# Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries

CONTRACT ENER/2020/NUCL/SI2.838109

## Final Report

Luxembourg: Publications Office of the European Union, 2023



PDF ISBN 978-92-68-03163-6 doi:10.2833/270804 MJ-09-23-201-EN-N

| **Reference** | EC-07-EP&R-28-A-22/02/2023 – Final Report | | | |
|---|---|---|---|---|
| **Accessibility** | | ***Public*** | ***Restricted*** | ***Confidential*** |
| | ***Internal*** | *X* | | |
| | ***External*** | *X* | | |

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## Acknowledgements

This report has been prepared by the consortium partners (NucAdvisor, ENEA, VUJE and EK) and compiled by NucAdvisor for and on behalf of the European Commission.

## Disclaimer

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# Acknowledgements

This report has been prepared by the consortium led NucAdvisor, with ENEA (Italy), VUJE (Slovakia) and EK (Hungary), with the support of many stakeholders involved in the EP&R field, including safety authorities and civil protection organisations, governmental authorities, nuclear utilities, international organisations, civil society organisations and municipalities.

The authors would like to acknowledge with gratitude all the participants who gathered robust and diverse information from the inside of the EP&R sphere with a practical and operational view. They spent time filling our questionnaires and responding to our requests, and provided a large set of data, allowing us to understand better the complexity of improving EP&R provisions and aligning behaviour at the national and international levels. The consortium hopes that this report gives an accurate image of their expression.

The authors are also very grateful to all contributors to the two-day workshops of the project, on 17th-18th November 2021 and on 13th-14th December 2022, gathering representatives from 31 countries of the European continent. The key insights of the study were discussed and challenged to enable recommendations to be made. Their valuable input brought pertinent perspectives the consortium has tried to reflect in this report.

Finally, the authors warmly thank the technical officers of the European Commission and the expert members of the Steering Group for their continuous support and advice in guiding the work of the consortium throughout the two years 2021-2022 of the project.

# Abstract (English version)

The European continent includes countries with nuclear power plants, located at different distances from the borders of neighbouring countries, and whose EP&R arrangements are primarily intended to deal with national nuclear accidents and coordination with neighbouring countries with or without nuclear power plants but sharing a border with nuclear countries and having to develop EP&R arrangements in case of transboundary events, related with nuclear accident beyond the national border.

More than ten years after the Fukushima disaster, the EC proposes to take stock of the arrangements for radiological emergency management in the event of a major nuclear accident on European soil. It wished to undertake an analysis of the practical implementation of the Directives issued by the European Council, reviewing emergency management systems, stakeholder organisation, national protection strategies, cross-border cooperation, and internal and public communication channels in order to identify areas for improvement.

Thirty-three countries and other international organisations were involved thoroughly in transmitting and challenging data on the practical implementation of national emergency management systems and response plans and the practical measures for coordinating with other countries.

As a result of this 2-year study, a guide with six recommendations for the European Commission to improve cross-border cooperation, the involvement of civil society and the improvement of the protection strategy was produced.

Reminding that "closer integration of EP&R into the health and civil protection mechanisms at European level increases awareness and confidence level of European civil society, and contributes to more effective use of resource", the consortium believes that the project results have fulfilled significant achievements to this main objective.

# Abstract (version française)

En Europe, plusieurs pays ont sur leur territoire des centrales nucléaires, situées à des distances plus ou moins proches des frontières de leurs voisins, pour lesquelles, en cas d'accident nucléaire, sont mises en œuvre des actions internes et externes de gestion de crise qui nécessitent une coordination et des actions spécifiques entre pays frontaliers.

Plus de dix ans après le Tsunami au Japon qui a conduit à l'accident nucléaire de Fukushima, la Commission européenne a proposé de faire un bilan des actions réalisées dans le domaine de la gestion de crise en cas d'accident nucléaire majeur survenant sur le continent européen. Elle a souhaité entreprendre une analyse de la mise en œuvre pratique des Directives émises par le Conseil européen, en passant en revue les systèmes de gestion des urgences, l'organisation des parties prenantes, les stratégies de protection nationales, la coopération transfrontalière, ainsi que les moyens de communication interne et vers la population, afin d'identifier les domaines nécessitant des actions d'amélioration.

Trente-trois pays européens et de nombreuses organisations internationales ont participé activement à cette étude et à l'analyse des données collectées sur la mise en œuvre pratique des systèmes nationaux de gestion de crise et des plans d'intervention, ainsi que sur les mesures pratiques de coordination avec les autres pays.

Cette étude, réalisée entre 2021 et 2022, a conduit à proposer la formulation de six recommandations à l'intention de la Commission européenne, ayant pour objectif d'améliorer les coopérations bilatérales et multilatérales entre les pays européens, de renforcer l'implication de la Société Civile et des citoyens et de progresser dans la mise en œuvre des stratégies de protection.

Une meilleure intégration de la dimension transfrontalière en Europe dans la gestion de crise en cas d'accident nucléaire accroit la confiance de la Société Civile dans la mise en œuvre des mécanismes opérationnels de protection des citoyens. Les résultats de cette étude menée par le consortium proposent des actions concrètes ayant cet objectif d'amélioration.

# Executive summary (English version)

In order to maintain a high level of Emergency Preparedness and Response, the EU has laid the foundations of a robust legal framework. Whilst a set of guidelines provided by the IAEA exists on the matter, the EU framework is legally binding for all Member States.

Following the Fukushima disaster, two fundamental Directives were adopted laying down basic safety standards and requirements in radiation protection and nuclear safety, including radiological and nuclear emergency preparedness & response (EP&R) at the EU level, introducing several new and strengthened provisions compared to earlier Directives:

- Council Directive 2013/59 of 5 December 2013, laying down basic safety standards (BSS) for protection against the dangers arising from exposure to ionising radiation;
- Council Directive 2014/87 of 8 July 2014, amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations (NSD).

At the international level, IAEA General Safety Requirements (N°GSR Part 7), published in 2015, is a fundamental document that provides guidelines and recommendations for governments, authorities and licensees in the EP&R field.

The two European organisations HERCA and WENRA have carried out extensive work on EP&R, starting in 2011, just after the Fukushima accident, with "the overall aim to come up with **practical and operational solutions** leading to a uniform and efficient way of dealing with any serious radiological emergency situation, **regardless the national border lines."** As a result of this work, the "HERCA-WENRA Approach[1]" was approved by the board of HERCA in June 2014, proposing "a response mechanism for the Early Phase of an accident for a better cross-border coordination of protective actions".

As mentioned in the European Council Conclusions on "Off-site nuclear emergency preparedness and response" issued on 15 December 2015, it must be acknowledged "that the provision of EP&R arrangements is a

[1] HERCA-WENRA Approach for a better cross-border coordination of protective actions during the early phase of a nuclear accident-2014

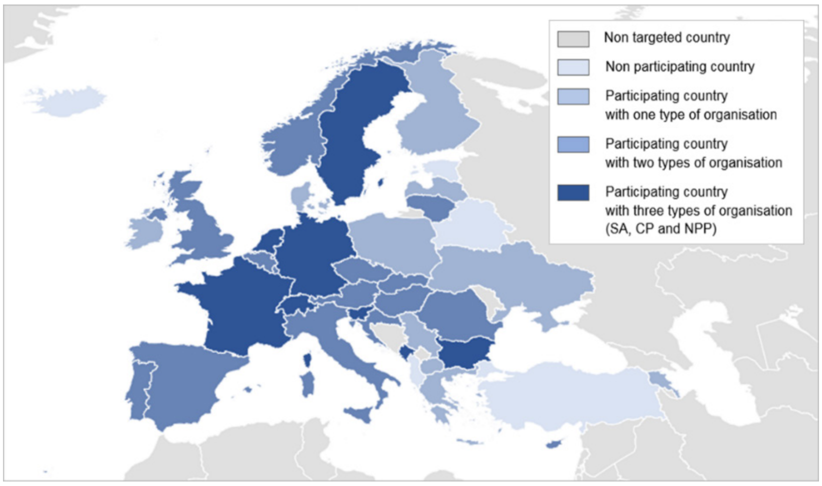
national responsibility yet bearing in mind that the consequences of a nuclear accident **can go beyond national borders**".

In this context, the European Commission, Directorate-General Energy, commissioned the consortium led by NucAdvisor (France) composed of ENEA (Italy), VUJE (Slovakia) and EK (Hungary) to carry out the review and analysis of the "Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries" (contract N°ENER/2020/NUCL/SI2.838109).

A significant effort was committed to inviting EU Member States and EU Neighbourhood countries to participate in this Project in order to:

- Review and evaluate the **practical implementation** of national emergency preparedness and response arrangements in all the participating countries, including **cross-border cooperation and coordination** aspects and **public confidence**;
- Develop recommendations for future policy actions at the EU level.

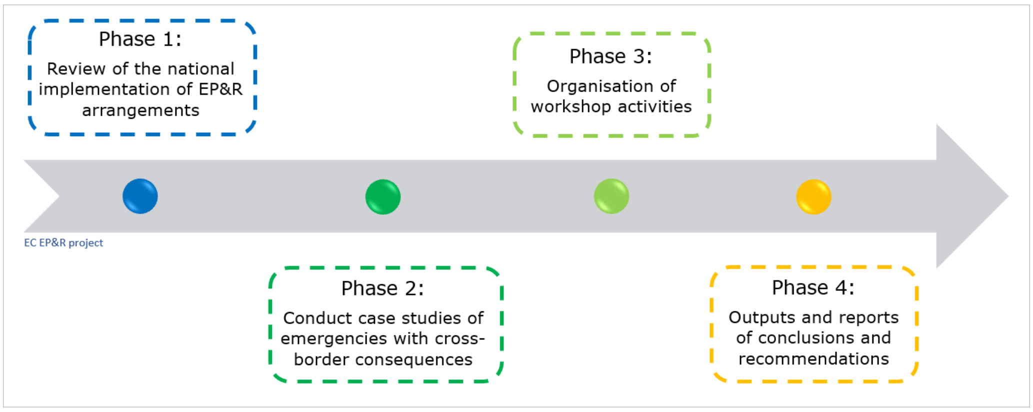
Thirty-three countries (25 EU Member States and 8 non-EU Members) and other organisations involved in the EP&R field were invited to participate and respond to questionnaires to obtain quality data on the practical implementation of national emergency management systems and contingency plans in their countries and on practical measures for coordination with other countries. Safety authorities (SA) and civil protection (CP) organisations, governmental players, nuclear utilities, international organisations, civil society organisations and municipalities contributed to the project in the frame of exchanges, steering committees, workshops, questionnaires, and case studies.




**Representation of the participating countries to the study**

To assess the practical implementation of the EP&R arrangements in Europe, the analysis started with the conduct of a review at the national level (phase 1). On the basis of the rules and regulations in force and the preliminary studies, questionnaires were established and sent to the participating countries and entities, and their answers were analysed. Then, the practical aspects of the EP&R arrangements were tested in the frame of a non-real-time exercise which aims to evaluate the transborder issues during a simulation of a large-scale radiological accident (phase 2).

Two workshops were organised to disseminate information and the outputs of the project (phase 3). Best practices, challenges and recommendations were identified and formulated in the final report of the study (phase 4).




**The four phases of the project**

Prior to the review of the latest status of EP&R arrangements in Europe, the consortium performed an overall synthesis of the international EP&R rules, regulations and guidelines, along with the findings and recommendations derived from all the past projects dealing with EP&R arrangements. In addition, an in-depth pilot study of EP&R provisions was carried out in 4 European countries (France, Italy, Hungary and Slovakia), allowing precisely to establish a mapping of the practical implementations observed on the different topics related to EP&R arrangements. These preliminary tasks allowed to gather the appropriate input to establish questionnaires necessary for the review of the national implementation of EP&R arrangements of the 33 participating countries. Three different questionnaires were established for safety authority and civil protection organisations, nuclear utilities, civil society organisations and international organisations. The level and the means of EP&R implementation were analysed for each participating country and organisation via the existing documentation and the questionnaire responses.

**The detailed analysis of Phase 1 of the project is reported in "PART A" of the final report.**

Then, case studies were conducted to allow for reviewing and analysing the practical application of the EP&R arrangements for accidents with cross-border consequences. These were exercises based on a series of questionnaires covering the actions of different stakeholders and following an accident scenario based on a succession of three stages (from INES 1 to INES 6). Nine nuclear countries agreed to take on the role of "accident-affected country" grouped into four regions, as follows:

- Nordic Region: Sweden (SE) and Finland FI)
- North-western Region: France (FR), Belgium (BE) and Switzerland (CH)
- Central Eastern Region: Hungary (HU) and Slovenia (SI)
- South-eastern Region: Bulgaria (BG) and Romania (RO)

Neighbouring countries ("NC") close to the border of the affected AC (or at a distance involving emergency preparedness and response) agreed to participate in each case study. In addition, a list of volunteer observers assigned to each case study was established, including other countries far removed from the accident and other stakeholders such as civil society and international organisations.

Nine exercises were implemented, gathering in total: 9 AC countries, 28 NC countries, 17 countries as observers, 4 international organisations (HERCA, NERIS, IAEA, NEA, GMF[2] and CLI[3]) and 2 nuclear utilities (Borsele in The Netherlands and ENDESA in Spain). The responses of all these stakeholders were analysed and used to identify the points of strength and weakness in managing an accident with transborder consequences.

**The detailed reporting is presented in "PART B" of the final report.**

The main topics reviewed and analysed can be ranked into ten categories: Emergency Management System; stakeholders' responsibilities; emergency situation categories; protection strategy; tools and measures;

[2] GMF: Group of European Municipalities with Nuclear Facilities
[3] CLI: Local Information Commission - specific to France. There is one CLI per nuclear site. The various CLIs are coordinated at the French national level by an association called ANCCLI (the national association of local information committees and commissions)

communication; testing and exercising; cross-border cooperation; public information; quality.

This study highlights the good compliance of EP&R provisions with EU regulatory requirements, both for Member States and EU neighbouring countries, from a legislative point of view and on the ground. However, there is a wide range of variations in how these provisions are applied and implemented. The differences in response in the context of nuclear accidents involving different countries are particularly impactful.

Some fundamental actions are still needed to standardise practices, and improve communication and knowledge of radiological risk management for better preparation and response.

Focusing on improving what already exists, avoiding duplicating the work and causing an overload of work, the consortium raised six recommendations, discussed by the stakeholders of the project and the participants during the workshops.

**Recommendations**

The recommendations are classified by topic. They are all of equal importance.

**R1.** The European Commission should launch an initiative in cooperation with HERCA/WENRA to **reach an appropriate mutual understanding between all concerned stakeholders and to achieve greater harmonisation of the implemented protection strategies between neighbouring countries in Europe** in case of radiological or nuclear emergencies.

Today, the implementation of more harmonised responses faces a lack of common criteria and the prevailing legal obligation to maintain national sovereignty in the decision-making process. The European Commission should consider developing a process to define how to go beyond a voluntary willingness for HERCA/WENRA approach implementation in promoting mutual understanding and formalising firm commitments from national authorities. The goal is to reach an alignment between the countries via a common understanding and common decision-making.

The bilateral agreements could be used to improve international cooperation and the coherence of the national responses. Complete and efficient bilateral agreements should already include the bases for a harmonised response. The European Commission could further support countries by elaborating recommendations on this topic to guide them in preparing and improving their bilateral agreements, reflecting good practices in existing agreements.

Based on the outputs of the study, there is a need for HERCA to clarify the aspects of consistency and coherence in the responses and the means to reach it in their approach.

**R2.** The European Commission should develop EU recommendations on **joint drills or exercises between neighbouring countries** to support MS implementation of the BSS requirements on cooperation (i.e. Art 99).

Exercising is a recognised good practice to improve the national EP&R management systems. But at the international level, exercises implemented periodically by the IAEA, or the NEA are large activities requiring a high level of involvement. Therefore, they are not frequent. Several relatively short or simple exercise activities carried out between neighbouring countries would be easier to organise more regularly.

They should allow a better knowledge of the EP&R systems of the neighbouring countries helping to improve the level of mutual understanding and thus enabling better reactivity and coordination in case of a real emergency. Referring to the obligation of international cooperation between MS under the BSS Article 99 and the Council Decision 2015 "Off-site nuclear emergency preparedness and response", MS should realise joint drills or exercises. These exercises should include national and transborder communications as well as the management of social media. The EC should be involved as an observer of their implementation.

**R3.** The European Commission should give consideration to **extending the scope of existing European notification and information exchange systems to the phase prior to the declaration of an emergency.**

This recommendation intends to be applied in **exceptional circumstances, in agreement with the concerned Member State(s)** where prior to the declaration of an emergency, the nuclear facility is facing an ongoing threat which could move to an emergency.

The recent experience of assessing the situation in Ukraine has allowed reflection on the mechanisms available at the European and international levels to exchange information on the development of a potential radiological/nuclear emergency and of potential exposure scenarios in case of cross-border impacts that could involve multiple countries.

The need for a tool for communication and preparation is recognised to allow information exchange on potential scenarios and their assessment to commence even before a country takes measures to protect the population in response to a confirmed emergency. Such a mechanism would allow early exchange and coordination on potential exposure scenarios, including source term and their time dependence, protective measures, and public information need in a cross-border context, particularly when several countries may be impacted.

**R4.** The European Commission should consider launching an initiative to formalise and **harmonise citizen participation in emergency preparedness in the vicinity of nuclear installations in order to enhance communication and transparency** with the official national and local bodies responsible for coordinating decisions and actions in case of a nuclear accident.

Local Authorities and Civil Society Organisations (CSO) represent the level closest to the population. Due to their proximity to the practical field and the general public, the role of the CSOs is primordial in public acceptance and preparedness for the protection policy. Today, at the national, international and strategic levels, the trend is towards greater involvement of civil society organisations, which are still under-represented.

Achieving the goals requires public buy-in, a legal basis, and effective support in terms of training, information, funding, and transparency. The holistic approach should take into account the reaction of people to improve trust, public confidence and participation.

Exchanges, trust building and decision-making between the population, the local level and the national level should be facilitated and integrated into the deployment of EP&R measures.

**R5.** The European Commission should give consideration to **elaborating guidance in developing practicable strategies and arrangements for longer-term protective measures, such as relocation and decontamination.**

The recent analyses carried out highlight a deep lack of strategic development for evacuation, decontamination, return from evacuation or relocation arrangements. These steps are the most complex ones to simulate and assess.

It is a common issue in many countries. An agreed framework should be established to guide countries in developing their practicable strategies and arrangements for longer-term protective measures. It is key when developing those practicable strategies and arrangements to involve civil society at an early stage.

**R6.** The European Commission should consider **launching a study about the impact of a pandemic and other non-nuclear emergencies on nuclear/radiological emergency arrangements.**

It could be done through a dedicated benchmarking study from what was observed during the covid-19 pandemic.

It will allow to collection of a significant set of information from a real emergency situation. It should identify the risks involved and develop countermeasures regarding issues like lack of manpower, freedom of movement for people, transport, critical material, the role of the experts, the interaction between experts and decision-makers, public confidence and social media.

The final objective is that the Member States update their EP&R Management System accordingly.

## Résumé (version française)

Afin de maintenir un niveau élevé de préparation et de conduite des interventions en cas de situation d'urgence consécutive à un accident nucléaire, l'Union Européenne a établi un cadre juridique robuste. Dans ce cadre également, l'AIEA a publié des guides et recommandations pour les Etats membres, mais c'est le cadre législatif européen qui doit obligatoirement être respecté pour tous les États Membres de L'Union Européenne.

Suite à l'accident nucléaire de Fukushima, consécutive au Tsunami, deux directives fondamentales ont été adoptées par l'Union Européenne, fixant les normes et exigences de base en matière de radioprotection et de sûreté nucléaire, y compris la préparation et la conduite des interventions en cas de situation d'urgence nucléaire ou radiologique (EP&R), et introduisant de nouvelles dispositions, renforcées par rapport aux directives précédentes :

- Directive 2013/59 du Conseil du 5 décembre 2013, fixant les normes de base relatives à la protection sanitaire contre les dangers résultant de l'exposition aux rayonnements ionisants ;

- Directive 2014/87 du Conseil du 8 juillet 2014, modifiant la directive 2009/71/Euratom établissant un cadre communautaire pour la sûreté nucléaire des installations nucléaires.

Au niveau international, les prescriptions générales de sûreté de l'AIEA (N°GSR Part 7), publiées en 2015, constituent aussi un document fondamental qui fournit un guide et des recommandations aux gouvernements, aux autorités et aux titulaires de licence dans le domaine EP&R.

Les deux organisations européennes HERCA et WENRA ont mené des travaux approfondis sur les dispositions EP&R, dès l'année 2011, après l'accident de Fukushima, avec "l'objectif global de trouver des solutions pratiques et opérationnelles conduisant à une approche uniforme et efficace de faire face à toute situation d'urgence radiologique grave, indépendamment des frontières nationales". À la suite de ces travaux, ce qui a été appelé « l'approche HERCA-WENRA[4]" a été approuvée par le conseil d'administration de HERCA en juin 2014, proposant "un mécanisme

[4] HERCA-WENRA Approach for a better cross-border coordination of protective actions during the early phase of a nuclear accident-2014

de réponse pour la phase précoce d'un accident pour une meilleure coordination transfrontalière des actions de protection".

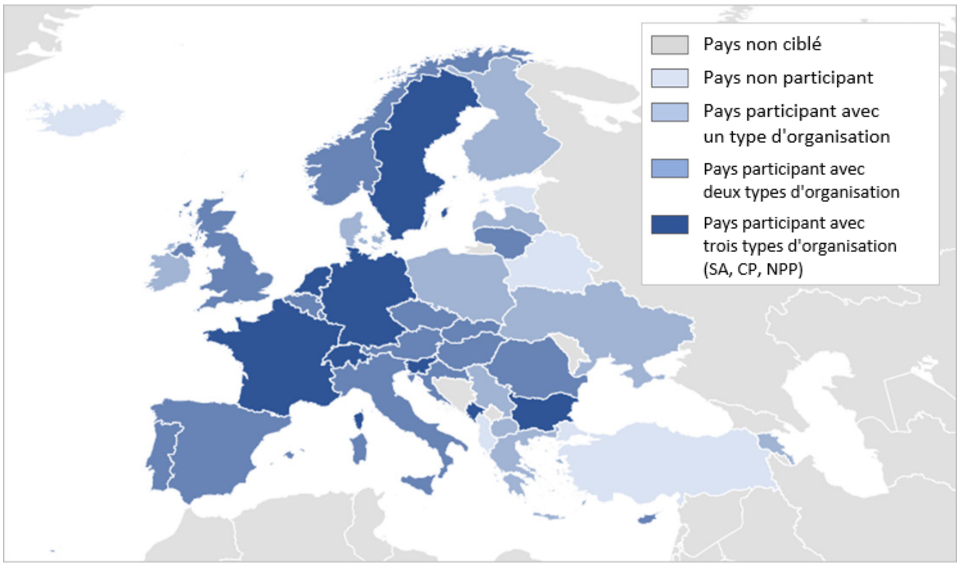
Comme mentionnées dans les conclusions du Conseil européen sur la préparation et l'intervention en cas d'urgence nucléaire hors site, publiées le 15 décembre 2015, il faut souligner "que la mise en place de dispositifs de préparation et d'intervention en cas d'urgence nucléaire relève de la responsabilité nationale, tout en gardant à l'esprit que les conséquences d'un accident nucléaire peuvent dépasser les frontières nationales".

Dans ce contexte, la Commission européenne, Direction Générale de l'Energie (DG ENER), a sollicité le consortium piloté par NucAdvisor (France) et regroupant ENEA (Italie), VUJE (Slovaquie) et EK (Hongrie) pour procéder à l'examen et à l'analyse de la "mise en œuvre des exigences en matière de préparation et conduite des interventions en cas de situation d'urgence nucléaire ou radiologique dans les États membres de l'UE et les pays voisins" (contrat N°ENER/2020/NUCL/SI2.838109).

Lors de l'étude, l'objectif a été de rassembler tous les États membres de l'UE et ses pays voisins autour de ce projet afin :

- d'examiner et évaluer la mise en œuvre pratique des dispositifs nationaux de préparation et de conduite des interventions d'urgence dans tous les pays participants, y compris les aspects de coopération et de coordination transfrontalières, ainsi que la confiance du public ;
- d'élaborer des recommandations pour les futures actions politiques au niveau de l'UE.

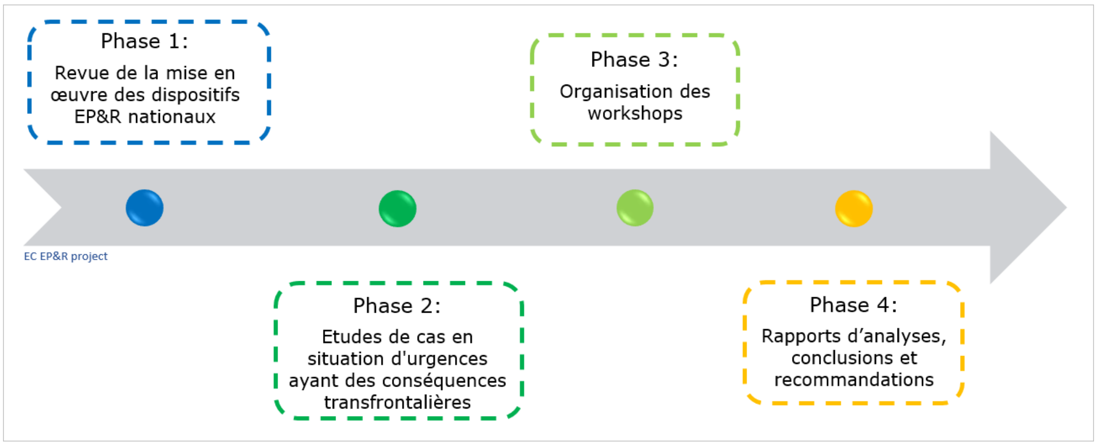
Trente-trois pays (25 États membres de l'UE et 8 non-membres de l'UE), d'autres organisations internationales ainsi que la société civile impliquées dans le domaine EP&R ont été invités à participer et à répondre à des questionnaires adaptés aux parties prenantes afin d'obtenir des données de qualité sur la mise en œuvre pratique des systèmes nationaux de gestion des situations d'urgence et des plans d'action et sur les mesures pratiques de coordination avec les autres pays. Les autorités de sûreté (AS) et les organisations de protection civile (CP), les acteurs gouvernementaux, les exploitants d'installations nucléaires, les organisations internationales, la société civile et les municipalités ont contribué au projet dans le cadre d'échanges, de comités de pilotage, d'ateliers, des questionnaires et des études de cas.




**Représentation des pays participants à l'étude**

Pour évaluer la mise en œuvre pratique des dispositions EP&R en Europe, l'analyse a été initiée par la réalisation d'un examen au niveau national (phase 1). Sur la base de la règlementation en vigueur et des études antérieures disponibles, des questionnaires ont été établis et envoyés aux pays et entités participants, puis, leurs réponses ont été analysées. Ensuite, les aspects opérationnels des dispositions EP&R ont été testés dans le cadre d'un exercice en en temps non réel visant à évaluer les questions transfrontalières lors d'une simulation d'un accident radiologique de grande ampleur (phase 2).

Deux réunions, (dont la deuxième avec des groupes de travail) ont été organisés avec les parties prenantes pour diffuser les données et les résultats du projet (phase 3). Les bonnes pratiques, les difficultés majeures et des recommandations ont été identifiées et formulées dans le rapport final de l'étude (phase 4), prenant en compte les avis et remarques des parties prenantes.




**Les quatre phases du projet**

Avant d'analyser l'état actuel des dispositions en matière d'EP&R en Europe, le consortium a réalisé une synthèse globale des règles, réglementations et lignes directrices internationales sur le sujet, ainsi que des conclusions et recommandations issues de tous les projets antérieurs traitant de ces dispositions. En outre, une étude pilote approfondie a été menée dans 4 pays européens (France, Italie, Hongrie et Slovaquie), permettant précisément d'établir une cartographie des mises en œuvre pratiques observées sur les différentes thématiques liées aux arrangements EP&R. Ces tâches préliminaires ont permis de recueillir les informations nécessaires à l'établissement des questionnaires requis pour l'examen de la mise en œuvre nationale des dispositions d'EP&R dans les 33 pays participants. Trois questionnaires différents ont été établis pour les autorités de sûreté et les organisations de protection civile, les exploitants nucléaires, la société civile et les organisations internationales. Le niveau et les moyens de mise en œuvre ont été analysés pour chaque pays et organisation participants à partir de la documentation existante et des réponses aux questionnaires.

**L'analyse détaillée de la phase 1 du projet est présentée dans la « PART A » du rapport final.**

Ensuite, dans la phase 2 des études de cas ont été menées pour permettre l'examen et l'analyse de la mise en œuvre pratique des dispositions EP&R pour les accidents entraînant des conséquences transfrontalières. Il s'agit d'exercices basés sur une série de questionnaires couvrant les actions des différentes parties prenantes et suivant un scénario d'accident à trois étapes (de l'échelle INES 1 à INES 6). Neuf pays ayant un ou plusieurs réacteurs nucléaires de puissance sur leur territoire ont accepté de jouer le rôle de "pays où un accident nucléaire a lieu" (Accident Country AC), regroupés en quatre régions de la façon suivante :

- Région nordique : Suède (SE) et Finlande (FI)
- Région du Nord-Ouest : France (FR), Belgique (BE) et Suisse (CH)
- Région Centre-Est : Hongrie (HU) et Slovénie (SI)
- Région du sud-est : Bulgarie (BG) et Roumanie (RO)

Les pays voisins (Neighbouring Countries "NC") proches de la frontière du pays accidenté AC affecté (ou à une distance impliquant la préparation et la conduite d'interventions) ont participé à chaque étude de cas. En outre, une liste d'observateurs volontaires affectés à chaque étude de cas a été établie, comprenant d'autres pays très éloignés de l'accident et d'autres parties prenantes telles que la société civile et les organisations internationales.

Neuf études de cas ont donc été mises en œuvre, rassemblant au total : 9 pays AC, 28 pays NC, 17 pays observateurs, 4 organisations internationales (HERCA, NERIS, AIEA, NEA), deux associations de la Société Civile GMF[5] et les CLI[6]) et 2 compagnies d'électricité nucléaire (Borsele aux Pays-Bas et ENDESA en Espagne). Les réponses de toutes ces parties prenantes ont été analysées et utilisées pour identifier les points forts et les points faibles dans la gestion d'un accident ayant des conséquences transfrontalières.

**Le rapport détaillé de la phase 2 est présenté dans la « PART B » du rapport final.**

Les principaux sujets examinés et analysés peuvent être classés en dix catégories : système de gestion des urgences, responsabilités des parties prenantes, catégories de situations d'urgence, stratégie de protection, outils et mesures, communication, tests et exercices, coopération transfrontalière, information du public et qualité.

Cette étude met en avant la bonne conformité des dispositions EP&R avec les exigences réglementaires de l'UE, tant pour les États membres que pour les pays voisins de l'UE, d'un point de vue législatif et également sur le terrain. Cependant, il existe un large éventail de variations dans la manière dont ces dispositions sont appliquées et mises en œuvre. Les différences de

[5] GMF : Group of European Municipalities with Nuclear Facilities
[6] CLI : Commission Locale d'Information- spécifique à la France-Il existe une CLI par site nucléaire. Les différentes CLI sont coordonnées au niveau national français par une association l'ANCCLI (l'Association Nationale des Comités et Commissions Locales d'Information)

conduite dans le contexte d'accidents nucléaires impliquant différents pays ont un impact significatif.

Certaines actions fondamentales sont encore nécessaires pour normaliser les pratiques et améliorer la communication et la connaissance de la gestion du risque radiologique pour une meilleure préparation et conduite.

