Review of Current Off-site Nuclear Emergency Preparedness and Response Arrangements in EU Member States and Neighbouring Countries

ENER/D1/2012-474

Final Report

Main Text

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ENCO FR-(13)-29

Catalogue number MJ-01-14-256-EN-N
ISBN 978-92-79-36547-8
DOI 10.2833/20298

Prepared by:

for European Commission, DG ENER

December 2013

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EUROPEAN-LEVEL ACTIONS TO IMPROVE OFF-SITE NUCLEAR EMERGENCY PREPAREDNESS AND RESPONSE

The findings, conclusions and recommendations developed in this study are set out in detail in Section 12 of this report and are summarised in the Executive Summary. They are wide-ranging, covering technical, organisational, legal and other issues, are aimed at different actors (eg, Member States, individually or collectively, associations of competent or regulatory authorities in Europe, as well as the European Commission), and vary in the priority they should be given. An effective response to the conclusions and recommendations of this study will require action at a European level and initiatives by the European Commission. The relevant key findings and priority actions, at a European level, are identified below.

The study findings show that current arrangements and capabilities for off-site nuclear emergency preparedness and response (EP&R) appear, on paper, to be broadly compliant with current EU legislative requirements and international guidance. However, these findings need to be confirmed by a more in depth examination of arrangements **in practice**. In addition, a number of gaps and inconsistencies were identified that need to be addressed.

The findings highlight the need for a response, at a European level, in the following areas:

Provide greater assurance to the EU public: Whilst the organisational, decision-making structures, resources and capabilities at national and local level appear generally to meet legislative requirements or international guidance, a stronger demonstration of the adequacy of these arrangements **in practice** would enhance public confidence. This could be achieved by extending the use of peer reviews or other suitable verification mechanisms, coupled with the development of formal guidance or Codes of Practice on what constitutes best practice, to off-site nuclear EP&R, in addition to those for other areas of nuclear safety. This would also facilitate greater sharing of experience and technical exchanges and promote greater harmonisation at the EU level.

Longer term protective measures: The most significant gap in arrangements identified concerns a general lack of strategies and arrangements for longer term protective measures and for the return to normality following an emergency. These issues were hugely problematic for many years in the Former Soviet Union in managing the aftermath of the Chernobyl accident and similar problems are being encountered in Japan post Fukushima. This gap represents a significant risk for Europe as a whole that could have major and lasting social, economic and political consequences in the event of any future accident in Europe. This issue merits action, as soon as practicable, at a European level.

Harmonisation of criteria: Although international standards and guidance exist and all EU MS's are signatories to the Convention on Nuclear Safety, these standards are often implemented differently in different countries, and lead to differences in, for example, the sizes of detailed planning zones or criteria for the implementation of protective measures. These differences reflect differing judgements regarding, for

example, what it is reasonable to plan for in detail, and can often be justified from a radiological protection perspective. However, they contribute to reduced public confidence. Resolving some of these differences requires action at a political level. Other differences could be addressed by the establishment at European level of formal guidance or Codes of Practice on best practice.

Cross-border arrangements: Information exchange and cooperation agreements exist between many neighbouring countries, and there are some good examples of multi-lateral agreements in Europe. However, there is considerable variability in the nature of the arrangements in practice, and some countries see this as a major weakness and impediment to consistent and effective arrangements across European borders. This is a specific issue that would benefit from the establishment of formal guidance or a Code of Practice at European level.

Effective use of resources and cost savings: There are major opportunities for pooling or sharing resources and capabilities for EP&R within Europe, in particular, but not only, where these are very expensive to develop and maintain but have very little likelihood of ever being used. In addition to achieving major cost savings through avoiding needless duplication, this would enhance the quality of EP&R in countries where this is currently less well developed or robust.

Mainstreaming nuclear emergency preparedness into civil protection mechanisms: EP&R arrangements for nuclear emergencies should be a sub-set of the larger system of response to all disaster types, including chemical, biological, radiological, natural and man-made, but are currently dealt with separately. This serves to reinforce public and political misconceptions about the special nature of nuclear emergencies. Integrating nuclear EP&R fully into civil protection mechanisms at European level would increase the preparedness level of European civil society, ensure clarity of command structures and consistency of response, and contribute to more effective use of resources.

Governance: Responsibilities for nuclear EP&R are shared between different ministries, authorities, agencies and expert groups at local, national and European levels. Off-site nuclear EP&R issues would be improved by making its governance more inclusive to better reflect the cross-governmental nature of any emergency response and better represent the civil protection organisations who would be responsible for implementing arrangements in practice.

PRIORITY ACTIONS AT THE EU LEVEL

Subject to making use of existing mechanisms for coordination between the European Commission and the IAEA to ensure complementarity of activities, and respecting the principles of subsidiarity and proportionality, there are number of actions that can and should be taken at the European level.

The European Commission, should:

a. Make proposals for legislation to introduce EU-wide peer reviews to cover the arrangements and capabilities for the third pillar of nuclear safety which includes off-site EP&R, in a similar way to those being proposed for other elements of nuclear safety.

b. Establish a mechanism to develop and formally adopt guidance or Codes of Practice on best practice in Europe on a wide range of key off-site EP&R issues. Issues to be addressed include cross-border arrangements, what it is reasonable to plan for, and extendibility of detailed plans.

c. Work with Member States to establish, as soon as practicable, a broadly agreed framework for use by Member States in developing practicable strategies and arrangements for longer term protective measures, including, where practicable, the criteria to be used for the introduction and removal of protective measures.

d. Develop a case for action at a political level to achieve greater harmonisation across Europe of the rationale for establishing emergency planning zones and criteria for the introduction of protective measures. The case should be based, not on consideration of the technical pros and cons of different approaches, which has resulted in impasse in the past, but on the benefits of improved public confidence and trust.

e. Evaluate, in consultation with Member States, how best use could be made of the extensive capabilities in Europe for EP&R in enhancing the protection of European citizens and avoiding needless expenditure. In this process, it should explore the potential contribution that could be made by its Emergency Response Coordination Centre.

f. Carry out a wide ranging review of its organisational structure and arrangements related to radiological and nuclear EP&R and aim to achieve a fully integrated approach for responding to all emergencies including nuclear. With others, it should reflect on whether it continues to be appropriate for the radiological protection community to be the principal arbiter in defining the conceptual basis of radiological and nuclear EP&R arrangements.

In principle, provisions in the revised Basic Safety Standards Directive have the potential to contribute to addressing some of these recommendations, in particular those relating to strategies for protective measures and cross border arrangements. The extent to which they do so in practice will depend on how the Directive is implemented and its provisions enforced.

EXECUTIVE SUMMARY

BACKGROUND, SCOPE AND APPROACH

This study, carried out under contract to DG Energy, has reviewed current off-site nuclear emergency preparedness and response arrangements in EU Member States and neighbouring countries. The study was commissioned to complement the so called 'stress tests' carried out by the European Nuclear Safety Group (ENSREG) and the European Commission (EC), which focused on the on-site safety response to extreme external events at nuclear power plants. The study aimed to provide an indication of best practice, gaps, overlaps and inconsistencies in arrangements, and make recommendations on potential areas for improvement, including through future Community policy action.

The study reviewed arrangements in the 28 Member States of the EU as well as those in Norway, Switzerland and Armenia. Consideration was limited to off-site arrangements at operating nuclear power plants but many of the findings are also applicable to preparedness and response arrangements for other types of radiological emergencies.

The approach adopted was, firstly, to collect authoritative information on arrangements and capabilities in each country via questionnaires addressed to national contacts. This was supplemented by information, particularly on case studies and potential improvements, collected via workshops held at national and regional levels. Information was also obtained from two Directorate Generals within the EC (ENER and ECHO) on current and planned activities in the field of emergency preparedness and response.

The information collected was then analysed by:

- Benchmarking arrangements and capabilities in each country against EU legislative requirements and the (non-binding) requirements developed by the International Atomic Energy Agency (IAEA); and
- Mapping arrangements and capabilities across the participating countries and against international and European guidance, as a means of identifying good/best practice and areas of weakness or gaps.

The findings from this analysis and the study's conclusions and recommendations were then developed and refined via a series of workshops with a Stakeholder Group, representing all those with an interest in and responsibility for off-site emergency preparedness and response arrangements, as well as participating countries and those with policy, operational, technical and administrative roles, and with a smaller Core Group, which included the main interest groups. The Stakeholder Group provided valuable input into the development and refinement of the conclusions and recommendations of the study, but there were often differences of view between members as to the best way forward in one or another area. In finalising the conclusions and recommendations, account was taken of the views of the Stakeholder Group and of feedback on factual matters provided by an EC Task Force (comprising

representatives of several Directorates General with an interest in or responsibility for emergency preparedness and response) established to monitor and interact with the project. The final conclusions and recommendations have been developed by the project team on the basis of the evidence gathered and the strength and quality of arguments made by the Stakeholder Group, either collectively or individually, on the initial draft. They represent the views of the project team and should not be attributed to the Core Group or Stakeholder Group, either as a whole or individually.

THE NEED FOR A EUROPEAN APPROACH

Widely differing views were expressed by SG members and participating countries on the need for action at a European level on off-site EP&R. Some felt strongly that further action at a European level was not justified at this time and that it would be better to rely on what was being done at the international level by the IAEA. Others, equally strongly, felt that action at a European level was essential to ensure a consistent approach to compliance with EU legislative requirements and a framework that is optimised for European, rather than for wider international, social and economic conditions.

The project team has carefully evaluated the arguments underpinning these conflicting views and concluded that action at a European level is essential in a number of important areas. The main considerations that influenced this conclusion were:

- Well known lessons from previous accidents have not been fully taken up by all EU countries;
- Any future accident in the EU would likely affect more than one country; consequently, there is a need for close cooperation between Member States in the preparedness, response and post-emergency phases. This would lead to more consistent approaches to EP&R, and provide greater public reassurance concerning their safety;
- Experience with past accidents has shown that the lack of strategies and criteria for protective measures in the longer term can have tremendous and long lasting social, economic and political consequences; the lack of such strategies in the EU represents a major risk that could be readily mitigated by appropriate planning at a European level;
- Nuclear safety is addressed at European level; EP&R is the third pillar of nuclear safety, and the rationale underpinning the need for improvements at a European level, and the nature of the improvements being proposed through revision of the Nuclear Safety Directive in areas such as technical safety, on-site EP&R, transparency, governance, etc, apply equally to off-site EP&R;
- Concerted action at a European level has the potential to achieve significant cost savings, avoid unnecessary duplication and provide some smaller countries (or those with limited knowledge and experience with radiological and nuclear matters) with technical and other support of far higher quality than they could provide themselves.

KEY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The findings, conclusions and recommendations developed in this study are set out in Section 12 of the Final Report. They are wide-ranging, covering technical, organisational, legal and other issues, are aimed at different actors (eg, Member States, individually or collectively, associations of competent or regulatory authorities in Europe, as well as the European Commission), and vary in the priority they should be given. The more significant findings and conclusions and higher priority recommendations are highlighted in the remainder of this summary.

In brief:

- The study has shown that, at the depth to which it has been able to probe, current arrangements and capabilities for off-site nuclear emergency management are broadly compliant with European legislative requirements and (non-binding) international requirements.
- There are a number of gaps or inconsistencies in current arrangements that need to be addressed to improve emergency preparedness and response in Europe. The most significant concern: a general lack of strategies and arrangements for longer term protective measures and for the return to normality following an emergency; and coherence in cross border arrangements. These gaps should be addressed as soon as practicable[1].
- Member States often take different approaches to the practical implementation of essentially the same principles and objectives for off-site EP&R. While these differences can be justified on technical grounds, they can be a source of misunderstanding and undermine trust in arrangements. In the context of the implementation of the current revision of the Basic Safety Standards Directive, there is an opportunity for political action to overcome the technical obstacles and achieve greater harmonisation of criteria, thereby improving public confidence.
- The resource demands of emergency preparedness and response arrangements can be significant, particularly for smaller Member States, and in view of the very low likelihood of the arrangements being put into practice. There are opportunities for greater sharing of resources and capabilities, but even greater benefits can result from integrating arrangements for nuclear emergencies within those for other types of emergency, at all levels, including within the European Commission itself.

The findings of the study are unlikely to be substantively altered by the revised EU Directive on Basic Safety Standards which contains some additional provisions on EP&R. However, these provisions have the potential, in principle, to contribute to addressing some of the study's recommendations, in particular those relating to strategies for protective measures and cross border arrangements. The extent to

[1] The new EU BSS contains provisions relating to the development of optimised strategies for protective measures and international cooperation.

which they do so in practice will depend on how the Directive is implemented and its provisions enforced.

Further details are given below and in the report itself.

1. Gaps in current arrangements and capabilities

The most significant gap in arrangements identified in the study concerns a general lack of strategies and arrangements for longer term protective measures and for the return to normality following an emergency. These issues were problematic for many years in the Former Soviet Union in managing the aftermath of the Chernobyl accident and similar problems are being encountered in Japan post Fukushima. There was also an absence in many countries of strategies and arrangements for the management of the large quantities of radioactive waste that might be produced, particularly from the contamination of foodstuffs but also from possible remediation of the built environment. A major contributory factor in these gaps is that criteria for longer term protective measures are far less mature than those for urgent measures, with frequent changes to relevant international guidance over the past two decades and a lack of broad consensus. The issue is complex, particularly as guidance and criteria need to be applicable to the very wide range of circumstances that might arise in practice. Some countries prefer the adoption of outline, flexible arrangements that can be adapted to the prevailing situation.

The absence of strategies and arrangements for longer term measures represents a major risk for individual countries and for Europe as a whole. In the event of an accident that affected several countries in Europe, the measures being taken in these countries would inevitably be compared, and there would be public and political pressure, that would be difficult to resist, to adopt the standards or criteria seen as offering the best level of protection, regardless of the wider social and economic consequences. Countries without a strategy or criteria would find it hard to do anything other than follow practice adopted elsewhere. This could lead to significant and lasting social, economic and political problems. A broadly agreed Europe-wide framework for longer term protective measures would provide guidance to Member States in developing their own strategies[2] and mitigate these risks.

For the specific issue of the management of wastes from the contamination of foodstuffs and the remediation of the built environment, sound technical bases have been established for the development of such strategies and arrangements, but have yet to be made use of by many countries. Member States without such strategies and/or arrangements should develop them at the earliest opportunity, taking advantage of existing technical information and of experience with strategies developed elsewhere.

The most significant potential gap in capabilities identified in the study was in the area of radiation survey and environmental measurements following an emergency, where capabilities varied widely but were not always obviously related to need.

[2] As will be required under the new EU BSS

Medical response to, and follow up after, an emergency is a further area where current arrangements and capabilities may not be sufficient, in particular in relation to emergency plans and their possible extension. Capabilities in this area have degraded considerably within Europe over the past decade or so and how this may be remedied is addressed in Section 5 below.

The project **recommends** that:

- The European Commission, in cooperation with Member States and their regulatory/competent authorities, should, establish, as soon as practicable, a broadly agreed framework at the EU-level to provide guidance to Member States in developing their own practicable strategies and arrangements for longer term protective measures. To the extent practicable, the framework should include the criteria to be used for the introduction and removal of protective measures.
- Countries without strategies for relocation or subsequent return, or for decontamination of the built environment (and management of waste arisings) should develop them at the earliest opportunity and demonstrate they are practicable. Countries with strategies, but without having assessed their practicability, should put in hand arrangements to do so at the earliest opportunity.
- Countries without an integrated strategy for the management and disposal of contaminated foodstuffs and livestock should develop one at the earliest opportunity and demonstrate that it is practicable. Countries with a strategy, but without having assessed its practicability, should put in hand arrangements to do so at the earliest opportunity. Particular attention should be given to the implications of the likely resistance of the food industry and consumers to the processing and/or consumption of produce contaminated at levels far below CFILs.
- Should countries fail to establish strategies or arrangements for the management and disposal of contaminated foodstuffs and wastes from the decontamination of the built environment, the European Commission should take steps to ensure that they do, if necessary by making proposals for legislation.
- The European Commission should seek assurances and evidence from Member States, possibly in the context of verification actions under Article 35 of the Euratom Treaty, that their capabilities for radiation survey and environmental measurements (fixed and mobile) following an emergency are fully commensurate with needs foreseen in their emergency plans and their foreseeable extension.

2. Enhancing confidence in the adequacy of arrangements and capabilities in practice

With the exception of these more significant gaps, the study has shown current arrangements and capabilities for off-site nuclear emergency management to be

broadly compliant with European legislative and international requirements. However, this has been a high-level desk-based study; it has involved no deeper investigation or audit of arrangements in practice. Public and political confidence would be enhanced by deeper investigation of the adequacy of arrangements in practice.

The project **recommends** that:

- Countries should assure themselves that their current arrangements and capabilities are compliant **in practice** (and not just on paper) with European legislation and international requirements. They should particularly focus on:
    - The effectiveness of their organisational and decision making structures and coordination of EP&R at all levels;
    - The sufficiency of resources and capabilities at local/municipal, regional and national levels for responding to scenarios adopted as the basis for planning;
    - The efficacy of arrangements and capabilities as a whole in achieving the objectives of EP&R irrespective of the particular choice of Emergency Planning Zone;
    - The adequacy of the objectives and practice of exercising off-site EP&R at all levels;
    - The adequacy of capabilities for monitoring in the event of an accident in meeting needs foreseen in emergency plans and their foreseeable extension.
- To provide independent assurance of compliance in practice, and thereby enhance public trust and confidence, countries should periodically request a peer review of EP&R arrangements as a whole.
- The European Commission should make proposals for legislation to introduce EU-wide peer reviews of national off-site EP&R arrangements at specified intervals, in analogy with arrangements being considered for some aspects of nuclear safety in the proposed revision of the EU Nuclear Safety Directive.

3. Promoting greater harmonisation of approaches within Europe

Broadly similar principles and objectives underlie off-site emergency preparedness and response arrangements throughout the EU and elsewhere. However, Member States take different approaches to the practical implementation of these principles, in accordance with their own particular administrative, organisational, legislative, social, political and economic circumstances. Such differences are not surprising. And, there is no evidence that any one approach is better than any other in meeting the broadly agreed objectives.

However, these differences are a source of misunderstanding, particularly among the public and politicians. It is, for example, difficult to explain to a lay audience why criteria for the introduction of protective measures should be different on one side of

a national border than on the other. Some Member States contend that, as a result, such differences cause a loss of trust and confidence in emergency preparedness and response arrangements more generally, and that the solution lies in greater harmonisation. Previous attempts at greater harmonisation at European level have generally failed (with a few exceptions), largely because, from a technical point of view, the differences might be justifiable.

The transposition and implementation of the new EU Basic Safety Standards Directive could provide a rare opportunity, while Member States are revisiting existing arrangements, to achieve greater harmonisation in some areas, for example, in the rationale for the establishment of Emergency Planning Zones (EPZ) and the choice of criteria for the introduction or removal of protective measures, where efforts have failed in the past.

The project **recommends** that the European Commission should develop a case for action at a political level to achieve greater harmonisation of criteria across Europe. This should be based, not on consideration of the technical pros and cons of different approaches, which has resulted in impasse in the past, but on the benefits of improved public confidence and trust.

4. Promoting best practice within Europe

Greater harmonisation of approaches can be expected to occur naturally over the longer term through processes such as peer review and continual improvement. These processes could be supported and encouraged through the establishment of broadly agreed guidance or codes of practice on what constitutes good or best practice in Europe, as this would enable countries more easily to benchmark their arrangements and identify opportunities for improvement.

A specific example where guidance or a code of practice would be helpful is in cross border arrangements. Nearly all countries have mechanisms in place for timely notification of emergencies to neighbouring countries that go beyond the obligations of the established ECURIE mechanism. Furthermore, detailed cross border arrangements are in place, or under development, in all cases where the emergency planning zone of a nuclear power plant extends into the territory of a neighbouring country. There are also multi-lateral arrangements, notably between the Nordic countries and in the “Greater Region” (comprising several Belgian, Dutch, French, Luxembourg and German regions). However, there is considerable variability in the nature of the arrangements in practice, and in the extent to which agreements are governed by any binding legal basis or more substantive political accord. In many cases, the arrangements have evolved over a long period of dialogue and are sustained largely by good will or ‘gentleman’s agreements’. Some countries see this as a major weakness and impediment to the establishment of effective arrangements across European borders.

This is an area where an initiative by the Heads of European Radiation protection Competent Authorities (HERCA), supported by the West European Nuclear Regulators Association (WENRA), aimed at enhancing the consistency of protective actions across national borders, is making a significant contribution. However, this initiative needs

to be made more inclusive through the active involvement of other organisations that have an important role in off-site emergency preparedness and response, for example, those responsible for civil protection.

Other key issues identified in this study for guidance/codes of practice on best practice in Europe include: what it is reasonable to plan for in detail, the rationale for establishing emergency planning zones and their extendibility; strategies for protective measures and their implementation in practice; intervention levels; strategies for exercising arrangements at various levels and their practical implementation; environmental sampling and measurements; environmental surveys; decision support; and medical support.

The project **recommends** that:

- Neighbouring countries should maintain active dialogue on EP&R at all levels[3] to reinforce trust and confidence.
- The European Commission should monitor the effectiveness of cross border arrangements, and, if necessary, take steps to require improvements in those cases where arrangements are deficient. Should existing powers[4] not be sufficient for the latter purpose, they should be obtained through further legal provision or administrative mechanisms.
- The European Commission, in consultation with Member States, should establish a mechanism, using existing legislative provisions or, if necessary, by making proposals for legislation, to develop and formally adopt guidance or Codes of Practice on what represents good/best practice in Europe on a wide range of key off-site EP&R issues, including cross border arrangements where the HERCA initiative should provide the starting point.

5. Making more effective use of resources and capabilities within Europe

In developing nuclear emergency preparedness and response arrangements, a judgement needs to be made about what it is reasonable to plan for in detail. The likelihood of a nuclear accident, particularly one involving the release of substantial quantities of radioactive material into the environment, is very low. On the one hand, making extensive and very detailed plans, and committing the necessary supporting resources, for extremely unlikely events could result in limited public resources being unavailable for better use elsewhere. On the other hand, the potential consequences of these accidents are such that adequate preparations are essential. Finding the right balance involves complex and difficult trade-offs between often conflicting social, economic and political considerations. It is not therefore surprising that this study identified major differences between the participating countries in approach and levels of detailed planning.

Given the demanding nature of some of the resources needed to support nuclear emergency plans (for example, in terms of the technical and human capabilities for

[3] And as will be required under the new EU BSS
[4] Or further provisions included in the new EU BSS

monitoring, laboratory analysis, medical treatment etc, and to ensure their readiness in the event of an emergency), there are opportunities for pooling or sharing resources within Europe (or regions within it). Many functions can only be carried out at local, regional or national levels. Enhanced cooperation within Europe (or regions within it) offers opportunities to improve arrangements in countries where their arrangements or capabilities are less well developed or robust, while at the same time achieving major cost savings through avoiding unnecessary duplication.

Some Member States oppose any initiative at a European level to improve the pooling or sharing of capabilities, fearing loss of autonomy and extension of the remit and influence of the European Commission's services. However, there were many areas identified in the project where any loss of autonomy from greater cooperation would be limited and outweighed by the benefits offered, and where such improved cooperation would involve no more than facilitating actions by the European Commission's services. For example, some Member States have expressed a willingness to make the information they would generate to support their own decisions (eg, diagnoses of the status of a nuclear power plant and prognoses of the development of an accident, including off site consequences) available more widely, possibly through channels such as the EU Emergency Response Coordination Centre. This would provide many countries with information of better quality and timeliness than they could generate themselves with their own resources. The only action needed at European level would be to facilitate the submission and dissemination of the information to and from the Emergency Response Coordination Centre. Other areas where similar cooperation, either at European or regional level, would be beneficial include the provision of technical support to decision makers, and the sharing of expensive and rarely used assets and capabilities, including for example, aerial survey, bio-dosimetry and medical treatment of over-exposed people.

Without prejudice to subsidiarity or national competences, the project **recommends** that:

- The European Commission should facilitate greater cooperation between Member States in areas, such as those indicated, where there are opportunities to make better use of limited resources and capabilities for off-site emergency preparedness and response and avoid unnecessary duplication.
- The European Commission, in consultation with Member States, should evaluate how data from early warning and monitoring networks can be more fully exploited, and whether the EU Emergency Response Coordination Centre should play an enhanced role in nuclear emergencies, either as a conduit for the wider dissemination of authoritative information, or as the focal point for mutual assistance in Europe, or both.

6. Embedding preparedness and response arrangements for nuclear emergencies within those for all other emergencies

Institutional arrangements for nuclear emergencies are often different from those for most, if not all, other types of emergency. As an example, at the European level, nuclear matters are covered by a separate treaty. The practical outcome of this is

that, in many countries, 'ownership' or 'leadership' of nuclear emergency preparedness and response arrangements rests with national institutions with radiological or nuclear expertise, with civil protection organisations providing support. For most, if not all, other types of emergency, ownership or leadership is exercised by civil protection organisations, with supporting input from relevant specialists, depending on the nature of the emergency. This has important implications for how emergencies are handled in practice and how, and by whom, authority is exercised.

