples
Countermeasures for agricultural and food production systems Countermeasures for food and drinking water Dietary aspects	• Salting of meat • Marinate/boil/pickle food and reject liquid before eating • Using natural casing in the production of cooked sausages • Ploughing in of crops/vegetables/grass • Shallow ploughing • Skim and burial ploughing • Deep ploughing of land for crops • Topsoil removal • Dilution of contaminated food/milk/water with uncontaminated food/milk/water • Use of crops/milk in excess of contamination criteria as animal feed • Leaching of horticultural peat • Prevention of fire in forests, shrub land and other sensitive areas • Selection of alternative land use (*e.g.*, cultivation of plants not intended for consumption) • Alternative use of contaminated biomass for energy production • Monitoring of foodstuffs • Restrictions on sale of certain foods • Dietary advice to consumers • Food labelling • Restrict gathering of wild foods • Wash and peel vegetables/fruit Countermeasures against short-lived radionuclides: • Postpone harvest of leafy vegetables/fodder • Decay storage of suitable foods • Drying and decay storage of suitable products (*e.g.*, hay, herbs, spices, dried meats) • Conservation and decay storage of animal feed (silage) • Decay storage of factory preserved products (*e.g.*, canned goods) • Production of long-life dairy products Countermeasures for drinking water • Restrict use of rainwater/shallow surface water • Provide alternative drinking water supply • Purification of water at treatment plants • Changes to water abstraction points or location of water source • Controlled blending of drinking water supplies • Purification of drinking water at the point of use (tap)
Decontamination	• Decontamination of people, infrastructure, environment, etc.
Decontamination: indoor	• Vacuum cleaning, using appropriate personnel protective equipment • Washing • Other cleaning methods (scrubbing, shampoo, steam cleaning etc.) • Surface removal *e.g.* paint, wallpaper, carpets etc. • Removal of furniture, soft furnishings and other objects • Aggressive cleaning of indoor contaminated surfaces in large public buildings • Storage, shielding/covering, gentle cleaning of precious objects
Decontamination: outdoor	• Grass cutting • Plant and shrub removal • Turf harvesting • Top soil and turf removal (mechanical/manual) • Add layer of clean soil • Demolish buildings • Fire hosing/high pressure hosing • Sandblasting (walls) • Roof brushing • Roof cleaning with pressurised hot water • Roof replacement • Treatment of walls with ammonium nitrate • Mechanical abrasion of wooden walls • Tie-down (fixing contamination to the surface) • Turning paving slabs • Vacuum sweeping of roads/paths • Surface removal (road planning) and replacement

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Table A1. **Examples of countermeasures for consideration in consequence management and the transition to recovery** (Cont'd)

Type of countermeasures	Examples
Decontamination: outdoor (Cont'd)	• Rotovating of soil/grassy areas (mechanical digging) • Manual digging • Cover grassed and soil surfaces (*e.g.* with asphalt) • Triple digging • Ploughing • Deep ploughing • Skim and burial ploughing • Peelable coatings • Snow removal • Collection of fallen leaves • Tree & shrub pruning/removal
Decontamination: specialised surfaces	• Ultrasound treatment with chemical decontamination • Cleaning of contaminated ventilation systems • Filter removal • Chemical cleaning of metal surfaces, plastic and coated surfaces • Application of detachable polymer paste on metal surfaces • Electrochemical cleaning of metal surfaces
Waste storage/disposal	• Establish repositories or storage facilities for radioactive waste • Biological treatment (digestion) of crops • Biological treatment (digestion) of milk • Burial of animal carcasses • Burning of animal carcasses/crops • Composting of crops/grass • Disposal of contaminated milk to sea • Incineration • Landfill • Land spreading of milk and/or slurry • Ploughing-in of a standing crop • Processing and storage of milk products for disposal • Rendering of animal carcasses
Restoration of services, infrastructure, economic activity, population movement, environment	• Raise contamination criteria to allow resumption of local practices • Provide public information on contamination levels/associated risks • Provide local monitoring • Decontaminate buildings, land etc.
Advice to the population	• Travelling • Dietary • General counselling
Financial/Compensation	• Compensation scheme for public, businesses, farmers, food industry, retailers etc.