En se focalisant sur l'amélioration et l’optimisation des outils déjà existants, ainsi que sur la minimisation de la duplication et de la surcharge de travail induite, le consortium a formulé six recommandations, élaborées avec le soutien des parties prenantes du projet et des participants lors des ateliers.

## Recommandations

Les recommandations sont classées par thème. Elles sont toutes d'importance égale.

**R1.** La Commission européenne devrait lancer une initiative en coopération avec HERCA/WENRA afin de **parvenir à une compréhension mutuelle et appropriée entre toutes les parties prenantes concernées et à une plus grande harmonisation des stratégies de protection mises en œuvre entre les pays voisins en Europe** en cas d'urgences radiologiques ou nucléaires.

Aujourd'hui, la mise en œuvre de plans d'intervention harmonisés se heurte à un manque de critères communs et à l'obligation légale de maintenir la souveraineté nationale dans le processus décisionnel. La Commission européenne devrait envisager de développer un processus pour définir comment aller au-delà de la mise en œuvre volontaire de l'approche HERCA/WENRA en promouvant la compréhension mutuelle et en formalisant des engagements fermes de la part des autorités nationales. L'objectif est de parvenir à un alignement entre les pays, via une compréhension et une prise de décision communes.

Les accords bilatéraux pourraient être utilisés pour améliorer la coopération internationale et la cohérence des interventions nationales. Des accords bilatéraux plus complets et efficaces devraient pouvoir déjà inclure les bases d'une réponse harmonisée. La Commission européenne pourrait soutenir davantage les pays en élaborant des recommandations sur ce sujet pour les guider dans la préparation et l'amélioration de leurs accords bilatéraux, en reflétant les bonnes pratiques des accords existants.

Sur la base des résultats de l'étude, il nous parait nécessaire que HERCA clarifie les aspects d'uniformité et de cohérence dans les plans d'intervention et les moyens d'y parvenir dans leur approche.

**R2.** La Commission européenne devrait élaborer des recommandations sur la mise en œuvre des **exercices conjoints entre pays voisins** afin de confronter les exigences des BSS en matière de coopération (article 99) entre les Etats Membres.

Les exercices nationaux ou au niveau international  sont une bonne pratique reconnue pour améliorer les systèmes nationaux de gestion de la protection civile et de la sécurité. Au niveau international, les exercices mis en œuvre périodiquement par l'AIEA ou la NEA constituent des activités de grande envergure qui nécessitent un haut niveau d'implication. Par conséquent, ils ne sont pas fréquents. Il serait plus facile d'organiser régulièrement plusieurs séries d'exercices relativement courts ou simples, réalisés entre pays voisins. Cette pratique existe déjà mais est limitée à quelques pays entre eux.

Ces exercices transfrontaliers devraient permettre une meilleure connaissance des systèmes d'EP&R des pays voisins, contribuant à améliorer le niveau de compréhension mutuelle et permettant ainsi une meilleure réactivité et coordination en cas d'urgence réelle. Du fait de l'obligation de coopération internationale entre les États membres en vertu de l'article 99 des BSS et de la décision du Conseil de 2015 "Préparation et conduite d'intervention en situation d'urgence nucléaire hors site", les États Membres devraient organiser des exercices conjoints entre pays frontaliers. Ces exercices devraient inclure des tests de communication nationale et transfrontalière ainsi que sur la gestion des médias sociaux. La Commission Européenne devrait être impliquée en tant qu'observateur à ces exercices.

**R3.** La Commission européenne devrait envisager **d'étendre le champ d'application des systèmes européens existants d'échange de notifications et d'informations en cas d'urgence radiologique à la phase précédant la déclaration d'une situation d'urgence**.

Cette recommandation est destinée à être appliquée dans des **circonstances exceptionnelles, en accord avec le ou les États Membres concernés**, lorsque, avant la déclaration d'une situation d'urgence, l'installation nucléaire est confrontée à une menace permanente qui pourrait évoluer vers un accident majeur.

L'expérience récente de l'évaluation de la situation en Ukraine a permis de réfléchir aux mécanismes disponibles aux niveaux européen et international pour échanger des informations sur le développement d'une situation d'urgence radiologique/nucléaire potentielle et des scénarios d'exposition potentiels en cas d'impacts transfrontaliers pouvant impliquer plusieurs pays.

La nécessité d'avoir un outil de communication et de préparation est reconnue pour permettre l'échange d'informations sur les scénarios potentiels et leur évaluation, avant même qu'un pays ne prenne des mesures pour protéger la population en réponse à une urgence confirmée. Un tel mécanisme permettrait un échange et une coordination précoces sur les scénarios d'exposition potentiels, y compris le terme source et sa dépendance temporelle, les mesures de protection et les besoins d'information du public dans un contexte transfrontalier, en particulier lorsque plusieurs pays peuvent être touchés.

**R4.** La Commission européenne devrait envisager le lancement d’une initiative visant à formaliser et à **harmoniser la participation des citoyens à la préparation aux situations d'urgence à proximité des installations nucléaires, afin d'améliorer la communication et la transparence** avec les organismes officiels nationaux et locaux chargés de coordonner les décisions et les actions en cas d'accident nucléaire.

Les autorités locales et les organisations de la société civile (CSO) représentent le niveau le plus proche de la population. En raison de leur proximité avec le terrain et le grand public, le rôle des CSO est primordial dans l'acceptation et la préparation du public à la politique de protection. Aujourd'hui, aux niveaux national, international et stratégique, la tendance est à une plus grande implication des organisations de la société civile, mais qui sont encore sous-représentées.

La réalisation de ces objectifs nécessite l'adhésion du public, une base légale et un soutien efficace en termes de formation, d'information, de financement et de transparence. L'approche holistique doit tenir compte du comportement des personnes pour améliorer la confiance, l'adhésion et la participation du public.

Les échanges, l'instauration de la confiance et la prise de décision entre la population, le niveau local et le niveau national doivent être facilités et intégrés dans le déploiement des mesures EP&R.

**R5.** La Commission européenne devrait envisager l'**élaboration d’un guide d’orientations pour le développement de stratégies et de dispositions opérationnelles pour les mesures de protection à long terme, telles que la relocalisation et la décontamination**.

Les récentes analyses effectuées mettent en évidence un manque profond de développement stratégique pour les mesures d'évacuation, de décontamination, de retour d'évacuation ou de relocalisation. Ces étapes sont les plus complexes à simuler et à évaluer.

Il s'agit d'un problème commun à de nombreux pays. Un cadre convenu devrait être établi pour guider les pays dans l'élaboration de leurs stratégies et dispositions pratiques pour les mesures de protection à long terme. Lors de leur élaboration, il est essentiel d'impliquer la société civile à un stade précoce.

**R6.** La Commission européenne devrait envisager le **lancement d'une étude d'impact d'une pandémie et d'autres situations d'urgence non nucléaire sur les dispositifs EP&R**.

Cela pourrait se faire par le biais d'une étude comparative spécifique à partir de ce qui a été observé lors de la pandémie de covid-19.

Elle permettra de recueillir un ensemble conséquent d'informations à partir d'une situation d'urgence réelle. Elle devrait identifier les risques encourus et développer des contre-mesures concernant des sujets tels que le manque de main-d'œuvre, la liberté de mouvement des personnes, le transport, le matériel critique, le rôle des experts, l'interaction entre les experts et les décideurs, la confiance du public et les médias sociaux.

L'objectif final est que les États Membres mettent à jour leur système de gestion EP&R en conséquence.

# Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries

N°ENER/2020/NUCL/SI2.838109

## Final Report

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## Acronym

| | |
|---|---|
| **AC** | Accident Country |
| **BSS** | Basic safety standards |
| **CBRN** | Chemical, Biological, Radiological and Nuclear |
| **EC** | European Commission |
| **ECURIE** | European Early exchange of information between countries in the event of a radiological emergency |
| **ENSREG** | European nuclear safety regulators group |
| **EP&R** | Emergency preparedness and response |
| **EPD** | Extended planning distance |
| **EPREV** | Emergency preparedness review |
| **EPZ** | Emergency planning zone |
| **ETSON** | European technical safety organisations network |
| **EU** | European Union |
| **EUCPM** | EU Civil Protection Mechanism |
| **EURDEP** | European Radiological Data Exchange Platform |
| **GMF** | Group of European municipalities |
| **GSR** | General safety requirements |
| **NuclearEurope** | Former Foratom (European Atom Forum), trade association for the nuclear energy industry in Europe |
| **HWA** | HERCA-WENRA approach |
| **HERCA** | Heads of the European radiological protection competent authorities |
| **IAEA** | International Atomic Energy Agency |
| **ICDP** | Ingestion and commodities planning distance |
| **IEC** | Incident and emergency centre |
| **INES** | International nuclear and radiological event scale |
| **INEX** | International nuclear exercise |
| **MS** | Member State |
| **NC** | Neighbouring country |
| **NPP** | Nuclear power plant |
| **NSD** | Nuclear safety directive |
| **OIL** | Operational Intervention Levels |
| **PAZ** | Precautionary action zone |
| **RANET** | IAEA Response and Assistance Network |
| **SA** | Safety authority |
| **SG** | Steering group |
| **SGM** | Steering group meeting |
| **TSO** | Technical support organisation |
| **UPZ** | Urgent protective action planning zone |
| **USIE** | IAEA Unified System for Information Exchange in Incidents and Emergencies |
| **WANO** | World association of nuclear operators |
| **WENRA** | Western European nuclear regulators association |
| **WGE** | Working group on emergencies |

## Country bigrams

| | |
|---|---|
| **AL** | Albania |
| **AM** | Armenia |
| **AT** | Austria |
| **BE** | Belgium |
| **BG** | Bulgaria |
| **BY** | Belarus |
| **CH** | Switzerland |
| **CY** | Cyprus |
| **CZ** | Czech Republic |
| **DE** | Germany |
| **DK** | Denmark |
| **EE** | Estonia |
| **EL** | Greece |
| **ES** | Spain |
| **FI** | Finland |
| **FR** | France |
| **HR** | Croatia |
| **HU** | Hungary |
| **IE** | Ireland |
| **IS** | Iceland |
| **IT** | Italy |
| **LT** | Lithuania |
| **LU** | Luxembourg |
| **LV** | Latvia |
| **ME** | Montenegro |
| **MK** | Republic of North Macedonia |
| **MT** | Malta |
| **NL** | The Netherlands |
| **NO** | Norway |
| **PL** | Poland |
| **PT** | Portugal |
| **RO** | Romania |
| **RS** | Serbia |
| **SE** | Sweden |
| **SI** | Slovenia |
| **SK** | Slovakia |
| **TR** | Turkey |
| **UA** | Ukraine |
| **UK** | UK |

# 1. Structure of the final report

The present section is the main text of the final report of the contract "Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries" (reference N°ENER/2020/NUCL/SI2.838109) carried out for the European Commission, Directorate-General Energy.

The final report is composed of three documents:

- The main text of the final report, the present section, presenting the conclusions of the project in the form of recommendations and suggestions.
- Part A of the final report, reporting the detailed analysis performed about the practical implementation of EP&R arrangements from the perspective of the Safety Authority, Civil Protection, Civil Society, International Organisations and Nuclear Utilities. It reminds the objectives of the project and presents the methodology used for implementing the survey on the national implementation of EP&R arrangements. It presents the content of the questionnaires and the participating organisations. It describes the main findings of the responses and analyses per type of targeted organisations and raised topics for improvement related to the emergency management system, stakeholders' responsibilities, emergency situation categories, protection strategy, tools and measures, communication, testing and exercising, cross-border cooperation, public information, and quality.
- Part B of the final report, gathering the outcomes of the complete analysis of the case studies (non-real-time) implemented in the case of a large nuclear accident with cross-border consequences. Part B provides the list of stakeholders involved in the nine case studies, the detailed description of the accident scenario developed in three distinct steps, and the full questionnaires dedicated to the stakeholders involved in the case studies. This part contains eleven annexes (9 case study reports and 2 specific reports on NERIS and IAEA) reporting the responses to the stakeholder questionnaires and presenting the analysis carried out by the consortium and used for the formulation of the final recommendations and suggestions of the project.

## 2. Recommendations for EP&R improvements

As part of the project, the consortium implemented a large-scale survey and practical case studies on the operational management of radiological and nuclear emergencies.

Three different questionnaires were prepared and submitted for three different types of organisations: Safety Authorities (SA) and Civil Protection (CP) organisations, Nuclear Utilities (NU), and Civil Society Organisations (CSO).

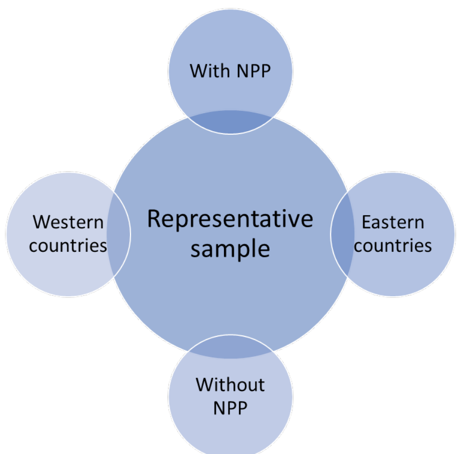
Answers from 30 countries were collected:

- 30 responses on the 33 targeted from the SA/CP questionnaire;
- 7 from Nuclear utilities;
- And 21 from CSOs from GMF, NTW and the French CLIs.

Nine case studies of emergencies with cross-border consequences were conducted based on an accident scenario developed in three consecutive steps simulating a virtual accident from an initiating event to an INES 6 or 7 accident in an NPP. They were implemented through a series of questionnaires covering the actions of different stakeholders (an accident country, its neighbouring countries, and some observers):

- 2 cases in the Nordic Region: accidents in Sweden and Finland;
- 3 cases in North-western Region: France, Belgium and Switzerland;
- 2 cases in Central Eastern Region: Hungary and Slovenia;
- 2 cases in South Easter Region: Bulgaria and Romania.

The significant quantity of data, their sources and origins ensure good representativeness of the different topics and players involved in the EP&R field.




The detailed analysis of the Practical implementation of EP&R arrangements from the perspective of the Safety Authority, Civil Protection, Civil Society, International Organisations and Nuclear Utilities is reported in "Part A" of the final report.

The detailed analysis of the case studies is reported in "Part B" of the final report.

Many key insights and findings, as well as proposals for recommendation themes, were raised during the study and discussed with the participating stakeholders to ensure their legitimacy and applicability on the ground.

Six recommendations resulted from this 2-year study on the state of the art of EP&R provisions, but also suggestions for improvements based on good practices and challenges raised by the participants.

The 6 recommendations selected focus on 3 major challenges:

- Cross-border cooperation and coordination;
- Civil Society involvement in EP&R;
- Protection strategy improvement.

They are presented here below.

## 2.1. Recommendations on cross-border cooperation and coordination

**R1 - Recommendation n°1:**

The European Commission should launch an initiative in cooperation with HERCA/WENRA to **reach an appropriate mutual understanding between all concerned stakeholders and to achieve greater harmonisation of the implemented protection strategies between neighbouring countries in Europe** in case of radiological or nuclear emergencies.

Today, the implementation of more harmonised responses faces a lack of common criteria and the prevailing legal obligation to maintain national sovereignty in the decision-making process. The European Commission should consider developing a process to define how to go beyond a voluntary willingness for HERCA/WENRA approach implementation in promoting and formalising firm commitments from national authorities. The goal is to reach an alignment between the countries via a common understanding and common decision-making.

Such improvements, eg the EU Basic Safety Standards, could provide an opportunity, while the Member States are revisiting existing arrangements, to reach an appropriate level of mutual understanding along all concerned stakeholders as well as 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 implementation of protective measures or lifting of countermeasures.

This should be based, in addition to consideration of the technical advantages and disadvantages of different approaches, on the benefits of increased public confidence.

The BSS Directive provides recommendations for dose ranges for the Reference Levels. Member States can decide to adopt these values or not, depending on various factors. The results obtained from the survey indicate, on the one hand, a very high rate of successful practical implementation of Reference Levels and, on the other hand, a low degree of harmonisation. If shared and common Reference Levels for the whole EU would be an enormous advantage in terms of coherence and harmonisation of response to cross-border accidents, this might introduce less flexibility in the design of optimisation strategies and is, anyway, not a realistic target at the present time. A common thought formulated by the participants in the project is that better harmonisation could be reached without having standardised Reference Levels.

Regarding EP&R management in a cross-border situation and, in particular, the HERCA-WENRA approach (HWA), the responses received to the questionnaires show that only one-third of respondent countries have implemented it in full (36%), 60% have implemented the HWA only in part, and a very limited number have not implemented it at all (4%). Its practical implementation faces a lack of trust or a lack of common understanding at the different levels. No specific exercises on HWA have been conducted yet, and data about HWA applicability are missing.

To facilitate the understanding of the HWA, an official self-assessment tool could be designed to be used by countries to assess the extent to which the HWA can be applied in their Emergency Management Systems. At the same time, such a tool could indicate which areas need improvements before the complete adoption of the HWA becomes feasible.

A greater harmonisation at the European level is a long-lasting issue, already been raised in previous studies. The issue is to try to understand the reasons for the partial failure to succeed in the legal formalisation of this harmonisation in the past. The recommendation aims to launch an initiative to understand the obstacles and the levers, not to develop a process at this stage. The importance of a mutual understanding of the general issue, its challenges, constraints and limits for all stakeholders (experts, decision-makers, authorities, citizens) should be emphasised.

The bilateral agreements could be used to improve international cooperation and the coherence of the national responses. Complete and efficient bilateral agreements should already include the bases for a harmonised response. The European Commission could further support countries by elaborating recommendations on this topic to guide them in preparing and improving their bilateral agreements, reflecting good practices in existing agreements.

Based on the outputs of the study, there is a need for HERCA to clarify the aspects of consistency and coherence in the responses and the means to reach it in their approach.

**R2 - Recommendation n°2:**

The European Commission should develop EU recommendations on **joint drills or exercises between neighbouring countries** to support MS implementation of the BSS requirements on cooperation (i.e. Art 99).

Exercising is a recognised good practice to improve EP&R management systems. But at the international level, exercises, implemented periodically by IAEA or NEA, are large activities involving many and different resources over very long periods. Therefore, they are not frequent. A possibility to overcome this could be to require several relatively short or simple exercise activities carried out between neighbouring countries that would be easier to organise regularly. Sharing the experience gained by countries through specialised workshops or meetings could be a good way to stimulate this type of activity, especially in countries that do not yet do so. Incorporating transboundary aspects into current exercises could avoid too much burden caused by too many additional exercises.

They should allow a better knowledge of the EP&R systems of the neighbouring countries helping to improve the level of mutual understanding and thus enabling better reactivity and coordination in case of a real emergency. Referring to the obligation of international cooperation between MS under the BSS Article 99 and the Council Decision 2015 "Off-site nuclear emergency preparedness and response", MS should realise joint drills or exercises. These exercises should include national and transborder communications and the management of social media. The EC should be involved as an observer of their implementation, as the participation of other non-neighbouring countries.

The already heavy burden on the various actors in the sector must be taken into account. Thus, the focus must be on quality rather than on quantity to avoid duplication with existing exercises. Incorporating transboundary aspects into current exercises could avoid too much burden with too many exercises.

Developing and conducting specific exercises, even simple ones, could stimulate the adoption, when necessary, of the HWA. Various types of scenarios can be included, and not only for NPPs, with a focus on specific aspects (one per exercise: food, communication, different target groups such as the young generation, etc.). Bilateral exercises could also be easier to organise. The number of times cross-border cooperation was tested could be the subject of a Key Performance Indicator to encourage this kind of exercise. The feedback of these exercises should be made available for further improvements through best practices and examples.

**R3 - Recommendation n°3:**

The European Commission should give consideration to **extending the scope of existing European notification and information exchange systems to the phase prior to the declaration of an emergency.**

This recommendation intends to be applied in exceptional circumstances, in agreement with the concerned Member State(s), where prior to the declaration of an emergency, the nuclear facility is facing an ongoing threat which could move to an emergency.

The recent experience of assessing the situation in Ukraine has allowed reflection on the mechanisms available at the European and international levels to exchange information on the development of a potential radiological/nuclear emergency and of potential exposure scenarios in case of cross-border impacts that could involve multiple countries.

This situation is somewhat different from a classic case of a fast-developing scenario that would quickly develop into an emergency, since it is characterised by a slow build-up, leading to a long 'preparedness' period prior to any potential emergency event. However, from a preparedness perspective, the recommendation still would apply to all types of emergencies with variable development times.

The need for a tool for communication and preparation is recognised to allow information exchange on potential scenarios and their assessment to commence even before a country takes measures to protect the population in response to a confirmed emergency. Such a mechanism would allow early exchange and coordination on potential exposure scenarios, including source term and their time dependence, protective measures, and public information need in a cross-border context, particularly when several countries may be impacted.

The idea to have a tool for exchange formally before an emergency is well received by the different stakeholders involved in the EP&R field: regulators, civil society and international organisations. They are convinced that it is worth exploring this proposal, the currently existing solutions being incomplete.

A better preparation to face an emergency is possible by improving the exchange and coordination. As some mechanisms already exist, the EC should try to build on them to achieve this goal and also to help less armed but equally affected countries. The ECURIE system has been in place since 1987 and was never updated. It does not fulfil this coordination function before and during an emergency. The EC should look at the ECURIE platform to make it evolve to share information when it is necessary. Extending the scope of ECURIE could be considered to facilitate also coordination activities, including pre-emergency and during-emergency phases.

In the context of the war in Ukraine, HERCA had to set up a dedicated Task Force. HERCA realised the lack of an exchange tool to prepare for a nuclear accident and to coordinate future actions in a situation where an emergency can happen at any time. All the tools in place are useful once the emergency is declared. Moreover, only HERCA members could benefit from the working group implemented.

The Civil Society Organisations underline the fact that only regulators use the ECURIE system and not the local level and civil society, which are in charge of managing the population on the field. They must be kept in the loop by the crisis managers at the national level.

The need for this tool is well recognised, but attention should be given not to making it too prescriptive. A framework that is too restrictive, requiring a significant level of internal validation, could be detrimental to its proper use and flexibility.

## 2.2. Recommendation on civil Society involvement in EP&R

**R4 - Recommendation n°4:**

The European Commission should consider launching an initiative to **formalise and harmonise citizen participation in emergency preparedness in the vicinity of nuclear installations in order to enhance communication and transparency** with the official national and local bodies responsible for coordinating decisions and actions in case of a nuclear accident.

Local Authorities and Civil Society Organisations (CSO) represent the level closest to the population. Due to their proximity to the practical field and the general public, the role of the CSOs is primordial in public acceptance and preparedness for the protection policy. Today, at the national, international and strategic levels, the trend is towards greater involvement of civil society organisations, which are still under-represented.

Nuclear Transparency Watch (NTW) points out non-harmonisation and unclarity about issues like measures in agriculture, economy, prophylaxis intake, and evacuation plans, but also long-term arrangements and a general lack of transparency and public participation in the development of EP&R measures.

Achieving the goals requires public buy-in, a legal basis, and effective support in terms of training, information, funding, and transparency. The holistic approach should take into account the reaction of people to improve trust, public confidence and participation.

Hosting municipalities should be considered preferred partners in stakeholder management.

At the European level, associations or groups of municipalities having NPP on their territory exist. Such organisations may differ from one Member

State to another. Common objectives are to involve citizens, with national/local authorities and the nuclear facility, in cooperation and periodic information on Emergency & Preparedness arrangements. Such forums are of importance for getting trust and public confidence in the way of transparency and adherence from local citizens, associations and local and regional political levels.

A civil society organisation called CLI for Local Information Commission has been developed in France, created within the framework of the law and with an allocated budget. It demonstrates the feasibility of creating an organisation within civil society with a legal framework and concrete action on the ground.

Exchanges, trust building and decision-making between the population, the local level and the national level should be facilitated and integrated into the deployment of EP&R measures.

### 2.3. Recommendations Protection strategy improvement

**R5 - Recommendation n°5:**

The European Commission should give consideration to **elaborating guidance in developing practicable strategies and arrangements for longer-term protective measures, such as relocation and decontamination.**

The recent analyses carried out highlight a deep lack of strategic development for evacuation, decontamination, return from evacuation or relocation arrangements.

These steps are the most complex ones to simulate and assess. It is why a very low number of entities elaborating appropriate indicators can be observed, and the corresponding estimated levels of efficiency on long-term protective measures are quite low too. A lack of experience and training combined with a lack of targeted objectives and means for assessment hinder a concrete projection of the situation and translate the low preparation of the public in an emergency case.

Planning for longer-term protective measures is hindered by a lack of useful frameworks to consider the non-radiological effects of accidents and protective actions. By their nature, longer-term protective actions have major non-radiological impacts on the population, which can be either positive or negative. Thus, decision-making on these actions requires consideration of these non-radiological consequences and currently there is limited understanding and little in the way of best practices on how to include these in the decision-making for protective actions.

It is a common issue in many countries. An agreed framework should be established to guide countries in the development of their own practicable strategies and arrangements for longer-term protective measures. It is key when developing those practicable strategies and arrangements to involve civil society at an early stage.

The IAEA and the NEA have proposed guidance that should be considered to avoid duplication of work. It could be analysed with regard to its level of implementation at the national level in Europe and the major gaps between its written recommendations and practical implementation.

IAEA's Emergency Preparedness and Response Standards Committee (EPReSC) has recognised these challenges, and managing non-radiological consequences is one of the points of emphasis in the current draft for its next medium-term plan. Work in guidance for longer-term protective actions should thus be done with consideration of the issues being addressed within IAEA's guidance development.

**R6 - Recommendation n°6:**

The European Commission should consider **launching a study about the impact of a pandemic and other non-nuclear emergencies on nuclear/radiological emergency arrangements.**

It could be done through a dedicated benchmarking study from what we observed during the covid-19 pandemic.

It will allow to collection of a significant set of information from a real emergency situation. It should identify the risks involved and develop countermeasures regarding issues like lack of manpower, freedom of movement for people, transport, critical material, the role of the experts, the interaction between experts and decision-makers, public confidence and social media.

The final objective is that the Member States update their EP&R Management System accordingly.

While the effects of the pandemic can still be felt, it should be noted that, to date, only half of the surveyed nuclear countries considered the Pandemic scenario, and the countries with no NPP did not consider it at all in their EP&R management system. It is very important that the system integrates the good practices learned, especially since the risk of recurrence is significant.

It seems of utmost importance that the system integrates the pandemic scenario (and, by extension, non-nuclear emergency as natural disasters, flooding, and forest fires).

It would be appropriate to consider the triggers for updating the emergency management system outside of exercises, workshops and emergencies. Today, the lessons learnt from Covid are not integrated.

## 3. Additional suggestions

The study collected a significant amount of information, describing the EP&R arrangements and current issues, how European or national legislation and guidance are practically implemented in the field of EP&R, and what are the best practices and challenges.

Thus, suggestions for improvements in EP&R, good practices, but also remaining points where views are different and must be addressed are presented in this chapter.

The proposals submitted relate to the following themes:

- Dedicated Peer Review Missions;
- Enhanced Communication with the Public;
- Enhanced Bilateral Agreements;
- Evolution of HWA;
- Enhanced coherence of Reference Levels.

Each of these themes was discussed in working sessions during the second workshop.

It is to be noted that these themes are often interrelated.

Generally, the countries emphasise that it is important for any recommendations or suggestions to evaluate whether the European Commission is the most appropriate body to oversee the implementation of each given action and to consider which actions could be carried out in cooperation with other organisations. It is essential that the actions do not result in duplication of ongoing elsewhere as resources available for radiation emergency preparedness are limited in member states and is likely to be further constrained in future in view of different ongoing crises. All the countries have obligations at the national level that go above and beyond the EC legislative boundaries. Therefore, extensions of obligations from the EC could be contested if they cause unnecessary burdens without a proper understanding of the global nature of sharing information and the global nuclear community for assistance. Local understanding of geographical or socio-economic aspects, as well as non-radiological consequences, should always have a role in decision-making. Actions that result in decreasing the role of sovereign decision-making in emergencies by Member States in the name of harmonisation may be useless if these aspects are not taken into account.

## 3.1. Suggestion about dedicated peer review missions

A proposal of recommendation was to launch an initiative for implementing a specific Topical Peer Review on Emergency and Preparedness provisions in the EU Member States, with the objective of examining how well EP&R provisions meet international requirements. At the same time, such Topical Peer Review could:

- Enable participating countries to review and self-assess their provisions for EP&R with a specific focus on cross-border cooperation between neighbouring countries as part of bilateral agreements;
- Identify good practices and areas for improvement;
- Share operating experience during EP&R exercises.

Such a Topical Peer Review process should include the participation of civil society associations.

The implementation of peer reviews is a powerful tool for progress in many fields. It was naturally proposed in the framework of this project as a recommendation, especially as not all participants benefit from it, such as non-nuclear countries. This recommendation was not supported as such by the participants in the project.

International organisations already propose peer review implementation.

At the IAEA level, the EP&R Information Management System (EPRIMS) is an interactive, web-based tool for Member States to share information on their EPR capabilities for nuclear and radiological emergencies at the preparedness stage. The system allows Member States to record information about their EP&R arrangements and perform a self-assessment of their status with reference to the recommendations outlined in the IAEA Safety Standards on emergency preparedness and response.

In addition, IAEA implements EPREV. This is a service provided by the IAEA to Member States on their request to appraise their level of preparedness for nuclear or radiological emergencies. EPREV services facilitate the development of national emergency response capabilities consistent with the IAEA safety standards. An EPREV can be requested by any Member State. However, it is acknowledged that the EPREV report issued by IAEA is not a public document, but the usual rule is that the Member State has the willingness to implement IAEA recommendations.

As far as nuclear safety is concerned, several external assessment formats for nuclear facilities exist, either peer review from IAEA (OSART, SALTO, IRRS) or WANO or from ENSREG, which recently implemented the first Topical Peer Review (TPR) on “Overall Ageing Management Programmes (OAMPs) in the EU”.

Therefore, the added value of a specific EU-organised peer review has yet to be proven before it is developed. Peer Reviews felt like an additional burden that is not worth the possible achievable improvements. The associated objectives can be coordinated with other initiatives to avoid the burden. Taking advantage of the peer reviews already in place is encouraged rather than doing something new.

KPI, well developed and challenging, focused on the aim and not generic, are preferred over Peer Reviews.

An indicator allows to define an objective and to follow the progress of actions to reach the target. It can help evaluate the efficiency level in the targeted areas and implement improvement actions. In addition, by being able to measure better and quantify the effectiveness of actions taken, it will become easier to communicate and positively impact public confidence.

They could be included in Bilateral Agreements. To initiate the activity on KPI, a feasibility study on their implementation should be considered.

**S1 – Suggestion n°1:**

Develop dedicated Performance Indicators to measure cooperation in transboundary cases.

## 3.2. Suggestions about enhanced communication to the public

Several ideas were shared with the stakeholders based on the weak points identified in the different surveys of the project:

- Stimulate the involvement of the public in the EP&R arrangements;
- Stimulate the realisation of joint communication campaigns towards the public;
- Stimulate coordination and advance sharing of information to the public (press, social network, prior official press releases, …);
- Encourage joint press releases between the accident country and the neighbouring country;
- Encourage EC, HERCA and IAEA to disseminate potential best practices on effective, failsafe, and efficient coordination arrangements and mechanisms already in place with some Member States regarding Communication to the Public;
- Develop dedicated tools to measure the confidence of the public, with a focus on border areas;
- Develop official and shared templates for communication with the population;

By law, the countries have to inform the public immediately in case of an accident. This makes it difficult, if not impossible, to implement joint communication campaigns during an emergency phase. Similarly, stimulating coordination and advancing the sharing of information with the public seems unfeasible within each country's legislative and press freedom framework. However, it can be improved only via a preparation activity in the preparedness phases. In crisis time, communication is very complex and very different from peacetime. But peacetime is necessary to work together, define and establish contacts, and implement drills and iodine campaigns.