There is little, if any, justification for nuclear emergencies being treated differently from any other type of emergency. Continuing to do so reinforces public and political misconceptions about the special nature of nuclear emergencies. Integrating nuclear emergency preparedness and response arrangements within those for other types of emergency would ensure clarity in command structures and consistency of response, and contribute to more effective use of resources. Specialist nuclear and radiological expertise would still play an essential role, but this role would be clarified as being to provide specialist input to well-structured and frequently implemented arrangements for the management of any emergency (rather than to lead on separate, and extremely rarely implemented, arrangements for nuclear emergencies).

Within the European Commission itself, the lead on nuclear emergency management is taken by DG ENER with input mainly from national nuclear regulators and radiation protection competent authorities. Coordination within the European Commission relies on 'in-house' arrangements established for responding to crises generally, whatever their nature; the adequacy of these arrangements has been questioned by some Member States given the need for many organs of government to be involved in decisions on the management of nuclear emergencies. The governance of nuclear emergency management both within the European Commission and in most Member States needs to better reflect the cross-governmental nature of any emergency response and better represent the civil protection organisations who would be responsible for implementing arrangements in practice.

The project **recommends** that:

- The European Commission should fully integrate its own arrangements for nuclear emergency management with those for other hazards under the Civil Protection Mechanism.
- The European Commission should encourage Member States to embed their arrangements for nuclear emergencies fully within those for other types of emergency.
- All parties should reflect on whether it continues to be appropriate for the radiological protection community to be the principal arbiter in defining the conceptual basis of radiological and nuclear EP&R arrangements.

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HU	Hungary
NL	Netherlands
RO	Romania
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
UK	United Kingdom
AM	Armenia
CH	Switzerland

COUNTRY CODES – NON-NUCLEAR COUNTRIES

Code	Country
AT	Austria
HR	Croatia
CY	Cyprus
DK	Denmark
EE	Estonia
GR	Greece
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
PL	Poland
PT	Portugal
NO	Norway

ACRONYMS USED IN THIS REPORT

ARGOS	**Accident Reporting and Guidance Operational System**
BDBA	Beyond Design Basis Accident
BSS	Basic Safety Standards
CEE	Central and Eastern Europe
CFIL	Council Food Intervention Level
CG	Core Group
CONVEX	Convention Exercise (IAEA)
CPM	Civil Protection Mechanism
CTBTO	Comprehensive Test Ban Treaty Organization
DBA	Design Basis Accident
DEPZ	Detailed Emergency Planning Zone
DEVCO	DG Development and Cooperation - Europeaid
DG	Directorate-General
EC	European Commission
ECHO	DG Humanitarian Aid and Civil Protection
ECURIE	European Community Urgent Radiological Information Exchange
EEAS	European External Advisory Service
ENCO	ENCONET Consulting
ENER	DG Energy
ENSREG	European Nuclear Safety Group
EP&R	Emergency Preparedness and Response
EPZ	Emergency Planning Zone
ERCC	Emergency Response Coordination Centre
ESTE	Czech Decision Support Software
ETSON	European Technical Support Organisation Network
EU	European Union
EURATOM	The European Atomic Energy Community
EURDEP	European Radiological Data Exchange Platform
FORATOM	European nuclear industry association
FSU	Former Soviet Union
GMF	Group of Municipalities with Nuclear Facilities
GW(th)	Giga Watt (thermal)
HASS	High Activity Sealed Source
HERCA	Heads of European Radiation Protection Competent Authorities
IACRNE	Inter Agency Committee on Radiological and Nuclear Emergencies
IAEA	International Atomic Energy Agency
ICPD	Ingestion and Commodities Planning Distance
IL	Intervention Level
INEX	International Nuclear Emergency Exercise
INSC	Instrument for Nuclear Safety Cooperation
IRMIS	International Radiation Monitoring Information System (IAEA)
IRRS	Integrated Regulatory Review Service (IAEA)

JRC	Joint Research Centre
LOCA	Loss of Coolant Accident
MIC	Monitoring and Information Centre
MoU	Memorandum of Understanding
MS	Member State
NCP	National Contact Point
NEA	Nuclear Energy Agency
NERIS	European platform on preparedness for Nuclear Emergency Response and Recovery
NGO	Non Governmental Organisation
NPP	Nuclear Power Plant
OIL	Operational Intervention Level
PAZ	Precautionary Action Zone
PPA	Public Protective Actions
PSA	Probabilistic Safety Analysis
QA	Quality Assurance
RANET	Response Assistance NETwork (IAEA)
RODOS	Real-Time On-Line Decision Support System for Off-Site Emergency Management in Europe
RTD	Research and Technological Development
SANCO	DG Health and Consumers
SG	Stakeholder Group
Sv	Sievert
UJV	Ustav Jademeho Vyzkumu Rez
UNICEF	United Nations International Children's Emergency Fund
UNDP	United Nations Development Programme
UPZ	Urgent Protective Action Planning Zone
USIE	Unified System for Information Exchange in Incidents and Emergencies (IAEA)
USNRC	United States Nuclear Regulatory Commission
WENRA	West European Nuclear Regulatory Association
WHO	World Health Organization

1 INTRODUCTION

This report has been prepared by a consortium, comprising ENCO and UJV, under contract to the DG Energy of the European Commission. The report sets out the objectives, scope, methodology and main findings of a study of current arrangements and capabilities for off-site nuclear emergency preparedness and response (EP&R) in Europe. Particular attention has been given to the coherence and completeness of EP&R arrangements and capabilities, both within and between countries in Europe, as well as to best practice, gaps and inconsistencies, in particular related to cross border arrangements. In addition, consideration has been given to how current arrangements could be made more effective and recommendations made on potential areas for improvement.

The report comprises a main text supported by several substantive Appendices. Sections 3 and 4 of main text address the objectives and scope of the study. Section 5 sets out the approach or methodology adopted. Section 6 summarises the main outcomes of the benchmarking of EP&R arrangements and capabilities in each country against international requirements and Section 7 the outcomes of mapping, both between countries and with respect to international guidance. Section 8 addresses improvements in EP&R that have been, or are being, made following reviews of arrangements in each county post Fukushima. Section 9 is concerned with cross border arrangements and Section 10 with a review of arrangements for EP&R within the European Commission. Section 11 summarises activities undertaken by a number of international and European organisations or associations on EP&R post Fukushima and further initiatives foreseen in this area. Section 12 contains the main conclusions and recommendations of the study; these are based mainly on the findings of the benchmarking and mapping but also take due account of activities and planned initiatives of international and European organisations and associations.

The Appendices, *inter alia*, comprise the questionnaires used to gather information on EP&R from each country; detailed international requirements or guidance use in the benchmarking and mapping; more detailed results of the mapping exercise; more detailed analysis of cross border arrangements; notes of key points arising from national and regional workshops on potential improvements on EP&R and/or cross border arrangements; notes of meetings on arrangements within the EC on EP&R; and summaries of activities and initiatives on EP&R by international and European organisations and associations.

2 BACKGROUND

Immediately after the Fukushima accident in March 2011, the European Council requested that the safety of all EU nuclear plants should be reviewed, on the basis of a comprehensive and transparent risk and safety assessment (“stress tests”). The European Commission and the European Nuclear Safety Group (ENSREG) agreed to work on these EU stress tests to assess how well nuclear power plants can withstand the consequences of extraordinary triggering events such as earthquakes or flooding,

potentially leading to multiple loss of safety functions requiring severe accident management. All the operators of nuclear power plants in the EU had to review the response of their nuclear plants to those extreme situations.

Although any review of the management of severe accidents may include off-site emergency preparedness and response, this topic was not within the scope of the stress tests. Furthermore, in consideration of comments and suggestions at public meetings on the stress tests, and considering the events of the Fukushima accident, the topic of off-site emergency preparedness and response arrangements in EU countries has been acknowledged as an important area to be reviewed by both ENSREG and the Commission.

As a first step, the Commission called for the present study on "Review of Current Off-Site Nuclear Emergency Preparedness and Response Arrangements in EU Member States and Neighbouring Countries". The intended purpose of the study, the scope and the questions to be answered are described in the specifications (Section 25 - Annex I). The Commission indicated that the study should complement the findings of the stress tests, and provide an indication of potential areas for future Community policy action, as well as identify priority areas and further follow-up.

3 OBJECTIVES

The objectives of this study were to:

- Assess the status of the existing arrangements and capabilities for off-site emergency preparedness and response (EP&R) within and between the EU Member States (MS) and neighbouring countries in respect of their coherence and completeness;
- Identify best practice, gaps and inconsistencies, in particular related to cross border arrangements;
- Assess how current arrangements and capabilities could be made more effective (in particular optimised to make better use of available resources and avoid duplication, both nationally and across borders); and
- Make recommendations on potential areas for improvement.

4 SCOPE

4.1 What is meant by off-site EP&R?

The key **objectives** of off-site response to a nuclear emergency are:

- To prevent injuries and deaths by implementing urgent protective actions for the workers and the public;
- To keep the doses to workers and the public below accepted levels for which protective actions and other actions are justified to reduce the risk of health effects to the extent practicable;
- To prevent or reduce psychological, economic and societal effects in the population by promptly:
    - Addressing the concerns of the public;
    - Ensuring that all traded goods meet international standards.
- To enable, to the extent practicable, the resumption of social and economic activity after the accident.

Achieving these objectives in the event of an emergency requires adequate preparedness arrangements are put in place in advance.

One of the most important features of good preparedness is that the required arrangements, as well as the technical and human resources, are agreed and made available and integrated among the different bodies involved. In addition, provisions ensuring clear lines of responsibility and authority based on legislation are needed. As severe nuclear accidents with major off-site consequences are rare events, the response arrangements required to meet the agreed objectives have to be derived from risk analyses or hazard assessments; these include, as central elements, plant conditions, release characteristics (source term) and the prevailing meteorological situation at the site. Based on the identified risks or hazards and the potential consequences of a nuclear or radiological emergency, protection strategies have to be developed. Central elements of protection strategies are available generic dose criteria and operational criteria for effective implementation of urgent protective actions and other response actions. These protective actions aim at avoiding or minimising severe deterministic effects and reducing the risk of stochastic effects. Several options to implement urgent protective actions and other response actions within a protection strategy are available.

An important aspect of the preparedness phase is the implementation of appropriate management structures and the training of personnel, essential to ensure prompt actions when an accident occurs. These aspects include the clear establishment of authorities and technical organisations, their interaction, staffing and qualifications, the establishment of response plans, the definition of procedures, as well as provisions for the logistical support needed. The response staff needs to participate in

regular training, drills and exercises. The establishment of a quality management programme is integral to preparedness to ensure a high degree of availability and reliability of all supplies, equipment, communication systems and facilities, plans, procedures and other arrangements necessary for effective emergency response.

Information exchange between all actors is a prerequisite of good preparedness. This includes provisions for secure and reliable technical communication systems at all levels of the management system, including the plant operator as well as the availability of key organisations 24/7. In addition, provisions and training of key members of the response organisation have to be in place to communicate effectively with the public.

The key elements of emergency preparedness arrangements are summarised in Figure 4-1. A detailed description of all these elements is given by the IAEA publication within the Safety Standard Series "Preparedness and Response for a Nuclear or Radiological Emergency" (GS-R-2) [IAEA, 2002].

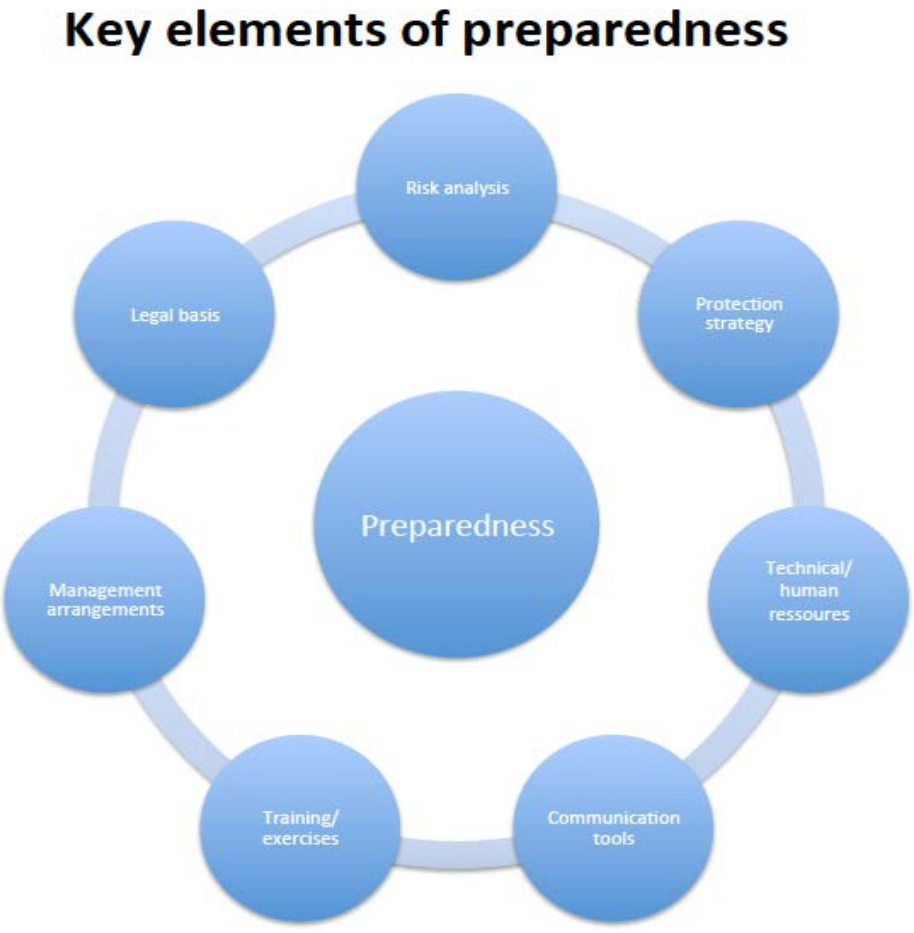

Figure 4-1: Key elements of preparedness

After the declaration of an emergency by the competent authority, the pre-planned and agreed protection strategy has to be implemented promptly. This step is followed – with some delay - by verification of the appropriateness of the implemented protective actions to meet the overall objectives. Based on the results of the verification the strategy can be optimised by terminating or complementing urgent protective or other actions. A schematic presentation of this situation is given in Figure 4-2.

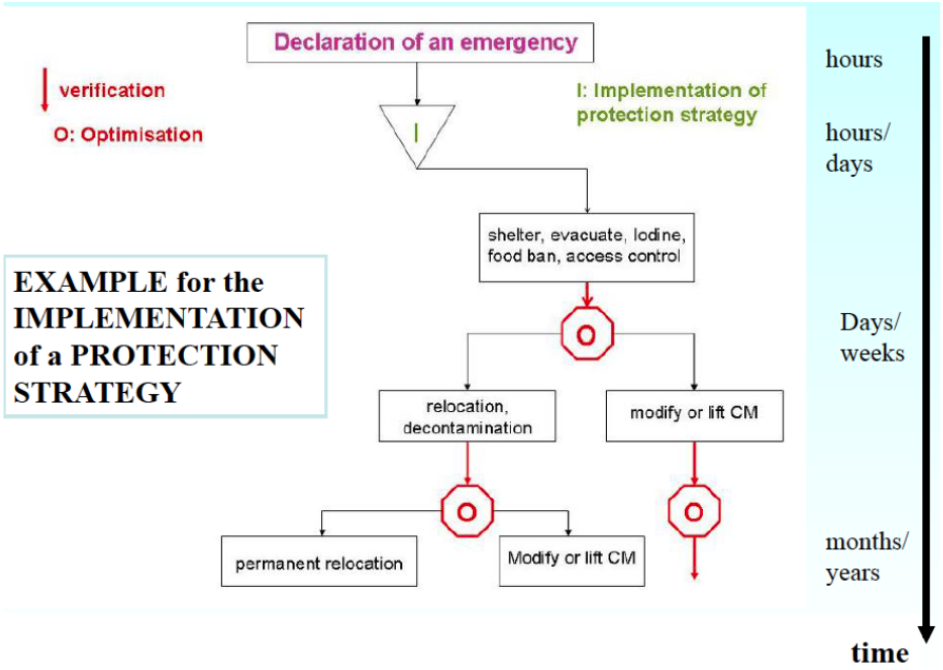

Figure 4-2: Example for the implementation of a protection strategy

The key elements of an **emergency response system** are summarised in Figure 4-3. They include – as a central element - the assessment of the plant status and of its development with time as the basis for decision-making. Well founded decision making, based on pre-defined concepts and considering all key aspects of the actual situation, as well as the prompt implementation of urgent protective actions are crucial to achieve both a high level of protection of the people and to minimise the risk of collateral damage and other unwanted consequences of the response actions. Included are considerations of the possible long-term consequences of urgent protective actions, such as the production of waste or the need for compensation. In addition, the communication of the radiological risks to the population associated with the accident is of outstanding importance to maintain public trust and to avoid major societal impacts, which might be unrelated to the radiological situation. This might include the need for medical and psychological support for special groups within the population.

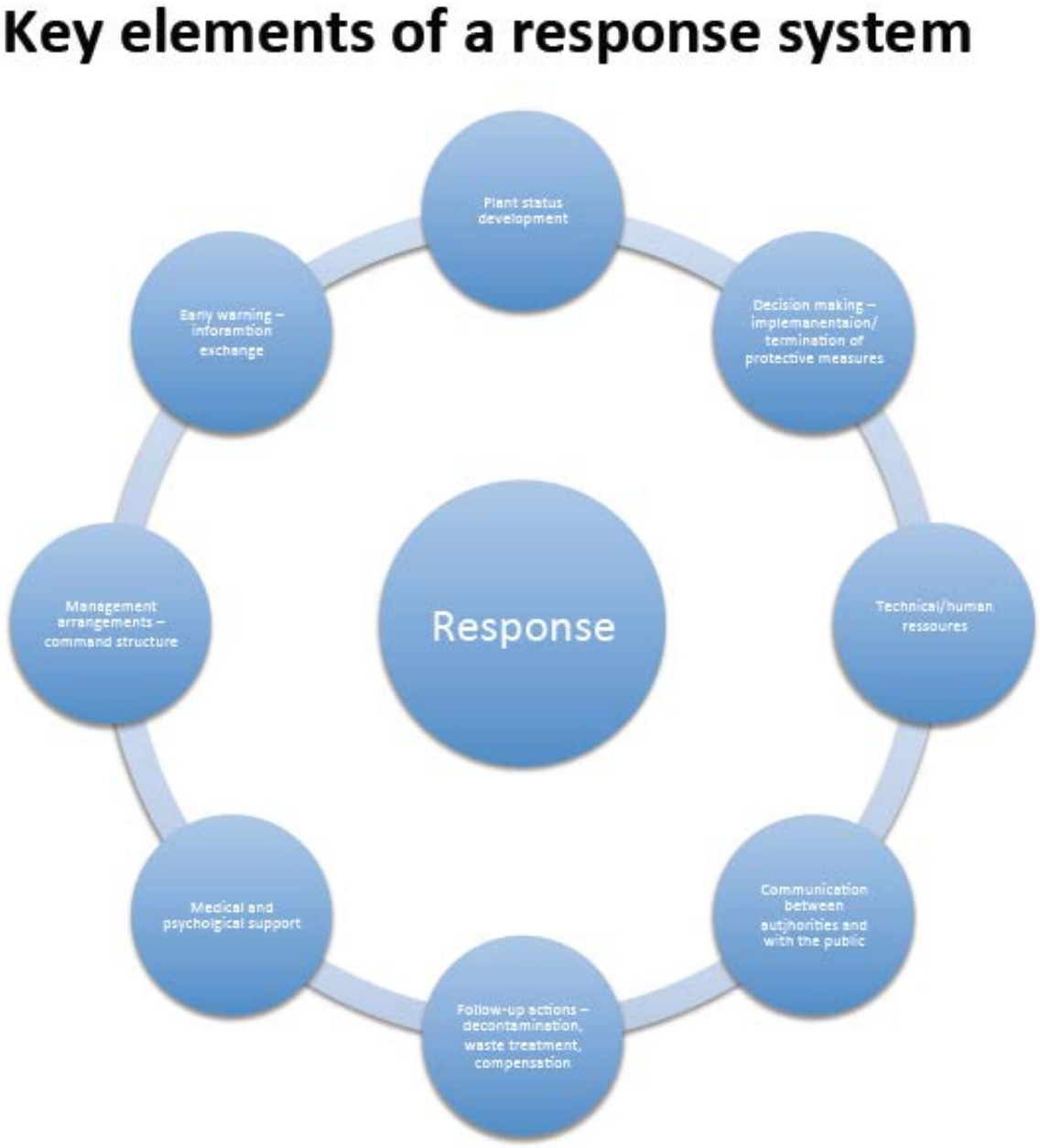

Figure 4-3: Key elements of a response system

4.2 Study scope

The scope of the study of arrangements and capabilities for off-site EP&R was limited in the following respects:

- The geographical scope was limited to the 28 MS of the EU and the following neighbouring or near-neighbouring countries – Norway, Switzerland and Armenia;

- Consideration was limited to arrangements and capabilities for EP&R at operating nuclear power plants (NPP) (i.e., no account taken of emergencies at NPP that have shut down and been de-fuelled and/or are being decommissioned, or during the transport of spent fuel from NPP);
- No consideration was given to on-site EP&R other than where this had potential implications off-site.

Limiting the scope to EP&R for operating NPP is not expected to have much practical impact on the outcomes of the study. Most of the findings for NPP are likely to be more broadly applicable to other types of nuclear installation; differences in some of the more detailed technical arrangements are, however, to be expected depending on the type of installation and the nature of activities carried out. Apart from the above limitations, the scope of the study covered all aspects of off-site EP&R at operating NPP that may affect the efficacy with which those at risk in an emergency would be protected; *inter alia*, these included the legislative basis, policy, regulations, standards, guidance, institutional responsibilities, coordination, emergency plans, resources, arrangements and capabilities (i.e., manpower, equipment, training, exercises/rehearsals, notification and information exchange, public information¸ communication, emergency services, medical support, technical expertise in the radiological sciences, strategies for environmental monitoring, food and feedstuff control, release scenarios and emergency planning zones, arrangements for funding, etc.), as well as stakeholder involvement, cross-border arrangements, liability, etc.

In light of the Fukushima accident, the scope of the study also included an assessment of the robustness (or extendibility) of current arrangements and capabilities to accidents of magnitude or duration greater than those currently assumed for (detailed) planning (at least in many countries) and, in particular, implications for cross border arrangements. The effect of extensive infrastructure damage on the adequacy and efficacy of current arrangements and capabilities has also been assessed, in particular when associated with accidents of long duration.

5 THE APPROACH ADOPTED

Following the Fukushima accident most countries in Europe have undertaken, or are in the process of undertaking, a review of their off-site EP&R arrangements; those that have completed their reviews are, in general, still in the process of implementing their findings. Consequently, arrangements and capabilities for off-site EP&R are, to varying degrees, undergoing change and this 'moving target' has significantly complicated the study. To overcome this problem, the study has been undertaken in two distinct parts: firstly, an assessment of the current status of arrangements and capabilities, as of March/April 2013; and, secondly, an assessment of improvements that were, or could be, under consideration for the future. The approaches used in the two assessments are summarised below and they differ in a number of respects.

5.1 Current status of arrangements and capabilities

5.1.1 Collection of information

Information on current arrangements and capabilities was collected by means of an extensive questionnaire (see Section 14 - Appendix A) comprising more than one hundred questions. The questionnaire is divided into nineteen sub-sections addressing particular aspects of EP&R and was designed to meet the following objectives:

- To collect information in a structured manner, thereby facilitating its subsequent assessment and comparison in a fair and transparent way;
- To provide responses that were sufficient to enable current arrangements and capabilities to be benchmarked against international requirements and EU legislative provisions (see Section 5.1.2);
- To provide responses that could be readily and effectively compared between countries and with international guidance, standards, etc (see Section 5.1.3);
- To provide a comprehensive data base on arrangements and capabilities (including references to more substantive documentation underpinning responses to the questionnaire) for future reference and use.

The detailed content of the questionnaire was an unavoidable compromise between two conflicting aims – the establishment of comprehensive information on EP&R arrangements and capabilities in each country and minimising the demands on those who had to complete the questionnaire, in particular at a time when many national organisations responsible for EP&R remained heavily committed in addressing post-Fukushima issues.

With a view to minimising the demands on those completing the questionnaire, a significant number of questions required a simple yes/no answer (eg, compliance with one or other international requirement, existence of a capability, etc), supplemented by reference to documentation that supported the response that could be consulted by project staff. Other questions were more searching and were directed at gaining a better understanding of the rationale/s for particular arrangements (eg, emergency planning zones, intervention levels, strategies for intervention, termination of protective measures, etc), in particular in areas where significant differences were known to exist between countries or where arrangements were less well developed or mature.