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Annex 2

Bibliography of related programmes

This bibliography contains a non-exhaustive list of several international and national programmes relevant to the topics discussed in this report, for which the reader may find interest.

- CORE (Co-operation for Rehabilitation of living conditions in Chernobyl affected areas in Belarus)

  Objective: improve the living conditions of the inhabitants of selected districts by reaching out to the people themselves, helping them to contribute to formulating specific individual and common project proposals.

  http://www.core-chernobyl.org/eng

- EURANOS (European approach to nuclear and radiological emergency management and rehabilitation strategies)

  Objective: bring together best practice, knowledge and technology to enhance the preparedness for Europe's response to any radiation emergency and long-term rehabilitation, including, amongst others: collate information on the likely effectiveness and consequences of a wide range of countermeasures; provide guidance to emergency management organisations and decision makers on the establishment of an appropriate response strategy; and develop guidance which assists Member States in developing a framework for the sustainable rehabilitation of living conditions in contaminated areas.

  EURANOS products include:

  Generic Handbook for Assisting in the Management of Contaminated Food Production Systems in Europe following a Radiological Emergency, EURANOS(CAT1)-TN(09)-01, (v 2.0, 2009)

  Generic Handbook for Assisting in the Management of Contaminated Inhabited Areas in Europe Following a Radiological Emergency. Part I: Decision-making Framework, EURANOS(CAT1)-TN(07)-02 (V1.0, 2007)

  Generic Handbook for Assisting in the Management of Contaminated Drinking Water in Europe following a Radiological Emergency, EURANOS(CAT1)-TN(06)-09-02 (v2.0, 2009)

  Sustainable rehabilitation of living conditions in contaminated territories after a nuclear accident or a radiological event: Guidance for engaging inclusive rehabilitation strategies, EURANOS(CAT3) – RTD 01, (2007)

  http://www.euranos.fzk.de

- FARMING (Food and Agriculture Restoration Management Involving Networked Groups)

  Objective: set up a network of stakeholder working groups in five Member States, involving more than 50 individual stakeholders, to assist in the development of robust and practicable strategies for restoring and managing contaminated agricultural land and food products in a sustainable way.

  ec.europa.eu/research/energy/pdf/off-site_nuclear_emergency_mangement_en.pdf

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- STRATEGY (Sustainable Restoration and Long-Term Management of Contaminated Rural, Urban and Industrial Ecosystems)

  Objective: develop and assess new methods whereby individual countermeasures can be combined within a robust, realistic, cost effective and socially acceptable restoration strategy, to advance the European Member States abilities to sustainably manage the long-term consequences of any future nuclear incident.

  http://www.strategy-ec.org.uk/
  ftp://ftp.cordis.europa.eu/pub/fp5-euratom/docs/strategy.pdf
  http://www-naweb.iaea.org/nafa/emergency/countermeasures.htm (Joint IAEA/FAO Programme)

- France: CODIRPA (Comité directeur pour la gestion de la phase post-accidentelle)

  Objective: prepare an approach for post-accident situation management following a nuclear or radiological accident with dispersal of radioactive substances over French territory.

  http://www.asn.fr/comite-directeur-pour-la-gestion-de-la-phase-post-accidentelle-1

- United Kingdom: UK Resilience website

  Objective: provide a resource for civil protection practitioners, supporting the work which goes on across the United Kingdom to improve emergency preparedness

  http://www.cabinetoffice.gov.uk/ukresilience/response.aspx

- United Kingdom: UK Nuclear Recovery Plan Template, UK Nuclear Emergency Planning Group (NEPLG) Consolidated Guidance (Chapter 18)

  Objective: provide specific guidance on recovery from events involving an off-site radioactive release from a civil or defence nuclear reactor as well as events involving nuclear weapons or special nuclear materials in transit. The template is based on the UK National Recovery Guidance and Recovery Plan Guidance Template.

  http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/issues/emergency_plan/neplg/guidance/guidance.aspx

- United Kingdom: UK Recovery Handbook for Radiation Incidents: 2009 (HPA-RPD-064)

  Objective: assist decision makers in the management of contaminated food production systems, drinking water and inhabited areas following an incident in which radioactive material is dispersed into the environment.

  http://www.hpa.org.uk/Publications/Radiation/HPARPDSeriesReports/HPARPD064

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Annex 3

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