To better target the areas for improvement in communication to the public and thus better manage the public’s reaction, public confidence could be assessed. Some surveyed countries answered that they do not have available information on this subject, which translates to the absence of a measurement tool and a corresponding action plan to improve public confidence based on practical data. It can be done via surveys.

Communication means already exist. They must be based on what people are used to. There is no need to develop a solution dedicated to nuclear matter. Nevertheless, it is important not to saturate services highly involved in the protective measure's implementation and essential communication means by having a dedicated communication unit to receive public requests. A real issue deals with the manpower available to address the reaction of the public and its behaviour due to anxiety.

All participants reached a consensus on developing and using shared templates and procedures for communicating certain countermeasures to the population in a common way. It is very difficult to have joint activities (especially press releases) during the early phases of emergencies; joint activities suit better during the preparedness phase. Later, these works will be useful and beneficial also for the emergency phase. The realisation of joint communication exercises can be stimulated to test communication in reality with mutual training and learning elements. Education and training of experts on communication in the area of EP&R must not be forgotten.

Furthermore, it is to be noted that the Council Directive on the Basic Safety Standards, including provisions on EP&R, was adopted in 2013. The EC should consider proposals to update it. In particular, the Council Conclusions 2015 invited MS to: "intensify their efforts to regularly organise together with the concerned neighbouring Member States, joint training sessions and nuclear emergency exercises representative of real emergency situations and assuring the commitment of all relevant stakeholders, with the objective of testing cross-border arrangements." The Civil Society Organisations should be clearly mentioned as belonging to the "stakeholders" in the Directive.

The following suggestions for EP&R have been retained:

**S2 – Suggestion n°2:**

Develop official and shared templates for communication to the population to explain in the simplest possible way why certain countermeasures are applied and where.

| **S3 – Suggestion n°3:** |
|---|
| Measure the confidence of the public via surveys in order to assess it and better manage the reaction of the public. |

| **S4 – Suggestion n°4:** |
|---|
| Have a unit dedicated to communication with the public, with trained interlocutors to address the reaction of the public and not to saturate services highly involved in the protective measure's implementation and essential communication means. |

| **S5 – Suggestion n°5:** |
|---|
| Update the European Directives (BSS Article 98 "Emergency Preparedness" and Council Decision 2015 "Off-site nuclear emergency preparedness and response" Paragraph 2) to formalise the participation of the Civil Society in exercises and drills in different emergency cases, including cross-border situations. |

### 3.3. Suggestions about enhanced bilateral agreements

The outputs of the study tended to demonstrate that a need the following objectives should be assessed:

- Foresee immediate interactions and discussions also for accidents, which do not imply off-site releases, but that could later result in severe accidents with off-site consequences;
- Increase awareness of capabilities and available resources in neighbouring countries;
- Improve the exchange of data (like NPP data, Source Term, weather data, etc.) between accident and neighbouring countries during an accident (development of already existing platforms, etc.).

In the case of a potentially severe accident, international interactions are immediately initiated. Exchanges between countries already cover cases in which a situation may evolve into a severe accident, and the stakeholders agree there is no need to inform also about simple "events" that might evolve unexpectedly and rapidly into severe accidents in order not to saturate the information flow. The results obtained from the implementation of the case studies in the project showing a lack of interaction may be due to the conduct of non-real exercises, as behaviour and responses are inevitably different in a real emergency.

However, the study indicated that the knowledge of available and shareable resources in neighbouring countries needs to be addressed. Some suggestions can be put forward to try to decrease or reduce this gap. For example, one possibility could be the realisation of ad-hoc Resources Fact Sheets, similar to those produced by HERCA, that can describe which resources (or competencies) can be available and shared in case of accidents. Another possibility is the specific introduction of exchange of information in the bilateral agreements with neighbouring countries, to include also elements related to available and shareable resources. This would also align with the HERCA Guidance for Bilateral Arrangements; therefore, a practical action could be the specification to periodically exchange information on resources when updating or renewing the existing arrangements.

Only about half of the respondent countries indicated that they have in place mechanisms for the automated transfer of data with neighbouring countries. To promote the discussion on how to improve the situation, some discussions could be launched to understand the reasons behind this. These initiatives could also be seen as a place where to exchange ideas and practices and the prerequisites for the establishment of automatic transfer of data.

The bilateral agreements could be used to improve international cooperation and the coherence of the national responses. It would be beneficial to enhance bilateral agreements through additional protocols with a precise specification of agreed details and information as a result of review meetings and discussions. The existing agreements could be benchmarked to identify good examples and best practices while allowing for flexibility. They are easier to manage and implement than introducing or changing laws at the EU level. The European Commission could further support countries by elaborating recommendations on this topic to guide them in preparing and improving their bilateral agreements.

**S6 – Suggestion n°6:**

Enhance bilateral agreements by additional protocols with precise specifications of agreed details and information as a result of review meetings and discussions.

### 3.4. Suggestions about the evolution of HWA

The EC has been encouraging the Member States to adopt the HWA since its publication in 2015. Nevertheless, the implementation of this method is still not unanimous. The question of whether it should be formalised at the EU level or maintained on a voluntary basis can be raised.

This is a divisive issue. Some countries would like it formalised in EU laws/regulations because its implementation in various countries is still incomplete. Other countries prefer instead to incorporate it somehow into Bilateral Agreements.

In the second case, bilateral agreements, used as an alternative to the HWA, should be strengthened to exchange all necessary data for completely independent assessments of the situation and its prognosis by the neighbouring countries.

The need to understand the reasons for the partial failure of legal formalisation in the past is paramount before trying again to transform it into a legally binding instrument.

A first step could be to launch an investigation at the national level, which would allow listing of the applicable and not applicable points of the methods and the reasons why for each country.

**S7 – Suggestion n°7:**

Define an action plan to improve the HWA implementation based on countries' responses and HERCA's self-assessment.

### 3.5. Suggestions about enhanced coherence of Reference Levels

Harmonisation and standardisation are the keywords and objectives put forward to facilitate a common understanding and consistent protection strategies. On the basis of the insights of the project, the national Reference Levels, the accident typologies considered in the protection strategy and the approach to response for highly uncertain situations are three items which showed a low coherence between the participating countries. They were surveyed on their interest and the possibility of implementing the following action to reduce the gap:

- Increase coherence and compatibility of Reference Levels in various EU MSs.
- Promote the update of accident categorisation to include new and emerging accident typologies not considered in the past, like those involving floating NPPs, etc.
- Encourage discussion to achieve greater coherence in the approach to response for highly uncertain situations, especially for those in which the decision-making process should decide quickly between relatively unlikely scenarios with large consequences or more likely scenarios but with more limited consequences.

Enhance coherence in Reference Levels is a long-standing challenge, extremely difficult to implement. It appeared not to be a priority at all. Moreover, coherence in response can be achieved even if Reference Levels are not perfectly aligned. The focus should be on protective actions instead, where Bilateral Agreements can play a role in this. Complete and efficient bilateral agreements should already include the bases for a harmonised response.

Regarding the approach to responding to highly uncertain situations, considering the worst or the most probable case, it can be seen that, most often, the worst-case scenario is considered, even if this choice is very demanding in the implementation of countermeasures; but it is not systematic. The discussion could be started on this issue to harmonise the approach of responding, using a conservative or probable scenario, with a graded approach or not.

**S8 – Suggestion n°8:**

Investigate the feasibility of harmonising the response approach by using a conservative, probable or graded scenario, considering the capacity of implementing the corresponding countermeasures.

# Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries

**N°ENER/2020/NUCL/SI2.838109**

## Final Report - PART A

## Practical implementation of EP&R arrangements from the perspective of the Safety Authority, Civil Protection, Civil Society, International Organisations and Nuclear Utilities

| | | | | |
|---|---|---|---|---|
| ***Reference*** | EC-07-EP&R-28-A-22/02/2023 – Final Report – PART A | | | |
| ***Accessibility*** | | ***Public*** | ***Restricted*** | ***Confidential*** |
| | ***Internal*** | *X* | | |
| | ***External*** | *X* | | |

| ***Revision*** | ***Prepared by the Consortium*** | ***Reviewed by NucAdvisor*** | ***Approved by NucAdvisor*** |
|---|---|---|---|
| *A*<br>*22/02/2023* | *Sarah Madureira (signed)*<br>*Federico Rocchi*<br>*Jarmila Bohunova*<br>*Tamas pazmandi* | *Roger Seban* | *Roger Seban* |
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## Acknowledgements

This report has been consolidated on the basis of different reports prepared by the Consortium partners (NucAdvisor, ENEA, VUJE and EK) and compiled by NucAdvisor for and on behalf of the European Commission.

## Disclaimer

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## Acronym

| | |
|---|---|
| **AC** | Accident Country |
| **BSS** | Basic safety standards |
| **CBRN** | Chemical, Biological, Radiological and Nuclear |
| **EC** | European Commission |
| **ECURIE** | European Early exchange of information between countries in the event of a radiological emergency |
| **ENSREG** | European nuclear safety regulators group |
| **EP&R** | Emergency preparedness and response |
| **EPD** | Extended planning distance |
| **EPREV** | Emergency preparedness review |
| **EPZ** | Emergency planning zone |
| **ETSON** | European technical safety organisations network |
| **EU** | European Union |
| **EUCPM** | EU Civil Protection Mechanism |
| **EURDEP** | European Radiological Data Exchange Platform |
| **GMF** | Group of European municipalities |
| **GSR** | General safety requirements |
| **Foratom** | European atomic forum |
| **HWA** | HERCA-WENRA approach |
| **HERCA** | Heads of the European radiological protection competent authorities |
| **IAEA** | International Atomic Energy Agency |
| **ICDP** | Ingestion and commodities planning distance |
| **IEC** | Incident and emergency center |
| **INES** | International nuclear and radiological event scale |
| **INEX** | International nuclear exercise |
| **MS** | Member State |
| **NC** | Neighbouring country |
| **NPP** | Nuclear power plant |
| **NSD** | Nuclear safety directive |
| **OIL** | Operational Intervention Levels |
| **PAZ** | Precautionary action zone |
| **RANET** | IAEA Response and Assistance Network |
| **SA** | Safety authority |
| **SG** | Steering group |
| **SGM** | Steering group meeting |
| **TSO** | Technical support organisation |
| **UCPM** | European Union Civil Protection Mechanism |
| **UPZ** | Urgent protective action planning zone |
| **USIE** | IAEA Unified System for Information Exchange in Incidents and Emergencies |
| **WANO** | World association of nuclear operators |
| **WENRA** | Western European nuclear regulators association |
| **WGE** | Working group on emergencies |

## Country bigrams

| | |
|---|---|
| **AL** | Albania |
| **AM** | Armenia |
| **AT** | Austria |
| **BE** | Belgium |
| **BG** | Bulgaria |
| **BY** | Belarus |
| **CH** | Switzerland |
| **CY** | Cyprus |
| **CZ** | Czech Republic |
| **DE** | Germany |
| **DK** | Denmark |
| **EE** | Estonia |
| **EL** | Greece |
| **ES** | Spain |
| **FI** | Finland |
| **FR** | France |
| **HR** | Croatia |
| **HU** | Hungary |
| **IE** | Ireland |
| **IS** | Iceland |
| **IT** | Italy |
| **LT** | Lithuania |
| **LU** | Luxembourg |
| **LV** | Latvia |
| **ME** | Montenegro |
| **MK** | Republic of North Macedonia |
| **MT** | Malta |
| **NL** | The Netherlands |
| **NO** | Norway |
| **PL** | Poland |
| **PT** | Portugal |
| **RO** | Romania |
| **RS** | Serbia |
| **SE** | Sweden |
| **SI** | Slovenia |
| **SK** | Slovakia |
| **TR** | Turkey |
| **UA** | Ukraine |
| **UK** | UK |

# 1. Introduction

The present document is part of the contract "Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries" (reference N°ENER/2020/NUCL/SI2.838109) carried out for the European Commission, Directorate-General Energy.

It reports the analysis performed about the practical implementation of EP&R arrangements from the perspective of the Safety Authority, Civil Protection, Civil Society, International Organisations and Nuclear Utilities, and highlights themes for potential recommendations.

This document also presents the involved stakeholders and reminds the overall methodology used for implementing the survey via questionnaires.

The report is structured as follows:

- Section 2 presents the themes for potential recommendations raised from the analysis;
- Section 3 reminds the objectives of the survey and presents the participating organisations;
- Section 4 describes the methodology implemented to collect data from the Safety Authority, Civil Protection, Civil Society, International Organisations and Nuclear Utilities;
- Section 5 reports the main findings of the responses and analyses per type of targeted organisations.

All themes of recommendations collected and raised from the different responses of the survey are shown in the section 2 for an easy overview reading, with possibility of referring for more details in the Section 5.

# 2. Preliminary topics of recommendations for EP&R improvements

This study highlights the good compliance of EP&R provisions with EU regulatory requirements, both for Member States and EU neighbouring countries, from a legislative point of view and on the ground.

However, there is a wide range of variation in how these provisions are applied and implemented. The differences in behaviour in the context of nuclear accidents involving different countries are particularly impactful.

The topics listed and summarized in this section aim at standardizing practices, improving communication and knowledge of radiological risk management for better preparation and response.

## 2.1. Emergency Management System

From the analysis of the answers received in relation to the Emergency Management Systems, some proposals of recommendations or suggestions can be formulated, in particular to try to strengthen the harmonization of responses in case of transboundary accidents.

- Increase the awareness of the need of more coordinated approaches and of the HWA

Some answers to the Questionnaires indicated a not thorough understanding of the HWA or of parts of it; this might point to the need of organizing dedicated workshops targeted at enhanced discussions on the HWA itself, trying to improve on one side the dissemination of its knowledge, for example highlighting and sharing the ways in which some countries successfully implemented it in their Emergency Management Systems, and on the other side the discussion of certain critical points that currently generate difficulties in the complete implementation in other countries. More than 5 years have elapsed since the first and last workshop on this theme was organized by HERCA and WENRA, and thus it appears that the considerations developed nationwide in the meantime are mature enough to be shared at EU level.

As a direct element to facilitate the understanding of the HWA, an official self-assessment tool, similar to those developed by IAEA in other contexts, could be designed, to be used by countries to evaluate, and possibly quantify, the extent and degree by which the HWA can be applied in their

Emergency Management System. At the same time this tool could indicate which are the areas needing improvements before the complete adoption of the HWA becomes feasible.

- Conduct frequent joint exercises

Another very important aspect is the need to increase the number and frequency of joint exercises or drills, even of the table-top type, between neighbouring countries, trying to involve as much as possible all the relevant stakeholders. The complexity of such exercises needs not be very high at the beginning; as well, technical elements should be introduced gradually, so that, year after year, the important aspect of discussion among players can be enhanced and trust be empowered. The simplicity of the exercises may also leverage and increase the frequency with which they are performed. For example, some specific exercises could be foreseen just for the sake of the HWA. Some countries reported that there is no experience on the application or applicability of the HWA, therefore, the execution of some exercises can generate the right confidence in how to implement it and how to apply it. The feedback collected after some of these exercises could be used in case the need to modify to a certain extent the HWA is found. It should also be understood that the HWA, as it is conceived now, is not *per se* immutable, but can be modified, revised, or adjusted according to the knowledge and experience gained during these joint exercises.

- Beyond the HWA

There might be situations that, by their precise nature, cannot be dealt with the HWA, simply due to its inapplicability. For example, some physical constraints can hinder the alignment of countermeasures, even if this alignment is foreseen and considered ideal. Other cases can occur, in which there are profoundly different views on the diagnosis and prognosis of an evolving situation, implying that an improved communication to the public is needed to avoid misunderstandings or mistrust in the institutions. Therefore, possible alternative ways to explain the differences and the deviations from the alignment or coherence of responses should be devised in advanced, and these methods possibly shared, so that negative counter-effects on the accident country are possibly minimized. In other words, a strategy to deal with such cases needs to be developed, also for those Emergency Management Systems which, ideally, foresee the HWA.

- Increase Reference Levels harmonization

Even if the official introduction in the national legislation of the Reference Levels of the BSS Directive has been declared by the largest part of respondent countries, some comments were received about the difficulties in the adoption of the HWA consisting of too large differences, between neighbouring countries, in dose limits. This appears a bit contradictory, therefore some future activities could and should be envisaged to try to understand the real situation, maybe through some simple tests thought explicitly for checking consistency in intervention levels. Other types of activities to the same aim could be envisioned as a kind of self-evaluation process carried out within or through the HERCA Working Group on Emergency, whose official output could be an evaluation of the situation itself. The process of self-evaluation can at the same time also be a stimulus to increase the harmonization of Reference Levels, thus removing one of the potential obstacles in the adoption of the HWA.

## 2.2. Stakeholders' organisation

All national organisations involved in EP&R should be on a regular basis self-assessed with a large coverage of their responsibilities, organisation, skills & competences, human resources, transborder cooperation and public information. Systematic self-assessment about the organisation was not observed in the responses of the questionnaires.

## 2.3. Emergency situation categories

The answers on this topic show a fair amount of harmonization among the EU member states, anyhow some recommendations can still be made to improve the situation and move towards a shared and coordinated accident categorization.

- Encourage adoption and harmonization of the accident categorization proposed by IAEA GRS Part 7;
- Promote the update of accident categorization to include new and emerging accident typologies that have not been considered in the past, such as floating NPPs, etc.

## 2.4. Protection strategy

From the analysis of the answers received in relation to area of protection strategy, some proposals of recommendations or suggestions can be formulated:

- Providing guidance in developing practicable strategies and arrangements for longer term protective measures: Arrangements for relocation (and/or subsequent return) and decontamination of the built environment are immature and lacking practicable strategies in case of an accident. Most of the countries do not have a defensible strategy nor have arrangements that could be practically implemented. Since this is a common issue for many countries, a broadly agreed framework should be established to guide countries in development of their own practicable strategies and arrangements for longer term protective measures.

- Improvement of communication between authorities and organizations involved in emergency management, and communication between authorities, stakeholder, and the public (e.g. conducting more trainings with joint participation, inclusion of more participating organizations in routine exercises and considering the feedback from these activities).

- Increasing of public confidence (improvement of public information and communication, building a safety culture among the population through for instance exercises, public communication campaigns on ionizing radiation).

- A more precise evaluation of the impact of a pandemic on emergency arrangements – a pandemic can affect several aspects of protection strategy, e.g. availability of human resources, burden on health care services, challenges regarding evacuation and sheltering. Measures to correct the shortcomings regarding the pandemic might affect preparedness for radiological emergencies regarding evacuation and preparedness for combined events as well as justification of protective measures.

## 2.5. Tools and measures

Vast majority of the countries use EURDEP and USIE systems and agree that the parallel use of the two systems is time consuming, EC and IAEA should facilitate an automatic data exchange between ECURIE and USIE, but redundancy has a positive aspect.

It was not addressed in the questionnaire, but importance of details of the measured value (e.g. duration of air sample collection, averaging measuring time, units of measurement) and reporting uncertainty should be mentioned here also. Exercises should have an important role also in the harmonization of these fields and should also focus on these issues in the future.

## 2.6. Communication

Based on the responses, the following recommendations can be formulated.

- Templates used for communication in case of emergency should be shared between the countries. Based on the evaluation and assessment of these templates good practices could be defined. Harmonization of the templates could facilitate the cooperation in case of emergency.
- Information about the best practices for updating the contact lists should be elaborated; harmonization might reduce needed resources. Sharing this information in common databases could be a solution (EC, IAEA databases also exist).
- There is no common and harmonized way of exchanging massive data between countries. Compatibility between data types and data formats could be improved as well.

## 2.7. Testing and exercising

Exercises should be organized regularly at different level; internal and external communications should have an important role in it. Role of social media should be recognized. Social media should be used for communication and should be monitored continuously. The emergence of newer and newer platforms should be considered.

## 2.8. Cross-border cooperation

From the analysis of the answers received in relation to Cross border Cooperation, some proposals of recommendations or suggestions can be formulated.

- Increase awareness of capabilities and resources in neighbouring countries

Some answers indicated that the knowledge of available and shareable resources in neighbouring countries is not at hand. To try to decrease or reduce this gap, some suggestions can be put forward. For example, one possibility could be the realization of ad-hoc Resources Fact Sheets, similar to those produced by HERCA, that can describe which resources (or competences) can be available and can be shared in case of accidents. These Fact Sheets should include the type and amount of shareable resources, the minimum time needed to share them, the maximum distances (if applicable) at which they can deployed, the ways to ask for them, etc. The resources can be of various types, ranging from extra iodine pills for prolonged iodine thyroid blocking to devices to make field measurements, from special drones to be used in the emergency areas to devices to cope with the management of the accident itself, and so on. These Fact Sheets could be standalone and self-referencing documents, or they could form an appendix or an add-on to the existing HERCA Country Fact Sheets on EP&R.

Another possibility is the specific introduction of exchange of information in the bilateral agreements with neighbouring countries, to include also elements related to available and shareable resources. This would also be in line with the HERCA Guidance for Bilateral Arrangements; therefore, a practical action could be the specification to exchange periodically information on resources when updating or renewing the existing arrangements.

- Increase the realization of joint drills or exercises

As stated in the previous paragraph, there exist room for improvement in the area of the organization and execution of joint drills and exercises. While it is true that international exercises are designed and conducted periodically by IAEA or OECD/NEA, these are large activities, involving many and different resources over very long periods, and therefore are not frequent. A possibility to overcome this could be, again with the proper introduction of the relevant legal aspects in the bilateral agreements, to require that several, relatively short or simple exercise activities are carried out between neighbouring countries. The sharing, through dedicated workshops or meetings, of existing experience by those countries already implementing this practice could be a good way to stimulate these types of activities also in countries not yet implementing them. Another suggestion could be to encourage the participation of other, non-neighbouring countries as observers to the joint exercises already in place.

- Further encourage data exchange

Only about half of the respondent countries indicated that they have in place mechanisms for the automated transfer of data with neighbouring countries. To promote the discussion on how to improve the situation, some initiatives (like workshops or specific working groups at EU level, etc.) could be launched to discuss and understand the reasons behind this. These initiatives could also be seen as a place where to exchange ideas and practices, the prerequisites for the establishment of automatic transfer of data (confidentiality limits, cybersecurity, data management and conservation, ownership of data, use of data, any other issues related to transparency, testing programs, uniformity of data formats), the experience gained so far, the desiderata in terms of minimum datasets, and so on. Possible discussions should be as broad as possible, including not only the field of measurement data, but also other types of data, like mast weather data, plant data, other conditions, etc.

- Stimulate the realization of joint communication campaigns

It seems that no countries have in place joint communication/information campaigns. The first step, therefore, is to understand the reasons for this, and then to stimulate the process to initiate this type of communication. While recognizing the difficulties in devising, designing, and conducting these activities, it is important to stress the great benefits that could come from them, both at the preparedness and response stages. One practical possibility could be to identify and propose one pilot test case constituted by two volunteering neighbouring countries with NPPs very close to the respective borders, and initiate the necessary preliminary steps needed to implement in practice the joint communication campaigns. Language barriers need to be lowered and the best channels to carry the information must be identified. After this first pilot study, that could last even a few years, the knowledge gained, and the experience accumulated should be disseminated so that best practices can be shared and then implemented also in other countries.

## 2.9. Public information

The analysis of the responses related to public information showed a room for improvement and potential topics for recommendations:

- Support of communication: multiply the means of communication used to inform the public. The survey raised a list of all the communication means to reach a maximum of people. This could be used to develop more ways to communicate during a crisis in all the countries.
- Cross-border issue: In the case of an accident impacting several countries, in the urgent phase the challenge is doble: managing internal crisis and informing abroad, in particular ensuring accurate translation in different languages for bilateral /international exchange. One practical implementation proposed is that neighbouring states have mutual access to electronic situation reporting systems, like for the Nordic countries Group and bilateral cooperation between Switzerland-Germany-Austria.
- Fake news: The provisions are very focused on protective measures to protect our environment. But given the short- and long-term impacts of poorly managed communication with the public, institutions have to set up communication units to counteract fake news. In Hungary, the malignant spread of false information is against the law. In the frame of significant nuclear accident, malevolence could cause serious damages. This is definitely a factor while handling a crisis.
- Unit dedicated for communication with public: A real issue deals with the manpower available to address the reaction of the public and its behaviour due to anxiety. It is important to have a dedicated unit to receive the public requests in order to not saturate services highly involved in the protective measure's implementation and essential communication means.
- Measuring of confidence: A few respondents answered they do not have available information on this subject, which reflects the fact of

the absence of a measurement tool and a corresponding action plan to improve public confidence based on practical data.

- Lessons learnt from Covid: The exercises have been suspended. An important source of information can be collected about the crisis management and the confidence of the population.

## 2.10. Quality system

Four potential topics of recommendations are identified to improve the Quality systems:

- Implementing peer review: Audits and peer reviews are important tools used by the European countries, except by a few non-nuclear countries. All the countries should implement peer reviews.
- Implementing performance indicators: The definition of objectives, both global and intermediate, and the possibility of measuring their achievement, make it possible to better target the actions to be carried out, and to focus on the points to be improved. Implementing effective solutions is facilitated by setting up a well-defined monitoring and performance indicator. By being able to better measure and quantify the effectiveness of actions taken, it will become easier to display progress, communicate and have a positive impact on public confidence.
- Pandemic scenario: To date, the countries with no NPP on their territory did not consider the pandemic scenario in their EP&R emergency management system. It seems of utmost importance that the system integrates the pandemic scenario and the good practices learned, especially since the risk of recurrence is significant.
- Lessons learnt from Covid: Half of the nuclear countries did not update their EP&R arrangements because of the pandemic. It would be appropriate to consider the triggers for updating the emergency management system outside of exercises, workshops and emergencies.

# 3. Presentation of the study

## 3.1. Objectives of the mission

The major objectives of the project are the following:

- Review and evaluate the **practical implementation** of national emergency preparedness and response arrangements, emergency management systems and emergency plans in all EU Member States and participating countries in line with the provisions of the BSS and Nuclear Safety Directives;
- Provide information on the effectiveness of existing arrangements and **capabilities in practice** at all relevant levels (Regulators, licensees, Civil Protection);
- Review to what extent existing international and European standards, guidance and approaches are applied **in practice**;
- Share national experiences amongst the relevant authorities and highlight effective **practices that would improve public confidence**;
- Develop recommendations for future policy actions at the EU-level and identify broadly supported and practical proposals **to improve implementation practices**. Recommendations will also target a best harmonisation of arrangements in practises in the EU Member States.

## 3.2. Participating stakeholders

### 3.2.1. Countries involved in the study

Among EU 27 Member States, 13 countries have one or more nuclear power reactors on their territory. In the EU neighbourhood countries, comprising all EU candidates and other neighbourhood countries (a total of 22 countries), nuclear reactors are under operation or under construction close to be put in operation.

Thus, 39 countries have been invited to participate in the study and to be involved thoroughly in answering to questionnaires in order to get data of quality on the practical implementation of national EP&R arrangements emergency management systems and emergency plans in their country and practical measures for coordinating with other countries.

Among the 39 countries included in the perimeter of the study (27 MS, 4 candidates and 8 EU neighbouring countries), different categories can be numbered:

- Countries with Nuclear Power Plants, located at various distances from nearest neighbouring countries borders (from a few to hundreds of kilometres), with EP&R arrangements first aimed at dealing with national nuclear accidents;
- Countries without Nuclear Power Plants, but sharing a border with Nuclear Countries and having to develop EP&R arrangements for cross-border events, with NPP located:
  - Up to 25-30km from the border;
  - Between 25-30km and 80-100km;
  - Beyond 100km from the national border including far distant accidents.

**Table 1: List of the targeted countries of the study**

| Countries with Nuclear Power Plant(s) | | Countries without NPP and nearest foreign Nuclear Power Plant … | | |
|---|---|---|---|---|
| | | Less than 25-30km | Between 25-30 km and 80-100 km | Beyond 100 km from the national border |
| **19 countries** | | **3 countries** | **5 countries** | **12 countries** |
| Armenia | Romania | Croatia | Austria | Albania |
| Belarus | Slovakia | Lithuania | Cyprus | Denmark |
| Belgium | Slovenia | Luxembourg | Estonia | Greece |
| Bulgaria | Spain | | Poland | Iceland |
| Czechia | Sweden | | Serbia | Ireland |
| Finland | Switzerland | | | Italy |
| France | Turkey | | | Latvia |
| Germany | UK | | | Malta |
| Hungary | Ukraine | | | Montenegro |
| Netherland | | | | N. Macedonia |
| | | | | Norway |
| | | | | Portugal |

A total of 34 countries (87% of the target for this study) answered positively to participate to the project. All EU Member States and 9 non-EU Member States are represented. The missing countries are Albania, Belarus, Estonia, Malta and Turkey.

To optimise the involvement of the stakeholders among Member States and neighbouring countries, the consortium prepared and exchanged with EC a list of appropriate contact points to solicit answers to EP&R questionnaire and participation to the steering Committee and workshops. For each country, different stakeholders were contacted to inform them of the launching of the study and the request for participation and sharing of experience/national situation.

#### 3.2.2. Types of organisation represented

EP&R arrangements can be developed and implemented by many entities: national safety authorities, technical support organisations, corresponding ministries, licensees, civil protection, local communities, civil society organisations, etc. In addition to national stakeholders, international and European organisations directly or indirectly involved in EP&R considerations also participate in the frame of guidance, steering committees, workshops and case studies.

All these different types of organisation were contacted, and numerous participants accepted to contribute actively.

- EP&R national Competent Authorities

Competent Authorities, gathering governmental institutions, Safety Authorities and Civil Protection Organisations, from 34 countries on the 39 targeted, participated to the study (AM, AT, BE, BG, CH, CY, CZ, DE, DK, EL, ES, FI, FR, HR, HU, IE, IT, IS, LT, LU, LV, ME, MK, NL, NO, PL, PT, RS, RO, SE, SI, SK, UA, UK).

- National Civil Protection organisations

18 national Civil Protection Organisations attended to the European survey (AT, BE, CH, CY, CZ, DE, FR, HR, IT, LT, LU, ME, NO, PT, RO, RS, SE, SI).

- Nuclear Utilities

Nuclear Utilities or Nuclear operators from 7 countries provided information about their EP&R arrangements (BG, DE, ES, HU, NL, SK, UK).

- Civil society

Three different organisations are involved in the survey:

- GMF: the Group of European Municipalities with Nuclear Facilities. GMF is a not-for-profit association of municipalities and associations of municipalities with nuclear facilities across European countries.
- ANCCLI: the "Association Nationale des Comités et Commissions Locales d'Information" in France. France has 19 Nuclear Power Plant sites; each one has a "CLI": Commission Locale d'Information (Information Local Commission). ANCCLI represents all CLI towards national and international bodies involved in nuclear activities.
- NTW: Nuclear Transparency Watch.

- International organisations

Without participating in the survey that is the subject of this report, the following international organisations are involved in the project: IAEA, NERIS, ENISS, HERCA, ETSON, NEA, IFRC, WANO, WHO. FORATOM relies on ENISS participation in the Steering Committee, and WHO limits participation to the two workshops as observers.