The adequacy and efficacy of the questionnaire were tested before use through its trial application to four countries by project staff. Changes were made in both the structure of the questionnaire and in the content of individual questions in light of this trialling and comments from DG Energy.

Ideally, the questionnaire would have been further tested or trialled in one or two countries prior to its distribution to all. However, because of external constraints on the project's implementation schedule, this was not practicable.

The questionnaire for each country was partially filled (ie, responses provided to questions) by project staff to the extent practicable based on information in the public domain (eg, official publications and web-sites, etc). This was done to minimise the effort required by each country to complete the questionnaire, in particular given its demanding nature. The extent to which questionnaires could be pre-filled varied greatly between countries depending on the extent of information in the public domain; typically, the pre-fill ranged from a few percent of the questions to considerably more than half.

The partially filled questionnaire for each country was sent to the National Contact Point (NCP) - nominated by the country - who was responsible for validating the pre-fill and for completion of the questionnaire, or coordinating its completion by those organisations with a role or responsibility for off-site EP&R. Completed questionnaires were returned to the project, following which clarification was sought from the NCP where responses were unclear, inconsistent or incomplete. The responses to the questionnaire were compiled in an Excel data base which was interrogated for the purposes of benchmarking and mapping.

A short, supplementary questionnaire (see Appendix B) was subsequently sent to each country at a later stage in the collection of information. This addressed a number of issues where the questions in the original questionnaire were not sufficient, or the answers not of sufficient clarity, to form a judgement on the extent to which current arrangements were in compliance with international requirements. These supplementary questions were concerned with three main issues: quality assurance, medical treatment and longer-term non-radiological issues.

5.1.2 Benchmarking

The nature of the review and benchmarking carried out by the project needs to be qualified in a number of respects to avoid potential misunderstanding. Firstly, the arrangements and capabilities declared by MS and neighbouring countries in their responses to the questionnaire have not been formally audited by the project – this would have required resources far beyond those available. Secondly, the responses have been assumed to be accurate (ie, the project has not carried out any systematic or comprehensive validation or checking of responses, although clarification has been sought where the responses were believed to be internally inconsistent or unclear). Consequently, the information benchmarked should be seen largely as that resulting from a self-assessment of arrangements and capabilities by the respective countries.

The benchmarking was carried out in two stages. Firstly, an initial benchmarking was carried out on the basis of responses to the questionnaires available to the project by a deadline in early June 2013. The results of this initial analysis were presented in the interim report of the project. MS and neighbouring countries, via their NCP, were then requested to validate their responses to the questionnaires in light of this initial benchmarking, in particular to resolve any ambiguities or inconsistencies identified by the project and to respond to questions so far not answered. Secondly, the benchmarking was updated taking account of corrections made by NCP to responses

initially provided and of new information provided prior to a second deadline in August.

Requirements

The international requirements and/or legislative provisions against which the current arrangements and capabilities for off-site EP&R has been benchmarked comprise the following:

- International Atomic Energy Agency (IAEA)

  GS-R-2: Preparedness and response for a nuclear or radiological emergency, 2002 [IAEA, 2002].

- European Union

  Council Directive laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, 96/29/Euratom, 1996 [EU, 1996].

  Council Directive on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency, 89/618/Euratom, 1989 [EU, 1989a].

  Council Regulation laying down maximum permitted levels of radioactive contamination of foodstuffs and of feeding-stuffs following a nuclear accident or any other case of radiological emergency, 3954/87/Euratom, 1987 [EU, 1987a], as amended by Council Regulation 2218/89/Euratom, 1989 [EU, 1989b].

The requirements from IAEA GS-R-2 and the relevant EU legislative provisions against which benchmarking has been performed are listed in Tables 16-1 and 16-2 of Appendix C. For each requirement, an indication is given of the questions (in the questionnaires) which are most relevant to forming judgements on compliance. Tables 16-1 and 16-2 do not include all of the requirements set out in the documents referenced; only those relevant to off-site arrangements relating to emergencies at operating NPP have been included. Moreover, the focus has been on the preparedness rather than the response phase; the latter can only really be tested in the event of an emergency (or in exercises), and it is the preparedness arrangements put in place to meet the response requirements that are of most interest to this study. Finally, where a specific requirement relating to EP&R arrangements at operating NPP (eg, for threat category I facilities in IAEA GS-R-2) was essentially duplicated by another more general requirement, the requirement was only included once.

Method for benchmarking against requirements

The outcome of benchmarking current arrangements and capabilities against each of the requirements or legislative provisions has been expressed in one or other of the following ways:

- Compliant;
- Compliant with qualification;
- Not compliant;
- Insufficient information to make a judgement.

Inevitably, some measure of judgement has had to be exercised in the benchmarking process, the degree depending on the nature of the requirement and on the extent and quality of information available. With a view to ensuring common or consistent judgements between different assessors/project staff when evaluating comparable information, the following approach was adopted and guidance developed for its implementation.

IAEA – GS-R-2

The requirements extracted from GS-R-2 for the purposes of benchmarking in this study comprise 170 separate requirements or 'shalls' (see Appendix C). These have been grouped under 19 numbered headings with further grouping into numbered paragraphs (reflecting separate paragraphs in GS-R-2), of which there are 90 in all. Benchmarking of current arrangements and capabilities was carried out systematically in terms of the requirements in each of the 90 paragraphs and in each of the 19 higher level headings.

The sheer number and the detail of these requirements (and these represent only a subset of the requirements set out in GS-R-2) are such that strict 100% compliance is virtually impossible: any mechanistic, 'box-ticking' exercise could easily find a 'shall' that was not fully complied with. Indeed, the IAEA's own IRRS missions take a very high-level view of compliance with its requirements, using them as a benchmark to identify broad areas of good practice and opportunities for improvement. This study has taken a similar pragmatic approach, with a similar aim: to identify areas of general good practice and areas for general improvement, particularly when looking across Europe as a whole.

The approach taken has, therefore, been to review the information provided by responding countries and reach a holistic judgement on the extent to which compliance is achieved with each of the (higher level) grouped requirements, taking account of the extent to which compliance is achieved with each of the individual requirements, according to the following guide:

> ***Compliant*** – arrangements and/or capabilities were judged to be 'compliant' with a (higher level) grouping of requirements in those cases where, based on the information provided in the questionnaire, compliance with all of the individual requirements is evident. Failure to comply with one or more of the numerous requirements contained within a grouping of requirements would not preclude the attribution of 'compliant' at the higher level, in particular if such a failure or failures concerned matters which, when taken together, were judged not to be of key importance in the context of the higher level issue being addressed in the grouping.

Compliant with qualifications – arrangements and/or capabilities were judged to be 'compliant with qualifications' in the following circumstances:

- Non-compliance or major reservations as to the degree of compliance with at most one requirement;
- Non-compliance or major reservations as to the degree of compliance with more than one requirement, but where these requirements, when taken together, were judged to be of secondary importance in the context of the higher level issue being addressed.

Not compliant - arrangements and/or capabilities were judged to be 'not compliant' in the following circumstances:

- Non-compliance or major reservations as to the degree of compliance with at least two requirements;
- Dispensation from this attribution was made in those cases where the requirements not being complied with were judged, when taken together, to be of secondary importance in the context of the higher level issue being addressed – in such cases the attribution was relaxed to 'compliant with qualifications'.

Insufficient information – This attribution is self-evident and requires no further explanation (ie, information not sufficient to make an informed judgement on the degree of compliance).

To provide added robustness to, and enhance the quality of, the process, all attributions of 'not compliant' were reviewed by a second assessor/project staff to corroborate the initial judgement/assessment.

In addition, each country had the opportunity to question the attributions and/or provide further information following the initial benchmarking; they were provided with a similar opportunity to challenge the revised benchmarking presented in a draft of this final report, and responses have been taken into account prior to the report being finalised.

EU legislative provisions

Unlike the requirements set out in IAEA GS-R-2, the provisions in the EU Directives and Regulations are legislative requirements, and in consequence have been written much more precisely; consequently, assessing compliance or otherwise with them is more straightforward and requires no further explanation or qualification here.

5.1.3 Mapping

The information collected from the questionnaires has been evaluated in order to identify good/best practice, possible gaps, inconsistencies, duplication, etc, between arrangements and capabilities in each country; this has been achieved by mapping

comprising two components: firstly, internal comparison of the arrangements and capabilities between countries; and, secondly, comparison with international or European requirements, guidance or recommendations where appropriate. The nature of the latter is summarised in Table 5-1 below, with further details provided in Appendix D.

Table 5-1: Summary of international or European requirements, guidance or recommendations used in mapping

Quantity used in mapping	Source/Reference
Guidelines for intervention levels (IL)	IAEA: GS-R-2 [IAEA, 2002]
Generic criteria for protective actions and other response actions	IAEA: GSG-2 [IAEA, 2011]
Default operational intervention levels (OIL)	
Guidance values for restricting exposure of emergency workers	
Default radionuclide specific OIL for foods	
Suggested emergency zones and area sizes	IAEA: EPR-NPP Public Protective Actions (2013) [IAEA, 2013]
Operational intervention levels	
Guidelines for iodine prophylaxis following nuclear accidents	WHO/SDE/PHE/99.6 [WHO, 1999]
Maximum permitted levels of radioactive contamination of foodstuffs, etc	EU Council Regulation 3954/87/Euratom [EU, 1987a] as amended by 2218/89/Euratom [EU, 1989b]

5.1.4 Stakeholder Group

The establishment of, and timely interaction with, a knowledgeable and representative Stakeholder Group (SG) were recognised as key elements of the project from the start and, indeed, a contractual requirement. The participation of the SG enhanced the legitimacy of the project's findings and provided a mechanism to test whether the draft recommendations of the project were realistic and, above all, practicable.

The functions of the Stakeholder Group, the criteria adopted in determining its composition, and its mode of working are set out in Appendix E and briefly summarised here.

The main function of the SG was to act as an informal reviewer of work carried out within the project, in particular of any recommendations made on how current EP&R arrangements and capabilities could be improved and/or made more coherent, and on how better use could be made of existing resources.

The composition of the SG was established with a view to ensuring that: it was sufficiently representative of those with an interest in and/or a responsibility for various aspects of off-site EP&R; that most, if not all, EU Member States and participating neighbouring countries were represented; and that an appropriate balance was achieved between those fulfilling policy, operational and more specific technical and administrative roles. A SG of about 50 members was established on this basis, with representation from a wide range of interest groups (ie, each participating country, nuclear regulatory authorities, civil protection/defence organisations, other national organisations/ministries responsible for EP&R, industry, local authorities, emergency services, technical specialists, citizen groups and NGOs). The composition of the SG is given in Appendix E.

Interaction between the project and the SG was achieved by two main mechanisms: correspondence and dedicated workshops to discuss/review the project's findings at key stages in their development. Two workshops were scheduled: firstly, in July, to discuss the outcomes of benchmarking and mapping of current EP&R arrangements and capabilities; and, secondly, in October, to discuss/review recommendations for improvements, based on the outcomes of the benchmarking and mapping and of further meetings held at a national or regional level.

To further enhance the efficacy of interaction with the SG, a smaller Core Group (CG) was established. The CG was a sub-set of the SG and comprised about 15 members (see Appendix E) with representation from each of the main interest groups identified above. The CG was intended to provide the project with a more focused and effective 'sounding board' for key project outcomes and recommendations prior to them being taken up with the much larger SG. Meetings with the CG were held immediately prior to each of the two dedicated workshops; in addition, a meeting was held in mid-September (ie, between the two workshops) to critically review the draft conclusions and recommendations of the study.

5.1.5 Case studies

Case studies have been developed by the project to elucidate a number of key issues for EP&R. Their scope has been limited to cross border arrangements, where a broad consensus is emerging that this is an area where significant improvements can and should be made. The purpose, scope and content of the case studies are described in Appendix H, and records of relevant workshops are included in Appendix I. The case studies contain examples of actual arrangements and, as such, provided a valuable framework for structured discussions among the Stakeholder Group of strengths, weaknesses, gaps, good practice, etc, in cross border arrangements and where improvements could be made. Three case studies have been developed (see Appendix H) and comprise cross border arrangements between AT and CZ, between DE and FR, and in the Nordic Region (DK, NO, SE, FI). Further information on cross border arrangements between Germany and Switzerland and in the "Greater Region" (BE, FR, DE, LU, NL) is provided in notes of workshops included in Appendix I.

5.2 Potential improvements

For the reasons previously indicated (ie, a 'moving target' in relation to arrangements and capabilities for EP&R), this study has been undertaken in two distinct parts: firstly, current arrangements (as of March/April 2013); and, secondly, potential future improvements. The approach adopted with respect to the latter is described in this Section and comprises two parts – the collection of information via a short questionnaire, followed by more in-depth discussions in national and regional workshops of opportunities for improvements and their practicability.

5.2.1 Collection of information

Information on potential improvements was also collected using a questionnaire (see Appendix F) that was channelled through the NCP. Contrary to that used to gather information on the current status of EP&R, this questionnaire was very short and largely non-prescriptive. The use of a non-prescriptive approach was deliberate and intended to avoid leading those who were completing the questionnaire and to encourage open and comprehensive responses. The downside of this approach is that it is then more difficult to compare responses in a rigorous and systematic manner. However, this shortcoming was judged acceptable in context, and recognising that follow up workshops were to be held subsequently where more detailed discussions were to be held on identified potential improvements.

The questionnaire sought responses on the following:

- Whether a review had been undertaken post Fukushima on off-site EP&R arrangements and capabilities and, if so, whether it was complete or ongoing;
- The main outcomes of any completed review;
- Whether the efficacy of EP&R could be significantly enhanced by:
  - Filling any identified gaps;
  - Improvements in cross border arrangements or in other areas;
  - Making better use of resources and capabilities in Europe (eg, mutual assistance, shared development of expensive but rarely used capabilities, etc).

5.2.2 National workshops

As a follow up to information gathered on potential improvements, three workshops were held at a national/regional level, covering nine countries (see Appendix I). The objectives of these Workshops were to:

- Provide a forum for identifying and discussing where improvements could be made in current national arrangements and capabilities (and in Europe more widely) - in particular, in terms of enhancing the efficacy of EP&R, making more effective use of limited national and European resources, and minimising needless duplication;
- To enable the project to become more fully informed of the nature, extent and outcomes of any review/s that have been made (or are still ongoing) of national arrangements and capabilities post Fukushima;
- To enable the project to become more fully informed of any improvements made to national arrangements and capabilities post Fukushima;
- To identify any initiatives that could be taken within Europe or more widely to further enhance, or facilitate the enhancement of, arrangements and capabilities (eg, by EC, ENSREG, HERCA, MIC, regional groupings, etc);
- To identify potential impediments to the adoption of more common or unified approaches in Europe.

6 BENCHMARKING OF CURRENT STATUS OF EP&R

The results of the benchmarking of the current status of EP&R against international and EU requirements are summarised in Tables 6-1 and 6-2 for countries with and without NPP[5], respectively. It should be noted that not all of the requirements are applicable to countries without NPP and that the requirements resulting from EU legislation are relevant only to EU Member States (although they have also been considered in the case of Switzerland and Norway, for perspective, because of the close ties and treaty agreements between these countries and the EU, while recognising they are not binding on these countries).

[5] Given the scope of this study, countries without operating NPP (ie, where the NPP have all been shut-down and de-fuelled and/or are in the process of being decommissioned) have been classed as countries without NPP. This applies specifically to Italy and Lithuania.

Table 6-1: Benchmarking for countries with NPP[6]

	BE	BG	CZ	FI	FR	DE	HU	NL	RO	SK	SI	ES	SE	UK	AM	CH
Requirement (IAEA GS-R-2)																
General requirements																
1. Basic responsibilities																
Functional requirements																
2. Establishing emergency management and operations																
3. Identifying, notifying and activating																
4. Taking urgent protective action																
5. Providing information and issuing instructions and warnings to the public																
6. Protecting emergency workers																
7. Assessing the initial phase																
8. Managing the medical response																
9. Keeping the public informed																
10. Taking agricultural countermeasures, countermeasures against ingestion and longer term protective actions																
11.Mitigating the non-radiological consequences of the emergency and the response																
12.Conducting recovery operations																
Requirements for infrastructure																
13. Authority																
14.Organization																
15.Coordination of emergency response																
16.Plans and procedures																
17.Logistical support and facilities																
18.Training drills and exercises [Questions 7.1, 7.2]																
19.Quality assurance programme [Questions 6.3, 7.1, 7.2, section 11]																
EU Requirements (Basic Safety Standards Directive, Public Information Directive, Regulations on food intervention levels)																
BSS Directive (96/29/Euratom)																
Article 50. Intervention preparation																
Article 51. Implementation of intervention																
Article 52. Emergency occupational exposure																
Article 53. Intervention in cases of lasting exposure																
Public Information Directive (89/618/Euratom)																
Article 5. Prior information																
Article 6. Information in the event of an emergency																
Article 7. Information of persons who might be involved in the organization of emergency assistance																
Article 8. Information procedures																
Regulation laying down maximum permitted levels of radioactive contamination of foodstuffs (Council Regulations 3954/87 and 2218/89 and Commission Regulation 944/89)																

[6] While the EU requirements do not apply to CH, benchmarking against them has been made to provide additional perspective

Table 6-2: Benchmarking for countries without NPP[7]

	AT	HR	CY	DK	EE	GR	IE	IT	LV	LT	LU	MT	PL	PT	NO
Requirement (IAEA GS-R-2)															
General requirements															
1. Basic responsibilities															
Functional requirements															
2. Establishing emergency management and operations															
3. Identifying, notifying and activating															
4. Taking urgent protective action															
5. Providing information and issuing instructions and warnings to the public															
6. Protecting emergency workers															
7. Assessing the initial phase															
8. Managing the medical response															
9. Keeping the public informed															
10. Taking agricultural countermeasures, countermeasures against ingestion and longer term protective actions															
11.Mitigating the non-radiological consequences of the emergency and the response															
12.Conducting recovery operations															
Requirements for infrastructure															
13. Authority															
14.Organization															
15.Coordination of emergency response															
16.Plans and procedures															
17.Logistical support and facilities															
18.Training drills and exercises [Questions 7.1, 7.2]															
19.Quality assurance programme [Questions 6.3, 7.1, 7.2, section 11]															
EU Requirements (Basic Safety Standards Directive, Public Information Directive, Regulations on food intervention levels)															
BSS Directive (96/29/Euratom)															
Article 50. Intervention preparation															
Article 51. Implementation of intervention															
Article 52. Emergency occupational exposure															
Article 53. Intervention in cases of lasting exposure															
Public Information Directive (89/618/Euratom)															
Article 5. Prior information															
Article 6. Information in the event of an emergency															
Article 7. Information of persons who might be involved in the organization of emergency assistance															
Article 8. Information procedures															
Regulation laying down maximum permitted levels of radioactive contamination of foodstuffs (Council Regulations 3954/87 and 2218/89 and Commission Regulation 944/89)															

[7] While the EU requirements do not apply to NO, benchmarking against them has been made to provide additional perspective

Key to Tables 6-1 and 2

	Requirement not applicable (State without nuclear power or not EU Member State)
	Compliant
	Compliant with qualifications (to be documented)
	Insufficient information to judge compliance
	Not compliant

The response to the questionnaire on the current status of EP&R arrangements and capabilities has been excellent, with completed (or partially completed) questionnaires received from all 31 countries. The quality of the responses is, however, variable and in a few cases the responses remain insufficiently complete for an assessment to be made. Lack of information is indicated by the orange shading in the two matrices (see, for example, the Czech Republic and France, and the IAEA requirements relating to quality assurance, where the relevant supplementary questions have not been answered, and the assessments for Cyprus and Portugal, where responses to the questionnaires were submitted later than those from other countries and where fewer iterations were therefore possible). Caution therefore still needs to be exercised in attempting to draw overly definitive conclusions from the results presented, as there are still some inconsistencies between responses, and examples where the response appears contradictory to that in other official documentation. Not all countries have responded to a request for final validation, and the findings of this study need to be qualified accordingly.

The few instances of judgements of not compliant also need some qualification. These judgements invariably stem from frank replies from the countries concerned about a lack of arrangements or capabilities in certain areas. For example, for Romania, Slovenia, Spain, Croatia and Luxembourg, the judgment of not compliant for the IAEA requirements relating to a quality assurance (QA) programme (requirement heading 19) was based on their responses to the supplementary questionnaire that declared they were not compliant with these requirements. Other countries may have been less transparent, for example, claiming compliance but not providing any further details, or choosing not to declare their compliance status (resulting in an apparently less negative assessment of 'compliant with qualifications' or 'insufficient information to judge'). As has been noted, the questionnaire response from each country, and therefore the benchmarking assessment based on it, represents essentially a self-assessment. Undue criticism should not, therefore, fall on the few countries with one or two indications of not compliant in the two matrices; in particular, these countries may have been more rigorous in assessing, and more open in reporting, their weaknesses than others.

Overall, the preponderance of 'mid-green' shading in both matrices indicates general compliance with both EU and IAEA requirements. For EU requirements, in particular, there are very few instances of light green (compliant with qualification) or red (not compliant). For nuclear countries, there are no examples of not compliant among these requirements, and only a few examples of compliant with qualifications (relating: for Slovenia, to responses which indicated a lack of detailed arrangements for the longer term; and, for the Czech Republic, Romania, Slovakia and Sweden, to responses that stated that their arrangements for the control of food and drinking water were not sufficiently comprehensive and robust to provide a high degree of assurance that food products would comply with EU legislation, although in all these cases information provided elsewhere supported the existence of suitable arrangements). Among non-nuclear countries, there are more examples of compliant with qualifications and some examples of not compliant with EU requirements. Considerations were similar to those described above for nuclear countries. This is

particularly the case for Croatia, which is new to the EU. There are also more examples of insufficient information to judge compliance, particularly for Cyprus and Portugal.

For the IAEA requirements, the extent of compliance is a little more patchy. In part, this is a reflection of the large number and detail of these requirements and the need for more judgement when assessing compliance. A general finding for nuclear countries is that the extent of compliance is less complete for requirements relating to agricultural countermeasures, countermeasures against ingestion and longer term protective actions (heading 10), to recovery operations (heading 12), and to quality assurance programmes (heading 19). Typically, weaknesses in the first two of these areas relate to a lack of operational intervention levels, and a lack of strategies for longer term actions (including processes for removing restrictions). Where information was provided about quality assurance, in many cases the arrangements required by GS-R-2 either did not exist, or were pending or not comprehensive. There is also some less than complete compliance in managing the medical response (heading 8), and in organisation (heading 14).

Non-nuclear countries show a similar widespread less than complete compliance with the IAEA requirements relating to agricultural countermeasures, countermeasures against ingestion and longer term protective actions (heading 10) and to conducting recovery operations (heading 12). These can be attributed to similar weaknesses as for the nuclear countries. There are also indications of some further general less than complete compliance with requirements relating to managing the medical response (requirement 8), and to mitigating the non-radiological consequences of the emergency and the response (heading 11). The former is likely to reflect a lower need for many of these countries to have facilities to treat those over-exposed; the latter can be attributed to a lack of detailed arrangements for proactively countering misinformation.

Among the non-nuclear countries, Croatia and Luxembourg have territory inside the Emergency Planning Zone (EPZ) of NPP in neighbouring countries and have been judged against a larger subset of IAEA requirements than other non-nuclear countries. The adequacy of their arrangements has also been judged in this context, and the greater prevalence of compliant with qualifications and not compliant judgements for these two countries is at least partially a reflection of their different circumstances. As an example, the lack of or limited capabilities for medical treatment and follow-up has been considered a more significant failing in Croatia and Luxembourg than in Greece and Ireland.

The areas where there appears to be more general failure to comply fully with IAEA requirements, particularly those on taking agricultural countermeasures, countermeasures against ingestion and longer term protective actions (heading 10) and on quality assurance programmes (heading 19), could be seen as indicating some divergence between the IAEA's and individual countries' perceptions of the need to fulfil some of these requirements. For example, few countries appeared to comply fully with the IAEA's requirements to develop optimised national intervention levels or operational intervention levels for environmental measurements, and fewer than

half claimed fully to meet the requirements for comprehensive quality assurance programmes in accordance with international standards. Indeed, the Netherlands reported that (although it claimed to meet the objective of the IAEA's requirements) it had dispensed with requiring formal QA.

7 MAPPING OF CURRENT STATUS OF EP&R

The detailed results of the mapping are provided in Appendix G for each of the questions in the questionnaire on the current status of arrangements and capabilities for off-site EP&R (see Section 14 - Appendix A), with the exception of those that were more appropriately addressed in the benchmarking. Consideration here is limited, for each area or issue mapped, to: firstly, providing a summary of the key findings that have emerged from the detailed mapping; secondly, identifying where further analysis and/or information may be needed to reach more fully considered judgements; and, thirdly, identifying potential shortfalls in arrangements and capabilities, as well as examples of good/best practice where this can be readily ascertained.

7.1 Regulatory framework for protection of the public

Responses on regulatory frameworks for protection of the public are summarised in Appendix G (Section 20.1). All countries, even those without NPP, have some regulations, standards, requirements or guidance in addition to primary legislation to provide a framework for protection of the public in the event of a nuclear emergency.

All NPP countries have a system for classifying abnormal events at NPPs with links to the need to take particular off-site actions. Many of these correspond to the IAEA emergency class descriptions (general emergency, site area emergency, facility emergency, alert). Most classification systems are based around the severity of the accident.

All NPP countries, with one exception, include requirements relating to off-site EP&R as conditions of licensing of NPP (eg, notification, adequacy of emergency response arrangements, conduct of emergency exercises).

On the criteria for termination of an emergency, some countries stated that they had no specific criteria; the decision would be for the relevant authorities to make depending on circumstances. Others mentioned only general criteria, such as NPP under control, radioactive releases having stopped (or being no greater than normal levels), etc. Very few countries addressed criteria for the transition from emergency to recovery phases and this warrants greater attention.

7.2 Emergency Planning Zones

A comparison of Emergency Planning Zones (EPZ) is made in Figures 20-1 to 20-4 for sheltering, evacuation, iodine prophylaxis and food restrictions; in each figure comparisons are made between countries and with IAEA guidance (EPR-NPP Public Protective Actions [IAEA, 2013]). The comparisons are limited to countries with commercial NPP and countries without NPP but whose borders fall within the EPZ of a neighbouring country. The rationale for the choice of EPZ in each country is summarised in Table 20-1.

7.2.1 Sheltering

EPZ for sheltering (see Figure 20-1) vary from a few km to 30 km. By far the majority fall within a range of 10 to 30 km, with only two countries having smaller zones. For comparison, IAEA guidance (EPR-NPP PPA [IAEA, 2013]) on the sizes of emergency zones where arrangements need to be made for taking urgent protective actions (which include sheltering) suggests ranges (for NPP greater than 1 GW(th)) from 3 to 30 km (comprising a Precautionary Action Zone (PAZ) of 3 – 5 km and an Urgent Protective Action Planning Zone (UPZ) of 15 – 30 km).

7.2.2 Evacuation

EPZ for evacuation (see Figure 20-2) vary from a few km to 30 km. In more than half of the countries, the EPZ is 10 km or less. For comparison, IAEA guidance (EPR-NPP PPA [IAEA, 2013]) on the sizes of emergency zones where arrangements need to be made for taking urgent protective actions (including evacuation) suggests ranges (for NPP greater than 1 GW(th)) from 3 to 5 km (PAZ) and 15 to 30 km (UPZ).

7.2.3 Iodine prophylaxis

EPZ for iodine prophylaxis (see Figure 20-3) vary over a wide range from a few km to 100 km. By far the majority fall within a range of 10 to 30 km, with only two countries having smaller zones and one a larger zone. For comparison, IAEA guidance (EPR-NPP PPA [IAEA, 2013]) on the sizes of emergency zones where arrangements need to be made for taking urgent protective actions (including iodine prophylaxis) suggests ranges (for NPP greater than 1 GW(th)) from 3 to 5 km (PAZ) and from 15 to 30 km (UPZ). The comparisons, however, need to be qualified in one important respect. In many countries, centralised arrangements and capabilities exist to provide iodine prophylaxis far beyond the EPZ; however, these arrangements tend to be governed by outline or contingency, rather than detailed, planning. Consequently, the apparent large disparity in the EPZ for DE in Figure 20-3, compared with other countries, may not be reflected in practice in the actual distribution of iodine following an accident.

7.2.4 Food restrictions

Many countries did not report an EPZ specifically for food restrictions. For those that did, there was wide variation in the extent of the EPZ. In most cases, the reported EPZ were broadly similar to those for other urgent countermeasures. In some cases, the extent of the EPZ was much greater (eg, ranging from 100 km in one case to the whole country in three others). For comparison, IAEA guidance (EPR-NPP PPA [IAEA, 2013]) on the maximum radius (for NPP greater than 1 GW(th)) for the Ingestion and Commodities Planning Distance (ICPD) is 300 km. Notwithstanding the differences in EPZ shown in Figure 20-4, in practice restrictions on foodstuffs would be largely the same in all EU countries (ie, in compliance with the Community Food Intervention Levels (CFIL).

7.2.5 Rationales for the selection of EPZ

The rationales for the selection of the EPZ are summarised in Table 20-1. In most cases, the distances have been determined on the basis that the estimated dose from an assumed release in assumed weather conditions would not exceed a specified intervention level or other level of dose. Significant differences are, however, apparent between countries in the assumptions made with respect to these three assumptions or quantities (ie, magnitude of assumed release, assumed weather and intervention level adopted). Not surprisingly, therefore, there are significant differences in the extent of the resulting EPZ.

The magnitudes of assumed releases vary over several orders of magnitude (see Appendix G, Section 20.2.5 for further detail). The variation in assumed weather conditions is also considerable ranging from 'average' to 'adverse' and in some cases to the 'worst' (represented by the 99.5th percentile in one case). The assumed intervention levels also differ significantly, varying by more than an order of magnitude between countries and often relating to different dose quantities. Given the extent of the variability between assumptions, it is surprising that even greater differences are not apparent between EPZ.

In most countries with NPP, the probability of occurrence of an accident was not an explicit consideration in determining the extent of the EPZ (or, more exactly, in the choice of the magnitude of the accident assumed for these purposes. Perhaps surprisingly, only one country appeared to address explicitly what it was reasonable to plan for (in detail) in the establishment of EPZ, noting especially the need to achieve a proper balance between ensuring that plans are sufficiently extensive to cope with serious emergencies, while avoiding the waste of resources through over-planning for the most improbable emergencies. This issue warrants further consideration in terms of the very low probabilities predicted for severe accidents, the effective use of limited resources, and comparability with EP&R for other technological sectors and/or natural disasters.

In most countries, controls are placed on the construction of new developments (eg, homes, industrial facilities, etc) within a prescribed distance (generally of smaller magnitude than the EPZ) of a NPP but there are a few exceptions.

7.2.6 Significance of differences in EPZ and potential for harmonisation

The principles underlying the establishment of EPZ are common in most countries. Notwithstanding this, the sizes of EPZ in practice differ considerably because of large differences in the assumptions adopted with respect to the assumed magnitude of the accident, weather and intervention level. These assumptions, *inter alia*, reflect differences in view as to what it is reasonable to plan (in detail) for.

It would be over-simplistic and wrong to conclude that, because of differences in EPZ, the protection afforded to people in one country was significantly better or worse than that elsewhere. Considered judgements on such matters would require holistic assessments to be made of the overall EP&R arrangements and not just of one aspect, ie, the extent of EPZ for which more detailed planning is undertaken. Depending on the nature of arrangements within and beyond EPZ, it is quite possible that a higher level of protection may be achieved in a country with a smaller EPZ. Undertaking and comparing holistic assessments of EP&R arrangements was, however, far beyond the scope and resources available for this project.

Overly simplistic and unsubstantiated conclusions on the level of protection being achieved will, nevertheless, continue to be drawn by some as a result of differences in the EPZ. This will be a source of (largely unjustified) public and political concern. Rationalisation of, or achieving greater harmonisation in, EPZ could help mitigate these concerns but would be unlikely to be achieved easily, at least not on technical grounds alone. Notwithstanding their apparent technical underpinning, the choices of EPZ reflect a large measure of socio-economic and political judgement regarding what is reasonable to plan for in a detailed manner. However, if the credibility and public acceptance of emergency arrangements were likely to be enhanced significantly by the adoption of more common EPZ, this is an issue that may warrant attention at a more political level.

7.3 Intervention Levels (IL) and Operational Intervention Levels (OIL)

Responses on intervention levels are illustrated in Figures 20-5 to 20-8 of Appendix G, Section 20.3. There are significant differences between countries in the intervention levels adopted for various protective measures (ie, sheltering, evacuation, iodine prophylaxis, relocation).

Indicatively, for each protective measure, the values range up to about 10 times higher and lower than the generic optimised intervention levels recommended by IAEA in GS-R-2[8] [IAEA, 2002].

These differences in intervention levels are a source of much public and political concern and disquiet due to the implied differences in the levels of protection being aimed for, and/or achieved, between countries; when differences occur between neighbouring countries, such concerns are further exacerbated. Numerous attempts have been made to achieve greater harmonisation of intervention levels within Europe. Notwithstanding the obvious benefits that would result in terms of public confidence and trust, with a few exceptions (e.g. among the Nordic countries – see Appendix H, Section 21.4), these attempts have met with little success. Despite this, it is interesting to note (see Figures 20-5 to 20-8) that, typically, more than half of the countries adopt the same intervention level - that is the generic optimised intervention level recommended by IAEA in GS-R-2 [IAEA, 2002]. This large measure of agreement among many countries may provide a clue as to how greater harmonisation might be achieved in future.

If the credibility and public acceptance of emergency arrangements were likely to be enhanced significantly by the adoption of more common intervention levels within Europe, this is an aspect that may warrant greater attention at a more political level. The need to transpose the pending revision of the EU Basic Safety Standards (BSS) Directive (which contains further provisions on EP&R) (see Section 24 - Appendix K) may provide a further opportunity or impetus to achieve greater harmonisation of intervention levels.

Relatively few countries reported the development and use of operational intervention levels (OIL), notwithstanding the importance given to them by IAEA for ensuring practicable and timely response (GS-R-2 [IAEA, 2002], GSG-2 [IAEA, 2011] and EPR-NPP PPA [IAEA, 2013]) (see also the similar finding from the benchmarking analysis). The reasons for this need to be better understood. Meanwhile, countries should either be encouraged to adopt what appears to be good practice as formulated by the IAEA, or, alternatively, the IAEA should review the effectiveness in practice of its requirements and guidance on this issue.

Criteria for the termination of protective measures are far less mature than for their introduction and varied widely, even among the relatively few countries that responded. This topic warrants increased attention in future, as the absence of well-considered criteria for termination of protective measures would be an impediment to the effective management of any future emergency.

[8] It is recognised that the IAEA's more recent GSG-2 [IAEA, 2011] provides a set of generic criteria for protective actions in terms of the dose that has been projected and that are compatible with reference levels within a range of 20-100 mSv. These criteria are noted in the figures, but not used for comparison purposes, because the figures would appear to show that many countries still base their intervention levels around the GS-R-2 values.

7.4 Plant status

Responses on plant status are summarised in Appendix G (Section 20.4). EP&R arrangements in all NPP countries use the status of the nuclear power plant and/or prognoses of its development as a basis for making decisions on the introduction of protective measures. In nearly all cases there are standards, guidance or recommendations setting out the conditions which should trigger particular protective actions. And, in all but one country, information about plant status and/or prognoses of its development is available in real time to those responsible for off-site EP&R. Clearly, this is best practice which all countries should aspire to.

7.5 Regulatory framework for the protection of off-site emergency personnel and rescuers

Responses on the regulatory framework for the protection of off-site emergency personnel and rescuers are summarised in Appendix G (Section 20.5). Most countries have some regulations, standards, requirements or guidance in addition to primary legislation to provide such a framework.

Dose criteria are, *inter alia*, specified for volunteers and non-volunteers and for different types of emergency action (eg, urgent protective actions, actions to prevent the development of the emergency, life-saving actions, etc). For most countries, the dose criterion for carrying out general urgent protective actions varies between about 50 and 100 mSv, but in some countries is about a factor of 2 lower or higher. The dose criteria for actions to prevent the development of the emergency, serious injury or large collective dose typically lie between about 100 and 500 mSv. Where specified, dose criteria for life saving actions generally vary between 250 and 500 mSv. Criteria adopted by most countries are generally in line with IAEA guidance [IAEA, 2011]. Most countries place restrictions on pregnant and lactating women taking part in emergency response actions.

Some nuclear countries provided no information on provisions for medical care and follow up of personnel exceeding the dose criteria; those that did so generally provided little information of a detailed nature (this was also noted in the benchmarking analysis). The limited response to this issue raises questions as to the adequacy of current arrangements in many countries; consequently, this aspect needs to be further addressed to provide reasonable assurance that arrangements in this area are appropriate.

7.6 Institutional arrangements

Responses on institutional arrangements are summarised in Appendix G (Section 20.6). There are significant differences in the regulatory frameworks (eg, responsibilities for developing plans, for implementing response, etc) adopted by the respective countries for off-site EP&R reflecting national custom and practice (see Appendix G, Section 20.6.1, for further detail). There is no compelling evidence to suggest that

one approach is better than another with each having been adapted to the particular administrative, organisational, legislative and political situation in the country.

In most countries, off-site emergency plans are subject to some form of consultation prior to being finalised, although this does not necessarily always include public consultation.

All countries (with one exception) claim that their institutional arrangements for nuclear off-site EP&R are coherent and compatible with arrangements for other emergencies – a GS-R-2 requirement [IAEA, 2002].

Overall, however, there was little information in the responses to the questionnaire about how coordination is achieved. References to where such information could be found were often provided, but it was beyond the scope of the project, and the resources available, to scrutinise them and/or analyse differences and commonalities in detail (although cursory review of this information for the benchmarking analysis generally provided sufficient assurance about coordination arrangements).

7.7 Cross border institutional arrangements

Notification: Nearly all countries (three exceptions) indicated that they have mechanisms in place to ensure timely notification of emergencies to neighbouring countries over and above obligations under the Convention on Early Notification of a Nuclear Accident and the Community's Urgent Radiological Information Exchange system.

Detailed arrangements: Detailed bi-lateral cross border arrangements have been established by 19 countries - 12 with NPP and 7 without NPP. Four countries with NPPs do not have detailed cross border arrangements in place. Arrangements are in place (or under development) in all cases where the territory of a country falls within the EPZ of a NPP in a neighbouring country. Multi-lateral arrangements have also been established, notably between the Nordic countries and in the “Greater Region” which comprises several French, Belgian, Dutch, Luxembourg and German regions.

7.8 Licensee’s arrangements and coordination with those responsible for off-site EP&R

Responses on the licensee’s arrangements and coordination with those responsible for EP&R are summarised in Appendix G (Section 20.7). In all countries the NPP licensee’s on-site EP&R arrangements are subject to regulatory approval; its off-site arrangements, however, are only subject to such approval in less than half of the countries. All countries were confident that the licensee’s organisational arrangements contained provisions for ensuring effective and timely liaison and communication with those responsible for off-site EP&R.

In most countries (with four exceptions), the NPP licensee has the power or responsibility to initiate off-site protective measures in the initial stages (ie, usually only until the relevant crisis centre has been established).

In most countries the licensee has obligations placed on it to contribute to off-site EP&R; where not, the licensee often does so voluntarily. The contributions include environmental monitoring, stockpiling of potassium iodide/iodate tablets, etc.

In nearly all countries (with one exception), the licensee is required to provide the regulator or other body with continuous information on the facility status. The latter ranges from notification reports on the situation sent every one to two hours, to continuous automatic transmission of critical plant parameters and monitoring data (numbering several hundred parameters every minute) via dedicated data link. The automatic transfer of such information would appear to have become best practice and the merits of its wider adoption warrants consideration.

In one country, the licensee is required to provide such information to governmental organisations in third countries; in a few other countries this is done voluntarily. Consideration should be given to the merits of adopting this approach more widely, in particular where NPP in neighbouring countries are within a few tens of km of a border – in principle, it could contribute to enhancing public and political confidence and facilitate the introduction of timely response to a developing emergency.

Licensees in all countries (with one exception) have tools available to predict radiological impact based on plant status and how it might develop, and/or on measurements of released material and levels of radiation in the environment. This has clearly become best practice and is something all licensees should aspire to.

7.9 Coordination of off-site EP&R – role of key stake-holders

Responses on the coordination of off-site EP&R are summarised in Appendix G (Section 20.8). All countries (with one exception) state that the roles, responsibilities and interactions between the key stakeholders in off-site EP&R are clearly defined and formally agreed by all parties. Similarly, all countries (with one exception) have a national coordinating authority to ensure that the functions and responsibilities of all parties are clearly assigned and understood.

Countries gave a more varied response to the question about whether an assessment has been made to determine the adequacy of resources and capabilities at local, regional and national level. Of the nuclear countries which had not carried out such an assessment, most were planning or in the process of doing so.

7.10 Timing and exercising of off-site EP&R arrangements

Responses on the timing and exercising of off-site EP&R arrangements are summarised in Appendix G (Section 20.9). All countries carry out testing of at least some, if not

all, of their on-site EP&R arrangements at least once per year. In principle, these testing schedules should enable on-site staff responsible for critical response functions to participate in a training exercise or drill at least once every year, in line with IAEA requirements (GS-R-2) [IAEA, 2002]. Whether this is the case for any off-site staff responsible for critical response functions (for example, in local response organisations) is less clear, as the frequency of testing of off-site EP&R arrangements is often less than once per year per NPP.

The frequency of exercising national arrangements varies from several per year to about once every five years. Specific cross-border exercises were reported by several countries where NPP were sited in relatively close proximity to the border of a neighbouring country. At international level, reference was most often made to CONVEX, INEX or ECURIE exercises.

Responses on how often the extendibility of EP&R arrangements was tested were much fewer, less clear and often not fully consistent with the responses to other related questions (see below). Given the importance of the extendibility issue post Fukushima, both politically and in practice, this aspect warrants close scrutiny in the coming years.

7.11 Practical aspects of protective measures

7.11.1 Issue of stable iodine

Responses on the issue of stable iodine are summarised in Appendix G (Section 20.10.1). Most countries (both nuclear and non-nuclear) use stable iodine as an isolated countermeasure but some use it only in combination with sheltering. The dosages prescribed are consistent with those recommended by the WHO [WHO, 1999] (see Section 17 - Appendix D) but there are major departures in most countries from WHO guidance on repeat intakes; WHO suggests repeat intakes only for infants, children and adolescents.

Stable iodine is pre-distributed in all nuclear countries and, typically, within the EPZ. It is also distributed in particular areas of some non-nuclear countries. Most nuclear countries also pre-distribute stable iodine to groups at particular risk, typically to schools, nurseries and hospitals; additionally, stocks of stable iodine are available centrally, with arrangements in place for its distribution, if necessary. Information/guidance about potential side effects is provided by almost all countries that pre-distribute stable iodine, generally in a leaflet inside the box containing the tablets.

7.11.2 Sheltering

Responses on the practical aspects of sheltering are summarised in Appendix G (Section 20.10.2). In the event of an accident, all nuclear and several non-nuclear countries would recommend sheltering prior to the release of radioactive material.

Nearly all countries have recommendations or guidance on the maximum duration of sheltering; most recommend a maximum duration of 48 hours, but others recommend 24 hours or, in one case, six hours.

7.11.3 Evacuation

Responses on the practical aspects of evacuation are summarised in Appendix G (Section 20.10.3). All nuclear countries, apart from the UK, would recommend evacuation prior to a release; such recommendations would, in general, be based on an assessment of the status of the NPP, and/or predictions of potential releases and their consequences in comparison with intervention levels. Evacuation in most countries would be achieved by a combination of self-evacuation and organised transport.

Most nuclear countries (with two exceptions) make special provisions within their plans for the evacuation of particular groups, in particular, hospitals, care homes, social institutions, schools and prisons. Most countries (nuclear and non-nuclear) claim that their pre-designated reception centres have sufficient capacity to accommodate the total population residing within the EPZ, although several countries acknowledge that they may be insufficient.

7.11.4 Food and drinking water restrictions

Responses on the practical aspects of food and drinking water restrictions are summarised in Appendix G (Section 20.10.4). All nuclear countries would, in the event of an accident, place restrictions on food and drinking water in pre-designated areas (occasionally over the whole country) prior to confirmatory measurements being made; in non-nuclear countries, more than half would follow this practice, with the others placing initial restrictions on the basis of model predictions.

Some countries chose not to respond on whether their arrangements for the control of food and drinking water were sufficiently comprehensive and robust to provide a high degree of assurance that products entering the market would meet EU requirements. Of those that did, four acknowledged that their arrangements were not sufficiently comprehensive and robust (and this has been reflected in the benchmarking analysis).

Relatively few countries (ie, seven) claimed to have developed a practicable strategy for the management and disposal of contaminated foodstuffs and livestock and to have made provisions for its implementation; none, however, provided further information about the nature of these strategies. Few countries without a strategy provided much further information on their current arrangements which were often described as ad-hoc.

Similarly, few countries had assessed the implications of their strategy or current arrangements to determine whether or not they were practicable – nor were any compelling reasons were put forward as to why such assessments were considered unnecessary.

7.11.5 Relocation

Responses on the practical aspects of relocation are summarised in Appendix G (Section 20.10.5). Only a minority of countries (five nuclear and four non-nuclear) claim to have developed a robust and defensible strategy for relocation and made provisions for its practical implementation. Several countries without a strategy provided no details of their current arrangements and some indicated that they had no arrangements. Only two countries had carried out any assessment of the implications of their strategy or current arrangements, in particular to determine whether they are practicable; but neither provided much detail about their findings. Several countries chose not to reply to this question.

7.11.6 Decontamination of the built environment

Responses on the practical aspects of decontamination of the built environment are summarised in Appendix G (Section 20.10.6). They show a similar pattern to those above for strategies for the control of foodstuffs and for relocation, ie, few countries claiming to have developed a strategy and even fewer having assessed the practical implications of their strategy or, alternatively, of their current arrangements. Equally, there were few reasons put forward as to why such assessments were considered unnecessary.

7.11.7 Return from evacuation or relocation

Responses on the practical aspects of return from evacuation or relocation are summarised in Appendix G (Section 20.10.7). Again, only a minority of countries have developed a strategy for the return of those evacuated or relocated and very few have assessed the implications of their strategy or their current arrangements. Also, little information was provided as to why such assessments were considered unnecessary.

7.11.8 Significance of lack of practicable strategies or arrangements for longer term protective actions

The identified general lack of practicable strategies and arrangements for longer term protective measures and the return to normality following an emergency represents a significant gap. This was also highlighted in the benchmarking summarised in Section 6. These issues were problematic for many years in the Former Soviet Union in managing the aftermath of the Chernobyl accident [IAEA, 1991; UNDP, 2002] and similar problems are being encountered in Japan post Fukushima.

A major contributory factor in this gap is that criteria for longer term protective measures are far less mature than those for urgent measures (see Section 7.3), with frequent changes to relevant international guidance over the past two decades and a lack of broad consensus. The issue is complex, particularly as guidance and criteria need to be applicable to the very wide range of circumstances that might arise in

practice. Some countries prefer the adoption of outline, flexible arrangements that can be adapted to the prevailing situation.

The absence of strategies and arrangements for longer term measures represents a major risk for individual countries and for Europe as a whole. In the event of an accident that affected several countries in Europe, the measures being taken in these countries would inevitably be compared, and there would be public and political pressure, that would be difficult to resist, to adopt the standards or criteria seen as offering the best level of protection, regardless of the wider social and economic consequences. Countries without a strategy or criteria would find it hard to do anything other than follow practice adopted elsewhere. This could lead to significant and lasting social, economic and political problems.

7.12 Countermeasures for farm animals

Most nuclear countries include provision in their EP&R arrangements for the control and management of livestock that may be contaminated or left in evacuated or relocated areas. These arrangements include provisions for restricting livestock movements, feeding and housing the animals, as well as for their evacuation, decontamination and/or slaughtering.

7.13 Early warning and radiation monitoring systems

Responses on early warning and radiation monitoring systems are summarised in Appendix G (Section 20.12). There is considerable variation in the spatial resolution and types of radiation monitors used in national early warning and radiation monitoring systems. The number of countries (among those responding to the relevant questions in the questionnaire) deploying different types of detector in their national systems are summarised in Table 7-1 together with their density. Further detail can be found in Appendix G (Section 20.12).

Table 7-1: Countries deploying different types of detector in their national systems and the typical range of densities of deployment

Detector (with real time data transmission unless indicated)	Countries with this type of detector in national system	Typical range in density of deployment in European countries (No/1000km^2)[a)]
Gamma dose rate monitor	All	≈0.1 to 10
Gamma spectrometer [b)]	About one third (12)	≈0.01 to 0.4 [c)]
Air sampler [d] **(with real time or delayed data transmission)**	Almost all (29)	0.02 to 0.5 [e)]

Notes:

a) – The density of deployment of detectors may not be uniform within countries

b) – With automatic real time data transmission

c) – Density in Belgium much higher, about 2 per 1000 km^2

d) – Real time data transmission from at least some of samplers in 18 of the countries

e) – Density in Luxembourg and Malta much higher, about 2 to 3 per 1000 km^2

Undue significance should not be attached to the wide variation in the densities with which the various types of monitor are deployed; in particular, it would be over-simplistic and wrong to attempt to infer best or good practice on this basis alone, or to conclude that some countries were better prepared than others. Many of these systems were developed and installed in the aftermath of the Chernobyl accident. Their design is often more a reflection of the prevailing social and political attitudes at that time and the perceived risk of further nuclear accidents in Central and Eastern Europe (CEE) and the Former Soviet Union (FSU). In many countries, such considerations, rather than need established on a strictly technical basis, determined the system design and the density with which detectors were deployed. In general, the type of detectors deployed and their density reflect judgements, made at a national level, of what was required in relation to the (often perceived) risk of accidents at nuclear facilities either within a country and/or elsewhere.