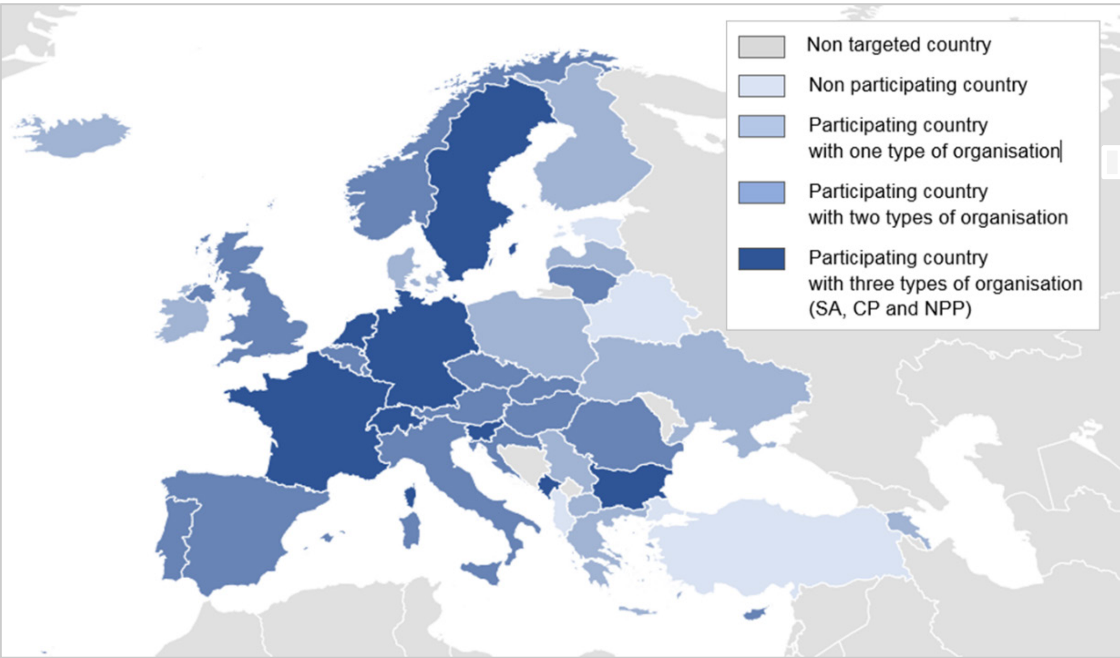



**Figure 1: Representation of the participating countries to the study**

The final list of the participating countries is reported in Annex 1 divided in three categories: EP&R national Competent Authorities, National Civil Protection organisations, Nuclear Utilities.

## 3.3. Methodology

### 3.3.1. Sequencing of the whole project

To reach the objectives of the study, four main tasks are implemented:

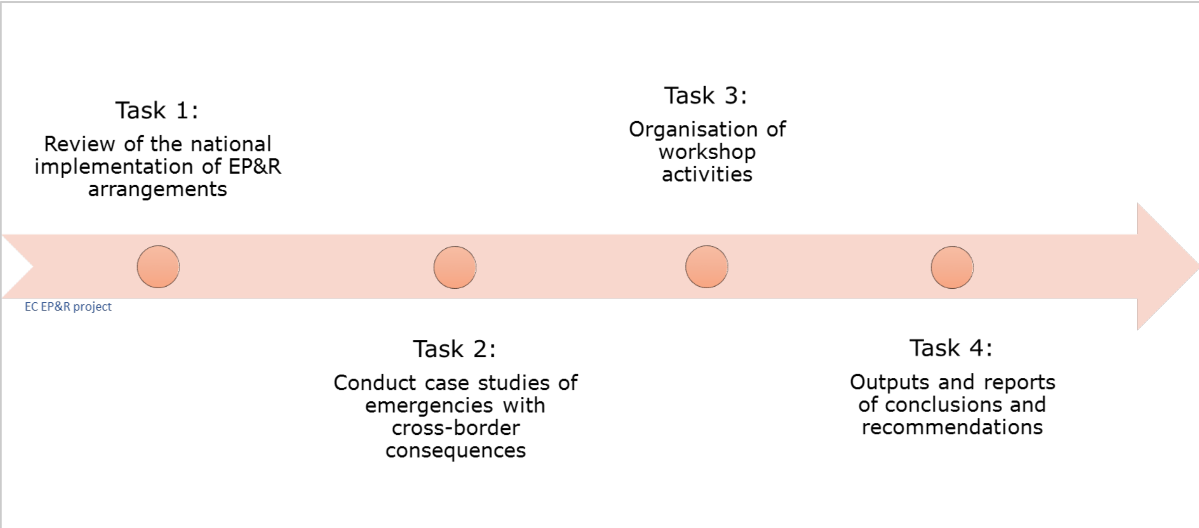



**Figure 2: The four main tasks of the project**

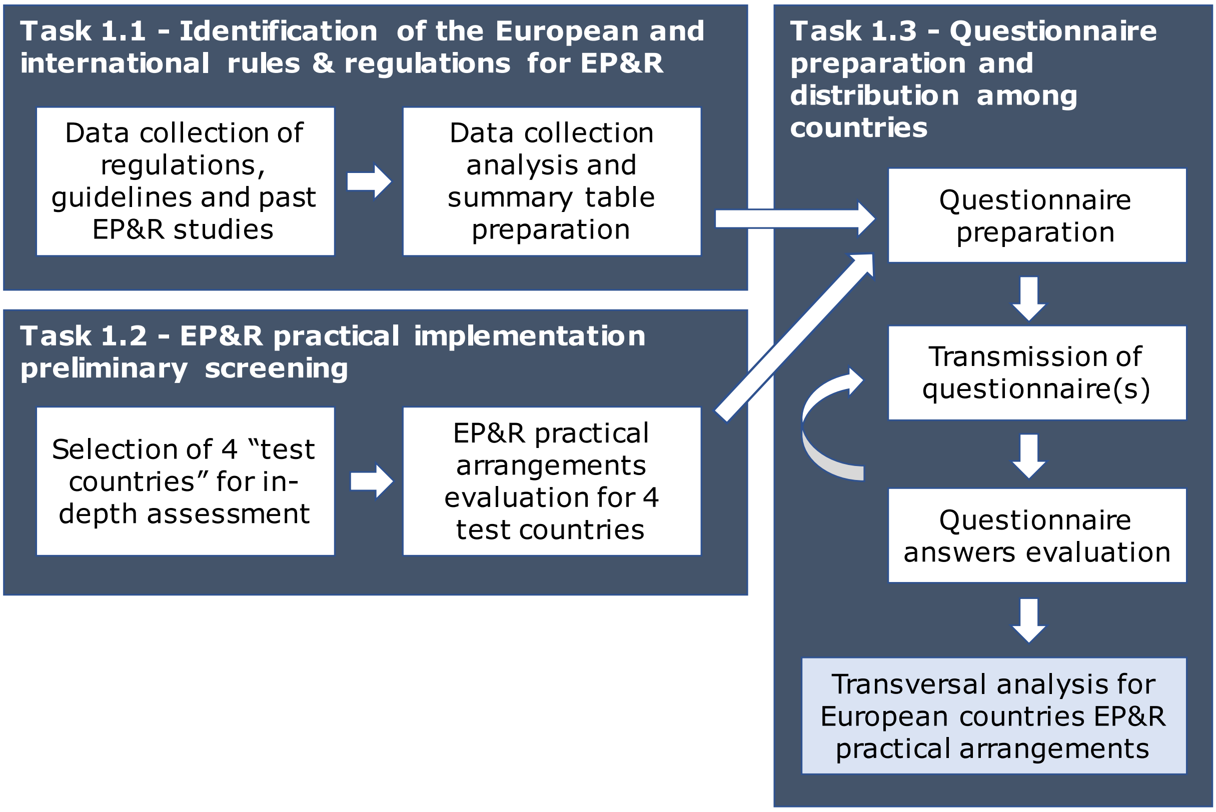
To assess the practical implementation of the EP&R arrangements in Europe, the analysis starts with the conduct of a review at the national level. On the basis of the rules and regulation in force and the preliminary study of four countries, questionnaires are established and broadcasted to the participating countries and entities and their answers analysed. Then, the practical aspects of the EP&R arrangements are tested in the frame of an exercise which aims to evaluate the transborder issues during a simulation of a large-scale radiological accident. Two workshops are organised to disseminate information and the outputs of the project. Best practices, challenges and recommendations will be identified and formulated at the end of the study.

| **TASK 1:** To review the National Implementation of EP&R arrangements | **TASK 2:** To conduct case studies of emergencies with cross border consequences | **TASK 3:** Organisation of two workshops activities to present and disseminate the findings of tasks 1&2 | **TASK 4:** Outputs and reports of conclusions and recommendations |
|---|---|---|---|
| • Review/evaluate: **practical implementation** of national EP&R and response arrangements<br>• Effective practices/ Public confidence<br>• Detailed EP&R review on 4 countries (FR,IT,HU,SK)<br>• Questionnaires & Answers | • Review/analyse the coherence of EP&R in **a cross-border context**<br>• **Coordination** approaches<br>• Case studies (non real time) based on European regional approaches<br>• Coherence/ harmonisation and implementation **in practice** | • To facilitate **cross-discipline** discussion/ exchanges<br>• Sharing of experience<br>• Series of activities/ to achieve wider awareness of national and **transboundary** arrangements<br>• **Effective** implementation practices | • **Outputs**<br>• **Reports**<br>• **Conclusions**<br>• **Recommendations** |

The current note reports the works performed in the frame of Task 1.

### 3.3.2. Task 1: Review of the national implementation of EP&R arrangements

The following figure describes the overall methodology implemented in Task 1, for the conduct of the survey subject to the present report.



#### 3.3.2.1 Task 1.1 – Identification of the European and international rules & regulations for EP&R

Through the implementation of the Directives 2013/59/Euratom and 2014/87/Euratom, European institutions put at the forefront EP&R considerations among various other safety topics. A virtuous approach towards general improvement of EP&R practices in Europe was observed in the last decade, with numerous collaborative projects, national and supranational initiatives (e.g. HERCA-WENRA, IAEA EPREV Missions).

Prior to the review of the latest status of EP&R arrangements in Europe, an overall synthesis of the international EP&R rules, regulations and guidelines is performed, along with the findings and recommendations derived from all the past projects dealing with EP&R arrangements. The list of the considered documents is reported below.

**Table 2: List of reference documentation**

| Type | Title |
|---|---|
| Directive | Directive 2013/59/Euratom (BSS Directive)<br>*Namely Articles 7, 69, 70, 71, 73, 97, 98, 99, 100, 101, 102* |
| Directive | Directive 2014/87/Euratom (Nuclear Safety Directive, NSD)<br>*Namely Articles 6 and 8d* |
| Regulation | Decision N° 1313/2013/UE of the European Parliament and of the council of 17 December 2013 on a Union Civil Protection Mechanism (UCPM)<br>Namely Articles 3, 9, 11, 13 |
| Regulation | Commission Implementing Decision (EU) 2019/570 of 8 April 2019 laying down rule for the implementation of Decision N°1313/2013/EU of the European Parliament and of the Council as regards rescEU capacities and amending Commission Implementing Decision 2014/762/EU |
| Regulation | Commission Implementing Decision (EU) 2021/88 of 26 January 2021 amending Implementing Decision (EU) 2019/570 as regards rescEU capacities in the area of chemical, biological, radiological and nuclear incidents |
| Decision | Council Decision 87/600/Euratom of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency |
| EU working document | Overview of natural and man-made disaster risks the European Union may face |
| Guideline | HERCA-WENRA Approach for a better cross-border<br>coordination of protective actions during the early phase of a nuclear accident |
| Guideline | Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015) |

| Type | Title |
|---|---|
| Guideline | Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011) |
| Guideline | Arrangements for Preparedness for a Nuclear or Radiological Emergency - Safety Guide, No. GS- G-2.1, IAEA (2007) |
| Guideline | Arrangements for the Termination of a Nuclear or Radiological Emergency – Safety Standards No. GGS-11, IAEA (2018) |
| Guideline | Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency<br>IAEA Safety Standards Series No. GSG-14 (2020) |
| Guideline | ICRP Publication 109: Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations |
| Guideline | ICRP Publication 111: Application of the Commission's Recommendations to the Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency |
| Guideline | ICRP Publication IXX: Radiological Protection of People and the Environment in the Event of a large Nuclear Accident - Update of ICRP Publication 109 and 111 |
| Working Group on Emergency | Emergency Preparedness - Practical proposals for further harmonisation of the reactions in European countries to any distant nuclear or radiological emergency, HERCA (2013) |
| Working Group on Emergency | HERCA-WENRA Approach (HWA) to better cross-border coordination of protective actions during early phase of a nuclear accident (2014) |
| Working group on Emergency | Guidance for Bilateral Arrangements, HERCA (2015) |
| Project sponsored by the European Commission | Review of Current Off-site Nuclear Emergency Preparedness and Response Arrangements in EU Member States and Neighbouring Countries, ENER/D1/2012-474, Catalogue number MJ-01-14-256-EN-N, ENCO (2014) |
| Project sponsored by the European Commission | Proposal for guidelines for the transposition and implementation of the provisions of Directive 2013/59/Euratom on EP&R, Catalogue number MJ-02-17-387-EN-N, VNS (2017) |
| Project sponsored by the European Commission | Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive, Catalogue number MJ-03-19-143-EN-N, SCK-CEN-Merience (2019) |

#### 3.3.2.2 Task 1.2 – EP&R practical implementation preliminary screening

EP&R arrangements are directly linked to each country specificities (national nuclear power plants, distance to nearest foreign reactor, number of reactors…), shaping the national strategy and the affected resources to develop and maintain an EP&R strategy.

Prior to the country-per-country analysis, a first batch of in-depth study is performed on 4 EU countries (3 Nuclear countries from both Western and Eastern Europe, along with a non-nuclear country), allowing to precisely establish a mapping of the practical implementations observed on the different topics related to EP&R arrangements:

- Contents of the emergency management system;
- Allocation of responsibilities and coordination at all levels;
- Communications related to on-site and off-site arrangements;
- Classification of emergencies;
- Protection strategies;
- Testing and exercising;
- Strategies for the management of existing exposure situations;
- Cross-border cooperation;
- Public information.

This preliminary study concerns France, Hungary, Italy and Slovakia.

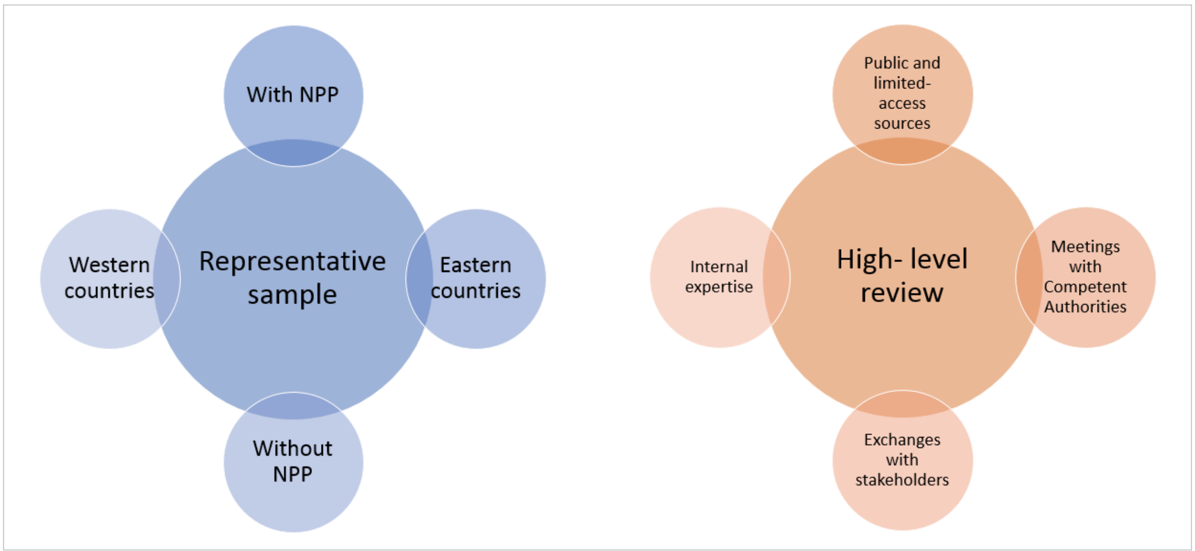



**Figure 3: Representativeness of the countries studied for preliminary EP&R arrangements screening**

The countries selected constitute a representative sample of countries from Western and Eastern Europe, with and without NPPs. They correspond to the ones of the consortium's members. Thus, the corresponding analyses are carried out by national experts with an easier access to national organisations linked with the EP&R fields.

The analyses and corresponding reports are consolidated from public documentation and with the support of operators, SA and CP Organisations. Meetings are organised with stakeholders from these 4 countries *(safety organisation, nuclear operators, state's representative, health authority, national civil protection authority…)* to exchange on the overall and practical EP&R arrangements, share the needed documentation to support in-depth study (regulation, past accident exercises, conclusions…) and discuss international cooperation and specifically transboundary considerations.

Each report is divided into three main parts to cover the description of the national EP&R plan, the stakeholders organisation and their level of practical compliance with European and international framework.

The reports highlight general good practices, good practices related with cross-border issues and current challenges for each country.

#### 3.3.2.3 Task 1.3 – Preparation and analysis of questionnaires

The preliminary tasks presented above, namely the identification of the European and international rules and regulations for EP&R and the drafting of the national reports on four test countries (France, Italy, Hungary and Slovakia), allow to gather the appropriate input to establish the questionnaires necessary for the review of the national implementation of EP&R arrangements in the 34 participating countries.

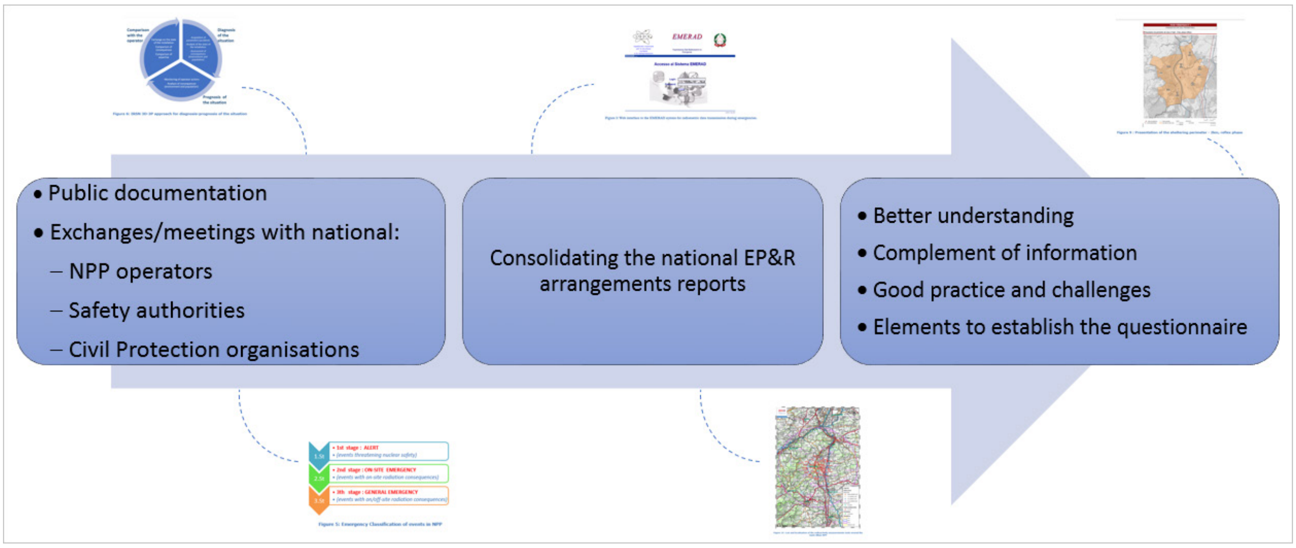



**Figure 4: Input data to establish the questionnaires**

Questionnaires are prepared and sent to all countries participating to the study, asking to provide information allowing to describe with enough details the EP&R arrangements in place in the country, along with transborder considerations.

The level and the means of EP&R implementation are to be analysed for each participating country via the existing documentation and the questionnaire answers.

The questionnaires are prepared with 3 objectives:

1. Describing on a national basis, how European/national legislation and guidance are practically implemented in the field of EP&R;
2. Allowing transnational comparisons, through both open/close-ended questions;
3. Ensuring the continuity with previous studies (and questionnaires) prepared by EC on EP&R arrangements.

Three different questionnaires, targeting three different type of entities, were established:

- One questionnaire to Safety Authority and Civil Protection Organisation (SA/CP);
- One questionnaire to nuclear utility (NU);
- One questionnaire to civil society organisations (CSO).

The questionnaires are broadcasted via the online tool named Evalandgo and made available to all participating countries and organisations.

For each question/topic of the questionnaire, the situation over Europe is summarized and compared. This output of the analysis is reported in *Chapter 4. Findings* of the present report.

### 3.3.3. Content of the questionnaires

The three questionnaires established are reported in annexes 2, 3 and 4.

#### 3.3.3.1 Questionnaire to Safety Authority and Civil Protection (SA/CP)

The questionnaire dedicated to Competent Authorities is divided into 10 topics covering EC requirements, as follows:

- Emergency Management System;
- Stakeholders responsibilities;
- Emergency situation categories;
- Protection strategy;
- Tools and measures;
- Communication;
- Testing and exercising;
- Cross-border cooperation;
- Public information;
- Quality.

#### 3.3.3.2 Questionnaire to Nuclear Utility (NU)

A second questionnaire is created to get first-hand information from the NU on EP&R provisions and especially on the:

- Responsibility in EP&R provisions (preparation, exercise, implementation);
- Activation of NPP Internal EP&R organisation;
- Activation of off-site EP&R arrangements;
- Incident/accident classification for Emergency Off-Site;
- Communication with Nuclear safety Authorities (local and national);
- Involvement of Corporate Level of Nuclear Utilities;
- Mobilisation of on-duty staff, expertise (local and national), external support and mobile equipment if needed, support to local and regional authorities;
- Site protective measures for NPP personnel and dispatch external personnel;
- Measurement, data collection and communication;
- Training to personnel, Emergency Exercise (frequency, reporting, lessons learnt);
- Inspection from the Nuclear Safety Authorities;
- Local relationship and dialogue with territorial level for emergency exercise and post-accident management exercise;
- Relationship with local residents and public confidence;
- Consideration of the Fukushima Tsunami and subsequent accident in the NPP, to get improvements implemented by NU on EP&R provisions.

#### 3.3.3.3 Questionnaire to civil society organisations (CSO)

A third questionnaire is addressed to the Civil Society Organisations/local authorities (CSO) and is sent to GMF, NTW, ANCCLI and CLIs.

They are requested to describe their role, their findings and their vision in the EP&R organisation at the national level and relations with other cross-border countries.

# 4. Findings

The chapter presents the consortium assessment of the responses to questionnaires, the best practices and challenges identified and preliminary topics for potential recommendations.

## 4.1. Responses to questionnaires

Three different questionnaires, targeting three different type of entities, were established and send to the participants:

- One questionnaire to Safety Authority and Civil Protection Organisation (SA/CP);
- One questionnaire to nuclear utility (NU);
- One questionnaire to civil society organisations (CSO).

For the questionnaire SA/CP, 30 responses on the 34 targeted were received (no feedback from Montenegro, Iceland, UK and Greece).

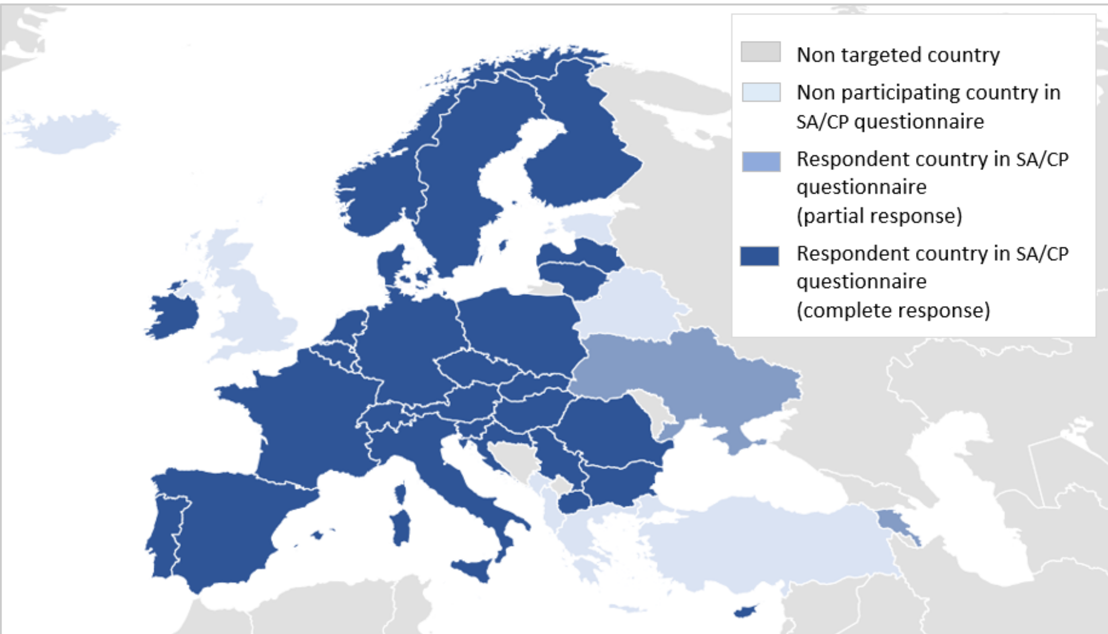



**Figure 5: Representation of the participating countries to Questionnaire SA/CP**

About 150 questions were studied among the 30 responses collected.

Regarding the questionnaire NU, there were 7 responses elaborated on the 10 targeted.

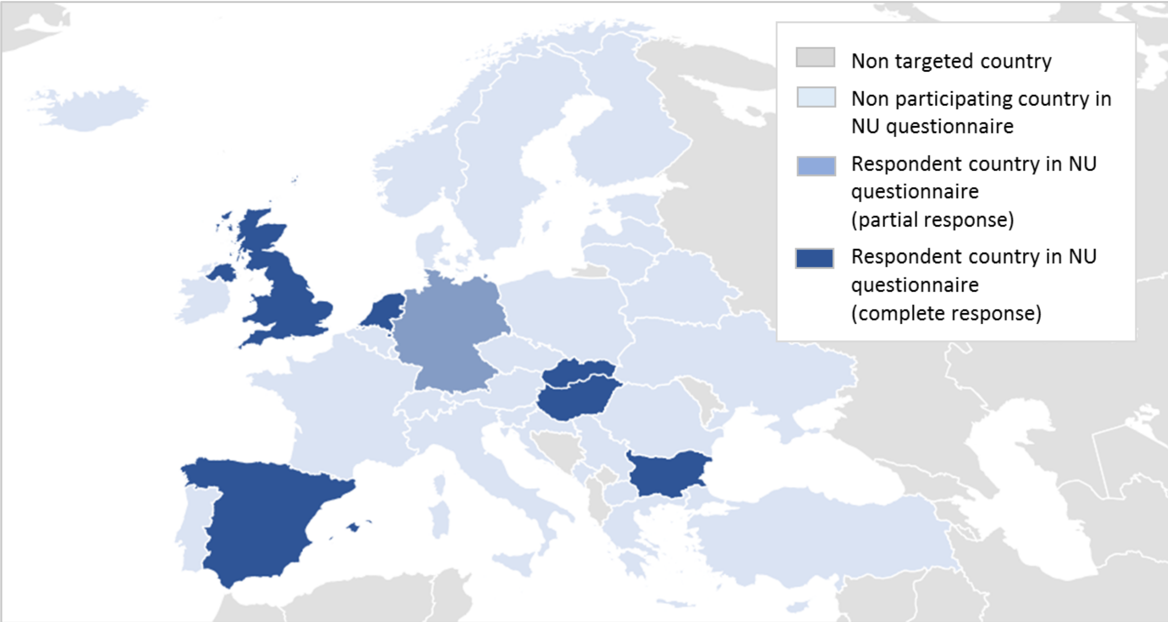



**Figure 6: Representation of the participating countries to Questionnaire NU**

For the NU questionnaire, 45 questions were reviewed for each participant.

For the questionnaire dedicated to CSO, 21 responses were collected including 17 from France (26 questions per questionnaire).

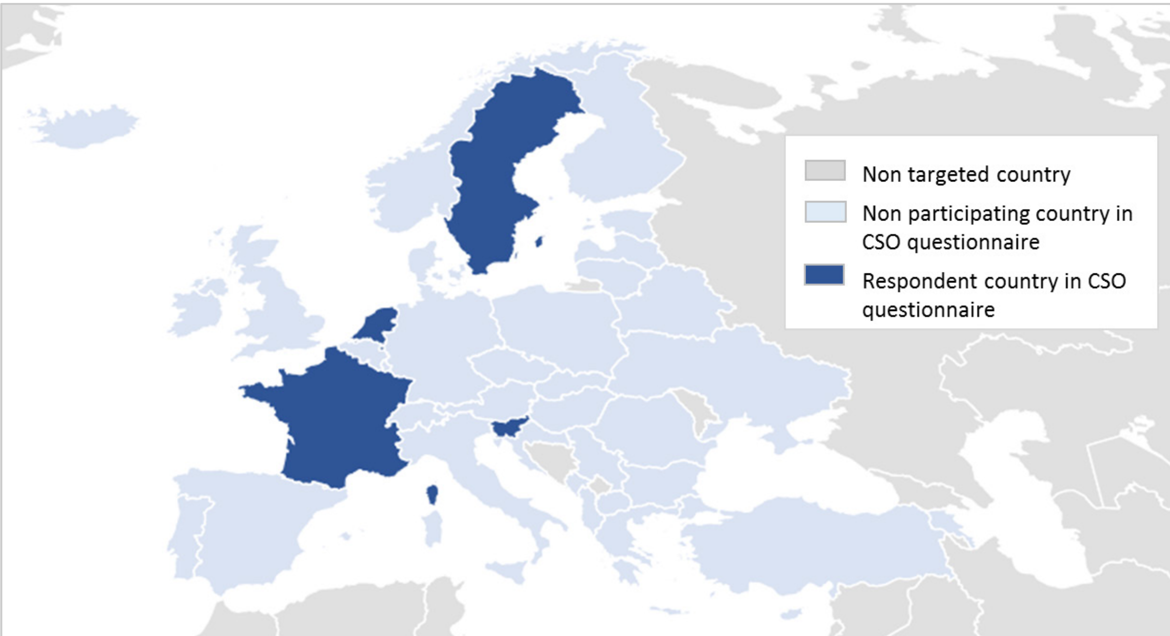



**Figure 7: Representation of the participating countries to Questionnaire CSO**

The consortium carried out an analysis of all the responses received which are reported in the following chapters, by questionnaire and topics.

## 4.2. Analysis of the practical implementation of EP&R arrangements from the perspective of the Safety Authority (SA) and Civil Protection (CP) Organisations from the questionnaire to SA/CP

This section presents the analysis of SA and CP Organisations responses to the questionnaire about the practical implementation of EP&R arrangements. For the different categories of topics targeted, the elements concerning the current regulation and context, as well as the specific topics studied, are reported before the analysis is provided.

### 4.2.1. Emergency Management System

#### 4.2.1.1 Context and regulatory situation

In the context of the current study, the questions addressed to the SAs and CPs of the participating countries were aimed mainly at getting information on the status of the practical implementation of the main European Union requirements that would facilitate international cooperation and harmonization of responses in case of transboundary accidents. These are mainly *EURATOM Directive 2013/59*, referred to as the Basic Safety Standard (BSS) Directive, *EURATOM Directive 2014/87*, referred to as the Nuclear Safety Directive, *the Council Decision on Union Civil Protection Mechanism* (UCPM), the *Council Conclusions 2015 on Off-site nuclear emergency preparedness and response*, the *HERCA Emergency Preparedness - Practical proposals for further harmonisation of the reactions in European countries to any distant nuclear or radiological emergency*, the proposed *HERCA-WENRA Approach* (HWA) for better cross-border coordination of protective actions during the early phase of a nuclear accident, and the *Guidance for Bilateral Arrangements* issued by HERCA.

IAEA GSR Part 7 Requirement 1 explicitly recommends that governments establish and maintain an integrated and coordinated emergency management system. The emergency management system should include an overarching set of arrangements at the national level, containing also individual arrangements for each of the organizations that work together to achieve, in a coherent way, the goals of emergency preparedness and response, and any other pre-defined goals specified by a single Member State. IAEA GSR Part 3 Paragraph 4.5 and the Glossary to IAEA GSR Part 7 describe the essential elements to be covered by, and integrated in, the emergency management system at all levels. The documents, rules and processes that officially define an emergency management system should include elements for the practical implementation of specific national and international legal requirements in force in each country.

#### 4.2.1.2 Topics studied and input data

A series of questions have been submitted, targeted to specific items or rules extracted from the requirements or recommendations mentioned in the previous paragraph, to try to obtain a global picture of the status of their practical implementation in the emergency management systems of the participating countries.

Questions have been posed also about relevant points raised in several other documents of different nature, such as previous studies, other IAEA documents, ICRP publications, etc.

Some questions are only addressed to EU countries and not to neighbouring countries, such as the questions on the application of EU regulations.

The questions were mainly of the "closed answer" type, with twofold possibility (YES/NO) or threefold possibility (YES/NO/PARTLY or YES/NO/In Progress); a few questions required a more elaborate and extensive answer. This was particularly useful to get specific comments on certain points that needed clarification or more precise explanation.

This part of the questionnaire has a high response rate, even if not all the questions were answered by all participating countries.

#### 4.2.1.3 Assessment of the Emergency Management Systems

It is to be noted that the numbers and/or ratios given, also in the graphs, do not include the non-respondent countries, because it is not possible to differentiate between the actual – in some cases even multiple – reasons for not responding,[1] and therefore it would be extremely difficult to correctly interpret the absence of the answer as such. Given, however, that the number of answers is relatively high (on average greater than about 70%), the quality of the results obtained by the overall analysis can be considered good as regards average representativeness.

Concerning the practical implementation of the BSS Directive, one important point is the introduction of Reference Levels for doses to the public; these should be set both for emergency phases and existing exposure situations to implement countermeasures and to define and design optimized management and protection strategies. To understand the status of the introduction of Reference Levels in EU MSs, the following

[1] E.g. country not concerned, topic not in the competence of the entity that is compiling the questionnaire, answer not known or available, not enough time to complete a given question, etc.

question was addressed, making explicit reference to BSS Article 7: "Could you indicate if the practical implementation of the Directive 2013/59/Euratom (BSS Directive) Article 7 *Reference levels* in the Emergency Management System is completed?". Figure 8 shows the results obtained and indicates a very high rate of successful practical implementation of Reference Levels. It is important to remember that while Annex I of the BSS Directive gives recommendations for ranges of values of doses for the Reference Levels, MSs can decide to adopt these values or not, depending on various factors. On the one hand, shared and common Reference Levels for the whole EU would be an enormous advantage in terms of coherence and harmonization of response to cross-border accidents; on the other hand, however, this might introduce less flexibility in the design of optimisation strategies.

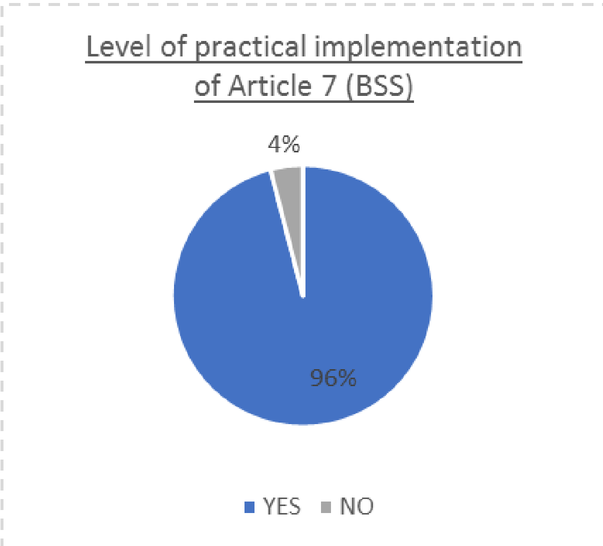



**Figure 8: Ratio of countries which completed the practical implementation of the Article 7 Reference level (BSS Directive) provisions of in the Emergency Management System**

As will be shown later, some answers to further questions indicated a low degree of harmonization in the Reference Levels as one possible cause of the difficulties in adoption of the HWA.

Other important elements of the BSS Directive of relevance for the project are the practical implementations of provisions for the information of members of the public. This is one of the most important aspects to be dealt with in an effective and efficient emergency management system. The prompt, diffuse, accurate, capillary, multi-channel dissemination of correct and coherent information helps to ensure, on the one hand, appropriate behaviour of those people directly involved in the application of countermeasures during an accident. It also helps in explaining the ongoing situation to those people living in unaffected areas. Additionally, timeliness in delivering coherent messages and information to the public, also involving neighbouring countries, helps in reducing the effect of fake news which is expected to be spread during an accident. To be effective, information should be channelled by trusted sources, implying that all the constant work of dissemination of necessary knowledge to the population has to be performed already at the preparedness stage. In this regard, the surveyed organisations were asked "Could you indicate if the practical implementation of the Directive 2013/59/Euratom Article 70 *Information to the members of the public likely to be affected in the event of an emergency* in the Emergency Management System is completed?". The answers indicated a positive result of 100%, meaning that all MSs which have responded have practically implemented provisions to deal with Article 70. The same results are obtained for the practical implementation of Article 71 *Information to the members of the public actually affected in the event of an emergency*.

Further on information to the public, the countries were asked to indicate if they have implemented in their Emergency arrangements IAEA Safety Standards Series No. GSG-14 - *Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency.* Paragraph 2.6 of this safety guide recommends that "There should be a long-term programme of activities in relation to public communication that contribute to gaining and maintaining public trust. Gaining public trust will increase the likelihood that the public will accept and comply with protective actions and other response actions in an emergency."

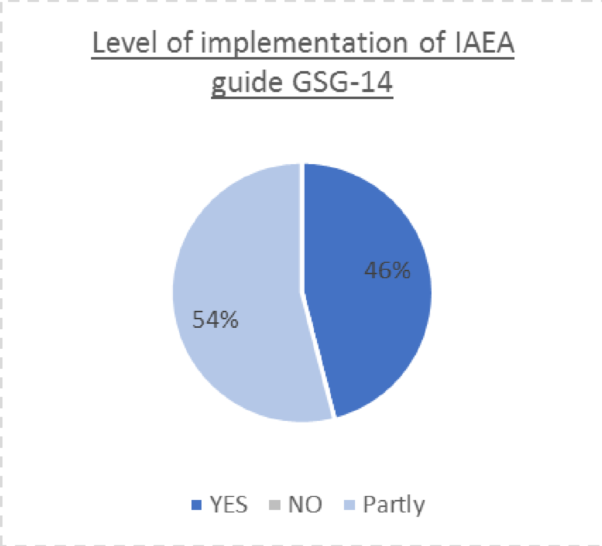



**Figure 9: Ratio of countries which implemented the IAEA Safety Standards Series No. GSG-14 - Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency**

More than 50% of responders answered with "Partly" (see Figure 9), and this can probably be attributed to the quite recent publication of GSG-14, dating back to 2020.

Another very important article of the BSS Directive is Article 99, dealing with international cooperation. This article requires that each EU MS cooperates during an emergency, by establishing contacts with all other MSs and with third countries which may be involved or are likely to be affected by an accident, with a view to sharing the assessment of the exposure situation and coordinating protective measures and public information. Key points are the sharing of the assessment, meaning that the highest number possible of MSs have the same view and understanding of the situation and of the consequences, and of the coordination of both protective measures and information to the public. A question therefore asked about the practical establishment in the emergency management system of provisions to implement Article 99 effectively and efficiently. Again, the positive answers amounted to 100% of those obtained.

Again, concerning international cooperation, other important aspects are those related to civil protection, especially in a cross-border accident. UCPM Article 13 deals with training, exercises, lessons learnt and knowledge dissemination. This is a very important point, because frequent, constant and varied execution of training, exercises and emergency drills, especially at a bilateral or multilateral level, highly enhances mutual trust and confidence between the staff and personnel of different countries, thereby increasing the possibility of better coordination and mutual understanding in case of an emergency. Likewise, sharing lessons learnt and disseminating knowledge are key factors for reaching comparable levels of response in real life. A question was therefore asked about the practical implementation of provisions to deal with the requirements of Article 13 of Council Decision on UCPM.

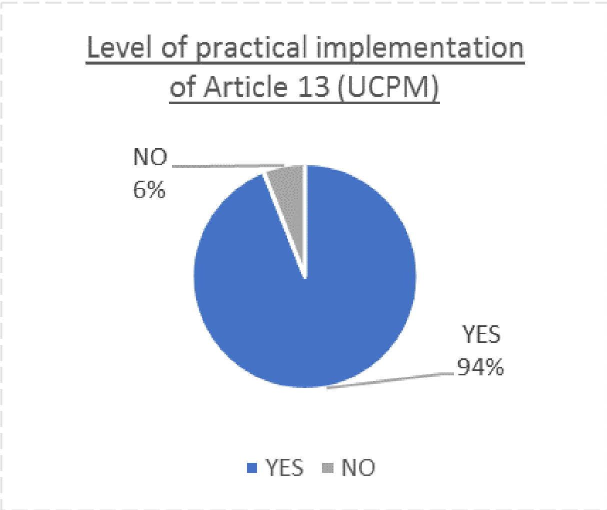



**Figure 10: Ratio of countries which completed the practical implementation of Article 13 of Council Decision on UCPM in the Emergency Management System**

The results are shown in Figure 10, where 94% of respondents answered positively.

Focussing attention to implementation of the HWA, a further question asked respondents to indicate whether they have implemented, in their Emergency arrangements, the HERCA-WENRA Approach for a better cross-border coordination of protective actions during the early phase of a nuclear accident (2014). Figure 11 shows the results, which indicate that the majority (60%) of respondent countries have implemented the HWA only in part; roughly one third (36%) of countries have implemented it in full; and a very limited number (4%) have not implemented it at all.

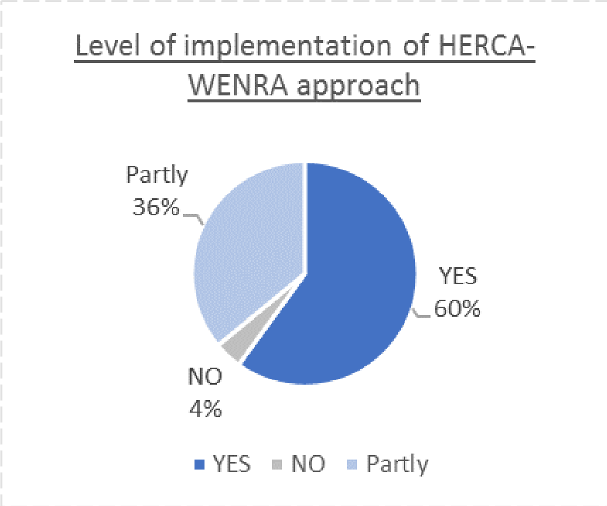



**Figure 11: Ratio of countries which have implemented the HERCA-WENRA approach**

The section of the questionnaire dealing with cross-border cooperation was designed to provide insight as to the reasons behind this result, and about alternatives to HWA, if any. Some of these are reported here, almost verbatim[2]:

- No obligation in national legislation to use HWA;
- Lack of common criteria, such as shared source term;
- Reference Levels in NC lower than those used by AC: it is expected that AC aligns to NC;
- Maintaining national sovereignty in the decision-making process;
- Differences in intervention guidelines and other associated reference values (OILs, etc.);
- Lack of trust or lack of common understanding at the different levels;
- Desiderata to improve acceptance of HWA: information and data exchange arrangements, use of liaison officers, organisation of regular effective bilateral exercises, reciprocal understanding of the response provisions, including assessment methods and tools, EPZs, intervention levels including their background and associated assumptions and limitations;
- Insufficient information about source term, plant status, etc., from the AC in the first hours, which could make it difficult to judge whether

[2] AC: Accident Country; NC: Neighbouring Country; OIL: Operational Intervention Level; EPZ: Emergency Planning Zone.

AC is "dealing with the emergency situation in full agreement with its own emergency planning";

- Regarding recommendations to NC citizens living in AC, the initial recommendation would always be to follow HWA;
- Obstacles are more inside the HERCA-WENRA approach, which contains an over-simplified approach to situations which, if followed as written, may often lead to overreactions that are not justified;
- Role of decision-makers that have to take into account the recommendations of SA but also other "non-nuclear" considerations (real possibility of evacuation, etc.);
- Lack of data about HWA applicability. No specific exercises on HWA have been conducted yet;
- Realism: too many differences in response in Europe. Example of COVID-19 pandemic quoted;
- An obstacle could be hypothetically that measures from AC cannot be executed in practice for whatever reason;
- The national options driven by public perception and pressure might limit the efficiency of that approach;
- Public concern that authorities do not adequately protect the public if following actions of AC;
- In the event of deviation with respect to AC, different templates have been prepared on how to explain the deviations to the public.

As can be seen, the reasons quoted are manifold and diverse. Not all of them show, however, a full and sound understanding of the HWA and its principles, meaning perhaps that this approach may not have been properly disseminated in the past 5-6 years. It is also interesting to note that some of the reasons cited refer to practical obstacles in HWA implementation; others report overly large differences in Reference Levels between neighbouring countries; others state that no experience has been gained about the real applicability of the HWA, indicating the need for specific and targeted exercises to test the HWA. Of relevance for some countries is the low level of trust in other countries, or the possible lack of data from the accident country during an accident, suggesting that exchange of information may be felt to be at least partially ineffective, even if the relevant legal instruments to facilitate such exchanges have been declared by the majority to have been practically provided for in their emergency management systems.

Concerning the alignment and coherence of protective measures among accident and neighbouring countries, following issuance of the HWA, the Council of the European Union Decision of 15 December 2015 on Off-Site Nuclear Emergency Preparedness and Response invites EU MSs, among others, to "include the alignment of protective measures along borders as a factor in emergency decision-making in accordance with the optimised protection strategy" and to "consider the principle that in the first hours of an accident, applied protective measures take into account those applied in the Member State where the accident has occurred, based on the information received from that Member State, taking into account Article 99 (2) of Council Directive 2013/59/Euratom." These two recommendations to MSs are basically promoting the adoption and implementation of the core elements of the HWA. A further question asked the countries "could you indicate if the practical implementation of the COUNCIL CONCLUSIONS 2015 *Off-site nuclear emergency preparedness and response provisions in the Emergency Management System is completed."* The answers obtained (see also Figure 12) indicate a 50-50 situation, which is, on average, coherent with the answer about the implementation of the HWA reported above. This clearly indicates that more efforts should be put in the direction of enhancing the coherence of applied protective measures in transboundary contexts.

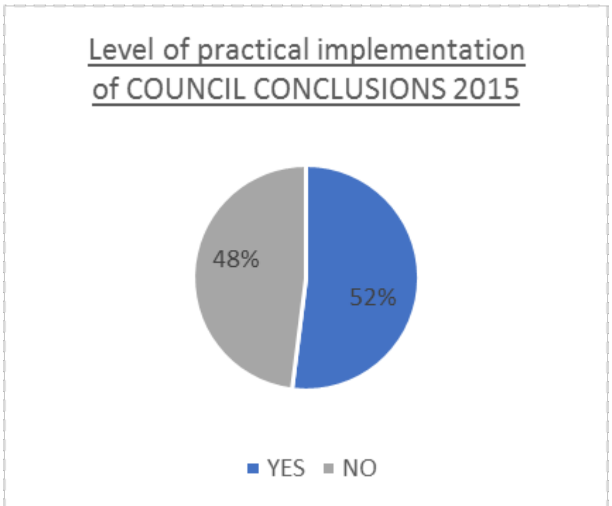



**Figure 12: Ratio of countries which have completed the practical implementation of COUNCIL CONCLUSIONS 2015 Off-site nuclear emergency preparedness and response**

To facilitate the interaction between nuclear safety authorities in EU MSs and the exchange of information, also during nuclear emergencies, as well as to increase the effectiveness of collaboration between neighbouring countries, in 2015 HERCA proposed a Guidance for Bilateral Arrangements between safety authorities. A question was asked about its consideration and implementation in the existing emergency arrangements. The answers are collected into Figure 13: 40% No, 40% Yes, and 20% Partly.

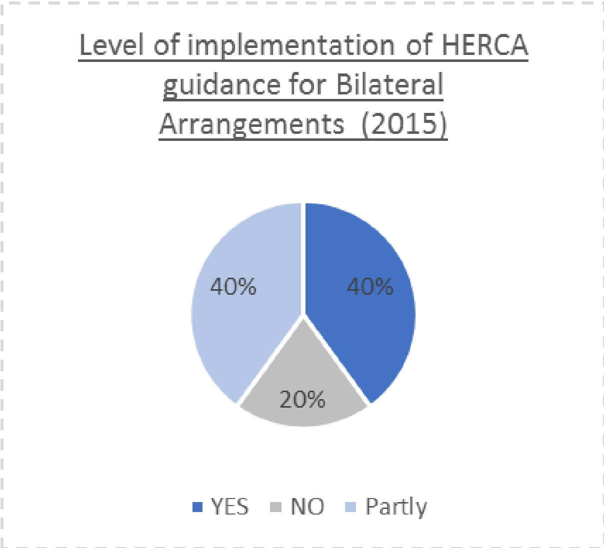



**Figure 13: Ratio of countries which have completed the practical implementation of HERCA guidance for Bilateral Arrangements (2015)**

Complementary to this question, an additional question was devoted to understanding if each country had reliable communications and efficient and effective agreements at all levels, including international ones. The results are shown in Figure 14, which shows that most countries consider the necessary provisions well established and implemented, also at the international level. This, however, somewhat contradicts the needs, expressed above, about potential insufficient information from an accident country during an emergency. This could be seen as meaning that mechanisms for communication are indeed in place, but they are deemed to be not sufficiently tested, robust or used efficiently during the emergency itself.

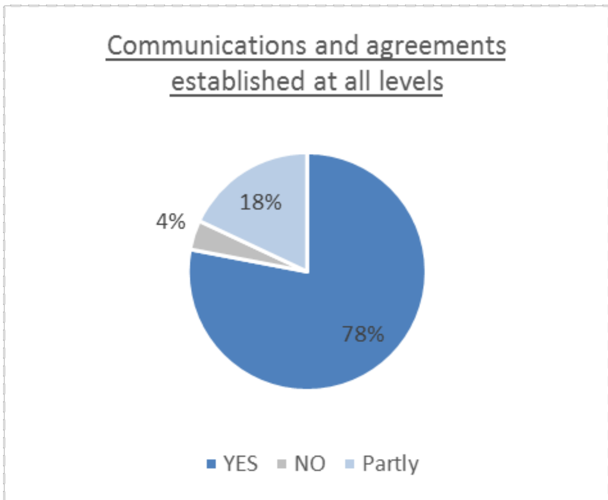



**Figure 14: Ratio of countries which have established reliable communications and effective agreements at all levels, including international ones**

From the analysis of the answers obtained, it appears that the vast majority of EU MSs have transposed into their national legislations the binding directives related to emergency preparedness and response. Furthermore, they have introduced into their emergency management systems provisions for implementing the necessary instruments in practice.

Still some challenges are present, the most important ones being related to the practical implementation of mechanisms to ensure coherence and harmonization in response actions to transboundary emergencies and in information and communication with the public. The HWA is the only practical proposal conceived up to now that can be used to increase harmonization, especially for the very first hours of an accident, and for those cases presenting many uncertainties in the unfolding of events and lack of data or information. Even if the HWA is not mentioned explicitly, its core elements have been formally recommended in the Council of the European Union Decision of 15 December 2015, recalled above.

Most of the reasons for not adopting the HWA could be grouped under the more general theme of responsibility: it seems in fact that adopting the HWA is perceived as risky, because, if the response actions of the accident countries are disproportionate, in one direction or the other, their automatic adoption will result in a negative feedback on the decision-makers of the neighbouring countries, and in negative consequences for the people or the economics. It seems also that neighbouring countries are keener to introduce response actions that are more consistent or harmonized with those of the accident country, if they are able (i.e. have the necessary information and time) to first make their own independent judgements and if the latter are found to be in line with those of the accident country. Such a reverse approach implies an *a priori* lack of trust in the accident country counterparts, something which is either well-founded on specific motivations, or founded on lack of knowledge of the capacities of the counterparts. In both cases, effective and long-standing agreements between nuclear safety authorities should create the basis for solving, or at least reducing, the issue of lack of trust. In any case, even if some neighbouring countries still prefer to have detailed information on which to base their own scientific judgement before taking decisions, they have again to rely on the availability, timeliness, and accuracy of the information from the accident country, and this again points to the strong implementation of effective and long-standing agreements between nuclear safety authorities, with continuous exchange of best practices, meetings, joint exercises, etc.

A few good practices have also been identified from the answers to the Questionnaires.

The existing so-called "sub-regional approaches," for example, seem already to provide a consolidated and tested practical framework for all the necessary actions that could increase coherence in response. The Nordic Manual and the Nordic Flagbook, written and adopted by Denmark, Finland, Iceland, Norway, and Sweden, are consolidated examples of good and effective cooperation and coordination. These reference texts are periodically updated, and they already contain some elements, at least, for considering novel issues or problems (e.g. fake news or rumours). They also contain some points related to transboundary accidents and synergies coming from the unified approach, also at the preparedness level, and even for response-strategy optimization, communication to the public, and joint exercises. It is true that this type of approach is made easier by the peculiar geographic connotation of the countries involved, the shared cultural background, and the historical, longstanding tradition of strong and tight political cooperation in nuclear matters over many decades. However, it could be a good starting point to try to implement similar methods in other European sub-regions as well – recognizing, however, that comparable results to those of the Nordic countries will be obtained in practice only in the long term.

Another interesting practice was declared by a country that has implemented the HWA only partly. Special templates have been prepared in advanced, with the aim of promptly informing public opinion should the situation in the two countries deviate significantly from the ideal alignment between the countries as described by the HWA. This seems to be an interesting option, at least for explaining to public opinion the reasons for any deviations that may be decided. For this approach to be effective and efficient, a special strategy for preparing the information and the related templates needs to be created well in advance, at the preparedness level, and be ready to be implemented very quickly. At the same time, special provisions need to be set up to deliver the information efficiently, in a clear, simple, and timely manner to the public. While clearly not an alternative to the HWA, this practice could be seen as a way of explaining the motivations and causes for not adopting a fully harmonized response. The information, however, should be delivered in a way that does not worsen the risk perception in the population of the accident country.

### 4.2.2. Stakeholders' organisation

#### 4.2.2.1 Context and regulatory situation

The nuclear sector has existed for decades and the decision-making and operational institutions necessary for its functioning are in place. Depending on the evolution of the perceived and proven risks, the organisation of the stakeholders is optimised.

Today, all European countries have a similar general organisation.

The international framework defined by the IAEA recommends the following points:

*"Requirement 20: Authorities for emergency preparedness and response*

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

*Requirement 21: Organization and staffing for emergency preparedness and response*

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

*Requirement 22: Coordination of emergency preparedness and response*

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

The previous study carried out by ENCO underlined the need to reinforce the positioning of Civil Protection within the response plan, in terms of protection operation and communication. Indeed, Civil Protection benefits well-structured and frequently implemented arrangements for the management of any emergency. Furthermore, disparities in dealing with cross-border issues were widely discussed.

#### 4.2.2.2 Topics studied and input data

The national structural organisations of each European country are described in the national emergency plans and reported by other international entities. The "Country Fact Sheets" produced by HERCA provide a synthetic view of the stakeholders' organisations around the emergency management centre.

Within the current study, the countries summarized the organisation of the stakeholders involved in the EP&R arrangements, at all levels of organisation (national, regional, local, off-site, in-site), in accordance with their national documentation.


The information received was produced by a majority of Safety Authorities, Governments and, to a lesser extent, Civil Protection organisations.

The questions asked deal with the description of the stakeholders involved in the EP&R arrangements, including those in the cross-border arrangements.

The analysis focuses on the specific organisation regarding cross-border issues and the place of Civil Protection.

#### 4.2.2.3 Assessment of stakeholders' organisation

In response to the Chernobyl accident in 1986, international institutions set up an organisation to alert and inform the community at short notice and to provide assistance in the event of a major radiological emergency. Most of the European countries are signatories of the IAEA Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. In the framework of these Conventions, states have agreed to provide notification of any nuclear accident that occurs within its jurisdiction that could affect other states, and notification to the IAEA of any assistance that they can provide in the case of a nuclear accident that occurs in another state that has ratified the treaty. National Warning Points and Competent Authorities under the Emergency Conventions have been identified and officially designated. The Warning Point is "a designated organization to act as a point of contact that is staffed or able to be alerted at all times for promptly responding to, or initiating a response to, an incoming notification warning message, request for assistance or request for verification of a message, as appropriate, from the IAEA" (IAEA GSR Part 7). Competent authorities to manage nuclear emergency and cross-border coordination are nominated at the IAEA and EU level. They all benefit from the ECURIE (EU) and USIE (IAEA) web-based communication tools to alert and inform all the stakeholders. Whether at national or international level, the stakeholders in European countries remain the same. In the case of a cross-border crisis, foreign ministries and diplomatic missions, in the country and abroad, are naturally called upon.

Thus, the roles, tools and communication processes are well established.

As far as interventions on the ground are concerned, in the event of an emergency, be it radiological or of any other nature, they are mainly carried out by civil protection following the instructions resulting from the knowledge of the situation.

In the questionnaires themselves, only half of the countries surveyed explicitly mentioned civil protection. Civil protection is systematically involved in the management of incidents impacting the population or the environment. This reflects on the one hand the way in which states perceive radiological accidents as separate emergencies, and on the other hand the risk of less involvement of Civil Protection in Emergency Preparedness and Response-related exchanges and training.

In the case of large-scale nuclear accidents, it is essential that all countries are prepared to deal with them, including non-nuclear countries that are far from power plants. Half of the surveyed countries interviewed are not nuclear countries and presented an appropriate organisation in terms of responsibilities structure whether they are members of EU or not.

Whereas the composition of the teams, their responsibility and functions, needed to implement an emergency response are well identified, the question of the sizing of the teams in practice may arise. The teams in place allow the implementation of the emergency preparedness and theoretical organisation of a response. In a real emergency case, the numbers of persons designated for managing the crisis and the relevant numbers to handle it do not necessarily coincide. It is challenging to assess the size of the intervening team in the context of a real complex situation. For example, in the case of Serbia, which is a small non-European and non-nuclear country, the Fukushima accident demonstrated that the team was not sized to deal with a disaster on the other side of the world. The safety authority was overwhelmed by calls from the public, expressing their concern, asking whether they had real information. It highly impacted their everyday workload. If a crisis occurred in Europe, it would be very difficult to manage the public need and to focus on the protective measures.

Beyond the existing international structure and the bilateral agreements between neighbouring countries, establishing a dedicated cooperation within a group of countries strengthens the capabilities of response to an emergency. For instance, Sweden belongs to three organisations dedicated to emergency crises:

- the five Nordic countries of Denmark, Finland, Iceland, Norway and Sweden, which have compiled a Nordic manual (NORMAN) for cooperation between their respective regulators in response to and preparedness for nuclear and radiological emergencies and incidents;
- Nordred, a co-operation forum for civil protection/rescue issues for the Nordic countries, whose purpose is to promote cooperation between Member States in various ways, both in terms of cooperation to develop the area but also operational collaboration in emergency rescue situations;
- Barents Agreement: Sweden, Finland, Norway and Russia are parties to the agreement on cooperation in the prevention, preparedness and response to emergencies in the Barents region, including mutual assistance and border crossing facilitation during emergency operations.

### 4.2.3. Emergency situation categories

#### 4.2.3.1 Context and regulatory situation

The classification of emergency situations into a limited number of categories simplifies and speeds up the response process through the exclusion of unnecessary branches in the analysis and decision-making trees. It also helps in the fast identification of the best procedures to adopt. If the classification adopted in a given country is the same or very similar to those adopted in neighbouring countries; this helps also the communication processes between the homologous organizations of the emergency management systems, and towards the public. This may furthermore help in the implementation of a graded approach for EP&R.

IAEA GSR Part 7 has set out in its Table I a classification into five categories:

- I: Facilities, such as NPPs, for which on-site events are postulated that could give rise to severe deterministic effects off-site;
- II: Facilities, such as research reactors or reactors used to provide power for the propulsion of vessels (ships and submarines) for which on-site events could give rise to doses off-site requiring urgent response actions;
- III: Facilities, such as industrial irradiation facilities or some hospitals, for which events are postulated that could require on-site response actions;
- IV: Activities and acts that could give rise to an emergency requiring protective actions in an unforeseen location. They can include: transport of nuclear or radioactive material, theft of dangerous radioactive sources, use of a radiological dispersal/exposure device, detection of elevated radiation levels of unknown origin, identification of clinical symptoms due to radiation, a transnational emergency not in Category V but arising from a nuclear or radiological emergency in another state;
- V: Areas within emergency planning zones and emergency planning distances in a state for a facility in category I or II located in another state.

Not all participating countries have already adopted and introduced into their own national response plans the categorization of GSR Part 7. Other categorizations are possible, tailored to the specific situations of each country. If, on the one hand, tailor-made categories can help in the optimization of resources and in the decision-making process, they do introduce a potential communication and discussion barrier when exchanging information during an accident.

#### 4.2.3.2 Topics studied and input data

A series of questions have been submitted, in order to evaluate and identify the categories used by participating countries.

The questions were mainly of the "closed answer" type, with twofold possibility (YES/NO); three questions required a more extensive answer. This was particularly useful in getting specific input on special categories devised in emergency plans. The ten closed-answer questions asked about the consideration in the emergency plans of categories like "Nuclear accidents: situation of uncertainty", "Nuclear accidents: different severity classes", "Nuclear accidents: different kinetics classes", "Nuclear accidents: accident abroad with potential significant impact in your country", "Nuclear accidents: accident abroad with little impact in your country", "Offshore accidents", etc.

A special question was addressed at the introduction of the categorization of IAEA GSR Part 7, Table I.

Of noteworthy interest is the question related to offshore accidents, because it incorporates different and new types of possible accidents, not just those that might happen aboard nuclear-powered military vessels or submarines, occasionally harboured near some cities, but also at so-called floating nuclear power plants transiting through diverse maritime routes. This is of course mainly relevant for those countries with borders on the sea or for those not far from the sea.

Of further interest is also the question on the consideration of accidents abroad with little radiological impact in the country. This is a specific issue whose awareness was triggered during the Fukushima event, and which, therefore, could have been considered explicitly in some emergency plans only in recent years. Even if the radiological impact on the non-accident country under consideration in such cases is very small or negligible, there are still issues that need consideration, such as that of citizens abroad staying or living in the accident country, personnel of embassies, and other types of specific interests (including geo-political or economic ones) to be monitored. Last but not least, proper dissemination of information to the public, even if not directly involved by countermeasures, is of strategic importance, not only for transparency, but also to avoid the spread of incorrect rumours or fake news in the accident country.

#### 4.2.3.3 Assessment of the Emergency Management Systems

It is to be noted that the numbers and/or ratios given, also in the graphs, do not include the non-respondent countries, because it is not possible to differentiate between the actual, in some cases even multiple, reasons for not responding,[3] and therefore it would be extremely difficult to interpret correctly the absence of an answer as such. Given, however, that the number of answers is relatively high (on average greater than about 70%), the quality of the results obtained by the overall analysis can be considered good as regards average representativeness.