The extensive network of gamma dose rate monitors, gamma spectrometers and air samplers offers a robust system for providing early warning and an estimate of the potential significance of a release of radioactive material within Europe, and/or of the arrival over the European land mass of material released elsewhere. Information from most of these networks is available across Europe and largely in real time (ie, via national web-sites and within the EURDEP system at a European level)[9]. Recent developments (see for example [Saunier et al 2013]) in the application of inverse modelling to data collected from early warning and radiation monitoring systems are now able to provide enhanced and more timely prognoses of the dispersion of released material and of its potential radiological consequences; this capability, however, is currently only available in one or two European countries. These countries should be encouraged to share the results of its application with other Member States or, failing this, consideration should be given to developing such a capability within the Joint Research Centre of the European Commission.

7.14 National capabilities for off-site EP&R

7.14.1 Radiation surveys and environmental sampling and measurement

Responses on national capabilities for radiation surveys, and environmental sampling and analysis, are summarised in Appendix G (Section 20.13). Capabilities for carrying out radiation surveys (vehicle based and aerial survey) and for taking and measuring

[9] To be extended globally in due course via the IAEA's IRMIS (International Radiation Monitoring and Information System) system.

environmental samples are summarised in Appendix G (Section 20.13.1 to 20.13.4). Nearly all countries have a vehicle based capability and some 16 countries are able to carry out aerial surveys, some with more than one device at their disposal. Most countries have a capability for sampling and measuring environmental samples. In general, the capability is greatest in those countries with larger numbers of nuclear installations and/or who were or continue to be actively engaged in nuclear RTD in either the civil or the defence sectors.

There are, however, some important exceptions to this generalisation. Firstly, several countries without NPP appear to have comparable or larger capabilities for the sampling and measurement of environmental samples than some countries with NPP. Secondly, five countries without NPP are capable of carrying out aerial surveys while several countries with NPP are not, including one with a large number of nuclear installations. This is surprising given the importance of quickly and reliably establishing, after an accident, the levels of deposition of radioactive material over extensive areas for the effective management of an emergency and in building public trust and confidence. Aerial survey clearly represents best practice for carrying out radiation surveys; it, therefore, behoves countries without this capability (especially countries with NPP) to aspire to its acquisition and use – or putting in hand arrangements for timely access to such capability (using aerial survey or other means) in the event of an emergency.

Attempts were made to assess the area that could be surveyed per day by vehicles or by aerial survey as an input to judgements on the sufficiency of current capabilities; unfortunately, this failed due to the incompleteness and/or inconsistency in responses obtained to the questionnaire. This issue warrants further scrutiny to provide greater assurance that current capabilities are commensurate with expectations and provisions in emergency plans.

It has not been possible within the resources available for this study to make a definitive assessment of the sufficiency of the capabilities for radiation survey and the analysis of environmental samples, either at a national level or for Europe as a whole. Such an assessment would, inevitably, be inextricably linked with the scope and expectations of the emergency plan and provisions for its extendibility. It is not clear whether such systematic assessments have been conducted at a national level (or updated in those cases where EPZ are being extended) and/or whether these have been documented. This remains an important issue for further reflection and analysis, not only in terms of ensuring the provision of timely and reliable information for the effective management of an emergency and its aftermath, but also to satiate the inevitable demand for reassurance monitoring from civil society. It will be important to demonstrate that current capabilities are fully commensurate with provisions foreseen within existing emergency plans (and/or their foreseeable extension) and the longer term post-accident management. Such analyses may exist and have been documented – but, within the scope of, and resources available to, this project, it has not been possible to address this matter further.

7.14.2 Systems or software for technical decision support

The availability of systems or software for technical decision support in various areas are summarised in Table 7-2 for those responding to this question (all except LU and MT). Further detail, including capabilities within specific countries, can be found in Appendix G (Section 20.13.4).

Table 7-2: Summary of availability of systems or software for various types of technical decision support

Capability	Scale	No of countries with the capability
Atmospheric dispersion	National/local scale	All
	European scale	All with a few exceptions
Hydrological dispersion – freshwater	National/local scale	9
	European scale	1
Hydrological dispersion – marine	National/local scale	6
	European scale	3
Transfer through the terrestrial environment	National/local scale	13
	European scale	6
Transfer through the aquatic environment	National/local scale	7
	European scale	2
Dose assessment	National/local scale	All
	European scale	Most
Evaluation of protective measures	National/local scale	About 60%
	European scale	About 30%
Integrated decision support systems	National/local scale	12
	European scale	10
Source term based on plant status		Almost all countries with NPP; a few without NPP

Almost all countries have systems/software to estimate atmospheric dispersion of radioactive material and for dose assessment. Few, however, have comparable systems for estimating hydrological dispersion. This doubtless reflects judgements on the relative likelihood of significant accidental releases to the atmosphere and aquatic environments. Notwithstanding this, consideration needs to be given to whether existing capabilities in many countries need to be strengthened – in particular should they wish to aspire to best practice in the aquatic area.

Little more than half of the countries have systems or software to evaluate the efficacy of protective measures. Such a capability is an important tool in aiding the development of well-considered strategies for protective measures; the absence of such strategies in many countries, as identified in Section 20.13.4 from responses to the questionnaire, indicate that this capability should be more fully exploited, and/or

acquired by countries not yet having access to it – in particular if they wish to aspire to best practice.

Many countries now have access to an integrated system for technical decision support, having participated in, or taken advantage of, the development of the ARGOS [ARGOS] and RODOS [RODOS] decision support systems with support from the EURATOM research programme. Others have developed comparable systems using nationally developed tools.

Most countries with NPP now have a capability for estimating source terms in real time based on plant status during an accident. This is a welcome development and a marked improvement with respect to the situation several years ago. Those still without this capability should acquire it if they wish to aspire to best practice in this area.

7.14.3 Decontamination capabilities for the built environment

Responses on decontamination capabilities for the built environment are summarised in Appendix G (Section 20.13.5). Few countries appear to have given detailed consideration to the scale and/or nature of resources they may need for decontamination in response to a severe accident or to their actual capabilities. Only a minority of countries have indicated that they have arrangements which include the stockpiling, or provisions for the rapid acquisition, of equipment and materials for decontamination.

Consequently, it would appear that very few countries can be confident that they would have sufficient capabilities for decontamination of the built environment in the event of a nuclear emergency.

7.14.4 Medical support and treatment

Capabilities in each country are summarised in Table 20-7 in Appendix G (Section 20.13.6). Most countries responding to this part of the questionnaire have indicated that they have arrangements in place for medical triage, personal decontamination, psychological support and emergency treatment. Quantitative information on the extent of national capabilities is, however, more limited and has only been provided by about 20 to 30% of the countries; the little information that is available indicates wide disparity in capabilities between countries.

It has not been possible to exercise any judgement on the adequacy or otherwise of the capabilities for medical support and treatment. Countries were requested to provide estimates of the numbers used for planning purposes (ie, for triage, decontamination, emergency treatment, psychological support, etc) but none were forthcoming. A more systematic assessment of such needs would appear to be warranted in the context of the scenarios used for the purposes of emergency planning – in particular, to provide assurance that actual capabilities are commensurate with those that may be needed. Such assessments may exist but it has

not been possible, within the scope of, or resources available to, this project to pursue this aspect further.

7.14.5 Assessing individual doses from measurements

National capabilities for assessing individual doses from different types of measurements are summarised in Table 20-8 of Appendix G (Section 20.13.7). There is wide variation between countries, both in the methods or techniques available and in the rates at which they can be used. Some of the techniques for assessing individual doses and dose reconstruction are highly specialised and are only available in a few centres/countries.

Capabilities for in-vivo monitoring (whole body and thyroid monitors) exist in up to 23 countries, albeit with significant differences in the number of measurements that can be made per day (typically ranging from about a few tens to more than 500 per day). These national capabilities for whole body and thyroid monitoring appear to be considerable; however, a careful and systematic assessment (if it does not already exist) should be made of their adequacy in relation to the scenario/s assumed/adopted for the purposes of emergency planning and the anticipated public demand for personal monitoring that may ensue following any nuclear accident, if only for reassurance.

Fourteen countries have institutes with recognised capabilities for individual dose reconstruction. This represents a major European capability that should be sufficient to cope with most eventualities; it would, however, need to be effectively coordinated/integrated were full and effective use to be made of it in any future accident that may affect Europe. It is unlikely that such arrangements exist (other than networking in a RTD context) and, in the context of EP&R, is something worthy of further consideration.

7.15 Public information and communication

Responses on public information and communication are summarised in Appendix G (Section 20.14 and, in particular in Table 20-9 and Table 20-10). All countries impose a legal obligation to provide information to the public on radiological and nuclear emergencies. For EU Member States, this is a requirement under European law.

In most countries (with several exceptions), the responsibility for providing prior information is shared among all or most of the institutions identified (eg, licensee, regulatory authority, local and national government, etc). Among nuclear countries, the most common basis for deciding which members of the public should receive prior information was those within the EPZ.

Most countries used more than one method for communicating prior information, although some rely solely on leaflets or brochures. The latter are most often used for

communicating prior information; public meetings are also frequently used as well as websites.

Responsibilities for informing the public in the event of an emergency have been defined by all countries within their off-site arrangements. For all nuclear countries, responsibilities have been placed on more than one organisation, and, in about half of the countries, on all of the organisations identified. Ensuring the provision of consistent information in these circumstances will not be easy given the multiplicity of actors.

Four countries stated that they do not have "arrangements or mechanisms in place to ensure that the information provided to the public by those responsible in the event of an emergency is useful, timely, truthful, consistent and appropriate" – a GS-R-2 requirement [IAEA, 2002] (three of these countries have accordingly been assessed in the benchmarking as only compliant with qualifications against IAEA requirements relating to keeping the public informed (heading 9); the fourth was assessed as compliant on the basis of other detailed information provided).

7.16 Mutual assistance

The status of arrangements for mutual assistance between countries and with supra-national organisations is summarised in Table 20-11 in Appendix G (Section 20.15).

Despite all countries (with one exception) being party to the IAEA Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, only eleven have so far registered capabilities with IAEA's RANET (Response and Assistance NETwork); a further two plan to do so. A comparable number (thirteen) have registered (or expressed a willingness to register) capabilities with the European Commission's Monitoring and Information Centre (MIC) (now the EU's Emergency Response Coordination Centre (ERCC) under the Civil Protection Mechanism).

Twenty-four countries have indicated that they have bi-lateral arrangements in place for mutual assistance with other European countries and these are illustrated in Figure 20-31 of Appendix G; there are, however, some reservations over the accuracy and completeness of the information presented which will need to be resolved. In particular, some countries included agreements for mutual assistance in the event of all types of emergency (i.e. natural and man-made disasters in general, but which include radiological emergencies), whereas others only responded on those specific to nuclear and radiological emergencies.

The number of European countries registering capabilities with RANET, and the overall number of capabilities registered, remains modest relative to the overall capabilities available. Opportunities for enhancing arrangements for mutual assistance within Europe also need to be explored (eg, enhancing the role of MIC (now the EU's ERC)). There is much potential to make more effective use of existing resources and capabilities, minimise unnecessary duplication and achieve major cost

savings through shared development and maintenance of expensive but rarely used assets.

7.17 Extendibility of arrangements

Information on the extendibility of arrangements is summarised in Table 20-13 of Appendix G (Section 20.16) for countries with NPP and those without NPP whose borders fall within an EPZ.

All but two countries reported that their arrangements included provisions for extension beyond the EPZ; furthermore, that these arrangements are exercised at varying intervals in all but four or five countries. Little or no information was provided on the nature of these exercises and they may differ considerably between countries. This latter aspect warrants more detailed analysis than was possible within the scope and resources of this project, in order to form considered judgements on the appropriateness of extendibility arrangements and their frequency of being exercised.

7.18 Robustness of arrangements when emergency is associated with a major loss of infrastructure

Responses on the robustness of arrangements when an emergency is associated with a major loss of infrastructure are summarised in Table 20-14 and Table 20-15 of Appendix G (Section 20.17). Most of the countries with NPP (with four exceptions) reported that account had been taken of such eventualities in their planning and/or that that their arrangements in this respect were robust. Notwithstanding this, all but one country indicated that their arrangements needed to be improved to better deal with such situations. A broad consensus appears, therefore, to exist on the need for improvement in this area – but there may be differences in view between countries regarding the nature and/or extent of any improvement needed.

7.19 Robustness of arrangements when emergency is protracted

Responses on the robustness of arrangements when an emergency is protracted are summarised in Table 20-16 and Table 20-17 of Appendix G (Section 20.18). Most countries with NPP (eleven out of the fifteen responding to this issue) reported that account had been taken of such eventualities in their planning. However, fewer than half considered that their current arrangements were robust to protracted emergencies, and there was a broad consensus that the current arrangements needed to be improved.

7.20 Commitment of licensee

All nuclear countries confirmed that their NPP licensees have demonstrated continuing commitment to their obligations with respect to off-site EP&R.

7.21 Funding

In five nuclear countries, each of the organisations involved bear their own costs of developing, maintaining and exercising the off-site EP&R arrangements; in three countries, the licensee/operator bears all the costs. Otherwise, the costs fall on local and national government. In non-nuclear countries, the costs are generally borne by national government.

7.22 Liability

Most nuclear countries describe arrangements regarding liability to pay compensation that are in accord with relevant international conventions. The majority of NPP countries (apart from six) do not include compensation arrangements and claims handling procedures within EP&R plans. Clearly, those that do constitute best practice and this is a goal that others might aspire to.

8 POTENTIAL FUTURE IMPROVEMENTS

The main responses to the questionnaire on potential future improvements are summarised in Table 8-1 for countries with, and without, NPP.

Table 8-1: Responses to the questionnaire on potential improvements

Nuclear Countries:

	BE	BG	CZ	FI	FR	DE	HU	NL	RO	SK	SI	ES	SE	UK	AM	CH
Reviewed or in process of reviewing arrangements and capabilities for off-site EP&R?	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Review been completed and conclusions/recommendations formulated?	N	Y	N	Y	N	N	N	Y	Y	Y	N	N	Y	Y	Y	Y
Gaps in arrangements/capabilities and areas for improvement identified?	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Areas for improvement in cross border arrangements identified?	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Areas identified where EP&R could be improved by making better use of resources/capabilities?	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y

Non-Nuclear Countries:

	AT	HR	DK	EE	GR	IE	IT	LV	LT	LU	MT	PL	PT	NO
Reviewed or in process of reviewing arrangements and capabilities for off-site EP&R?	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y
Review been completed and conclusions/recommendations formulated?	Y	N	N	N	N	Y			Y	N				Y
Gaps in arrangements/capabilities and areas for improvement identified?	Y	Y		Y	Y	Y	N	Y	Y	Y	N	N	N	Y
Areas for improvement in cross border arrangements identified?	Y	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y
Areas identified where EP&R could be improved by making better use of resources/capabilities?	Y	Y		Y	N	Y	Y	Y	Y	Y	N	Y	N	Y

Y Response of 'Yes'
N Response of 'No'

All countries with NPP that completed the questionnaire have undertaken a review of their off-site EP&R arrangements and capabilities post Fukushima, with the exception of Belgium which already had plans in place to review its arrangements in the period 2013-15. These reviews have been completed in most countries and measures taken to implement their findings; in six countries (CZ, DE, ES, FR, HU, SI) the reviews are ongoing with completion in most cases foreseen in 2013, but with some extending out to 2015.

Most countries without NPP that completed the questionnaire (all except CY) have also undertaken a review of their off-site EP&R arrangements and capabilities post Fukushima; IT, LV, MT, PL and PT are the exceptions. These reviews have been completed in four countries and are ongoing in five with completion scheduled for 2013-14.

The reported outcomes of the reviews are quite diverse and, consequent upon the (deliberate) use of an 'open-ended or free text form' as opposed to a highly structured/prescriptive questionnaire (see Section 19 – Appendix F), difficult to distil in any statistically rigorous way. In broad terms, the reviews indicated that existing arrangements and capabilities continue to provide a sound framework for off-site EP&R but could be enhanced by improvements in a number of areas (but not necessarily the same areas in each country). Some of the more significant issues highlighted in reported outcomes of the national reviews are summarised in Table 8-2. These should not, however, be taken out of context; they are particular to one or another country and, as such, have no statistical significance (ie, they cannot be generalised to represent the views of a larger number of countries). Consequently, the issues listed should be regarded solely as indicative.

Table 8-2: Selection of the more significant issues in reported outcomes of national reviews of off-site EP&R arrangements and capabilities

Reviews by countries with NPP
• **Broader range of scenarios to be taken into account in planning** • **Planning to be extended to nuclear emergencies in combination with natural disasters and for emergencies that were protracted** • **Planning to be extended to multiple events/emergencies** • **Need for criteria/guidance for removal or deactivation of protective measures** • **Greater clarity needed on roles and responsibilities of different organisations** • **More detailed follow-up reviews needed of particular aspects of arrangements and capabilities (eg, monitoring capabilities, reassurance monitoring, extendibility of arrangements, managing protracted events, etc)** • **Review and extension of EPZ and ingestion and commodities planning distances** • **Legal basis needs to be improved and organisational structure made more robust** • **Policy for remediation needs to be developed** • **Decision makers need to be better informed about radiation and nuclear**

Reviews by countries with NPP
installations • **Insufficient resources to deal with large scale/protracted emergencies** • **Strategy needed for dealing with social media** • **Strategy needed for scanning and decontamination of people and for caring for evacuees** • **Several tens of organisational and legislative improvements identified in one national review.**

Reviews by countries without NPP
• **Closer cooperation in assessing radiological consequences and recommending countermeasures for European citizens in third countries** • **Need for better concept for informing the public** • **Need for more comprehensive emergency exercises** • **Insufficient resources to deal with protracted emergencies** • **Arrangements needed for contaminated goods (non-food)** • **Need for improved communication between organisations within a country** • **Environmental monitoring system needs to be established** • **Better radiation detection equipment needed at border crossings**

Gaps in arrangements and capabilities were reported by all countries with NPP (apart from DE where a gap analysis was ongoing) and in most countries without NPP except DK, IT, MT, PL and PT. As for the outcomes of the reviews, there was great diversity in the gaps identified in different countries and these cannot easily be distilled in any rigorous statistical manner. However, a number of common issues emerge from an analysis of the responses and these are illustrated in Figure 8-1 and Figure 8-2 for countries with and without NPP, respectively. In each case, the number of countries that identified the need for an improvement in one or other of the areas listed is indicated; the need for improvements in many other areas were also identified but, in general, by no more than one or two countries.

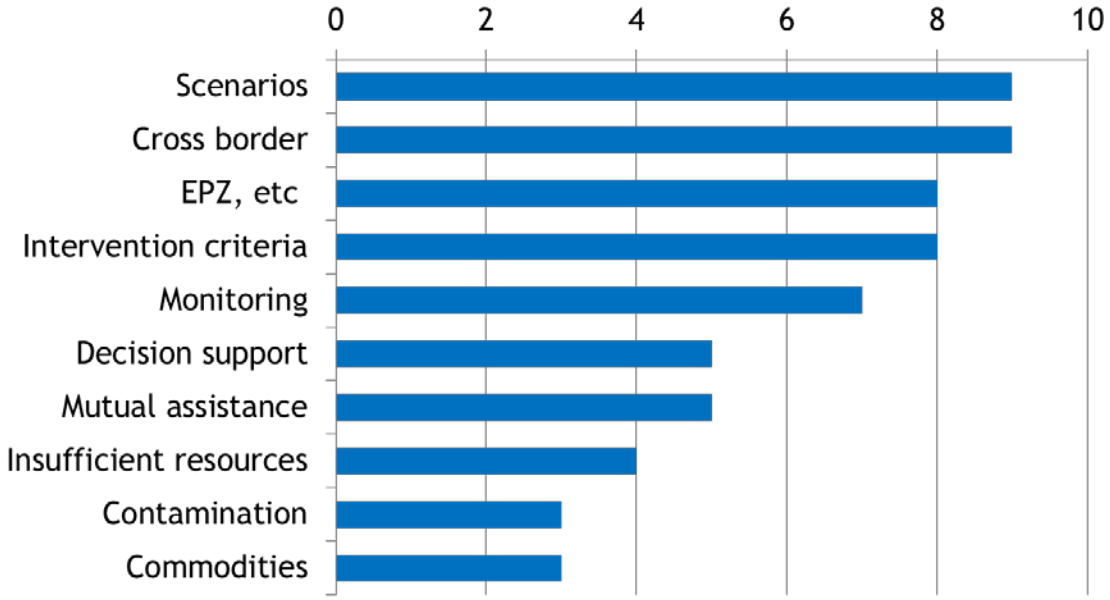

Figure 8-1: Number of countries with NPP identifying the need for improvement in EP&R in the areas indicated

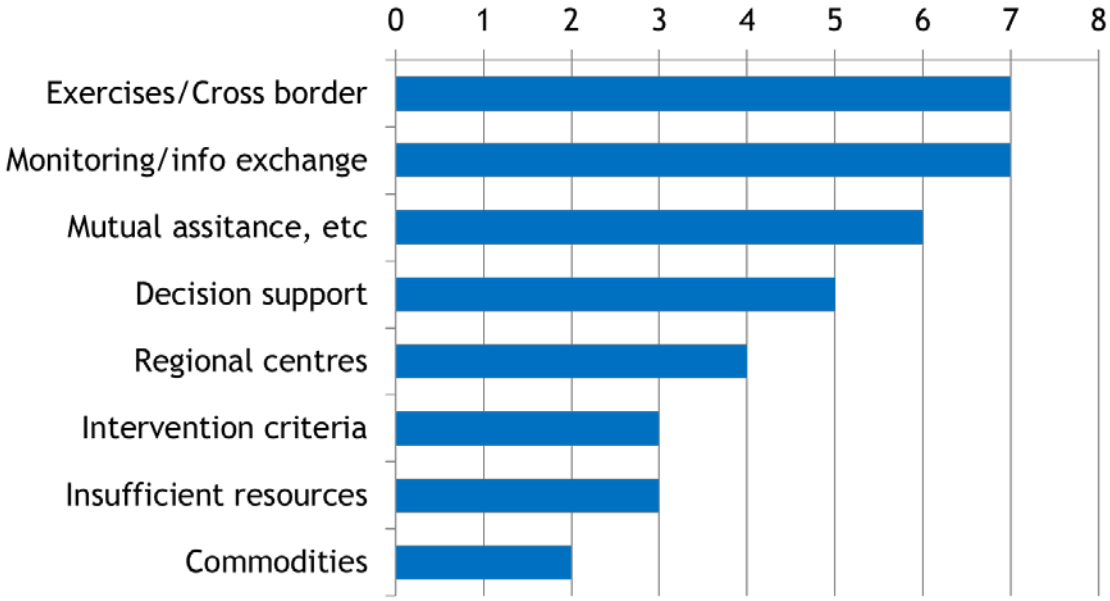

Figure 8-2: Number of countries without NPP identifying the need for improvement in EP&R in the areas indicated

Each of the broader areas listed in Figures 8-1 and 8-2 embrace a range of topics where the need for improvement has been identified; further detail on the more significant is presented in Table 8-3. The information provided in Figures 8-1 and 8-2 and in Table 8-3 should also be considered solely as indicative and without statistical significance consequent upon the manner in which this information was collected.

This information has provided valuable insights for the project in terms of optimising the scope, content and priorities of a series of follow-on national and regional workshops on potential improvements. These workshops, together with interaction and feedback from the Stakeholder Group, have provided more in-depth, and statistically more valid, information on potential improvements.