The surveyed countries were asked about consideration of emergency preparedness and response arrangements concerning "Nuclear accidents: Situation of uncertainty." This is a very important question, because this category can include situations in which, for instance, radioactivity has been measured environmentally, but a possible accident has not (or not yet) been officially declared,[4] in infringement of international conventions, or in which some type of emergency has been declared abroad but the situation has not yet evolved into a severe accident with off-site consequences, or in which there are a lot of uncertainties in information and data, so that taking quick decisions is indeed complicated. This last point has elements in common with the applicability/application of the HWA. If countries explicitly consider uncertain situations abroad, then they should have either implemented the HWA, or put in place alternative strategies, optimized or not, to deal with such cases. The answers to this question are summarized in Figure 15.

[3] Cfr. Note 1.
[4] Sometimes these cases are called "hidden emergencies".

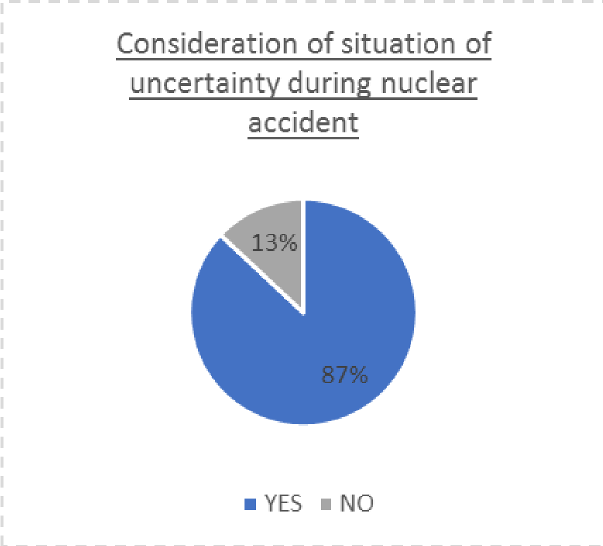



**Figure 15: Ratio of countries considering the emergency exposure "Situation of uncertainty" in EP&R arrangements**

The majority of participating countries, then, take situations of uncertainty into consideration in their emergency preparedness and response arrangements.

Another question was issued to understand whether countries take different severity classes for accidents into consideration in their emergency preparedness and response arrangements. This could be different cumulated source terms, or different radiological effects, or other different ways to introduce risk into the analysis. The use of different severity classes is also a way to introduce a graded approach in emergency preparedness and response, as indicated in IAEA GSR Part 7. The majority indicated that they indeed consider different severity classes, while only a minority do not consider them, and probably make reference to worst-case scenarios or other unified approaches. There appears to be a correlation in this with the fact that a country is a nuclear one or not: non-nuclear countries seem not to use different severity classes.

The organisations surveyed were asked whether, in the emergency preparedness and response arrangements, different kinetics classes related to accident processes and atmospheric releases are taken into account and used. This is something very important during the prognosis phases of the response, because a time-varying accident source term can modify a lot the foreseen impacted areas subject to countermeasures. The experience from the Fukushima case indicated the real possibility of lower release-rate but long-lasting source terms, with different impacts with respect to very short and very rapid accidents. While it is true that short and rapid accidents are compelling because they require immediate and proportionate reactions, it is also true that slow and long-lasting accidents may require different measurement approaches, and long-lasting actuation of some countermeasures. Answers are summarized in Figure 16.

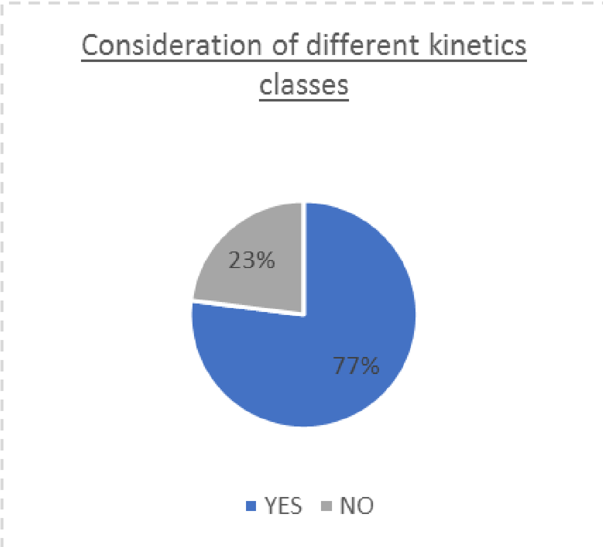



**Figure 16: Ratio of countries considering different kinetics classes into emergency situation categories**

Most respondent countries indicated that they consider accident categories with different kinetic classes.

The following question was used to assess the consideration of cases of accidents abroad with little radiological impact in the country but which, as stated above, in any case have relevance for a given country. Results are shown in Figure 17.

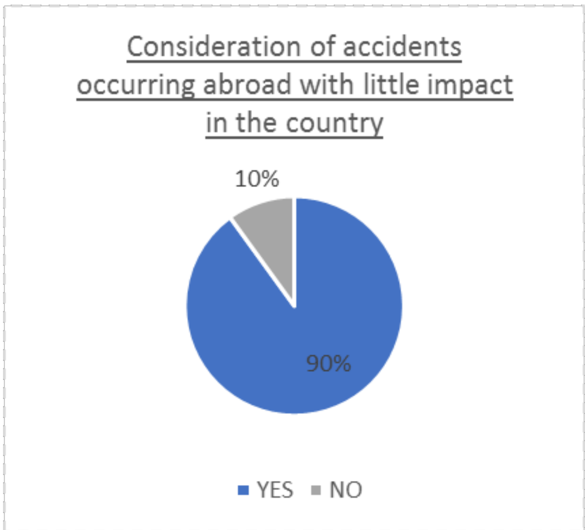



**Figure 17: Ratio of countries considering an accident occurring abroad with little impact in the country in EP&R arrangements**

The graph shows that a large share of responding countries also consider accidents with these features; many countries that responded "NO" added that they are considering adding this accident category soon into the next updates and revisions of the response plans.

The consideration of offshore accidents with a potential release was also addressed. The answers are collected in Figure 18, which shows that, again, most of the countries do indeed consider this special category.

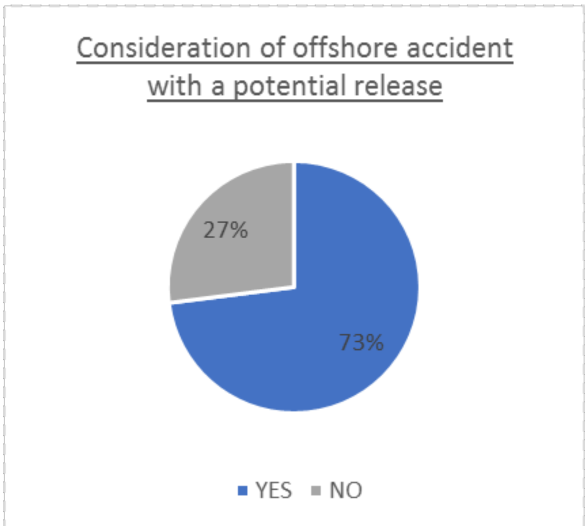



**Figure 18: Ratio of countries considering offshore accidents with a potential release in EP&R arrangements**

Regarding the consideration of IAEA GSR Part 7, Table I categories, the percentage of countries using them is summarized in Figure 19, showing that a majority of participating countries are taking them into account.

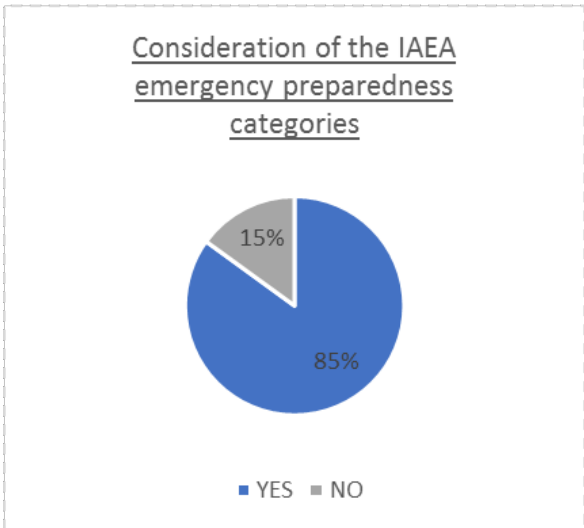



**Figure 19: Ratio of countries considering the IAEA emergency preparedness categories in EP&R arrangements**

From the analysis of the answers, no specific challenges emerge that may require special or urgent attention. Likewise, no paramount Best Practices that could be important to point out and try to disseminate are worth reporting, since they have already been known of for a long time.

It is true that room for improvement is always available. In this specific case one could indicate the area of categorization. However, the overall level seems fairly satisfactory.

Perhaps one point that could be explicitly mentioned relates to the level of awareness of the potential risks associated with floating NPPs. It is true that, up to now, not many of these special NPPs have been built, and that this sub-element of the offshore accidents category has been introduced quite recently; however it is something that should not be underestimated. Some countries have already updated and adapted their emergency plans to include this class of accidents, while others probably still have to implement it.

### 4.2.4. Protection strategy

#### 4.2.4.1 Context and regulatory situation

The issue of protection strategy is largely framed by regulations in force such as Directive 2013/59/Euratom (BSS Directive), namely articles 69, 73, 97 to 102. And requirements of the BSS Directive are consistent with IAEA General Safety Requirements No. GSR Part 7 as follows.

- Specification of off-site emergency planning zones and emergency planning distances - No. GSR Part 7 paragraphs: 5.38;
- Arrangements to execute off-site emergency response - No. GSR Part 7 paragraphs: 4.3, Requirement 3, 4.31, 5.3, 5.9, 5.10, 5.14, 5.16, 5.25, 5.33, 5.37, 5.39;
- Arrangements planning - No. GSR Part 7 paragraphs: 4.2, 4.18, 4.23, 5.32;
- Public protection - No. GSR Part 7 paragraphs: 5.4, 5.6, 5.41, 5.42, 5.43, 5.76;
- Strategy for economic and social continuity - No. GSR Part 7 paragraphs: 4.28 i.e. complex strategy, 4.29, Requirement 16;
- Public involvement - No. GSR Part 7 paragraphs: 5.46, 5.50;
- Experience dissemination - No. GSR Part 7 paragraphs: Requirement 19;
- Best practices - No. GSR Part 7 paragraphs: 5.8, 5.11 to 5.14, 5.77, 6., however best practice highlighting can be slightly subjective depending on reviewer preferences;

Except of GSR Part 7 IAEA, issued some additional standards such as:

- GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency;
- TS-G-1.2 (ST-3) Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material;
- GSG-2 Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency etc. that specify particular aspects of EP&R.

Previous studies, such as ENCO and VNS, reported conclusions about protection strategy arrangements.

The final findings of the ENCO report,[5] regarding the topics raised in the questionnaire of the present study, taken over from the chapter *European-level actions to improve off-site nuclear emergency preparedness and response* are the following:

- Specification of off-site emergency planning zones and emergency planning distances:

  ➔ Harmonisation of criteria: Although international standards and guidance exist and all EU MSs 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.

- Arrangements to execute off-site emergency response:

  ➔ 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.

- Arrangements planning:

  ➔ 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 they 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 it is currently less well developed or robust.

[5] Review of Current Off-site Nuclear Emergency Preparedness and Response Arrangements in EU Member States and Neighbouring Countries, ENER/D1/2012-474', Catalogue number MJ-01-14-256-EN-N, ENCO, 2014

➔ Governance: Responsibilities for nuclear EP&R are shared between different ministries, authorities, agencies and expert groups at local, national and European levels.

- Public protection:

➔ 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.

Furthermore, VNS report VNS-TR-16-03 presents a survey of the strategies and plans of 10 selected EU member states for the transposition and implementation of the EP&R provisions of Council Directive 2013/59/Euratom (BSS Directive). The NVS report also evaluated a need for guidelines or recommendations for the transposition and the implementation of the BSS provisions on EP&R. Ranking of the need for guidance (expressed by the 10 Member States) was as follows.

1. Transition from an emergency exposure situation to an existing exposure situation including recovery and remediation
2. Generic criteria for particular protective measures, default triggers, operational criteria for particular actions
3. Protection strategies for the public and optimisation approaches
4. Reference levels for public exposure
5. Involvement of stakeholders
6. Reference levels for emergency occupational exposure
7. Assessment of potential emergency exposure situations and associated public and emergency occupational exposures
8. Information to the public (likely to be affected or actually affected in the event of an emergency)
9. Prior information and training for emergency workers and all other persons with duties and responsibilities in emergency response
10. International cooperation
11. Health protection of emergency workers

The part of the NVS report dealing with the need for guidance also added *that one response indicated that there was sufficient guidance available internationally and there was no need to develop anything at the EU level*.

Chapter 10 of the VNS report provides the recommendations and proposals for the key measures that should be addressed in all possible 'non-binding guidelines' of the EU. The report states that internationally accepted guidelines provide a basis for developing EP&R arrangements and should therefore be used as a starting point for the consistent implementation of the EP&R provisions throughout the EU. Consequently, recommendations are given on how to use particular guidelines in such a way as to be consistent with the requirements of EU legislation (including the BSS Directive). Recommendations from Chapter 10 of the VNS report corresponding to the *Section Protection strategy* of the questionnaire are in particular the following:

- 10.1 Transition from an emergency exposure situation to an existing exposure situation including recovery and remediation
- 10.2 Generic criteria for particular protective measures, default triggers, operational criteria for particular actions
- 10.3 Protection strategies for the public and optimisation approaches
- 10.4 Reference levels for public exposure
- 10.8 Information to the public (likely to be affected or actually affected in the event of an emergency)
- 10.10 International cooperation

Most of the recommendations from chapter 10 of the VNS report are related to the Public protection topic.

#### 4.2.4.2 Topics studied and input data

Topics studied cover specification of off-site emergency planning zones and emergency planning distances including arrangements to execute off-site emergency response as well as some specific aspects of planning such arrangements. The topics also cover specific aspects of public protection and involvement, experience dissemination and implementation including best practices. Detailed categorization of topics is introduced below:

- General overview "nuclear" and "non-nuclear countries" of responders;
- Specification of off-site emergency planning zones and emergency planning distances;

- Arrangements for executing off-site emergency response;
- Arrangements planning;
- Public protection;
- Strategy for economic and social continuity;
- Public involvement;
- Experience dissemination;
- Best practices.

The responses analysed come from a majority of nuclear countries.

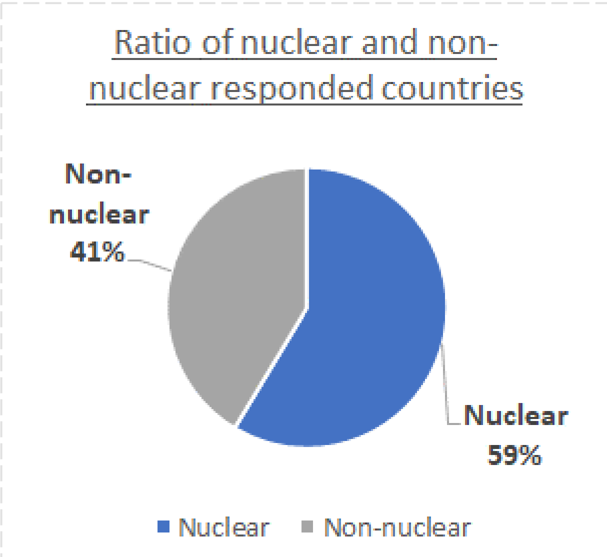



**Figure 20: Ratio of nuclear and non-nuclear responding countries regarding protection strategy**

#### 4.2.4.3 Assessment of protection strategy arrangements

The assessment is reported following the topics categorised in the previous chapter. This chapter presents results of the analysis topic by topic as introduced in chapter 4.2.4.1.

- Specification of off-site EPZs and emergency planning distances

Specification of off-site emergency planning zones and determination of emergency planning distances differ between nuclear and non-nuclear countries.

Almost all participants and all "nuclear countries" declare definition of Urgent protective action planning zone (UPZ). About 80% of countries declare definition of Precautionary action zone (PAZ), Extended planning distance (EPD) and Ingestion and commodities planning distance (ICDP).

**Table 3: Responses to the questionnaire on definition of PAZ, UPZ, EPD, ICPD**

| Code country | AM | AT | BE | BG | CH | CY | CZ | DE | DK | ES | FI | FR | HR | HU | IE | IT | LT | LU | LV | MK | NL | NO | PT | RO | RS | SE | SI | SK | UA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclear country | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | Y | N | Y | N | N | Y | N | N | N | Y | N | N | Y | N | Y | Y | Y | Y |
| PAZ | Y | N | Y | Y | Y | - | N | Y | - | N | Y | Y | - | Y | - | Y | Y | - | - | N | Y | - | - | Y | - | Y | Y | Y | Y |
| UPZ | Y | N | Y | Y | Y | - | Y | Y | - | Y | Y | Y | - | Y | - | Y | Y | - | - | - | Y | - | - | Y | - | Y | Y | Y | Y |
| EPD | Y | Y | Y | Y | Y | - | Y | Y | - | N | N | Y | - | Y | - | Y | Y | - | - | N | Y | - | - | Y | - | Y | Y | N | N |
| ICPD | Y | Y | Y | Y | Y | - | Y | Y | - | Y | N | Y | - | Y | - | Y | Y | - | - | N | Y | - | - | Y | - | Y | Y | N | N |

Y Response of 'Yes'  N Response of 'No'  - No answer

"Nuclear countries" define specific size and boundaries of the EPZs considering nuclear site properties, at least by type of nuclear reactor. Typical power reactor distances are as follows: PAZ ≈ 2 - 5 km, UPZ ≈ 5 - 30 km, EPD ≈ 20 - 100 km, ICDP 300 km and greater. Some "nuclear countries" used combination of zones (PAZ and UPZ) where neighbouring zones can be joined or overlapped. EPD and ICDP are in some cases determined according to current accident conditions (weather, results of radiological consequences estimation models, in-the-field measurements).

Regarding the other nuclear installations, such as research reactor, waste management facility, spent fuel facility etc., distances vary from several to tens of kilometres. Distances are defined individually with different radius depending on:

- the risks assessment of each nuclear facility; or
- the inventory of the installation; or
- the Emergency Preparedness Category of the facility.

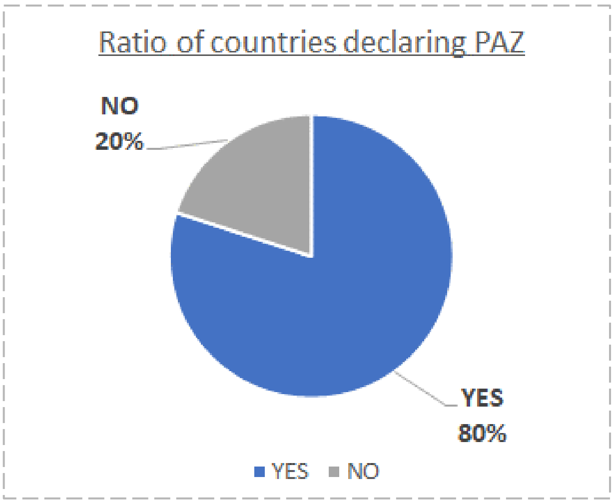



**Figure 21: Ratio of countries declaring PAZ**

- Arrangements to execute off-site emergency response

"Nuclear countries" provided a variety of answers regarding response related to nuclear installations, which can be generalized as follows: Each nuclear site has a plant-specific emergency plan, which foresees several action levels including executing off-site emergency response.

The criteria for triggering the off-site response are usually described in the off-site emergency plans and are based on several points such as:

- the Emergency Classes (Alert, Site Area Emergency, General Emergency) declared by the relevant plant operator based on specific plant parameters (Emergency Action Level - predetermined criterion for observable conditions used to determine the emergency class);
- conditions (both observable and predicted) related to the emergency having occurred;
- the criteria described in the on-site plans of the nuclear installations.

Off-site emergency response execution is directed by specific procedures that consider in-site situation as well as expected course of accident. It can be assumed, based on available information, that arrangements to execute off-site emergency response are in accordance with GSG-2.

Only one "non-nuclear country" uses generic criteria and operational criteria to execute off-site emergency response related to nuclear installations, which are defined in the national emergency response plan. The other responding "non-nuclear countries" have not defined criteria.

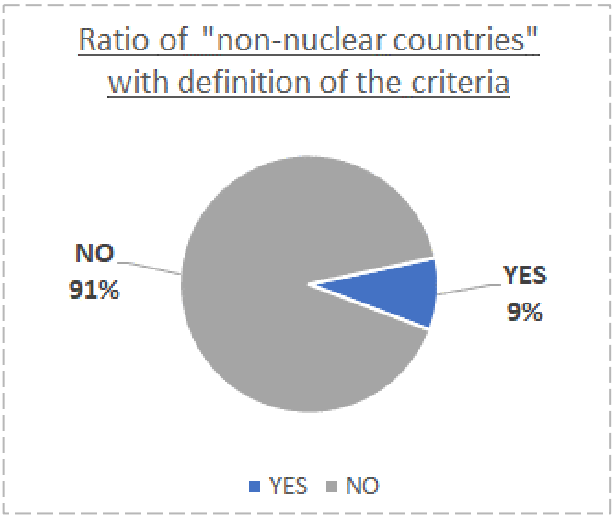



**Figure 22: Ratio of "non-nuclear countries" with definition of the criteria triggering the off-site response related to nuclear installations**

About 36% of countries foresee activating the EU Civil Protection Mechanism (EUCPM) in their national response plan. About 24% of responding countries are ready to request activation of the EU Civil Protection Mechanism if necessary, but the provisions for activating the EUCPM are not included in the emergency response plan. The main interaction would be carried out by some countries through the IAEA Response and Assistance Network (RANET) to seek the help of other countries by using the RANET system to obtain additional resources (e.g. radiation meters, measuring equipment) or international assistance from the EC DG ECHO ERCC. Almost all "nuclear countries" rely on their internal resources and external intervention is considered only in extraordinary cases.

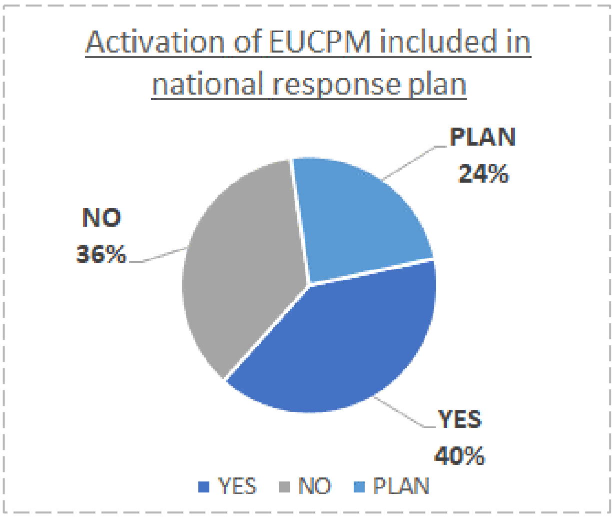



**Figure 23: Activation of EUCPM included in national response plan**

About 77% of countries have defined the criteria triggering the off-site response related with nuclear transport. Other countries have not defined the criteria in the response plan, or the criteria are defined only for radioactive source (there is no transport of nuclear material).

In general, emergency and rescue teams, whose activity is driven by national legislation, are activating off-site response related to nuclear transport. If necessary, the local response team passes information through the national emergency network. Consequently, regional and national levels of response can be activated. However, potential large releases of radioactive materials are specific only for "nuclear countries" and in such cases, any transport uses a specific arrangement which also considers recovery actions to suppress emergency, e.g. GS-G-2.1, etc.

- Arrangements planning

Based on answers, Emergency Response Plans are based on expected source term categories and magnitude of release (prediction of severe radioactive release to the environment, resulting in public exposure in excess of prescribed regulatory limits, and requiring partial or full implementation of planned countermeasures) rather than on particular accident scenarios depending on the reactor technology, e.g. LOCA.

Emergency Response Plans also consider several types of inventories in the risk areas. Namely, the people to be evacuated, vectors necessary for the evacuation of vulnerable people, the medical transport capacities of the departments, available means of transport, farms, sensitive installations, pharmacies and laboratories, drinking-water resources, electricity and telephone networks as well as other inventories are considered. On average, slightly less than 3/4 of the questioned countries are considering the above-named inventories.

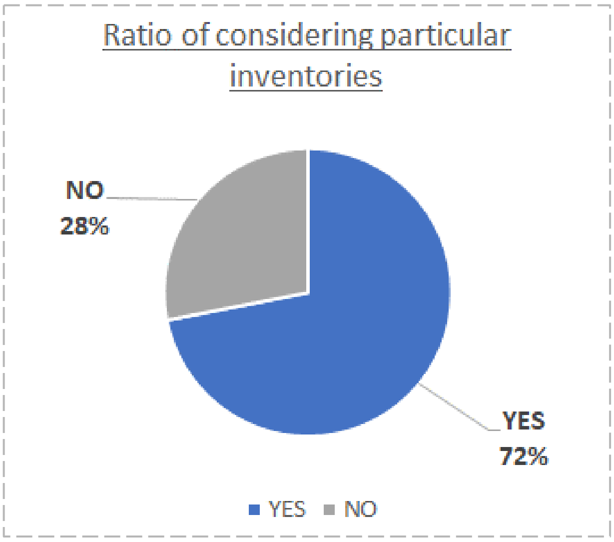



**Figure 24: Averaging of answers regarding consideration of particular inventories**

These inventories are regularly updated with a typical period of a half-year to four years. However, some countries are working on continual actualization.

- Public protection

Public-protection strategy follows requirements set down in GSR Part 7. EU countries also consider specific EU legislation, e.g. Council Regulation 2016/52/EURATOM. The corresponding criteria regarding sheltering, iodine prophylaxis, evacuation, food ban, control of person, vehicle and consumption, decontamination and relocation corresponds to criteria recommended by Appendix II of GSR Part 7. For instance:

  – Sheltering in place: when the release occurs quickly and is of short duration - 100 mSv in the first 7 days (projected effective dose or equivalent dose to foetus);

- Stable iodine prophylaxis: in the event of the release of radioiodine - 50 mSv in the first 7 days (projected equivalent dose to thyroid);
- Evacuation: from most contaminated areas from the fallout - 100 mSv in the first 7 days (projected effective dose or equivalent dose to foetus);
- Food bans - 100 mSv in the first 7 days (projected effective dose or equivalent dose to foetus) for production within the emergency area;
- Control of person, vehicle and consumption - 10 mSv in the first year (projected effective dose or equivalent dose for the full period of *in utero* development);
- Decontamination - 100 mSv in the first 7 days (projected effective dose or equivalent dose to foetus);
- Relocation - 100 mSv in the first year (projected effective dose or equivalent dose to foetus).

Countries having NPPs or neighbouring "nuclear countries" apply two basic strategies to distribute iodine tablets within the framework of emergency preparedness:

- Pre-distribution strategy, where the relevant share of the public living in PAZ and UPZ obtains iodine tablets. Further distribution of tablets within EPD etc. is organized by integrated rescue services;
- Central strategy where iodine tablets are kept in dedicated storage and distributed by integrated rescue services if necessary.

Both pre-distribution and central strategies assume coverage of the target population. Countries also have extra stocks to cover unpredictable cases and arrangements to ensure timely distribution (pharmacies, fire brigade or the civil protection operational forces). However, the number of people having received iodine tablets can be checked only indirectly.

In countries where stable iodine is not pre-distributed, arrangements are made to enable timely distribution by local municipalities. They have plans for distribution. In these plans, the municipalities determine the method of tablet distribution. It must be ensured that the tablets can be distributed to the population in the given times (e.g. 6 hours for a radius of 10 to 25 km around the NPP and 10 hours for the remainder of state area; in central zone (< 5km) within 6 hrs, in middle zone (5 - 20 km) within 12 hrs).

Most countries use the same dosage of potassium iodide:

- Infants (<1month) 16.25 mg
- Infants (1 month - 3 years) 32.5 mg
- Children (3 - 12 years) 65 mg
- Adults (12 - 45 years) 130 mg
- Pregnant women 130 mg
- Category others specifies some cases, e.g. > 45 years, risk of hyperthyroidism and possible thyrotoxic crisis, breastfeeding women etc.

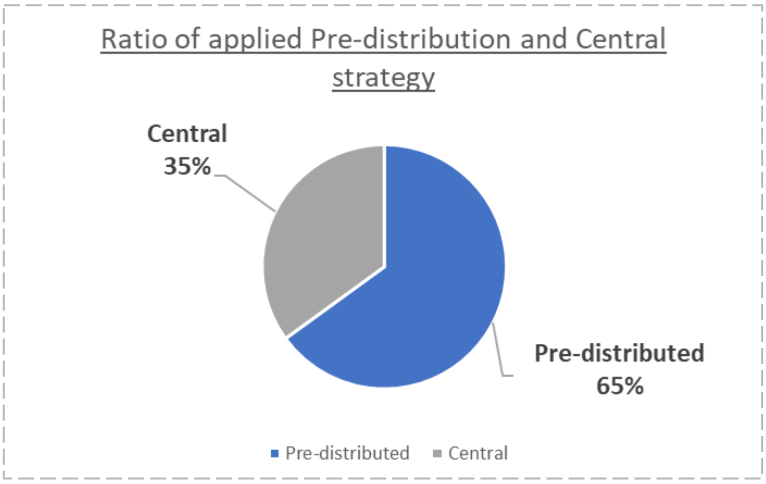



**Figure 25: Ratio of applied Pre-distribution and Central strategy for distributing iodine tablets**

94% of "nuclear countries" and 59% of "non-nuclear countries" have defined evacuation routes. All countries have prepared specific evacuation plans including measures to ensure the continuity of traffic communications. However, despite an expected intensified communication and information campaign, a complete evacuation cannot be guaranteed. Only a couple of countries declared readiness to accommodate an entire EPZ population in pre-designated reception centres. It is important to note that (part of) the population is expected to manage themselves and the majority of the people who need to be evacuated will do so using their own means of transportation and will seek refuge with family or friends outside of the affected area. The experience shows that a significant percentage of evacuees arrange their own accommodation (some evacuation plans stipulate that approximately 70% of population will self-evacuate and for the 30% evacuated population arrangements for accommodation have to be in place). The other countries rely on general measures to deal with emergencies such as natural disasters, etc.

A majority of countries assume that obeying government injunctions and long-term restrictions could be enforced by coercive measures within the law. There are various laws, regulations and governmental decrees (e.g. the Crisis Act using security forces (police, army)) that can be activated to impose penalties on those refusing to follow government injunctions. And refusal of populations to follow the Government's injunctions can be managed by informing the population of the importance of the precautionary measures prior to an emergency situation. Informing the population on the risks of ionizing radiation, on how to act upon an alarm from the nuclear power plant and what to do when a decision on protective or other response actions has been taken facilitates acceptance and understanding.

The process for the decontamination of contaminated areas is usually defined in the national response plans. Decontamination of contaminated areas and its extent and complexity will be mainly based on the size of the affected area and the level of contamination. Only one country described the national resources, in case of contamination of areas, that are to conduct the decontamination phase in terms of manpower, knowledge and technology.

All countries assume a need for international technical and methodical support in case of area decontamination:

- to face the decontamination of large areas and manage significant volumes of radioactive waste;
- for the procurement of equipment and training of members of Civil Protection who complete the CBRN module;
- laboratory measurements for the food industry;
- in case of a large-scale radiological/nuclear emergency, e.g. providing scientific and operational support for quickly establishing a large number of mobile decontamination teams;
- severe contamination in land or at the sea, for example in the uncommon event of an explosion of a nuclear vessel.