Table 8-3: More detailed information on where a need for improvements has been identified

Areas where need for improvement identified by one or more countries with NPP	
Scenarios	Nuclear emergencies in combination with natural disasters Emergencies involving multiple units/events Protracted emergencies More realistic source terms Larger scale exercises More challenging/extreme scenarios for exercises (eg, extended loss of communications) Planning for large scale evacuations
Cross border	Bi- and multi-lateral arrangements on information exchange More frequent and demanding joint exercises with neighbouring countries Rapid exchange of information in an emergency, including the source term Common rationale for and harmonisation of EPZ between neighbouring countries Harmonisation of implementation of protective measures International training centre Benchmarking of arrangements Regional centres for providing technical decision support
EPZ	Enlarge planning zones Improve arrangements beyond EPZ (extendibility)
Intervention criteria	Greater harmonisation of intervention levels Criteria for post emergency phase Commodities and flow of goods across borders
Monitoring	Adequacy of current monitoring arrangements/capabilities Insufficient monitoring and sampling equipment/capabilities More detailed review needed of sampling and measurement arrangements
Technical decision support	Source term estimation in real time Redundancy in key monitoring and forecasting systems

Areas where need for improvement identified by one or more countries with NPP	
Mutual assistance	Improvement and better integration of mutual assistance mechanisms Arrangements need to be improved for requesting and making use of assistance to ensure its timely and effective provision if/when needed Needed especially in areas of bio-dosimetry, medical triage and treatment, aerial survey and individual dose assessment where capabilities may be limited to a small number of European countries Harmonisation of advice to European citizens in third countries
Insufficient resources	Need for better understanding of equipment, material and personnel requirements Limited capacity/resources in nuclear assessment organisations in some countries Insufficient training, equipment, decision support, etc Insufficient resources to respond to protracted emergencies Insufficient capacity to analyse contaminated food and limited skills more generally for implementing food countermeasures Insufficient equipment for and competence of first responders

Areas where improvements identified by one of more countries without NPP	
Exercises/cross border	• More comprehensive exercises • Greater cooperation needed in informing and advising European citizens in third countries affected by an emergency • More frequent and demanding cross border/regional exercises and training • Need to share information on accident prognoses, dispersion, etc • Enhanced cross-border cooperation with third countries such as Belarus and Russia • Need for more harmonised cross border arrangements and response • Greater cooperation between off-site emergency centres • Better and more timely access to protective measures taken in other countries • Harmonisation of EPZ

Areas where improvements identified by one of more countries without NPP	
Monitoring/information exchange	• Environmental monitoring system needs to be developed • Network of monitoring stations and mobile laboratory needs to be upgraded • Strategy needed for environmental sampling (including food) and analysis • Resources for monitoring insufficient • Extension of the European monitoring network
Mutual Assistance	• Greater cooperation needed in informing and advising European citizens in third countries affected by an emergency • Regional civil protection centre ('module' in MIC/ERC) • Need to make better use of EU CPM and IAEA RANET • Establish European network of capabilities
Technical decision support	• Regional or supra-national centres to provide technical decision support
Regional centres	• Regional or supra-national centres to support decision making • Designated centres of excellence with resources that can be shared (eg, technical decision support, capabilities that are scarce or expensive and not available in all countries, etc) • Regional civil protection centre ('module' in MIC/ERC) • International training centre for first responders
Intervention criteria	• Criteria for countermeasures harmonised between neighbouring countries • Intervention levels should be harmonised
Insufficient resources	• Resources not sufficient for protracted emergencies • Insufficient trained personnel in all response organisations • Resources for monitoring insufficient • No preparedness for post-accident phase

9 CROSS BORDER ARRANGEMENTS

9.1 Background

An integral part of this project was to review cross border arrangements within Europe. This review was based on the results of bilateral and regional workshops as well as on the assessment of information provided by Member States and international organisations. Reference scenarios were developed by the project to guide the discussions. Further details on the outcome of the assessment are given in Appendix H.

The key driver of the existing cross border arrangements is the need to attain comparable protection of the population across national borders in an emergency. This can be achieved by enhancing cooperation in situation assessment, by a more rapid exchange of information, by improvement of the coherence of national responses, including balancing radiation protection and social issues, and by sharing resources available in a region or at international level.

Many countries in Europe are limited in geographical area and population size, and consequently have limitations in the resources available for EP&R as compared with the full spectrum of resources that might be available in larger and more populated countries. Many also share national borders with several other countries. Some countries have long lasting and extensive experience in cross border cooperation and information exchange, based on bilateral or multilateral cooperation agreements as well as in cross border exercises, while others do not. In some of the non-nuclear countries parts of the national territory falls within the EPZ of an NPP operated in a neighbouring country.

Workshops were conducted to discuss the existing arrangements of cross border cooperation between Germany and Switzerland, in the 'Greater Region' (Belgium, France, Germany, Luxembourg, the Netherlands), and in Central and Eastern Europe (Austria, Czech Republic, Hungary, Slovakia, Slovenia, Poland). In addition, published information on the cooperation between Germany and France and in the 'Nordic Region' (Denmark, Finland, Iceland, Norway, Sweden) as well as the work of HERCA was used in the assessment of the current situation and the plans for future development.

The existing agreements and arrangements cover a wide range of scenarios but the main focus was on EP&R specific to nuclear and radiological emergencies.

9.2 Scope and objectives

The scope and objectives of the workshops and assessments were directed mainly towards identifying issues that might impact the efficacy and practicability of existing EP&R arrangements, both within the EC and in Member States.

Common to these activities were four objectives:

- To assess the status of existing arrangements and capabilities inside and between the EU Member States and with non EU neighbouring countries;
- To identify best practice, gaps and inconsistencies within existing cross border arrangements;
- To assess how current EP&R could be more effective, eg, through better use of available resources, avoiding duplication, etc;
- To identify opportunities for improvements.

Detailed discussions of existing agreements focussed on the following topics, which are essential for planning EP&R:

- Information about the NPP;
- Typical release scenarios and source terms;
- Details of the emergency planning including the crisis organisation;
- Technical infrastructure available for the surveillance and assessment of the radiological situation off-site as well as in greater distances;
- Measurement strategies;
- Intervention levels;
- Protective measures;
- Provisions for the information of the public.

9.3 Need for improvement

The details of the existing bilateral agreements in Europe differ in nature and in the specific arrangements made. All countries participating in the discussions identified the need to improve the existing cross border emergency arrangements, because they expect they would be affected collectively by releases of radioactive material during a nuclear emergency were it to occur somewhere in Europe. It was emphasised that any approach used to achieve improvements of the current situation would have to clearly distinguish between the national obligation to provide urgent protection to the population in the early phase in the vicinity of an NPP, and the large scale, nation- or even EU-wide response to such an event. A continuation of bi-lateral and/or multi-lateral efforts in a region to identify and specify future initiatives and priorities aimed at further improving cooperation in clearly identified priority areas would be

required. In addition the need was identified to enhance the reliability and the quality of any additional arrangements. Further enhancement of cross border information exchange is, and will remain, an area of high priority.

During the assessments the need as well as opportunities for improvements in EP&R have been identified in several areas:

- Use of common scenarios for emergency planning;
- Clearly defined and regularly tested command structures;
- Availability of agreed and tested cross border arrangements for information exchange:
    - Informing competent authorities about plant status;
    - Decision making process to declare an emergency.
- Harmonised approaches for:
    - Emergency planning zones;
    - Intervention criteria;
    - Protection strategies based on harmonised OIL.
- Optimisation of monitoring infrastructures and strategies;
- Arrangements for continuous assessment of the radiological situation;
- Use of decision support systems;
- Availability/sufficiency of personal and technical resources;
- Arrangements for mutual assistance;
- Agreed procedures for the termination of protective measures;
- Agreed arrangements of standardised communication.

9.4 The way forward

While some of the existing agreements and arrangements are binding from a legal point of view, others are not. There was a controversal discussion on the optimal way to achieve robust solutions in the future. Some states are in favour of a more legally binding framework at European level, while others do not consider this possible or even desirable. The majority view was that it would be imprudent, at this time, to try and develop a legislative framework governing what should be done at EU level with respect to cross border arrangements for responding to a nuclear emergency. There was a belief of a greater potential for largely achieving the same outcome through the use of a softer mechanism, eg, codification of good/best practice (ie, code of practice) in cross border arrangements in Europe. A standardised framework for bilateral agreements defining good practice would be highly desirable but no agreement is currently available on how this could be achieved. In this situation the detailed "top down" approach for harmonisation developed by HERCA (www.herca.org) [Majerus, 2013] is currently considered as a promising way to move forward.

Any further development of existing cross border arrangements would require continuity in exchanging all relevant information across borders at all levels and regular testing/exercising of the agreed practical arrangements. An important result of the discussion was that – given the vast differences in the existing cross border characteristics – detailed cross border arrangements would have to be tailored to meet the local or regional needs.

Many countries expressed their hope that the future implementation of the new EU BSS would provide opportunities for further harmonisation in some of the areas identified. One promising area would be the need to establish numerical values for the protection of the population in the exposure situations recommended by ICRP, eg. emergency exposure situation and existing exposure situation.

10 ARRANGEMENTS RELATED TO EP&R WITHIN THE EUROPEAN COMMISSION

In parallel with the review of current arrangements for off-site EP&R in EU Member States and neighbouring countries, a review was also made of arrangements within the EC that are directly related to this matter. This review was limited in scope and content and was directed mainly towards identifying issues that might impact the efficacy and practicability of EP&R arrangements, both within the EC and in Member States (ie, consequent upon legislative provisions at a European level, or upon functions that are undertaken by the EC).

Legislative provisions relating to preparedness and response to radiological or nuclear emergencies are summarised in Section 5 and Appendix C. Those falling under the EURATOM Treaty comprise the Basic Safety Standards Directive (Council Directive

96/29/Euratom) [EU, 1996] (under revision), the Public Information Directive (Council Directive 89/618/Euratom) [EU, 1989a], Regulations laying down maximum permissible levels in food (Council Regulation 87/3954/Euratom [EU, 1987a] and Council Regulation 89/2218/Euratom [EU, 1989b]), and the Council Decision on the early notification and exchange of information in the event of a radiological or nuclear emergency (implemented via the ECURIE (European Community Urgent Radiological Information Exchange) system) (Council Decision 87/600/Euratom) [EU, 1987b]. Those falling under the EC Treaty comprise Council Decisions on a Civil Protection Mechanism, firstly in 2001 [EU, 2001], recast in 2007 [EU, 2007] and currently undergoing further revision based on a Commission proposal in 2011.

Meetings were held with Units in DG ENER and DG ECHO, respectively, with responsibility for the relevant EURATOM and EC legislative provisions. The objectives and outcomes of each meeting are summarised below. Based upon the outcomes of these two meetings and information from other sources, including the review of arrangements for EP&R in Europe, conclusions were reached and recommendations made regarding arrangements within the EC, and these are included in Section 12. In particular, Section 12.15 addresses matters that are largely internal to the EC, while Section 12.17 addresses an issue of broader relevance. The latter is concerned with whether it continues to be optimal or appropriate for radiological and nuclear emergencies to be treated differently from all other types of emergency, and for the radiological protection community to be the principal arbiter for defining the conceptual basis underpinning relevant legislative provisions at EU level and in most countries (and international IAEA requirements).

Meeting with DG ECHO

The objectives of the meeting with the Monitoring and Information Centre (MIC) – subsequently renamed as the Emergency Response Coordination Centre (ERCC) – were as follows:

- To gain a better and fuller understanding of the CPM mechanism, in particular:
- The nature, scope and extent of activities undertaken in relation to radiological and nuclear incidents;
- The extent to which its activities/mechanisms could enhance the efficacy of off-site preparedness and response for nuclear power plant accidents;
- Current and planned interfaces with DG ENER on arrangements for nuclear accidents (eg, early warning, assistance, etc);
- The extent to which the efficacy and cost effectiveness of arrangements within the Commission for responding to nuclear accidents could be enhanced through deeper integration between MIC (now ERCC) and DG ENER activities;
- The potential role of MIC (now ERCC) in relation to mutual assistance in response to a nuclear accident.

A note summarising the outcomes of the meeting can be found in Appendix J; the main points were as follows:

- The Emergency Response Coordination Centre (ERCC) will become the "operational heart" of the new EU Civil Protection Mechanism, replacing and upgrading the functions of the previous Monitoring and Information Centre (MIC);
- The ERCC will improve joint planning and response coordination within Europe, complement the role of the Member States and facilitate a coherent European response during all types of emergencies, both inside and outside Europe;
- A certification process will be established for all assets or resources that may be deployed, thus assuring their quality;
- The frequent response of the ERCC to emergencies worldwide (at least several times a year) will provide a high degree of assurance as to its operational readiness;
- Gaps will be identified in assistance that can be offered and, where appropriate, remedied with financial support from the EU or elsewhere;
- Increased co-financing of transport (beyond the current 50%) will enable assistance delivery to an affected country within a few hours with no budget constraints for individual Member States offering the assistance;
- The revised legislative framework (CPM) currently under review will provide numerous opportunities for enhancing preparedness and response to nuclear and radiological emergencies; the more significant include the following and these should be pursued by those concerned:
    - Further enhancement in cooperation between DG ENER and DG ECHO in the field of preparedness and response to radiological and nuclear emergencies – this is already being pursued under the auspices of a MoU between the two DGs but the scope could be usefully extended;
    - Evaluating the potential use of the ERCC as a single point of contact between IAEA's RANET system and the EU (ie, all mutual assistance from EU Member States being coordinated through the ERCC); the interest and/or commitment of EU Member States to using the ERCC as the single point of contact with RANET should be explored;
    - Identifying capabilities/modules (especially those which are expensive and rarely used) that could be included within ERCC's 'European Pool of Assets' with a view to making more effective use of limited resources (eg, aerial gamma spectrometry, biological dosimetry, specialised medical treatment for people with high radiation exposures);
    - Where appropriate, seek financial support from the new Mechanism to establish, reinforce and/or ensure the continuous availability of key capabilities/assets/modules;

- Explore the potential for the outputs of national systems used to provide technical support for decision makers to be made more widely available via the ERCC;
- Explore the possibility of gaining timely access to CTBTO data which could be valuable in responding to any future radiological or nuclear emergency;
- Exploring the potential for ERCC to provide common information and advice to Embassies (at least to the European External Advisory Service (EEAS)) following accidents in third countries.

Meeting with DG ENER, Unit D3

The following issues were explored:

- The nature and scope of any review carried out of EC's EP&R arrangements and capabilities post Fukushima and, if so, what were its findings;
- Current arrangements relating to EP&R, in particular:
  - Whether the arrangements/roles, etc, within and between DGs were fully documented and deemed to be effective;
  - Whether effective use was being made of the diverse technical skills available in the EC;
  - The nature and frequency of exercising arrangements and their review;
  - Arrangements for public communication and their efficacy;
  - Arrangements for obtaining assessments of radiological impact during an emergency and their efficacy;
  - Potential weaknesses identified in current arrangements.
- Cooperation with the ERCC:
  - Real time information exchange;
  - Mutual assistance;
  - Opportunities to further enhance cooperation.
- Whether better and more timely use could be made of information gathered via ECURIE and EURDEP for the purpose of aiding decision making, informing the public, etc);
- Whether the EC should take on greater responsibility in EP&R:
  - As a 'one stop shop' for providing mutual assistance from MS;
  - Taking the lead in informing (ideally in a more consistent manner) EU citizens in third countries (eg, via EEAS);

- Coordinate the provision of prognoses of radiological impact for wider use within MS, etc.

- Implications of the new EU BSS for EP&R.

A note summarising the main outcomes of the meeting can be found in Appendix J; the main points were as follows:

- No comprehensive review appears to have been performed after Fukushima at the level of the EC as a whole, ie, related to the global crisis mechanism system for the central management in the EC;
- No formal mechanisms are in place to review the implementation of EURATOM legislative provisions relating to EP&R; more generally, no peer reviews are being performed or planned for existing legislation relating to radiation protection more generally, the exception being for the HASS (High Active Sealed Sources) Directive;
- The new EU BSS contain several new provisions relating to EP&R; there is a need for the EC to support the transposition of these new provisions into national legislation in Member States to ensure this is done consistently;
- An internal review within DG ENER was carried out of the EC's EP&R arrangements and capabilities post Fukushima (ECURIE, EURDEP) and a number of lessons to be learned have been identified;
- Current arrangements within DG ENER related to EP&R (ECURIE, EURDEP, external support in providing prognoses of radiological impact in an emergency, etc) are broadly fit for purpose but there is room for improvement and for taking initiatives in a number of areas:
    - Increasing the number of exercises (communication checks, full exercises) and their degree of challenge;
    - Exercising potentially important aspects that appear never to have been exercised (ie, legislative provisions to amend CFILs);
    - Subjecting the exercises to critical review, either internally and/or externally, and introducing formal mechanisms to follow up on their findings;
    - Making better use of the monitoring and other data received by Member States to characterise the radiological situation in Europe as a whole;
    - Gaining timely access to additional monitoring data that would become available during an emergency – these would further enhance the quality of any characterisation of the radiological situation;
    - Taking the lead in informing EU citizens in third countries (eg, via EEAS).
- Further optimisation of arrangements (technical and organisational) between DG SANCO (foodstuffs regulation) and DG ENER;

- Make better use of personnel in other DGs (eg, JRC Petten, ERCC) with nuclear or broader EP&R expertise that could improve the operational capabilities of DG ENER, Unit D3, especially for responding to protracted emergencies;
- Enhanced cooperation with ERCC could contribute to harmonising communication systems at the EC level, for example:
    - Operation of a 24/7 contact point in Brussels for real time information exchange;
    - Shifting the responsibility for mutual assistance arrangements (eg, liability, QA/QC) to ERCC as a 'one stop shop' for mutual assistance in Europe;
    - Operation of the ECURIE systems (in the long term);
    - Coordination in the provision of prognoses of radiological impacts in an emergency.

11 ONGOING AND PLANNED ACTIVITIES OF OTHER ORGANISATIONS IN THE AREA OF EP&R

A summary of ongoing and planned activities of international organisations and other multi-national organisations or networks on off-site EP&R is provided in Appendix K. It focuses on activities during the last few years and it is not comprehensive for all organisations. Summaries are provided of activities within the European Commission, in particular related to legislative matters, the Civil Protection Mechanism, research and development, and cooperation with third countries under the auspices of its International Nuclear Safety Cooperation (INSC) programme; activities within the West European Nuclear Regulatory Association (WENRA), in particular relating to their initiative on mutual assistance between regulatory authorities and their collaborative work with HERCA; activities within the Heads of European Radiation Protection Competent Authorities (HERCA), in particular their work on a top-down approach to achieving greater consistency within Europe on EP&R and developing guidance for responding to emergencies occurring elsewhere in the world; and the wide ranging activities of both the Nuclear Energy Agency and the International Atomic Energy Agency, in particular those initiated following the Fukushima accident.

While the conclusions and recommendations of this study (see Section 12) are based largely on the results of the benchmarking and mapping (see Sections 6 and 7), due account has also been taken of the outcomes of extensive work carried out by the above organisations post Fukushima and of their ongoing work and planned initiatives.

12 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations of this study were discussed extensively in draft with the Core Group and Stakeholder Group and were revised as a consequence; in this process, account was also taken of input of a factual nature from the EC Task Force. However, the conclusions and recommendations set out below represent the views of the project team; they should not be attributed to the Core Group or Stakeholder Group, either as a whole or individually. In those cases where the views of the Stakeholder Group (or a significant fraction of its members) differ markedly from those of the project team, this is indicated.

The recommendations are directed at organisations or entities with a responsibility for, or an interest in, off-site EP&R in Europe, either in a national or European capacity. Where appropriate, an indication is given of which organisation or organisations appear best suited to take the lead in responding to a recommendation. The order in which the conclusions and recommendations appear[10] has no implications for their relative priority or importance in further enhancing EP&R in Europe; prioritisation of the recommendations is addressed in Table 12.1.

12.1 The need for a European approach

Widely differing views were expressed by SG members and participating countries on the need for action at a European level on off-site EP&R. Some felt strongly that further action at a European level was not justified at this time and that it would be better to rely on what was being done at the international level by the IAEA. Others, equally strongly, felt that action at a European level was essential to ensure a consistent approach to compliance with EU legislative requirements and a framework that is optimised for European, rather than for wider international, social and economic conditions.

The project team has carefully evaluated the arguments underpinning these conflicting views and concluded that action at a European level is essential in a number of important areas. The main considerations that influenced this conclusion were:

- Well known lessons from previous accidents have not been fully taken up by all EU countries;
- Any future accident in the EU would likely affect more than one country; consequently, there is a need for close cooperation between Member States in the preparedness, response and post-emergency phases. This would lead to more consistent approaches to EP&R, and provide greater public reassurance concerning their safety;

[10] Conclusions and recommendations have generally been set out according to EP&R topic. These topics are not mutually exclusive, however, and the major gaps found in the study have been highlighted in an early subsection; there is therefore some duplication in the recommendations set out here.

- Experience with past accidents has shown that the lack of strategies and criteria for protective measures in the longer term can have tremendous and long lasting social, economic and political consequences; the lack of such strategies in the EU represents a major risk that could be readily mitigated by appropriate planning at a European level;
- Nuclear safety is addressed at a European level; EP&R is the third pillar of nuclear safety, and the rationale underpinning the need for improvements at a European level, and the nature of the improvements being proposed through revision of the Nuclear Safety Directive in areas such as technical safety, on-site EP&R, transparency, governance, etc, apply equally to off-site EP&R;
- Concerted action at a European level has the potential to achieve significant cost savings, avoid unnecessary duplication and provide some smaller countries (or those with limited knowledge and experience with radiological and nuclear matters) with technical and other support of far higher quality than they could provide themselves.

12.2 Compliance with European legislation and international requirements (see Sections 6, 7 and 8)

The principles and objectives of off-site EP&R, established at European and international levels, are widely accepted and underpin arrangements in all European countries. There are, however, differences in emphasis and in the approaches adopted in practice by countries in achieving the agreed objectives.

There are significant differences in the regulatory frameworks (eg, responsibilities for developing plans, for implementing response, etc) adopted by European countries for off-site EP&R. There is no compelling evidence to suggest that one approach is better than another, with each having been adapted to the particular administrative, organisational, legislative and political, and societal situation in a country. The institutional arrangements for, and coordination of, nuclear off-site EP&R are reported by most countries to be coherent and compatible with arrangements for other emergencies.

Following the Fukushima accident, most European countries carried out a review of their arrangements and capabilities for off-site EP&R. These arrangements and capabilities were judged, by the countries, to be generally sound and broadly compliant with international guidance and/or requirements. Opportunities were, however, identified in most cases for further improvement and these are in the process of being implemented.

On the basis of information provided, and within the depth to which it has been able to probe, this study has confirmed that, with few exceptions, all countries appear to be broadly compliant with relevant European legislation and (non-binding) requirements of IAEA relating to off-site EP&R. Some gaps were identified, however,

which could have significant implications for Europe in the event of an accident (see 12.3 below).

Two matters of a more practical nature were identified where more detailed investigation would further enhance confidence in the adequacy and robustness of EP&R arrangements. These are: the organisational and decision making structures, and in particular how they function in practice; and the practical implementation of the arrangements, in particular the adequacy of resources at local, regional and national levels. The scope and nature of the project, which was largely a desk-based study, precluded an in-depth evaluation of these more practical matters.

Recommendations

*a) Countries should assure themselves that their current arrangements and capabilities are compliant **in practice** (and not just on paper) with European legislation and international requirements. In particular, they should periodically test and confirm:*

- *The effectiveness **in practice** of organisational and decision making structures and coordination of EP&R at all levels within the country; and that resources and capabilities at local/municipal, regional and national levels are sufficient **in practice** to provide an acceptable response to accidents or scenarios that have been adopted as the basis for preparedness and planning.*

b) To provide independent assurance of compliance in practice, and thereby enhance public trust and confidence, countries should periodically request a peer review of EP&R arrangements as a whole. The approach used in IAEA's EPREV could form the basis for such reviews, albeit possibly further refined or customised to make it more effective for the state of EP&R in the EU.

c) The European Commission should make proposals for legislation to introduce EU-wide transparent peer reviews of national emergency arrangements at specified intervals, in analogy with arrangements being considered for some aspects of nuclear safety in the proposed revision of the EU Nuclear Safety Directive[11]. Such reviews would need to cover the plethora of organisations having key and inter-dependent roles in EP&R.

d) The European Commission, in consultation with EU Member States, should establish a mechanism, using existing legislative provisions or, if necessary, by making proposals for legislation, to develop and formally adopt guidance or Codes of Practice on what represents good/best practice in Europe on a wide range of key off-site EP&R issues (eg, what it is reasonable to plan for in detail, rationale for establishing EPZ, extending response beyond the EPZ, strategies for protective measures and their implementation in practice, OIL, cross-border arrangements,

[11] Not all members of the SG agreed that existing mechanisms for peer review (by voluntarily requesting an EPREV review) need enhancing.

strategies for exercising arrangements at various levels and their practical implementation, environmental sampling and measurements, environmental surveys, decision support, medical support). The existence of authoritative good/best practice in Europe will provide a framework both for countries to benchmark their own arrangements and put in hand improvements where necessary, and for the recommended peer reviews of arrangements. Due account should be taken of guidance developed at an international level in this process.

12.3 Major gaps in current arrangements and capabilities (see Sections 6 and 7 and Appendix G)

The most significant gap in arrangements identified in the study concerns a general lack of strategies and arrangements for the control of food and drinking water and longer term protective measures and for the return to normality following an emergency. These issues were problematic for many years in the Former Soviet Union in managing the aftermath of the Chernobyl accident and similar problems are being encountered in Japan post Fukushima.

There was also an absence in many countries of strategies and arrangements for the management of the large quantities of radioactive waste that might be produced, particularly from the contamination of foodstuffs but also from possible remediation of the built environment. A major contributory factor in these gaps is that criteria for longer term protective measures are far less mature than those for urgent measures, with frequent changes to relevant international guidance over the past two decades and a lack of broad consensus. The issue is complex, particularly as guidance and criteria need to be applicable to the very wide range of circumstances that might arise in practice. Some countries prefer the adoption of outline, flexible arrangements that can be adapted to the prevailing situation.