If needed, international assistance would occur through the specific international channels (IAEA RANET, European Emergency Response Coordination Centre, etc.).

Complete availability of a strategy to return evacuated people (in terms of criteria, health care, environmental monitoring, etc.) was declared by 24% of responding countries. 11% of countries have strategy in development, 17% of countries have strategy described on the basis of radiological criteria.

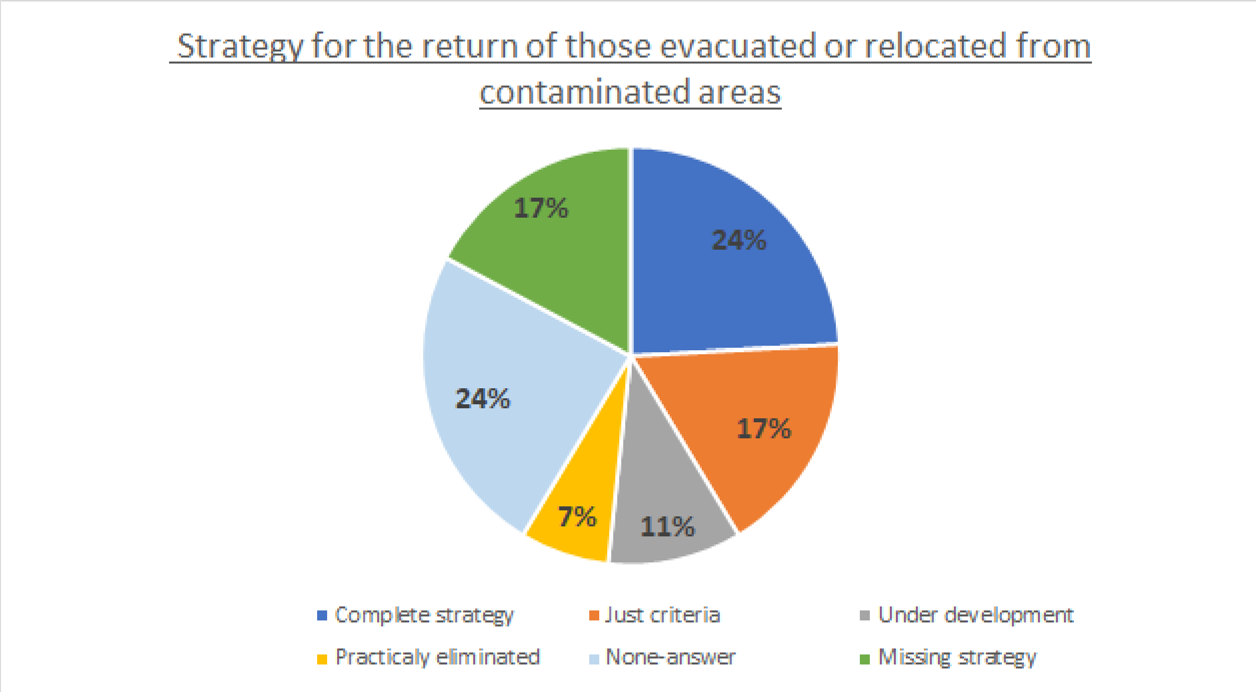



**Figure 26: Assessment of relocation strategy application**

There is a general opinion that a pandemic can affect several aspects of protection strategy, e.g. availability of human resources, burden of health care services, challenges in terms of evacuation and sheltering. Measures to correct the shortcomings regarding the pandemic might affect preparedness for radiological emergencies regarding evacuation and preparedness for combined events as well as justification of protective measures. On the other hand, the pandemic has shown that plans that involve potentially gathering people together, for example after an organised relocation or evacuation, might be challenged when implemented in practice. In these cases, sheltering in private houses might be the preferable option instead of relocation or evacuation.

- Strategy for economic and social continuity

Only 24% of countries declare having a strategy for economic and social continuity (after the accident). To enable the termination of the emergency, the strategy includes the reconstruction of infrastructure, jobs, and public services (e.g. public transport, shops, schools, kindergartens, health centres and police and fire services) which are a condition of normal life in the affected areas. This is also to be considered in those areas where evacuation or relocation has taken place. When dealing with nuclear and radiation accidents, the principle applies that individual ministries are responsible for the costs that arise from the obligations imposed on them by legislation.

The intention of keeping families together stated by law was declared by one country. Efforts are made to relocate people from the same area together. They are free to practice their religion and there is psychological and religious care (crisis intervention). Tension between different ethnic groups and subcultures is taken into consideration in order to minimize friction.

- Public involvement

About 58% of countries have an action plan for the preparation of the population in the normal period in case of an accident.

Action plans are implemented by regular public campaigns (brochures, leaflets, posters, printed calendar with info; workshops and presentations; websites, mobile applications, sessions on TV and radio) and exercises. The main principles of those action plans are:

- Educating the population regarding radiation safety and possible protection strategies in case of emergency;
- Familiarization with protection measures;
- General principles of protection and enhancement of self-protection knowledge;
- Communication strategy;
- Creating an atmosphere of trust;
- Tuning the cooperation of rescue services and intervention teams.

About 38% of countries take into consideration citizen participation in preparedness and recovery from a radiation accident. In several countries, citizen involvement is enshrined in legislation. Except for preparedness, there are two basic areas of participation:

- Consultation with professional and voluntary organizations (in preparedness stage);
- Involvement of citizens and voluntary organizations, especially in the transitional and late phase of an accident.

- Experience dissemination

The majority of countries attend international workshops and/or conferences regarding EP&R, namely concerning:

- Protection strategies and optimization approaches, including the use of reference levels - 96%, "non-nuclear countries" 100%;
- Generic criteria, operational criteria, default triggers - 89%, "non-nuclear countries" 83%;
- Arrangements for the transition from emergency to existing exposure situations - 86%, "non-nuclear countries" 83%.

In general, the impact of workshops on emergency arrangements is described quite generally as experience dissemination, harmonization and improvement of EP&R. Some countries highlight the global aspect of severe accidents as well as a difficulty in implementing new aspects and improvements of EP&R into existing national legislation frameworks.

- Best Practices

Communication among all involved parties; training; more frequent exercises; harmonization of the response procedures of all involved stakeholders; definition of reference levels and application of protection strategy optimisation concepts; enhancement of decontamination capabilities; developing all parts of a protection strategy as outlined in the IAEA EPR Protection Strategy publication; and more precise evaluation of the impact of a pandemic on emergency arrangements are all described as areas for further improvement of protection strategy.

The use of better prognostic and modelling tools, (real-time) information sharing, adopting the overall conceptual arrangements for the transition and recovery phase of the emergency, and development of decision support diagrams for an accident can be assigned as Best Practices.

From the analysis of the responses, good practices and challenges were raised.

The following ideas are highlighted good practices that could benefit from being shared among all the countries:

- Usage of better real-time prognostic and modelling tools;
- Real-time information gathering, processing and sharing;
- Integrated management systems including communication enhancement capabilities;
- Continuous actualization of particular inventories and their implementation in GIS (Geographic Information Systems);
- Building special funds to cover potential disaster expenditures;
- Adopting the overall conceptual arrangements for the transition and recovery phase of the emergency;
- Constant and regular preparations and exercises for stakeholders on every level. Implication of stakeholders from the preparation stage;
- Regular exercises or training sessions for several national and territorial authorities and citizens;
- Building a low barrier for cooperation between rescue, police, healthcare, licensee, and nuclear authority in EP&R matters.

Current challenges can be summarised as follows:

- Harmonization of national legislation and standard requirements can be difficult for some countries due to administrative barriers.
- Long-term evacuation and reallocation are treated quite generally; it should be clarified whether the current approach is sufficient.
- Regarding recovery actions to return to the pre-accident situation, including decontamination methodology and technology as well as funding of such activities, it should be clarified whether the current approach is sufficient.

- Building a safety culture among the population through exercises, for instance.
- Improvement of communication between authorities and organizations involved in emergency management, and communication between authorities, stakeholders and the public (e.g. conducting more training sessions with joint participation, inclusion of more participating organizations in routine exercises and considering the feedback from these activities).
- More precise evaluation of the impact of the pandemic on emergency arrangements.

### 4.2.5. Tools and measures

#### 4.2.5.1 Topics studied and input data

The Safety Authorities and Civil Protection Organisations were surveyed about the principles and tools used for describing an emergency situation.

Questions in this section gather information about diagnostics of the current situation, prognosis and assessing the possible consequences in case of an emergency. They covered the following areas: who is in charge of implementation of the plans, what is the number of measurement tools and tools put in place, what kind of monitoring tools are used for gathering real-time data.

Responders were asked if they are a member of the ECURIE agreement, if they use the European Radiological Data Exchange Platform (EURDEP), and if they use IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE).

#### 4.2.5.2 Assessment of tools and measures

The outputs of the responses are summarized in this chapter. It has to be noted that the numbers and ratios mentioned in the text and in the graphs do not include the non-respondent countries. The ratio of missing answers being below 20%, and in several cases below 10%, the quality of the answers can be considered quite high.

Responders were asked to describe the principles and tools for diagnosis/prognosis and assessing the possible consequences during an emergency situation. They were also asked to describe the organisation and the tools used to measure the level of radioactivity. Information was collected about the measurement methods used and the number of measurement tools put in place.

Responses vary in depth and level of detail, and the exact situation and practice varies from country to country, but it can be stated that licensee and high-level organizations (e.g. dedicated management boards, Ministries, agencies) are responsible for implementation of the plans.

Data from early warning system with gamma detectors and gamma spectra analysis, predicted values from numerical meteorological forecast are considered and decision support systems (e.g. RODOS, ARGOS) are used for assessing emergency situation and prognosing possible consequences.

Most of the countries use well-known decision support systems – for example different versions of the RODOS and ARGOS codes. In addition, in some countries in-house developed software tools are also used.

About the number of the measurement tools set in place, fixed and mobile radioactivity monitoring devices are used to measure gamma dose rate and gamma spectrum in the vast majority of the countries. Gamma dose rate monitoring stations are used for real-time monitoring. Air samplers and laboratories for sample analysis are also used in most of the countries.

It was asked whether responders are members of the ECURIE agreement. As can be seen in Figure 27, more than 90% of the organizations are members of the ECURIE agreement. If they are not members, it is because they are not an EU country, or the process of becoming a member of ECURIE is ongoing.

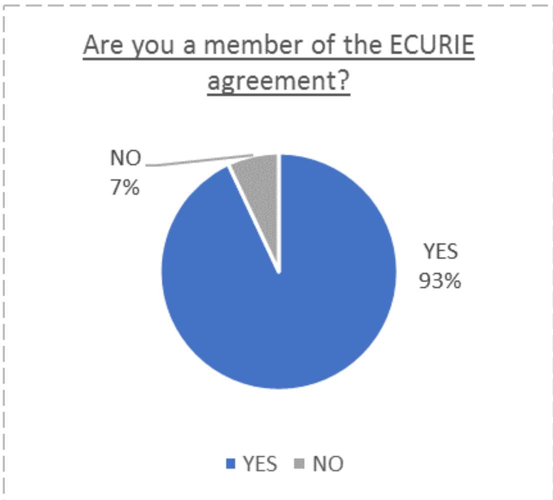



**Figure 27: Are you a member of the ECURIE agreement?**

According to the answers, about 90% of the countries use the European Radiological Data Exchange Platform (EURDEP) data (Figure 28) and all of them (except one country without an answer) use the IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE).

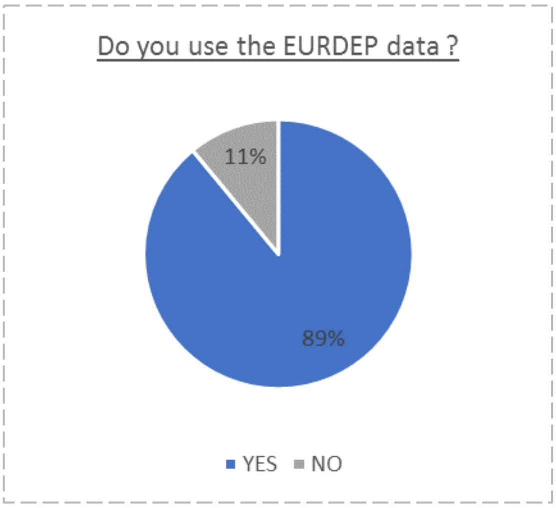



**Figure 28: Do you use the EURDEP (European Radiological Data Exchange Platform) data?**

Based on the answers, the EURDEP tool is used for getting and sharing information related to the radiological situation and the incidents. EURDEP data provide general information about the gamma-background. EURDEP data are important for evaluating the radiological situation in case of radiological emergencies and can be used to assess the radiological situation in other countries. These data can also be used for verification and to deal with rumours. In the event of a nuclear emergency, the measurement results reported by other countries on EURDEP would be reviewed as part of the technical assessment. It is very rare that a country postpones the transmission of data to EURDEP. It might happen only during maintenance or in case of non-valid data e.g. data are corrupted due to a device failure.

According to the replies received, the IAEA USIE (Unified System for Information Exchange in Incidents and Emergencies) system is one of the most important information sources on nuclear and radiological events worldwide (see Figure 29).

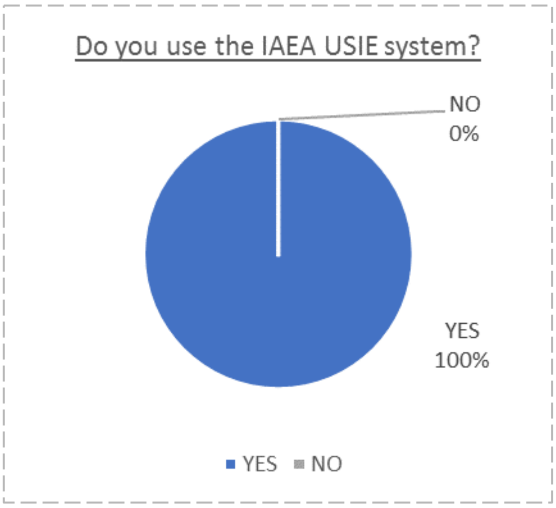



**Figure 29: Do you use the IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE)?**

Based on the answers the main role of the USIE system is the exchange of urgent information during nuclear or radiological incidents and emergencies with other states and international organizations. The USIE system can be used for broader purposes e.g. notification of an event, evolution of an event, response measures, radioactivity and environmental monitoring measurements, and requesting assistance. The USIE system is said to be a useful tool for gathering all the information related to a nuclear accident or radiological emergency and "the most important international system for emergencies." In addition, IAEA Member States can request official information in case of rumours, media reports or missing information.

It must be noted that based on the answers received, responders agree that reporting emergency data on several different platforms, like ECURIE and USIE, during an emergency situation is time-consuming and redundant. They would welcome connection between webECURIE and USIE and believe that EC and IAEA should facilitate automatic data exchange between ECURIE and USIE systems. It was emphasised that it is especially difficult to meet all the requirements in case of emergency and with a limited number of people.

However, having two separate systems provides some reliability in case one system is not available for some reason. Redundancy in this case is a positive aspect. The solution for more rapid information provision to different systems is automation of transfer of data from one system to another.

From the analysis of the answers, it can be summarized that the overall practice in each country is similar, with many differences in detail. It can be concluded that no particular challenges have been identified, and the overall level appears to be rather satisfactory.

#### 4.2.6. Communication

##### 4.2.6.1 Topics studied and input data

The Safety Authorities and Civil Protection Organisations were surveyed about tools and principles of communication on the national and international levels in case of an emergency.

Questions in this section gather information about the following areas:

- means of communication;
- frequency of sharing information on the progression of the accident;
- efficiency of the communication channels with the cross-border countries;
- compatibility between data types and data formats.

Best Practices and areas for improvements regarding communication were also collected.

It is to be noted that the information collected comes from nuclear and non-nuclear countries in equal proportions.

##### 4.2.6.2 Assessment of communication arrangements

The responses received enable summarisation of the structuring items of the means of communication.

About the time interval between the emergency notification in-site and the information towards the off-site team, the acceptable time for informing the off-site team is less than 1 hour. Responses vary between 15 and 60 minutes. In several countries the off-site team is to be informed "immediately" or "without delay".

According to the replies received, the frequency of information sharing on the progression of the accident between the in-site teams and the off-site teams depends on the situation and is not specified (or not mentioned in the answer). Responses that included a numerical value for this question indicated time intervals of between 30 minutes and 2 hours for additional information to be sent.

In most of the countries the means for communication are phones, e-mails, and fax. Usually, templates are used for written communication via e-mail or fax. Backup communication channels (e.g. secure radio network, emergency communication system, TETRA, satellite telephone connection) were also mentioned in several cases.

Most of the countries have a template for communication in case of emergency. These templates are used to analyse the current situation and to make prognoses. These templates may contain information about the date and time of the event, the classification and a brief description of the initiating event, the situation at the site and an initial assessment of the condition of the facility, weather conditions, information about potential releases of radioactivity to the environment, actions implemented or planned, recommendations, and contact details. In addition, corresponding templates for media and public information also exist.

These templates are prepared in advance and ready to be used for national communication and alert in case of emergency. In some countries these templates are not yet available and are under development or being improved.

Based on the answers, about half of the countries have a communication plan with an active dialogue between neighbouring countries on EP&R (Figure 30).

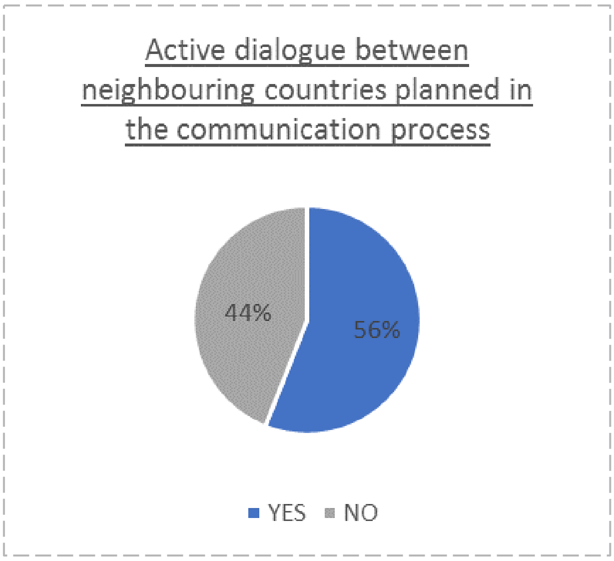



**Figure 30: Does your communication process plan an active dialogue between neighbouring countries on EP&R at all levels, local/municipal, regional and national, about the progression of the accident?**

According to the answers, the time interval between the emergency notification in-site and the information towards the cross-border countries is not specifically established but is typically not more than 2 hours. In bilateral EP&R agreements with neighbouring countries it can be specified, e.g. there could be a statement that each of the contracting parties has to inform the other party immediately.

In several countries for nuclear installations close to the country's border, the local/regional disaster management authority will alert neighbouring countries at the same time when federal authorities are alerted.

According to the answers, the vast majority of the countries have an updated national contact list with position, name and contact details; most of them also have a contact list of cross-border country entry contacts (Figure 31 and Figure 32). In most of the countries, these lists are updated regularly, e.g. once a year or more often.


**Figure 31: Do you have an updated national contact list with position, name and contact details?**

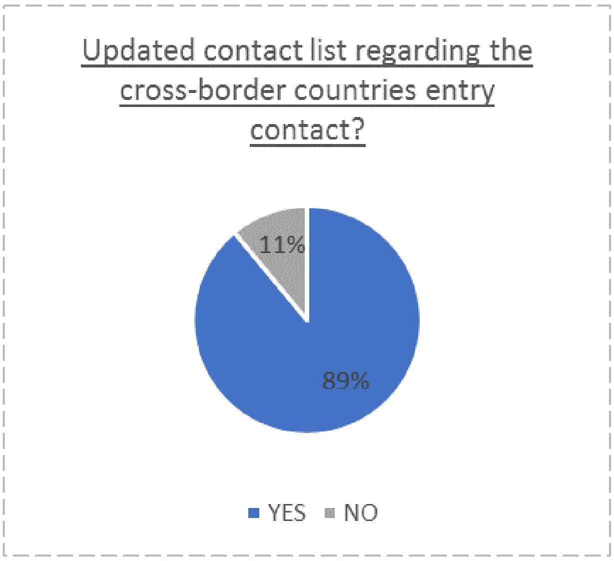



**Figure 32: Do you have an updated contact list with position, name and contact details regarding the cross-border countries entry contact?**

In many countries, great attention is paid to ensuring the efficiency of the communication channels with the cross-border countries. In order to ensure the efficiency of the communication channels, effective maintenance of the systems is implemented, and experts responsible for operating the systems and tools for communication are trained regularly. The communication channels are periodically tested during exercises.

It should be noted that there is no common and harmonized way of exchanging massive data between countries. There are no specific arrangements for exchanging massive data with different types and formats with neighbouring or other countries. In practice these processes are based on bilateral agreements between countries and use systems such as EURDEP and USIE, for example.

The surveyed countries shared their views about Best Practices and areas for improvement regarding communication.

Among the Best Practices, it may be mentioned that having a robust, redundant and reliable network connecting the emergency room, the nuclear facilities, other facilities, off-site emergency decision makers and other stakeholders is important. Cross-border exercises, in which the arrangements for cross-border information and data exchange are regularly tested, is also a good practice.

However, in general, communication at both national and international levels is a weak point and an area for improvement. One of the most important areas for improvement regarding communication is the need for more complex and detailed training of the experts who manage and perform communication with the public in case of emergency as the communication process in emergency situations is essential for effective implementation of protective actions.

The implementation of redundant (e.g. satellite-based) communication tools appears to be another area for improvement.

Coordination of communication with the public on the local, regional and federal levels could be improved as well. It has to be ensured that the same information and the same messages and recommendations are issued at all levels and by all involved actors. Otherwise, public trust in the authorities can be lost.

Improvements could be made concerning the updating of the contact list to make the process more regular with clear allocation of roles and responsibilities.

Increasing the role of social media was also mentioned as an area of improvement.

### 4.2.7. Testing and exercising

#### 4.2.7.1 Topics studied and input data

The countries were surveyed about EP&R exercises organized at the national and international levels and gathering of information and Best Practices related to this topic.

Questions in this section gather information about the types and frequency of the EP&R exercises in which respondents take part, lessons learnt and the action plan resulting from the previous EP&R exercise at national and international level.

#### 4.2.7.2 Assessment of testing and exercising arrangements

The aim of nuclear emergency planning exercises is to test the efficiency of the emergency response structure and system. Every exercise has specific objectives and issues to be tested, and topics are defined before each exercise.

Examples of topics that are regularly tested include, but are not limited to, the alerting procedure on different levels; different communication platforms; interaction between different authorities at different levels; and preparation of precautionary protection measures. Identifying Best Practices, gaps and areas for improvement are also important roles of these exercises.

EP&R exercises often focus on communication with the media and the public and the cooperation of and coordination between stakeholders.

The frequency of full-scale EP&R exercises at national level is around 3 to 5 years. Minor national exercises where the licensee and/or the Competent Authority participates are carried out at least once a year. National radiation measurement exercises are usually organized at least once a year.

According to the answers, in three quarters of the cases international observers are invited to take part and about 90% of the respondents have been participating in exercises involving other countries (see Figure 33 and Figure 34).

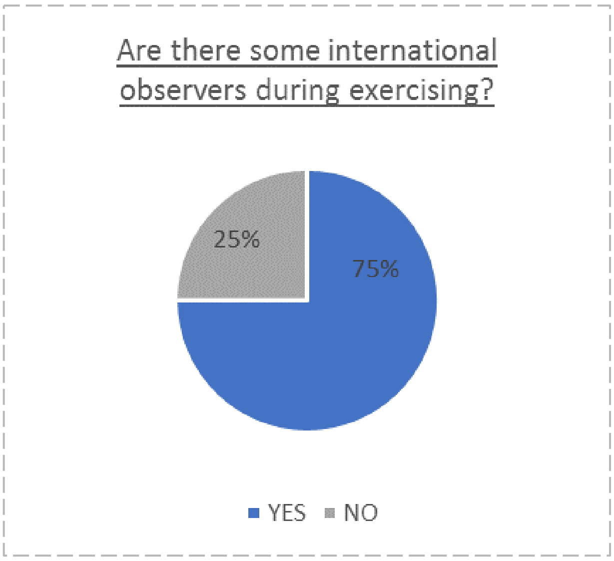



**Figure 33: Are there some international observers during exercising?**

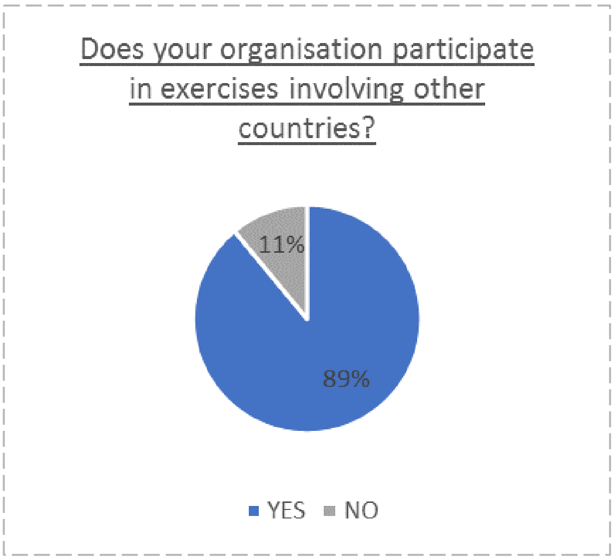



**Figure 34: Does your organisation participate in exercises involving other countries?**

According to the answers, there are large discrepancies in the frequency of bilateral comprehensive exercises conducted by the involved countries. This is a potential field for improvement.

One of the most important lessons learnt from national exercises is that rapid information exchange on the national level is essential for emergency management and needs to be performed at the required level of accuracy. Clear roles and responsibilities of stakeholders are of paramount importance. EP&R plans must be updated and adequate at all times. Cross-sector coordination is also of the utmost importance. Good information and communication strategies must be prepared in advance.

Due to the continuous changes in emergency documentation and staff, it is very useful to maintain regular training and examinations of functionality of the emergency preparedness and emergency response system in the form of national exercises. Off-site emergency plans must be continuously updated, and emergency processes need to be changed and adapted based on lessons learnt from the exercise.

There is a need to improve communication mechanisms between involved organizations; sharing information and knowledge between international experts and other participants plays an important role.

One of the lessons learnt from the previous EP&R exercises at the international level is the importance of technical information taking into account the specific nuclear technology in order for the proper assessment to be performed and suitable protective actions to be implemented. Improvements include additional training of experts involved in the assessment process and also of experts responsible for preparing information for other countries and international organizations.

Issuing of social media messages is not recorded formally and is not harmonized. Social media need to be monitored.

Further strengthening is needed in terms of resources, education and training, arrangements, plans and procedures.

The lessons of the COVID pandemic should also be evaluated.

According to the answers, in most of the countries the next EP&R exercise is planned in a year. One third of them are planning to increase the number of EP&R exercises in the coming years (Figure 35).

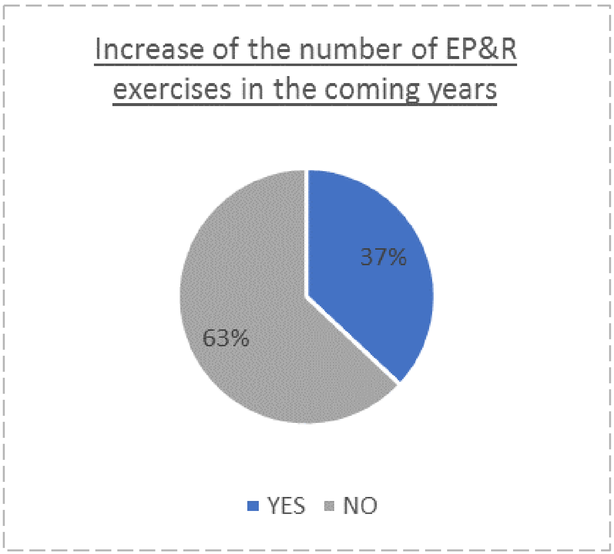



**Figure 35: Does your organisation plan to increase the number of EP&R exercises in the coming years?**

Based on the responses, about half of the organisations participate in the UCPM training cycle (MODEX) and participate in the Chemical, Biological, Radiological and Nuclear detection (CBRN) training cycle of the UCPM training cycle (Figure 36 and Figure 37). As the non-response rate to these questions is not negligible, it is presented in a second adjacent pie chart.

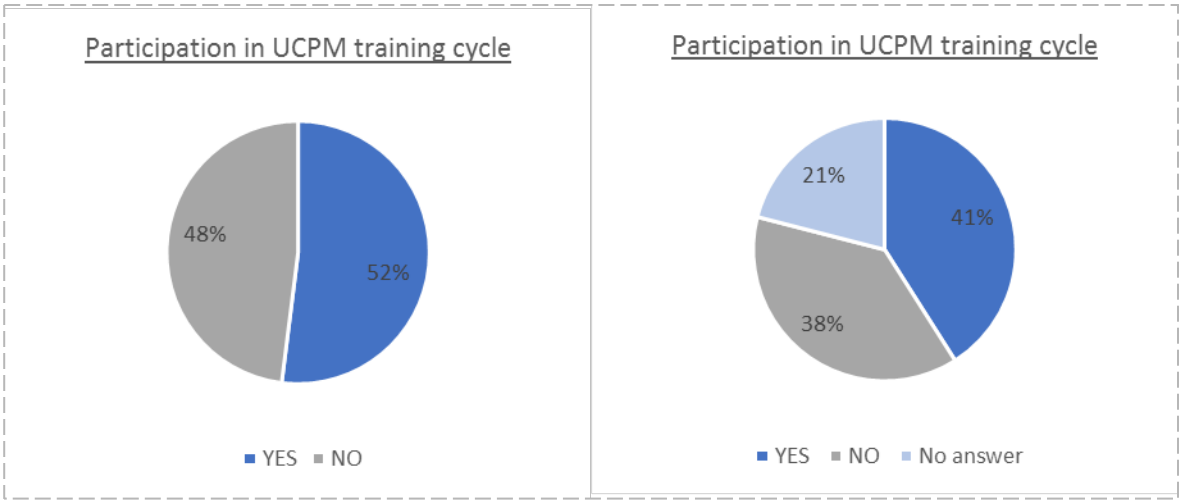



**Figure 36: Does your organisation participate in the UCPM training cycle (MODEX)?**

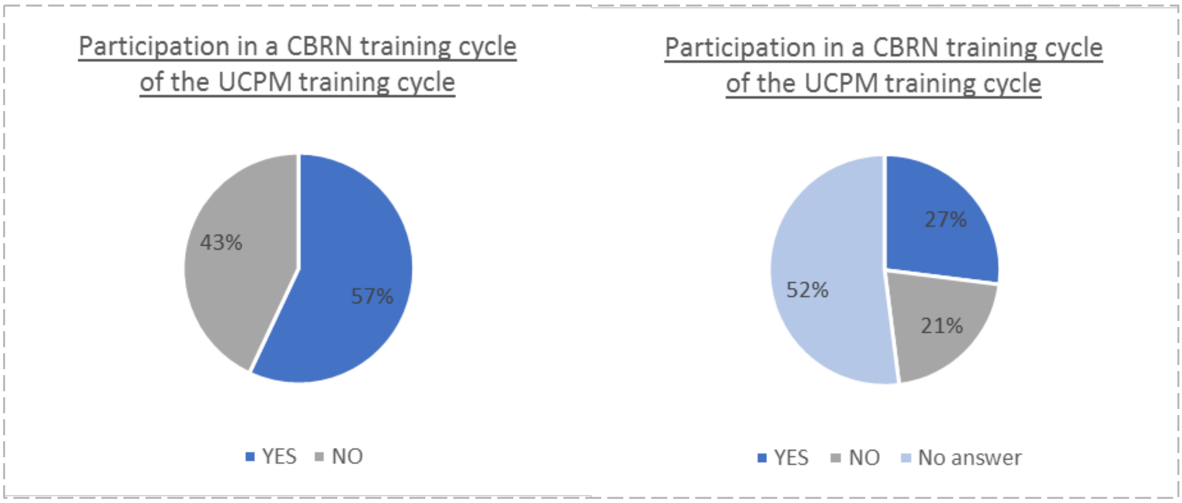



**Figure 37: Does your organisation participate in a Chemical, Biological, Radiological and Nuclear detection (CBRN) training cycle of the UCPM training cycle?**

A question was issued to understand whether countries have any recommendation and/or suggestion to the European Commission for additional training (MODEX). Very few responses were received; it is not possible to draw any general conclusions based on these.