The absence of strategies and arrangements for longer term measures represents a major risk for individual countries and for Europe as a whole. In the event of an accident that affected several countries in Europe, the measures being taken in these countries would inevitably be compared, and there would be public and political pressure, that would be difficult to resist, to adopt the standards or criteria seen as offering the best level of protection, regardless of the wider social and economic consequences. Countries without a strategy or criteria would find it hard to do anything other than follow practice adopted elsewhere. This could lead to significant and lasting social, economic and political problems. A broadly agreed Europe-wide framework for longer term protective measures would mitigate these risks.

For the specific issue of the management of wastes from the contamination of foodstuffs and the remediation of the built environment, sound technical bases have been established for the development of such strategies and arrangements, but have yet to be made use of by many countries. Member States without such strategies and/or arrangements should develop them at the earliest opportunity, taking

advantage of existing technical information and of experience with strategies developed elsewhere.

The most significant potential gap in capabilities identified in the study was in the area of radiation survey and environmental measurements following an emergency, where capabilities varied widely but were not always obviously related to need.

Medical response to, and follow up after, an emergency is a further area where current arrangements and capabilities may not be sufficient, in particular in relation to emergency plans and their possible extension. Capabilities in this area have degraded considerably within Europe over the past decade or so and how this may be remedied is addressed in Section 5 above.

Recommendations

a) The European Commission, in cooperation with Member States and their regulatory/competent authorities, should establish, as soon as practicable, a broadly agreed framework at the EU-level to provide guidance to Member States in developing their own practicable strategies[12] and arrangements for longer term protective measures. To the extent practicable, the framework should include the criteria to be used for the introduction and removal of protective measures.

b) Member States without a strategy[13] or arrangements for the management of wastes from restrictions on contaminated foodstuffs and remediation of the built environment should develop them at the earliest opportunity; should they fail to do so the European Commission should take steps to ensure that they do, if necessary by making proposals for legislation.

c) The European Commission should seek assurances and evidence from Member States, possibly in the context of verification actions under Article 35 of the Euratom Treaty, that their capabilities for radiation survey and environmental measurements (fixed and mobile) following an emergency are fully commensurate with needs foreseen in their emergency plans and their foreseeable extension.

12.4 Emergency Planning Zones (EPZ) (see Section 7 and Appendix G)

There is large variation (by more than an order of magnitude) in the size of EPZ around NPP in Europe. This reflects differing judgements between countries as to what it is reasonable to plan for in detail, in particular the choice of accident or scenario (ie, size and nature of release and the meteorological conditions to be considered) that has been used as the basis for detailed planning and preparedness. Social, economic, technical and political considerations enter into these judgements

[12] As required by the new EU BSS
[13] As required by the new EU BSS

and differences should not, therefore, be unexpected – in particular, as the judgements affect the use of public resources, raise issues of what it is reasonable to plan for in detail, as well as considerations regarding consistency with approaches to EP&R for other hazards.

Following the reviews of EP&R after the Fukushima accident, the size of EPZ will be increased in some countries, in particular to provide more detailed planning (ie, for the provision of technical resources and allocation of trained personnel) in response to accidents of greater severity than hitherto considered for planning and preparedness.

It is important to recognise that the EPZ represents only one element in EP&R arrangements, the efficacy of which can only be assessed by an evaluation of the arrangements as a whole and not of one or other part in isolation. In evaluating the efficacy of arrangements as a whole, the extendibility of arrangements beyond any pre-designated zone is an important consideration, in particular demonstrating convincingly that extendibility can be achieved with existing resources and capabilities.

Differences in the size of EPZ are often perceived to represent differences in the degree of protection afforded to potentially affected populations around NPP. This leads to understandable, if mistaken, public concern, especially between neighbouring countries. Some countries believe that the credibility and public acceptance of emergency arrangements would be enhanced by the adoption of more common EPZ in neighbouring countries; other countries, on the contrary, believe that differences in EPZ are justifiable and that public confidence can be gained through explanation of the reasons for the differences.

Recommendations

a) In the context of the self assessments and peer reviews recommended in 12.2 above, countries should demonstrate convincingly that their arrangements and capabilities, taken as a whole, can achieve the stated objectives of EP&R ***in practice****, irrespective of the particular choice of size of EPZ; in particular, the absence of any 'cliff edge' effects (in terms of the efficacy of arrangements) should be confirmed as the size of accident considered for EP&R increases.*

b) In the context of the mechanism to develop and formally adopt guidance or Codes of Practice recommended in 12.2 above, the European Commission should work with others (eg, ENSREG, HERCA, WENRA, etc) to achieve a common rationale for the establishment of EPZ, in particular where NPP are in close proximity to neighbouring countries; the magnitude and nature of the release used for the purposes of

establishing the size or sizes of EPZ are critical in this respect[14]. IAEA safety standards and guidelines could provide the basis for this work.

c) The European Commission should encourage neighbouring countries (especially where NPP are in close proximity to borders) to reach a common view at a political level on EP&R arrangements generally and on the extent of EPZ in particular; this would greatly enhance public trust and confidence in arrangements for EP&R.

12.5 Intervention levels (IL) and operational intervention levels (OIL) (see Section 7 and Appendix G)

The principles underlying the setting of intervention levels for the implementation of a protective measure are broadly agreed. The application of these principles, however, has resulted in marked differences in both the quantities and numerical values adopted for intervention levels (apart from those countries that have directly adopted generic levels recommended by IAEA). Such differences should not be surprising, as these levels should, at least in theory, represent the point where the benefit of introducing a protective measure outweighs the harm from its introduction. Inevitably, much judgement is involved in such decisions and there are differences, both between and within countries, in where the appropriate balance lies.

In practice, intervention levels have rarely been set on the strict quantitative application of this principle, not least because of the uncertainties in quantifying the disparate harms and benefits and comparing them on a common scale. Consequently, broad qualitative judgements have often been exercised and there has been much recourse to following past practice or generic international guidance. Numerous attempts have been made in Europe to achieve greater harmonisation in intervention levels but have almost invariably failed, although, at a regional level, the Nordic countries have recently made significant progress on this issue. The lack of progress elsewhere is somewhat surprising, given the less than (technically) rigorous manner in which most of the levels have been derived, and the simple adoption by many countries of the IAEA's generic levels. But, this situation is unlikely to change without action at a political, rather than a technical, level.

Some countries believe that the adoption of different intervention levels in neighbouring countries is a major source of public concern resulting in a loss of trust and confidence in the broader EP&R arrangements; on the other hand, other countries believe that the differences are justifiable and public concern can be alleviated by explaining the reasons for any differences.

Intervention levels for longer term protective measures, such as relocation and the removal of countermeasures, are far less mature than those for urgent measures.

[14] Some members of the SG disagreed with this recommendation, arguing that differences in the extent of EPZ could be justified in the context of EP&R arrangements as a whole and that the reasons for these differences could be could be readily explained to the public.

Guidance on the development of levels, and the levels themselves, has undergone frequent change over the past two decades and broad consensus in this area remains elusive (again with the notable exception of the Nordic countries at a regional level). This is largely a result of the inescapable complexity of the issue and the difficulty of developing guidance or levels that would be applicable to the very wide range of situations that might be encountered in practice. In these circumstances, some countries have favoured the adoption of outline and/or flexible arrangements that can be readily adapted to the circumstances prevailing at the time of any accident. Others have, more recently, developed a framework for addressing these issues (ie, CODIRPA).

Despite the apparent value of operational intervention levels (OIL), only about one third of countries in Europe appear to have systematically developed and use these quantities in their practical EP&R arrangements. The reasons for the limited use of OIL are not clear but contributing factors appear to be that the direct use of intervention levels is considered sufficient and that undue conservatism has often needed to be incorporated into OILs to enable their application to a wide range of uncertain scenarios.

The transposition of the new EU BSS into national legislation will offer a rare opportunity for the merits of greater harmonisation in this area to be debated more widely and at a more political level.

Recommendations

a) The European Commission should develop a case for action at a political level to achieve greater harmonisation of criteria across Europe for the introduction and removal of protective measures[15]. This should be based, not on consideration of the technical pros and cons of different approaches, which has resulted in impasse in the past, but on the benefits of improved public confidence and trust.

b) The European Commission, in cooperation with Member States and their regulatory/competent authorities, should, as soon as practicable, establish a broadly agreed framework to provide guidance to Member States in developing their own practicable strategies[16] and arrangements for longer term protective measures (including criteria to be used for the introduction and removal of protective measures). Failure to do so could lead to significant and lasting social, economic and political problems in the event of any future accident that might affect Europe (see also 12.3 above).

[15] Some members of the SG were opposed to this recommendation arguing that differences in criteria were consistent with the underlying principles of intervention, ie, reflecting differences between countries in socio-economic conditions

[16] As required by the new EU BSS

12.6 Off-site emergency personnel and rescuers (see Section 7 and Appendix G)

Most European countries have regulations, standards, requirements or guidance in addition to primary legislation for the protection of off-site emergency personnel and rescuers. Dose criteria are specified for different types of emergency action (eg, urgent protective actions, actions to prevent the development of the emergency, life-saving actions, etc). Criteria adopted by most countries are generally in line with IAEA guidance, and restrictions are placed on pregnant and lactating women taking part in emergency response actions.

No information was provided by some countries on provisions for dose record keeping and medical care and follow up of personnel exceeding the dose criteria; and those that did generally provided little information of a detailed nature. This raises questions as to the adequacy of current arrangements in this area, in particular resources for medical care.

12.7 Cross border arrangements (see Sections 7and 9 and Appendices G and H)

Nearly all countries have mechanisms in place to ensure timely notification of emergencies to neighbouring countries over and above obligations under the Convention on Early Notification of a Nuclear Accident and the Community's Urgent Radiological Information Exchange system. Detailed bi-lateral cross border arrangements have been established by 19 European countries. Arrangements are in place, or under development, in all cases where the territory of a country falls within the EPZ of a NPP in a neighbouring country. Multi-lateral arrangements have also been established, notably between the Nordic countries and in the “Greater Region” which comprises several Belgian, Dutch, French, Luxembourg and German regions.

Notwithstanding these numerous bi- and multi-lateral agreements, there are major differences in how they are implemented, both in the nature of arrangements in practice and in the extent to which they are governed by any binding legal basis or more substantive political accord (eg, the Melk Protocol between Austria and the Czech Republic or the legally binding agreements between Switzerland and Germany) – in many cases the arrangements have evolved over a long period of dialogue and are largely sustained by good will or ‘gentleman’s agreements’. Some countries see this as a major weakness and impediment to the establishment of effective, sustainable and broadly comparable arrangements across borders, and would welcome legally binding arrangements at a European level; others see no need for, and were strongly opposed to, any such arrangements.

HERCA is developing a new approach to further enhance the consistency of protective actions across national borders that is based on the principles of mutual understanding, coordination, mutual trust and alignment of recommendations for decisions between competent authorities. The road map for such efforts is being

developed in cooperation with WENRA. This is a major step forward in a complex area and augurs well for the future; but much will depend on how the concept is translated into practical arrangements in the coming months, in particular for the preparedness and urgent phases of an emergency. The existing process, however, may need to be made more inclusive, ie, through the active involvement of organisations, other than competent authorities and regulatory bodies, which have an important role in off-site EP&R.

Recommendations

a) Active dialogue between neighbouring countries on EP&R[17] should be maintained at all levels, ie, local/municipal, regional and national levels, to reinforce trust and confidence; this should be fully embedded within wider local/municipal and regional cross-border cooperation in preparedness and response to various types of hazards (all hazard approach) as well as on matters of broader common interest (ie, social, cultural, economic, etc). The experience of cooperation in the Nordic region could provide a valuable model.

b) In the context of the recommended mechanism to develop and adopt guidance or Codes of Practice (see 12.2), the European Commission, in cooperation with Member States (including their regulatory/competent authorities and civil protection organisations), should build on the HERCA initiative and develop guidance or a Code of Practice on what constitutes good/best practice in Europe on cross border arrangements. Compliance with such guidance should ensure the same level of protection across national borders.

c) The European Commission should monitor the effectiveness of cross border arrangements, making use of the results of any self assessments and peer reviews of arrangements against the authoritative guidance/Code of Practice (see 12.2)[18]. If necessary, it should take steps to require improvements in those cases where arrangements are deficient. Should existing powers not be sufficient for the latter purpose, they should be obtained through further legal provision or administrative mechanisms.

12.8 Protection of European citizens in countries other than their own (see Appendix K - Section 23.3)

European citizens in Japan following the Fukushima accident were provided with disparate and often conflicting information regarding their protection by their respective governments and embassies; comparable situations have arisen in the aftermath of other nuclear emergencies. This has led to much needless concern and anxiety, both for those directly affected and their relatives in Europe. Practical

[17] As required by the new EU BSS
[18] And against provisions on international cooperation included in the new EU BSS

proposals for further harmonisation of the response of European countries to any **distant** radiological or nuclear emergency have been developed by HERCA.

Recommendations

a) *Broadly agreed mechanisms should be developed and implemented for providing European citizens in countries other than their own (irrespective of how distant and including EU countries other than their own) with informed, considered and broadly consistent advice following a nuclear emergency. These mechanisms should, to the extent practicable, build those developed by HERCA for distant countries. The potential role of the European External Advisory Service (EEAS) in this context, at least for accidents occurring outside the EU, should be explored. Given what has already been done for distant countries, HERCA would appear to be best placed to develop such guidance with oversight and cooperation from the Commission.*

12.9 Exercising of arrangements and their extendibility (see section 7 and Appendix G, and Appendix K – Section 23.5)

Off-site EP&R arrangements are exercised periodically in all countries at local, national and supra-national levels with varying frequency and levels of detail, realism and challenge. Almost all countries with operating NPP have plans/arrangements for EP&R beyond the EPZ, though often of a less detailed nature; little information, however, was provided on the nature of the arrangements and/or how they are exercised.

Most countries with operating NPP reported that they had taken account of the loss of major infrastructure and of protracted emergencies in developing their EP&R arrangements; many reported that their arrangements were robust in these eventualities. Nonetheless, almost all indicated that improvements are needed in both areas, but provided little information on the nature of these improvements.

From the information provided it is not clear if arrangements are tested or exercised frequently enough, and with sufficiently challenging scenarios, to demonstrate their adequacy in the event of protracted emergencies, or those associated with major loss of infrastructure, or both.

IAEA is developing a standardised approach for the self-assessment of national EP&R arrangements and capabilities that takes account of the full spectrum of potential emergencies, including the more extreme. This standardised package will include a 'table-top exercise' to enable countries to evaluate or 'stress-test' the extendibility and robustness of their EP&R arrangements in responding to more extreme emergencies.

Recommendations

a) Countries with operating NPP which have not already done so should carry out a systematic analysis of the objectives and practice of exercising (frequency, scale, level of detail and realism, satisfying training needs, extendibility, review mechanisms and feedback to improve existing arrangements, etc) off-site EP&R at all levels (local/municipal, regional, national, cross-border) to assure themselves that the objectives and practice are adequate and in line with best practice. This should, depending on its outcome, assuage concerns that current exercises are not sufficiently realistic or challenging, nor fully integrated within an all hazards approach; alternatively, needs for improvement should be identified and subsequently addressed.

b) In the context of the recommended mechanism to develop and adopt guidance or Codes of Practice (see 12.2), the European Commission, in cooperation with Member States, should establish a common view within the EU on:

- *Approaches to extendibility, in particular its extent and the frequency with which arrangements are exercised; this should incorporate good/best national and international practice, and demonstrate the absence of 'cliff edge' effects (in terms of the efficacy of arrangements) as the size and complexity of accidents considered for EP&R increases (the IAEA standardised package could be used for this purpose); and*

- *The nature and extent of improvements that should be made to make EP&R arrangements more robust in relation to loss of infrastructure, multiple accidents and protracted emergencies.*

Once established, any need for improvement should be addressed by Member States.

12.10 Practical aspects of protective measures (see Section 7, Appendix G and Appendix K - Section 23.3)

12.10.1 Early protective measures

Issue of stable iodine: Arrangements for the distribution and issue of stable iodine appear to be sound and effectively implemented in most countries, although there are differences in detail. Stable iodine is pre-distributed in all countries operating an NPP, typically within the EPZ; additionally, stocks of stable iodine are generally available centrally, with arrangements in place for its distribution, if necessary. The dosages prescribed are broadly consistent with those recommended by the WHO but there are major departures from WHO guidance on repeat intakes. Information/guidance about potential side effects is provided by almost all countries, generally in a leaflet inside the box containing the tablets.

Sheltering: Arrangements for sheltering appear to be sound and effectively implemented in most countries, although there are again differences in detail. In the event of an accident, all nuclear and several non-nuclear countries would recommend sheltering prior to the release of radioactive material. Nearly all countries have recommendations or guidance on the maximum duration of sheltering; most recommend a maximum duration of 48 hours, but some recommend 24 hours or less.

Evacuation: Arrangements for evacuation appear to be sound and effectively implemented in most countries, although again there are differences in detail. With one exception, all countries with NPP would recommend evacuation prior to a release of radioactive material, generally based on an assessment of the status of the plant and/or predictions of potential releases and their consequences in comparison with intervention levels. Evacuation in most countries would be achieved by a combination of self-evacuation and organised transport.

Most nuclear countries (with two exceptions) make special provisions within their plans for the evacuation of particular groups, in particular, hospitals, care homes, social institutions, schools and prisons. Most countries (nuclear and non-nuclear) report sufficient capacity to accommodate the total population residing within the EPZ in pre-designated reception centres, although several countries acknowledge that they may be insufficient.

Food and drinking water: The adequacy of arrangements for the control of food and drinking water appears more equivocal. All nuclear countries would, in the event of an accident, place restrictions on food and drinking water in pre-designated areas (occasionally over the whole country) prior to confirmatory measurements being made; in non-nuclear countries, more than half would follow this practice, with the others placing initial restrictions on the basis of model predictions.

Some countries did not respond on whether their arrangements for the control of food and drinking water were sufficiently comprehensive and robust to provide a high degree of assurance that products entering the market would meet EU requirements. Of those that did, four acknowledged that their arrangements were not sufficiently comprehensive or robust.

Few countries (ie, seven) appear to have developed a practicable strategy for the management and disposal of contaminated foodstuffs and livestock and to have made provisions for its implementation; none, however, provided further information about the nature of these strategies. Few countries without a strategy provided further information on their current arrangements, which were often described as ad-hoc. Similarly, few countries had assessed the implications of their strategy or current arrangements to determine whether or not they were practicable (eg, resistance from the food industry and/or consumers to process and/or consume foodstuffs contaminated at levels far below CFILs) – nor were any compelling reasons put forward as to why such assessments were considered unnecessary.

Based on the responses to the questionnaire, major concerns must remain over the adequacy of current arrangements for the control of food and drinking water restrictions in at least several countries.

Recommendations

a) In the context of the recommended mechanism to develop and adopt guidance or Codes of Practice (see 12.2), the European Commission, in cooperation with Member States, should, using existing legislative provisions or, if necessary, by making proposals for legislation, develop EU-wide good/best practice for early protective measures, including their termination. This should be based on guidance recently developed by HERCA complemented, as necessary, by guidance developed by the IAEA.

b) The reasons for major departures from WHO guidance on repeat intakes of stable iodine should be explored by those countries concerned and, if appropriate, practice modified.

c) Countries that currently do not make special provisions for the evacuation of particular groups, eg, hospitals, care homes, social institutions, schools, prisons, etc, should do so because it represents best practice; otherwise they should demonstrate why this is not necessary.

d) Countries should satisfy themselves that, in the event of an accident, the capacity of reception centres is sufficient to accommodate the population who may need to be evacuated from within the EPZ (or a larger area foreseen in any extendibility arrangements).

e) Countries without an integrated strategy for the management and disposal of contaminated foodstuffs and livestock should develop one at the earliest opportunity and demonstrate that it is practicable. Countries with a strategy, but without having assessed its practicability, should put in hand arrangements to do so at the earliest opportunity. To the extent practicable, advantage should be taken of good/best practice in those countries with well-conceived and demonstrably practicable strategies. Particular attention should be given to the implications of the likely resistance of the food industry and consumers to the processing and/or consumption of produce contaminated at levels far below CFILs. Guidance/Handbooks developed under the auspices of the Euratom research programme may assist in this process.

f) The European Commission should require Member States without a strategy[19] or arrangements for the management of wastes, both from restrictions on contaminated foodstuffs and from remediation of the built environment (see below), to develop them at the earliest opportunity.

[19] As required by the new EU BSS

12.10.2 Medical support and treatment of members of the public

Limited information of a quantitative nature was provided on the extent of national capabilities in this important area of EP&R. Capabilities for triage and decontamination varied widely between countries and most countries indicated that they had some arrangements in place for psychological support and counselling following a nuclear accident. But, insufficient information was provided to confirm that current capabilities for medical triage, screening, treatment and psychological support would be adequate for the protection of the number of people who may be affected by the more severe accidents that are currently the basis of planning for EP&R in some countries or being considered as the basis in others.

Recommendations

a) Insofar as they do not already exist, countries should make systematic assessments of the needs for medical support and treatment that are commensurate with the scale and nature of accidental releases being considered for the purposes of detailed emergency planning.

b) Countries should, in the interests of cost-effectiveness, minimising duplication, enhancing quality and reliability of prognoses, etc, evaluate the merits of adopting more centralised or regional approaches to providing medical support and treatment, in particular in geographically proximate regions, or for use by countries with limited capabilities and/or resources/expertise (see also Mutual Assistance below).

c) The European Commission, in consultation with Member States, should exploit opportunities under the Civil Protection Mechanism to enhance capabilities within the EU for medical support and treatment, both in terms of responding to CBRN threats and accidents at nuclear installations.

12.10.3 Longer term protective measures

Relocation (and/or subsequent return): Arrangements for relocation are immature. Few countries (five nuclear and four non-nuclear) reported that they had developed a robust and defensible strategy for relocation and made provisions for its practical implementation. Several countries without a strategy provided no details of their current arrangements and some indicated that they had none. Only two countries had carried out any assessment of the implications of their strategy or current arrangements, in particular to determine whether they are practicable; but neither provided much detail about their findings. Several countries did not to reply to this question. Based on this evidence, major concerns must exist on the adequacy of current arrangements.

Decontamination of the built environment: Arrangements for decontamination of the built environment (and management of the resulting waste arisings) exhibit similar features to those for relocation, ie, relatively immature with little evidence of

well-conceived strategies or arrangements for their implementation or even reasons why their absence was deemed appropriate.

Recommendations

a) Countries without strategies for relocation (and/or subsequent return) and/or for decontamination of the built environment (and management of waste arisings) should develop them at the earliest opportunity and demonstrate that they are practicable. Countries with such strategies, but without having assessed their practicability, should put in hand arrangements to do so at the earliest opportunity. To the extent practicable, advantage should be taken of good/best practice (eg, CODIRPA, the Nordic Manual) in those countries with well-conceived and demonstrably practicable strategies, and/or use should be made of handbooks developed under the auspices of the EURATOM research programme.

b) Given that this issue is common for many countries, the European Commission, in cooperation with Member States and their regulatory/competent authorities, should, as soon as practicable, establish a broadly agreed framework at the EU level for use by Member States in developing their own practicable strategies and arrangements for longer term protective measures (including criteria to be used for the introduction and removal of protective measures)[20]. Failure to do so could lead to significant and lasting social, economic and political problems in the event of any future accident that might affect Europe (see also 12.3 and 12.5 above).

12.11 Technical support for decision making (see Section 7 and Appendix G)

Technical support for decision making can take many forms but ultimately relies on a combination of measurements and modelling (of many and diverse types) to provide decision makers with the best evidence base available at any time during the progression of an accident, or afterwards, to inform their decisions. There are significant differences between countries in the nature and extent of technical support used, eg, the balance between measurements and modelling, the nature and extent of measurements, the range of applicability and complexity of models used, etc. There is no compelling evidence to suggest that one approach is better than another; what is important is that, whatever approach is used, it is capable (when taken as a whole) of providing soundly based information at times when key decisions need to be made. The current status within Europe of some of the key elements of technical support is summarised.

Plant status: The status of a nuclear power plant and/or prognoses of its development are now used in all countries with NPP as a basis for making decisions on the introduction of urgent protective measures. In nearly all cases there are

[20] As required by the new EU BSS

standards, guidance or recommendations setting out the conditions which should trigger particular protective actions. And, in all but one country, information about plant status and/or prognoses of its development is available in real time to those responsible for off-site EP&R.

Early warning and radiation monitoring systems: There is considerable variation in the spatial resolution and types of radiation monitors used in national early warning and radiation monitoring systems in Europe. Many of the systems were developed and installed in the aftermath of the Chernobyl accident, and their design is often more a reflection of the prevailing social and political attitudes at that time rather than need established on a strictly technical basis. The extensive network of gamma dose rate monitors, gamma spectrometers and air samplers offers a robust system for providing early warning and an estimate of the potential significance of a release of radioactive material within Europe, and/or of the arrival over the European land mass of material released elsewhere. Information from most of these networks is available across Europe and largely in real time (ie, via national web-sites and within the EURDEP system at a European level)[21]. Recent developments in the application of inverse modelling to data collected from early warning and radiation monitoring systems are now able to provide enhanced and more timely prognoses of the dispersion of released material across Europe and of its potential radiological consequences; this capability, however, is currently only available in one or two European countries.

Radiation survey and environmental measurements following an accident: There is wide variation between countries in the approaches used for radiation survey and making environmental measurements following an accident, and in the nature and magnitude of equipment available; insufficient capability was reported in a number of countries. It was not possible, due largely to the incompleteness of responses to the questionnaires, to assess the sufficiency and robustness of existing capabilities for radiation survey and the analysis of environmental samples (ie, are they fully commensurate with needs foreseen in emergency plans and/or their foreseeable extension), either at a national level or for Europe as a whole.

Models and systems to aid decision making: There is wide variation between countries in the nature and sophistication of models and systems used to aid decision making. Some countries use custom built decision support systems, comprising a suite of integrated models and software that are suitable for most situations that can be envisaged, including accidental releases of radioactive material to the atmosphere and aquatic environments; others use more ad hoc approaches with models or software adapted to their specific needs. The development and fairly widespread use in Europe and elsewhere of the RODOS and ARGOS decision support systems (which have broadly comparable technical capabilities) has enhanced both the quality and sustainability of decision support capability (in particular in the preparedness mode).Effective and reliable use of these and other more extensive and complex systems (in particular in the response mode) requires the commitment of significant

[21] To be extended globally in due course via the IAEA's IRMIS (International Radiation Monitoring and Information System) system.

expertise and resources, which often exceed the capabilities of many smaller countries.

Recommendations

a) All countries should have arrangements and capabilities for the rapid and reliable establishment of the levels of deposition of radioactive material on their territory following an accident. This is critical for the effective management of an emergency and in building public trust and confidence. In those cases where the area affected is extensive, aerial survey (or other approaches with an equivalent capability) may need to be used in order to establish deposition patterns sufficiently quickly. Countries with NPP should either have a capability to carry out aerial survey or have arrangements in place to access such a capability (or an equivalent capability) at short notice if needed (eg, through prior agreements or mutual assistance arrangements).

b) Insofar as it has not already been done, countries should satisfy themselves that existing capabilities (both survey and environmental sampling) for monitoring in the event of an accident are fully commensurate with needs foreseen in emergency plans (and/or their foreseeable extension), and for longer term post-accident management, including reassurance monitoring.

c) The European Commission should seek assurances (and evidence) from Member States, possibly in the context of verification actions under Article 35 of the Euratom Treaty, that their capabilities for radiation survey and environmental measurements (fixed and mobile) following an emergency are fully commensurate with needs foreseen in their emergency plans and their foreseeable extension.

d) The European Commission together with Member States should evaluate how recent developments in the application of inverse modelling to data collected from early warning and radiation monitoring networks can be more fully exploited, in particular in providing all Member States with more timely and reliable prognoses of the dispersion of released material and its potential radiological consequences. In particular, those few countries with this technical capability should be encouraged to share the results of its application with other Member States (see recommendation f) below) or, failing this, consideration should be given to developing such a capability within the Joint Research Centre of the European Commission.

e) Countries, especially those in geographically proximate regions and/or with limited capabilities and/or resources/expertise, should evaluate the merits of adopting more centralised or regional approaches to providing technical support for decision making (ie, in the interests of cost-effectiveness, minimising duplication, enhancing quality and reliability of diagnoses and prognoses, sustainability, etc).

f) The European Commission, in consultation with Member States, should evaluate the potential for the ERCC to act as a focal point in disseminating authoritative diagnoses and prognoses (to be provided by one or other Member State) of the development of an emergency and its consequences, in particular to aid decision making in countries without the resources or expertise to make their own assessments[22].

12.12 Public information and communication (see Section 7 and Appendices G and K)

Responsibilities for public information and communication in an emergency appear to be clearly defined in all countries. However, insufficient information was provided to form a judgement on the adequacy of arrangements in each country.

This issue has received much attention at an international level post Fukushima and has resulted is significant developments. IAEA has issued practical guidance on how to prepare and train for emergency communication in advance of an emergency and provides principles and tools for communication to assist Public Information Officers in their work (EPR-Public Communication, 2012). The NEA Working Group on public communication of Nuclear Regulatory Organizations (WGPC) held a workshop on Crisis Communication to identify efficient approaches and practices to improve communication in a crisis. This led to the adoption of a new version of the WGPC Roadmap for Crisis Communication in December 2012.

Recommendations

a) Countries should review their arrangements for public information and communication against recently issued international guidance and, subject to the outcome of the review, evaluate whether their arrangements should be revised to benefit from the adoption of what is currently regarded, at an international level, as good/best practice.

12.13 Mutual Assistance (see Section 7 and Appendix G)

Twenty four countries have indicated that they have bi-lateral arrangements in place for mutual assistance with other European countries. Many have expressed a strong preference for bi-lateral, as opposed to European or international, arrangements, for mutual assistance, believing that these would be more timely and reliable in practice.

Currently eleven countries have registered capabilities with IAEA's RANET (Response and Assistance NETwork) and a further three plan to do so. A comparable number (thirteen) have registered (or expressed a willingness to register) capabilities with the

[22] Some members of the SG were opposed to this recommendation, preferring to rely on the IAEA to provide such diagnoses.

European Commission's Emergency Response Coordination Centre (ERCC, formerly MIC). Concerns have been expressed by several countries over duplication in registering capabilities with RANET and MIC/ERCC; there are differences of view in how best to avoid duplication, with some countries preferring to register exclusively with RANET, and others preferring MIC/ERCC. To some extent, these differences may reflect the backgrounds of the organisations responding to this study: radiological/nuclear emergency management or civil protection.

There is much potential within Europe to make more effective use of existing resources and capabilities, minimise unnecessary duplication and achieve major cost savings through shared development and maintenance of expensive but rarely used assets.

Recommendations

a) The European Commission should evaluate, in consultation with EU Member States, how best use could be made of the extensive capabilities (existing and potential) for EP&R within Europe in the interests of enhancing the protection of European citizens; and, in consultation with IAEA, how European capabilities could be most effectively deployed for the benefit of third countries via the RANET mechanism[23]. Particular attention should be given to:

- *Evaluating the potential of the ERCC to act as a focal point for mutual assistance within Europe;*
- *Evaluating whether ERCC is best placed to ensure the availability and timely deployment within Europe (and beyond) of certified technical resources and expertise of the requisite quality;*
- *Evaluating the potential of the ERCC to coordinate the development and maintenance of expensive and rarely used assets and capabilities for off-site EP&R (albeit, deployed for other uses pending their need in an emergency);*
- *Evaluating the potential and efficacy of the ERCC to act as a 'one stop shop' or single interface[24] with RANET in providing mutual assistance from the EU.*

[23] Several members of the SG were opposed to this recommendation on the grounds that it could duplicate arrangements under RANET, the system developed to implement some of the provisions of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; some EU Member States, however, take the opposite view, preferring to integrate their capabilities within Europe through the ERCC, with the ERCC then providing the interface with RANET.

[24] The member of the SG from IAEA was strongly opposed to this recommendation and questioned the legal validity of such an arrangement.

12.14 Interface between research, operational and policy communities on EP&R (see Appendix K)

Research on off-site EP&R has been effectively integrated under the auspices of the EURATOM research programme for much of the past two decades, in particular in the aftermath of the Chernobyl accident. This integration has made better use of limited, and generally diminishing, resources at most national levels, and has facilitated shared development and exploitation of research outcomes. More, however, could be done to enhance the effectiveness of the interface between the RTD and the operational and policy EP&R communities, both in better setting the research agenda, and in more fully exploiting the research outcomes; a useful step in this direction has been the creation of the NERIS platform in 2011. Numerous products from the research community have been developed that would adequately address a number of deficiencies in arrangements and capabilities identified in this study.

Recommendations

a) Those responsible, at national and European levels, for operational and policy aspects of off-site EP&R should enhance their awareness of what has been developed by the RTD community and exploit it more fully, in particular to remedy a number of weaknesses in current arrangements identified in this study.

b) The operational, policy and research communities at both national and European levels should establish sustainable mechanisms for achieving closer cooperation, in particular in setting the research agenda and fully exploiting its outcomes.

12.15 Arrangements within the European Commission on EP&R (see Section 10 and Appendices J and K)

Arrangements within DG ENER for fulfilling its obligations in relation to radiological and nuclear EP&R were reviewed following the Fukushima accident and a number of lessons learned, in particular related to the sufficiency of trained personnel for a prolonged emergency. No comparable review appears to have been undertaken of arrangements more widely across the European Commission as a whole.

The increasing cooperation between DG ENER and DG ECHO on EP&R (ie, MoU on cooperation on specific issues) is proving helpful in enabling better use of resources and the development of more common approaches to all emergencies, irrespective of their nature.

Cooperation between DGs with differing but related competences (eg, DGs ENER and SANCO in relation to radioactive material in foodstuffs) appeared to work effectively in the aftermath of the Fukushima accident. The extent and nature of cooperation (or pre-established arrangements) between DG ENER and other DGs with a potential role following a radiological or nuclear emergency was not ascertained in this study.

The establishment of the new Emergency Response Coordination Centre, ERCC, (integrating the Commission's response to humanitarian crises and natural and man-made disasters under the Civil Protection Mechanism) provides a unique opportunity for better integrating, and more fully exploiting, related activities implemented under the Euratom Treaty and the Civil Protection Mechanism (insofar as they concern radiological and nuclear emergencies).

The frequent response (several times per year) of the ERCC to world-wide humanitarian crises and man-made and natural disasters ensures its operational readiness, in particular the maintenance and development of properly certified key assets and their rapid deployment, as well as having mechanisms in place to address issues of liability and quality of assistance that are matters of concern for some Member States.

The collation and visualisation, via the EURDEP system, of data and information collected from national early warning and environmental monitoring networks, under the auspices of the ECURIE system, is a valuable asset capable of better informing EP&R; the success of EURDEP is exemplified by its being used as a basis for the development of the IAEA's International Radiation Monitoring Information System (IRMIS). The potential of these data, however, has not yet been fully exploited through concerted action to process and interpret the collated data, it being left to individual Member States to do this at their discretion (see also 12.11).

Recommendations

a) The European Commission should, in consultation with Member States, carry out a wide ranging review of its organisational structure and arrangements related to radiological and nuclear EP&R. Consideration should be given, inter alia, to whether its structure and arrangements remain appropriate, whether its resources are being effectively used, whether coordination between the many DGs with a role or responsibility for EP&R needs to be improved, and whether arrangements for interacting with Member States are optimal.

b) The European Commission should ensure that representatives of all DG with a role or responsibility in EP&R participate in meetings with Member States convened in the aftermath of a radiological or nuclear accident. This is essential for enabling timely and effective information exchange on measures being taken at national and European levels to manage the consequences, in particular the protection of the population taking into account the free circulation of goods and products within the EU.

c) The European Commission should facilitate the transposition of provisions related to EP&R in the new EU Basic Safety Standards, for example through its participation in workshops held at its own or others' initiative.

d) The European Commission should review its existing policy and/or strategy for exercising its EP&R arrangements for radiological and nuclear emergencies and the training of relevant staff; particular attention should be given to the frequency and nature of these exercises to ensure they provide assurance that the European Commission will be able to fulfil its obligations in the event of any reasonably foreseeable emergency.

e) The European Commission should arrange for its exercises to be subject to periodic external review (at least external to DG ENER and, from time to time, external to the Commission); the findings of such reviews should be documented, and a formal response provided as to what actions would be taken in response.

f) The European Commission should make arrangements to periodically exercise potentially important elements of its legislative provisions that have not so far been exercised (for example, provisions under the current Foodstuffs Regulation to amend CFILs following an emergency, or other provisions that may be included in the ongoing revision of this Regulation).

g) DGs ENER, ECHO, JRC and SANCO, as well as other involved DGs, should further reinforce their cooperation on matters related to off-site EP&R with a view to achieving, within a prescribed period, a fully integrated approach within the European Commission for responding to all emergencies including nuclear (ie, the adoption of an all hazards approach).

h) The European Commission should, in cooperation with others (eg, HERCA, WENRA, ENSREG, IAEA, etc) take initiatives in a number of areas (see above) where concerted action within the EU, or regions within it, would be welcome and would have the potential to enhance the efficacy and sustainability of off-site EP&R (eg, standards for contamination of commodities, mutual assistance, framework for cross border arrangements, etc).

12.16 Implications of the revision of GS-R-2 and the EU Basic Safety Standards (see Section 10 and Appendices J and K)

Internationally agreed (non-binding) requirements for 'Preparedness and Response for a Nuclear and Radiological Emergency', as set out in IAEA publication GS-R-2, are currently being revised and are likely to be updated in late 2014 or early 2015. The existing requirements are extensive and well-conceived, and any substantive change to their substance is unlikely; however, some change in emphasis can be expected. In the absence of substantive change, the findings of this study are unlikely to be greatly affected by any revision in GS-R-2.

The ongoing revision of the EU Directive on Basic Safety Standards is well advanced and is likely to be approved by Council before the end of 2013 or early in 2014[25]. The proposed revision contains some additional provisions (eg, emergency management system, optimised protection strategies, international cooperation, etc), none of which are likely to alter substantively the findings of this study. However, these provisions have the potential, in principle, to contribute to addressing some of the study's recommendations, in particular those relating to strategies for protective measures and cross border arrangements. The extent to which they do so in practice will depend on how the Directive is implemented and its provisions enforced.

12.17 Responsibility for emergency management

Institutional arrangements for nuclear emergencies are often different from those for most, if not all, other types of emergency. As an example, at the European level, nuclear matters are covered by a separate treaty: the Basic safety Standards Directive and the Nuclear Safety Directive are made under the Euratom Treaty. The practical outcome of this is that, in many countries, 'ownership' or 'leadership' of nuclear emergency preparedness and response arrangements rests with national institutions with radiological or nuclear expertise, with civil protection organisations providing support. For most, if not all, other types of emergency, ownership or leadership is exercised by civil protection organisations, with supporting input from relevant specialists, depending on the nature of the emergency. This has important implications for how emergencies are handled in practice and how, and by whom, authority and control is exercised.

The principles of radiological protection, which have been incorporated into legislation in the EU and in Member States via the Basic Safety Standards Directive, are based on balancing technical, social and economic considerations (optimisation of protection). As a result, the radiological protection community sees it as within its role to take account of social and economic factors when making radiological protection decisions, including those on EP&R arrangements (such as on criteria for protective measures). This is one of the reasons underlying the difficulties in achieving greater harmonisation of intervention criteria and other EP&R issues: from a strict radiological protection point of view, differences can be justified on the grounds that the trade-offs between technical, social and economic factors may well be different in different countries. Those with a broader perspective may well give greater weight to the benefits of more comparable arrangements. This raises a question about how EP&R arrangements are best dealt with: is it matter of incorporating social and economic factors into decisions about radiological protection, or of incorporating radiological protection considerations into decisions about society [Prêtre, 1998]. It is arguable that, rather than treating radiological/nuclear emergencies as a type of exposure situation within radiological protection, that needs to be addressed by the radiological protection community, it would be more

[25] The revised Directive on the BSS had not been adopted by the EU Council at the time this report was written (November 2013); it was subsequently adopted by Council on 5 December 2013.

appropriate to consider them as one particular (and extremely unlikely) subset of emergencies in general, addressed by the wider EP&R community.

The project's view is that there is no justification for radiological or nuclear emergencies being treated differently from any other type of emergency. Continuing to do so reinforces public and political misconceptions and prejudice about the special nature of nuclear emergencies. Integrating nuclear emergency preparedness and response arrangements within those for other types of emergency would ensure greater clarity in command structures and consistency of response, and contribute to more effective use of resources. Specialist nuclear and radiological expertise would still play an essential role, but this role would be clarified as being to provide specialist input to well-structured and frequently implemented arrangements for the management of any emergency (as opposed to leading on separate, and extremely rarely implemented, arrangements for nuclear emergencies).

Recommendations

a) All parties should reflect on whether it continues to be appropriate for the radiological protection community to be the principal arbiter in defining the conceptual basis of radiological and nuclear EP&R or whether it should more appropriately provide an essential, but supporting role, in tailoring arrangements applicable to emergencies more generally.

12.18 Responding to recommendations of this study

Effective response to the recommendations set out above will require action at many different levels (eg, national, regional or Europe wide) and by many different actors (ie, given the involvement of most organs of State in EP&R). Inevitably, because of the power they can exercise under legislative provisions, regulatory bodies will have a major role to play in achieving needed improvements, supported as necessary by other actors at local, regional and national levels.

Response at a regional or European level will require vision and leadership if best use is to be made of limited resources and capabilities, in particular in economically difficult times. Adopting a regional or wider European approach may result in some loss of national autonomy, but could be justified by improvements in the quality and sustainability of EP&R and reduced costs.

A number of recommendations have been made for improvements in EP&R at a regional or European level. These may be pursued through various mechanisms ranging from, at one extreme, the pursuit of a shared vision/objective through voluntary action within a region, or Europe-wide by Competent Authorities or regulatory bodies, and/or initiatives by the EC, to, at the other extreme, new EU legislation. The nature of the improvement and how it might best be achieved will determine the most appropriate course of action.

The project believes that the European Commission is best placed to respond (or coordinate a response) to the recommendations of this study, other than those recommendations that require a response at a national level. Achieving an effective response to many of the recommendations will be challenging and will require concerted action and commitment at many levels. But, given the potential for cost savings and improvements in the protection of European citizens that would undoubtedly ensue, such commitment should be forthcoming. The greatest challenge will be to establish an inclusive process in which the many actors, with differing roles and responsibilities for EP&R, can play an active role and not be dominated by one or other faction. Existing structures (eg, groupings of regulatory bodies, competent authorities for radiation protection, competent authorities for early notification, civil protection authorities, etc), each with competence and/or responsibility for one or other aspect of EP&R, are not conducive to reaching a shared understanding or agreeing a common way forward. Notwithstanding this, the European Commission is uniquely placed to facilitate such a process and, should this fail, has the right of initiative to propose legally enforceable mechanisms to achieve the same ends.

Table 12-1: Prioritisation of recommendations and to whom they are mainly directed

Topic	Recommendations	Response level		Priority
		Countries	European	
12.2: Compliance with European legislation and international requirements	a) Countries to assure themselves that arrangements and capabilities are compliant **in practice**.	✓		1
	b) Countries to periodically request a peer review of their EP&R arrangements as a whole.	✓		1
	c) EC to propose legislation to require peer reviews of national EP&R arrangements.		✓	1
	d) EC to establish mechanism to develop and formally adopt guidance or Codes of Practice on what represents good/best practice in Europe on a wide range of key off-site EP&R issues.	✓	✓	1
12.4: Emergency Planning Zones (EPZ)	a) Countries to demonstrate that arrangements as a whole can achieve EP&R objectives in practice, irrespective of EPZ size.	✓		1
	b) Achieve a common approach or rationale for establishment of EPZ.	✓	✓	2
	c) EC to encourage neighbouring countries to reach common view at political level on extent of EPZ.	✓	✓	2
12:5: Intervention Levels and Operational Intervention Levels	a) EC to develop case for action at political level to achieve greater harmonisation within the EU on criteria for protective measures, especially between neighbouring countries.		✓	1
	b) EC, in cooperation with Member States, to establish framework to provide guidance in developing practicable strategies and arrangements for longer term protective measures (including criteria for protective measures).	✓	✓	1
12.7: Cross-border Arrangements	a) Active dialogue between neighbouring countries on EP&R should be maintained at all levels.	✓		1
	b) EC in cooperation with Member States to develop guidance or Code of Practice on good/best practice on cross border arrangements (see also 1 d)).	✓	✓	1
	c) EC to monitor effectiveness of cross border arrangements and, if necessary, consider need for additional legal or administrative provision.		✓	1
12.8: Protection of European Citizens in Countries Other Than Their Own	a) Broadly agreed mechanisms to provide European citizens in countries other than their own with informed, considered and broadly consistent advice following a nuclear emergency.	✓	✓	2

Topic	Recommendations	Response level		Priority
		Countries	European	
12.9: Exercising of Arrangements	a) Systematic analysis of the objectives and practice of exercising and comparison with best practice.	✓		1
	b) EC in cooperation with Member States to establish common view on approaches to extendibility and on improvements for loss of infrastructure, multiple accidents and protracted emergencies (see also 1 d)).	✓	✓	2
12.10.1: Practical Aspects of Protective Measures (Early)	a) EC, in cooperation with Member States, to set out good/best practice for early countermeasures (see also 1 d)).	✓	✓	2
	b) Departures from WHO guidance on repeat intakes of stable iodine to be justified or practice modified.	✓		3
	c) Countries currently not making special provisions for evacuation of particular groups should do so, or justify why not.	✓		2
	d) Countries to satisfy themselves that capacity of reception centres is sufficient to receive the population who may need to be evacuated from within the EPZ.	✓		2
	e) Countries without integrated strategy for the control of food and drinking water should develop one at earliest opportunity and demonstrate its practicability.	✓		1
	f) Countries without strategy or arrangements for management of wastes from food restrictions and/or remediation to develop them at the earliest opportunity.	✓		1
	g) EC to take steps to ensure that countries failing to develop a strategy or arrangements indicated in f) above do so, if necessary by making proposals for legislation.		✓	1
12.10.2: Practical Aspects of Protective Measures (Medical Support and Treatment of Members of the Public)	a) Countries to make assessments of needs for medical support/treatment commensurate with accident/s assumed for detailed emergency planning.	✓		2
	b) Countries to evaluate merits of adopting more centralised or regional approaches to providing medical support/treatment.	✓		3
	c) EC to exploit opportunities under CPM to enhance capabilities for medical support and treatment.	✓	✓	2

Topic	Recommendations	Response level		Priority
		Countries	European	
12.10.3: Practical Aspects of Protective Measures (Longer Term)	a) Countries without strategies for relocation (and/or subsequent return) and/or for decontamination of the built environment should develop them at earliest opportunity and demonstrate their practicability.	✓		1
	b) EC, in cooperation with Member States, to establish framework to provide guidance in developing practicable strategies and arrangements for longer term protective measures (see also 3 b)).	✓	✓	1
12.11: Technical Support for Decision Making	a) Countries to have arrangements and capabilities for the rapid and reliable establishment of the levels of deposition of radioactive material on their territory following an accident.	✓		2
	b) Countries to satisfy themselves that monitoring capabilities are commensurate with needs foreseen in emergency plans (and/or their foreseeable extension).	✓		1
	c) EC to seek assurances from Member States that capabilities for radiation survey and environmental measurements (fixed and mobile) in the event of an emergency fully commensurate with needs foreseen in plans.	✓	✓	1
	d) EC and Member States to evaluate how data from early warning and radiation monitoring networks in Europe can be more fully exploited.	✓	✓	1
	e) Countries in geographically proximate regions, and/or with limited capabilities/expertise, to evaluate the merits of adopting more centralised approaches to decision support.	✓		3
	f) EC to evaluate potential of ERCC to act as a focal point in disseminating authoritative diagnoses and prognoses made by one or other Member State.		✓	2
12.12: Public Information and Communication	a) Countries and other organisations to review arrangements for public information and communication against recently issued international guidance and revise them if necessary.	✓	✓	2
12.13: Mutual Assistance	a) EC to evaluate how best use could be made of the extensive capabilities for EP&R in Europe and whether ERCC could act as a 'one stop shop' in providing mutual assistance from the EU to RANET.	✓	✓	2

Topic	Recommendations	Response level		Priority
		Countries	European	
12.14: Interface between Research, Operational and Policy Communities on EP&R	a) Increase awareness among operational and policy communities of research outcomes and exploit them more fully.	✓	✓	3
	b) Operational, policy and research communities to establish sustainable mechanisms for setting the research agenda and fully exploiting research outcomes.	✓	✓	3
12.15: Arrangements within the EC on EP&R	a) EC to carry out review of its organisational structure and arrangements related to radiological and nuclear EP&R.		✓	1
	b) EC to ensure representatives of all DG with role or responsibility in EP&R participate in meetings convened in aftermath of radiological or nuclear accident.		✓	2
	c) EC to facilitate transposition of the provisions of new EU BSS relating to off-site EP&R.		✓	1
	d) EC to review its existing policy/strategy for exercising its EP&R arrangements and training staff.		✓	2
	e) EC to subject its exercises to periodic external review.		✓	2
	f) EC to periodically exercise elements of its legislative provisions that have not so far been exercised (eg, provisions under the Foodstuffs Regulations to amend CFILs).		✓	2
	g) DGs ENER, ECHO, JRC and SANCO and other DGs to further reinforce cooperation to achieve fully integrated approach within the EC for responding to all emergencies (all hazards approach).		✓	1
	h) EC, in cooperation with others, to take initiatives in a number of areas where concerted action within the EU would enhance the efficacy and sustainability of off-site EP&R.	✓	✓	2
12.17: Responsibility for Emergency Management	a) All to reflect on whether the radiological protection community should continue to be the principal arbiter in defining the conceptual basis of radiological and nuclear EP&R arrangements.	✓	✓	1

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