Based on the answers, only one third of the organisations attend specific training in the radiological-nuclear field organised by CBRN Centres of Excellence (EU CBRN CoE) (see Figure 38). These courses are not as well-known and advertised as others such as the webinars organized by the IAEA. Easier access to such training activities could improve the simplicity of attending.

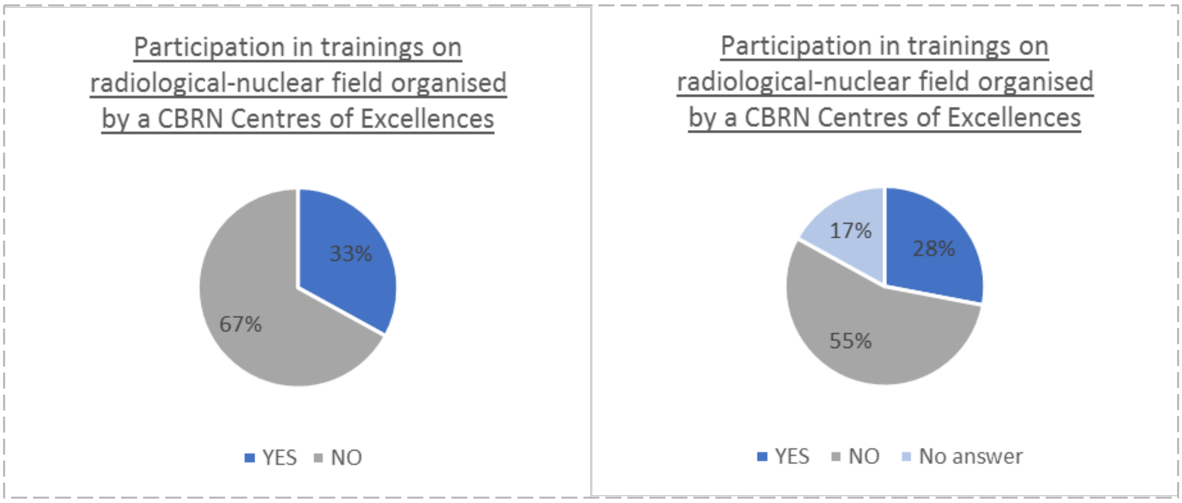



**Figure 38: Does your organisation attend specific training in the radiological-nuclear field organised by a CBRN Centre of Excellence (EU CBRN CoE)?**

Based on the answers, the vast majority of the organisations take part in ConvEX exercises, about two thirds of them participate in INEX exercises and about 80% of them participate in ECUREX exercises (see Figure 39 and Figure 40, Figure 41).

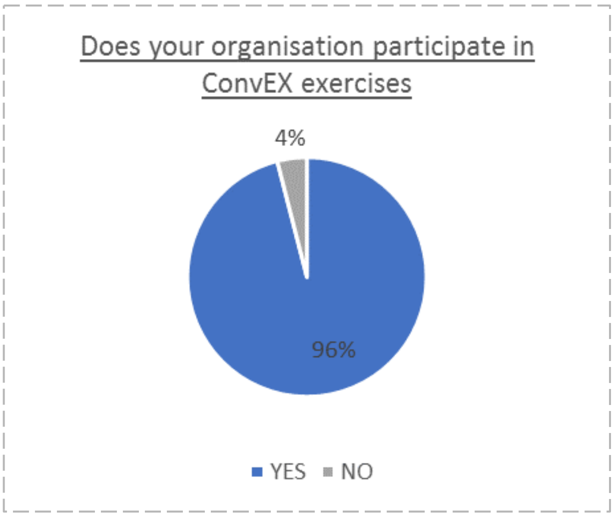



**Figure 39: Does your organisation participate in ConvEX exercises?**


**Figure 40: Does your organisation participate in INEX exercises?**

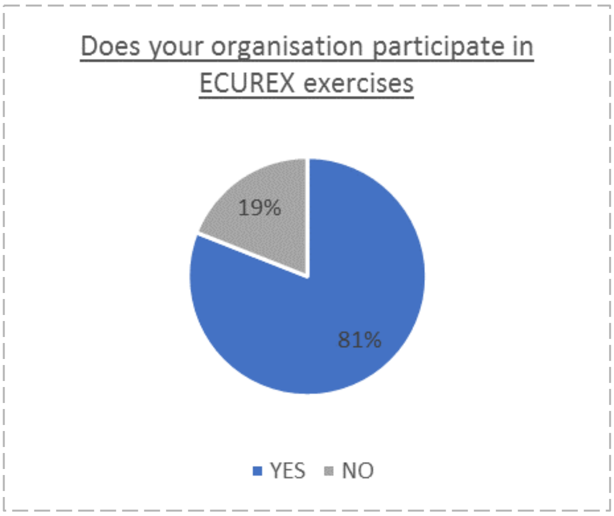



**Figure 41: Does your organisation participate in ECUREX exercises?**

The main challenges and lessons learnt from the last ConvEX, INEX and ECUREX exercises are the following:

- Better knowledge of technical questions and background is necessary;
- If several different (governmental) organizations are involved in a country, stakeholders have to be trained on a regular basis to be ready in case of emergency. Every stakeholder has to know the concepts and their tasks well;
- Time and volume of information exchanged between participating countries is essential for implementation of adequate protective actions;
- Cross-border communication and decision-making processes need to be improved and clarified;
- Harmonisation of protective actions across borders is lacking;
- Emergency plans should be supplemented with a dedicated part dealing with protection of citizens living (or staying) abroad during the emergency;
- National classification of the initial event should be harmonized with international classification.

The main communication is carried out via press releases and official news channels, without use of social media.

As requested, the countries reported Best Practices and areas for improvement regarding testing and exercising.

Based on the answers, a robust IT platform and support is very important. Participation of all the stakeholders is of utmost importance. A systematic approach to training and exercises is also very important, starting from small-scale exercises to train for specific tasks to larger-scale and more complex exercises. Exercises should always reflect a reasonable real-life scenario. Exercises also provide an opportunity to test the communication arrangements in place between stakeholders (both nationally and bilaterally) and how the public is to be informed.

The areas for improvement identified are making arrangements for more frequent communication tests and bilateral exercises with neighbouring countries.

### 4.2.8. Cross-border cooperation

#### 4.2.8.1 Context and regulatory situation

The topic of cross-border cooperation is fundamental in the realization of harmonized, aligned, coordinated or coherent implementation of countermeasures in transboundary accidents. Additionally, mutual help and collaboration in dealing with specific issues, such as the urgent foreseen or unforeseen movement of people or goods from a country to a neighbouring one during an accident, are pillars in strengthening the effective and efficient off-site management of an accident.

Formal agreements with neighbouring countries for cross-border cooperation are the first necessary element to be established and implemented. To then take these agreements from the legal to the practical level, several no less important elements are needed, such as: precise knowledge of the neighbouring countries' available resources, potential lacks or needs, capabilities; frequent joint training sessions and organization of exercises and drills; preparation and actuation of joint public communication campaigns both at the preparedness and response phases; the establishment of provision for automated data exchange, etc.

Other forms of cooperation include research actions, either directly performed or as stakeholders or end-users to projects, like those funded by the European Commission within the framework of EURATOM.

#### 4.2.8.2 Topics studied and input data

A series of questions was submitted in order to understand and capture the current status of practical implementation of provisions to facilitate cross-border cooperation.

The first group of questions dealt with bilateral or multilateral agreements between neighbouring countries; the second group focused on some practical and precise aspects of these agreements that are useful during emergencies; a couple of questions were related to the IAEA RANET; and a final group asked about the knowledge of results coming from a series of EC-funded research projects on emergency preparedness and response (PREPARE, OPERRA-SHAMISEN, ENGAGE, TERRITORIES, CONFIDENCE, SHAMISEN-SINGS, FASTNET and HONEST) and about the existence of action plans for the implementation of the scientific results stemming from these projects.

#### 4.2.8.3 Assessment of protection strategy arrangements

It is to be noted that the numbers and/or ratios given, including in the graphs, do not include the non-respondent countries, because it is not possible to differentiate between the actual, in some cases even multiple, reasons for not responding,[6] and therefore it would be extremely difficult to interpret correctly the absence of an answer as such. Given, however, that the number of answers is relatively high (on average greater than about 70%), the quality of the results obtained by the overall analysis can be considered good in terms of average representativeness.

A question was asked pertaining to knowledge of neighbouring countries, in particular about the available resources that could be used or exchanged in case of accidents. The precise question asked: "Do you know the resources available in the neighbouring countries?". The answers are reflected in Figure 42.

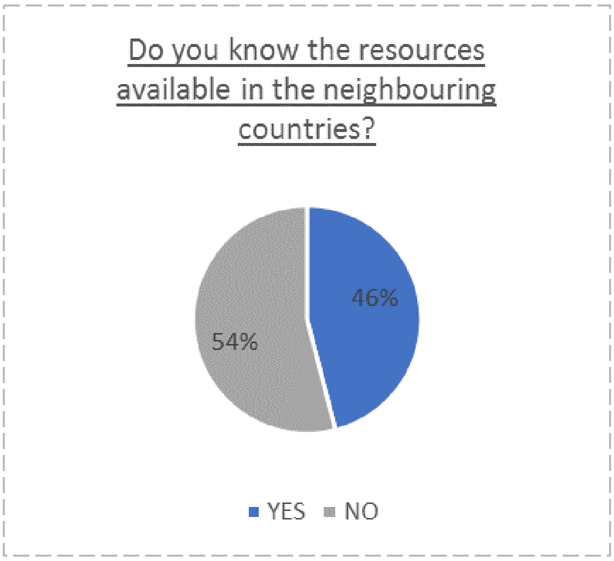



**Figure 42: Do you know the resources available in the neighbouring countries?**

Rather interestingly and surprisingly, a bit more than 50% of answers indicated "NO," pointing out a potential weakness of effective and efficient cross-border cooperation. Additionally, this can also indicate a potential issue within a single country; in fact, information about the available resources in neighbouring countries could be available to Civil Protection organizations, rather than Safety Authorities, but apparently this information, if available at all, is not immediately in the hands also of the Safety Authorities, implying a possible slowing down in the implementation

[6] Cfr. Note 1.

of requests for help or assistance. This also has an impact on the status of interfaces between Civil Protection organizations and Safety Authorities, in the sense that internal availability of this information might not have been properly dealt with in the Emergency Management System. It should also be stressed that the current version of the so-called HERCA EP&R Country Fact Sheets, which have been developed precisely to increase mutual knowledge of EP&R current situations in each country, does not cover this aspect of available resources. To counterbalance this negative aspect, it could be mentioned that available or shareable resources for EP&R are dealt with in the IAEA Response and Assistance Network (RANET). Not all Member States, however, participate in RANET and therefore information might not be readily accessible during an emergency. Countries lacking information on resources available in neighbouring countries may also have difficulties in introducing into their response strategies at the preparedness level the possibility of synergies with neighbouring countries and of their practical implementation. One possibility for reducing this gap could be the introduction of special provisions in the formal agreements with neighbouring countries to allow and put in practice the exchange and constant updating of information about available and shareable resources.
This last consideration, in turn, points to the vital question "Do you have EP&R agreement with all your neighbouring countries?" Answers are reported in

Figure 43.

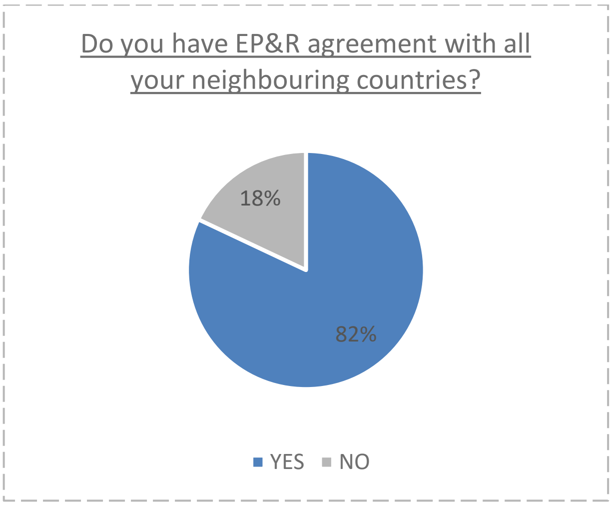



**Figure 43: Do you have EP&R agreement with all your neighbouring countries?**

This clearly shows that most of countries have formal agreements with all their neighbouring countries. However, considering the results of the question about the resources available, it can be concluded that, currently, these agreements do not always include the exchange of information on available or shareable resources. From a theoretical standpoint, the HERCA Guidance for Bilateral Arrangements covers the aspect of exchange of information about assistance capabilities, but this Guidance has not yet been fully implemented by many countries in the preparation of their bilateral agreements.

Going to the point of the automated transmission of data (measurements, plant status information, diagnosis and prognosis, assessments, etc.), it was asked of the respondents "Do you have arrangements with the neighbouring countries, regarding the automated transfer of measurement data?"

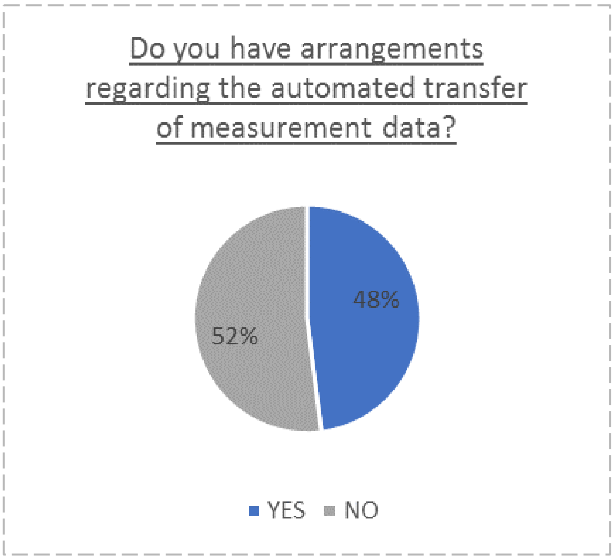



**Figure 44: Do you have arrangements with the neighbouring countries, regarding the automated transfer of measurement data?**

Figure 44 shows the results, which indicate that a little more than 50% of respondent countries do not have specific arrangements for the automated transfer of measurement data. The reasons behind this need to be clarified: lack of ad-hoc confidentiality clauses, lack of secure ways to exchange the data, or other.

Regarding the topic of organisation of joint drills and exercises, the countries were surveyed about their arrangements with their neighbouring countries. This is a fundamental aspect that helps in strengthening the coordination of responses, that increases mutual trust between stakeholders, and that facilitates the exchange of knowledge and best practices. It also helps in pointing out, and stimulating awareness about, possible weaknesses that can therefore be amended. Unfortunately, this topic seems not to be very much developed currently. Answers to this question, summarized in

Figure 45, indicate that about one third of respondents do not have arrangements to perform joint drills or exercises. This is an aspect that certainly deserves attention in the coming years and that necessitates improvements.

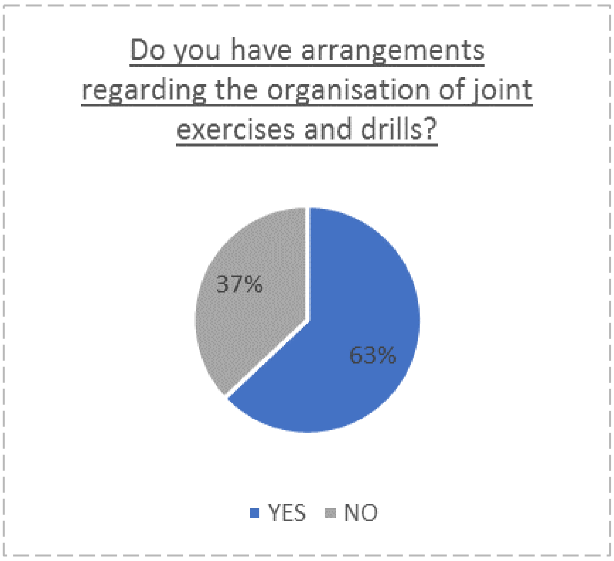



**Figure 45: Do you have arrangements with the neighbouring countries regarding the organisation of joint exercises and drills?**

To the same aims, another fundamental point is related to the design and implementation of joint public communication campaigns. These, apart from increasing awareness on the part the public, strengthen trust in preparedness and response plans and provisions, prepare the public itself, and help to get a more coherent actuation of countermeasures in real cases. To understand if participating countries organize joint communication campaigns to the public, the following question was asked: "Do you have arrangements with the neighbouring countries regarding joint public communication campaigns?" Unfortunately, 100% of the reported responses are "NO." This should stimulate a thorough reflection on the reasons behind these answers, and also to understand whether the specific issues are more of a practical type, and therefore quite easily solvable, or related to other aspects like differences of approaches from a political point of view.

Finally, another interesting element about cross-border cooperation in practice is the presence of appropriate mechanisms to rapidly exchange information in situations that require a very rapid decision-making process. Another question asked: "Do you have arrangements with the neighbouring countries, regarding mechanisms for rapid exchange of relevant information between appropriate authorities in case of a severe accident requiring rapid decisions for protective actions?" Answers are graphically summarized in

Figure 46.

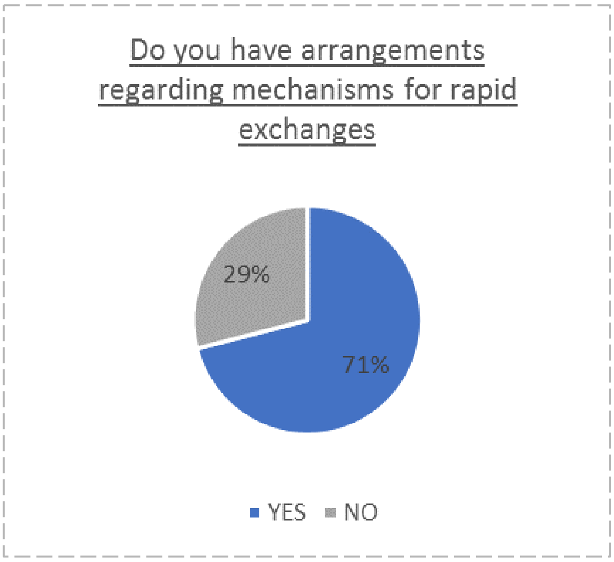



**Figure 46: Do you have arrangements with the neighbouring countries, regarding mechanisms for rapid exchange of relevant information between appropriate authorities in case of a severe accident requiring rapid decisions for protective actions?**

It shows that almost 3 countries out of 4 have such mechanisms in place. This indicates that the urgency of implementation of countermeasures is recognized as a really important factor, so that urgent exchange of information should also take place among the relevant counterparts.

Some challenges have been identified in the analysis of the answers to the relevant parts of the Questionnaires.

One of these is the still-insufficient knowledge of neighbouring countries, especially as regards assistance capabilities, including the availability of shareable resources. As stated in the previous paragraph, this could point to some weaknesses, either in the national Emergency Management Systems, or in the specificities of the signed bilateral cooperation agreements between relevant stakeholders. Independently from the cause, this issue may represent an important drawback in certain circumstances, in that it can slow down somewhat the implementation of response actions.

Another important challenge is the reduced number of practical implementations of mechanisms for the automated transfer of data (especially, but not exclusively, measurement data). To improve this aspect, the following should be considered: from the legal point of view, confidentiality issues; from the security point of view, important potential cybersecurity problems; from the cultural point of view, the issue of mutual trust. Some automated or semi-automated transfers of measurement data are currently implemented, just as an example, through the EURDEP platform maintained by JRC, and several good practices related to the necessary arrangements to be put in place could be taken from this specific experience and applied to the bilateral dimension of neighbouring countries.

A final important challenge would be the realization of joint communication campaigns to inform (and also involve) the public, especially in areas near the borders potentially impacted by transboundary accidents. This is a very relevant and useful practice that, if properly designed and introduced already at the preparedness stage, could be a great help in avoiding misunderstandings and confusion in case of transboundary issues, not only during the emergency phase of an accident, but also in the post-accident, long-term recovery phases that imply the transition towards existing exposure situations.

### 4.2.9. Public information

#### 4.2.9.1 Context and regulatory situation

In the event of a major radiological accident, the goal of an organised response is to avoid and mitigate any negative impacts on the environment and human society. To reach this goal, an optimal cooperation between all the concerned people must be settled on. Mutual cooperation implies a good level of information transmission and confidence, in particular with the general public. For an effective response, all the work of preparation must "ensure that an adequate capability is in place within the operating organization and at local, regional and national levels and, where appropriate, at the international level" (IAEA GSR Part 7 3.1). As recommended by IAEA GSR Part 7 article 1.12, the effective fulfilment all the EP&R arrangements must be verified, including the public communication modes.

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

[…]

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

All European countries surveyed confirm they all apply the IAEA General Safety Requirement (N°GSR Part 7). IAEA requirements no. 10 and no. 13 are dedicated to information to the public:

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

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

"Requirement 13: Communicating with the public throughout a nuclear or radiological emergency.

The government shall ensure that arrangements are in place for communication with the public throughout a nuclear or radiological emergency. Communication with the public in a nuclear or radiological emergency shall be carried out on the basis of a strategy to be developed at the preparedness stage as part of the protection strategy."

History has taught us that coordination and consistence in disseminating information to the general public is primordial. Thirty-five years after the Chernobyl catastrophe, distrust of the authorities and mistrust in the veracity of the information given out is still very present. The malfunctioning of information transmission has contributed to reinforcing the anxiety-provoking aspect of nuclear affairs.

In case of an accident, the nuclear community is engaged to explain the causes and to present the predicted evolution and the status at the moment. The countries must prepare a communication structure and means shared between all the stakeholders to "address public concerns regarding potential health effects."

The communications system must consider the quality of the transmitted information and control spurious data and fake news.

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

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

Depending on the severity of the event and the extent of the needs, support from the public will be beneficial. The population concerned is qualified as "helpers". They benefit from a specific regulatory framework to ensure their management and protection. "Helpers" interventions are taken into account jointly with the "emergency workers". The government shall ensure that arrangements are in place to protect emergency workers and to protect helpers in a nuclear or radiological emergency (Requirement no. 11, IAEA IAEA guide GSR Part 7).

For a targeted public such as health practitioners, dedicated information must be provided:

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

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

#### 4.2.9.2 Topics studied and input data

All countries surveyed compiled the structural elements of their organisation of communication to the general public. All topics from distribution of responsibilities to provisions for optimizing public confidence were summarized by the respondents.

Every country has its communication cell and a defined approach to communicating official announcements to the population. The means of communication used, the role of the players, the methodology for disseminating the relevant information with the proper timing, and consideration of external items such as any rumours and anxiety were reported.

The competent authorities shared information about the support documents made available and transmitted to the public in daily life and following a notable accident.

The key-points on the position of the population in relation to the authority and the experts in the field and levers for improving public confidence were also elaborated.

#### 4.2.9.3 Assessment of public information providing

In Europe as a whole, the psychological effect of the Chernobyl accident is still present, which causes a decrease in the public's trust in the competent authorities. Essential work needs to be done to communicate with the public in order to heal the traumas of the past and prepare the population in case of a potential radiological accident.

On the whole, it is government who is in charge of providing information aimed at the public and at the press in case of radiological emergency on the national territory, or even if the accident occurs abroad. All the countries have a dedicated ministry responsible for information and organization of warning of the population. They benefit from technical and radiological support of Civil Protection and the safety authority.

In some countries, like Bulgaria, if the emergency has the potential to impact the whole territory, headquarters are established at the regional level. These headquarters are the official source for informing the public and issuing press releases with information on the event's progression and protective actions to be implemented.

In all cases, one single source of information is established to ensure the consistency of the information that is then relayed. The official source of information notifies the media and provides information to the public on what actions they should or should not take and why, responding to incorrect information and rumours. It passes on the guidelines to the local level and concerned municipalities in charge of immediately providing information to the general public affected about the facts of the radiation accident, the steps to be taken and, if necessary, measures to be adopted for the protection of the general public.

In Germany, where the representation of the region is strong, dissemination of information and recommendations follows this principle of "one message - many voices." All authorities and organizations involved in the emergency response shall pass on the information and recommendations for conduct provided by the radiological situation centre and the disaster control authorities responsible to the population, the affected institutions fully adopting their content for their own area of responsibility.

In a limited number of countries, such as the Czech Republic, the licensee shall also immediately inform the general public affected by this radiation accident about the facts and expected development of the accident.

The means of communication used to inform the public are:

- Website;
- Press release;
- Announcements on public broadcast TV;
- Scrolls at the bottom of TV broadcasts;

- Announcements on public and private radio;
- Newspapers (online and paper);
- Printing presses for paper publications;
- Leaflets;
- Social networking media;
- Hotline;
- Mobile phones;
- SMS;
- Dedicated mobile phone application;
- Read voice messages to ordinary telephones;
- E-mail;
- Pre-prepared text templates for different scenarios and different types of radiological events and emergencies;
- Messaging in other languages to ensure effective communication;
- Siren alert;
- Spoken emergency information;
- Loudspeaker systems.

The process implemented in Czech Republic and reported in their response to the questionnaire gathered a broad range of information support towards the population directly impacted. In the case of the occurrence of a radiation accident, warning the population is the primary measure. The population is primarily warned through the "General Alert" warning signal. The signal is sounded by a siren warble tone for 140 seconds and it can sound three consecutive times at approximately three-minute intervals. The signal is activated by the Fire Rescue Service of the Czech Republic on request of the shift engineer of the operator of a nuclear installation. The signal is immediately followed by spoken emergency information notifying the population of the data on the imminent or emerged extraordinary event and of the measures for protection of the population. The provision of such emergency information is performed through the end warning elements, fitted with the module for transmission of voice information. The warning signal indicates a general danger. Other specific information on danger and protection mode will be communicated to the population immediately via radio (Czech Radio) and television (Czech Television, channels ČT 1, ČT 24), local radio, vehicles of the components of the Integrated Rescue System, or other available method. Another complement to the information system has been since 2018 is the system of information of the public via SMS gateway. The residents in the emergency planning zone have the possibility, after registration on the Web portals, of receiving important information about the operation of nuclear power plants via SMS and e-mail. Basic information for the case of a radiation accident at the NPP can be also found on these portals.

In the case of a radiation accident, the sirens are switched on and the public is warned of a serious situation. All further information will be given by the communication means.

To ensure that rapid and reliable information is dispatched to the public in case of emergency, the organisations are based on centralized information collection and distribution by a working group comprising all stakeholders, based on data from verified sources and using verified distribution platforms that are regularly maintained and supervised if necessary.

The frequency of sharing information with the public on the progression of the accident depends on the situation. There is no pre-decided fixed frequency; it depends on the progression of the accident itself. Information is transmitted systematically in case of a changing situation.

The frequency is based upon the verified new information and the severity of the situation. Usually, it is continuous during the early phases of the operations, the order of magnitude is every few hours via broadcasting and more frequently on social media; then it changes to be periodic as time progresses.

If an emergency occurs abroad and does not have impact on the national territory, the information coming from the accident country is relayed from official sources on its website when new or updated information is available. They also benefit from the information received from the IAEA and European network channels, transmitted to the national websites and competent authorities.

The control of the information, its source and the way to disseminate it is essential. In Norway for example, as in all nuclear countries, during an acute incident, the Communication unit at the Safety Authority is mandated to:

- Assist the Crisis Committee by developing communication strategies adapted to the incident at hand;
- Suggest and implement communication measures for the Crisis Committee in the various phases of the incident; and
- Assist the Crisis Committee in disseminating coordinated information to the general public and media.

The emergency centre guarantees the uniformity of the information transmitted to the media and presented on the Web portals, to keep the public informed and to prevent the spread of misinformation and panic.

All the countries have elaborated a strategy to maximise the consistency of the information communicated:

In case of a nuclear emergency that can or will affect Denmark, the communication to the public is coordinated in the Central Operational Communication Staff (DCOK). DCOK is hosted at the same facility as the National Operational Staff (NOST) and ensures close and updated information on the emergency from all relevant authorities. In case of a nuclear emergency that will not affect Denmark, the communication will be provided by DEMA (Danish Emergency Management Agency) experts who are trained as spokespersons.

In Hungary, in case the National Coordination Committee is activated, the DMCIC NERC (National Emergency Response Centre) decides about the release of the information for the public. The decision is based upon the proposal of the DMCIC NERC's Public Information Workgroup. This workgroup creates the content of the public information based on the assessments of the DMCIC SC NESES. After approval, the public information is transmitted to the involved nuclear installation and the participating organisations of the nuclear emergency who themselves provide the information for the public by their technical/electronic equipment and devices. In case of lesser events, the Hungarian Atomic Energy Authority (HAEA) and the establishment where the event occurred is responsible for the communication.

In Ireland, a Public Information & Media Monitoring sub-group of the National Emergency Coordination Group may be established to develop key public information messages in consultation with the Government Information Service. The Government Information Service has responsibility to streamline, simplify and implement Best Practice in government communications and supports clear citizen-focused communications. Members of the sub-group will include Government Information Service, Department of the Environment, Climate & Communications, Environmental Protection Agency, Met Éireann (Irish Meteorological Service), Department of Agriculture, Food & the Marine, Department of Health, Department of Foreign Affairs & Trade and press officers from other Departments and agencies. This ensures that coordinated information is provided to the public.

In Sweden, if rescue efforts are required in the municipal civil protection, as a result of accidents involving the release of radioactive substances and which involve an emergency situation that entails a risk of radiation, the Swedish Civil Contingencies Agency shall assist the municipality with information on how to inform the public.

Regular press releases and conferences with media ensure the availability and timely update of information. Competent authorities provide elements for public information by issuing of periodic technical dispatches towards the government bodies and Civil Protection. The technical dispatches are prepared in the first hours of the emergency by on-duty technical experts.

During a crisis situation, experts are approached by the media. This can be a source of information conflict. In general, the risks of this practice are reduced by the countries by training the technical staff in media and press management. Communications experts and technical experts work together closely. The method of transmitting information to the public and the media is part of the emergency response plan.

Even countries without NPPs must be prepared. For instance, in Lithuania, depending on the situation, if the State Emergency Operation Centre is activated together with the press centre, the experts from different organisations are summoned to the press centre to answer questions according to their competence. In case the State Emergency Operation Centre is not activated, each institution is responsible for communication with media. Institutions taking part in response to emergencies have dedicated public communication experts responsible for communication with media. For example, to ensure the preparedness of communication with media, the State Nuclear Power Safety Inspectorate invites public communication specialists every year to train and exercise dedicated experts for public communication. On the contrary, in Latvia, only designated personnel in the governmental bodies would be allowed to relay information to the media and press. In Portugal, questions from media and press are redirected to the communication departments of the relevant entities.

However, a need for additional training and drills for experts, decision makers, public information officers and spokespersons has been expressed by the surveyed Safety Authority and Civil Protection Organisations.

Given the large number of specialists working in the nuclear field who can be directly contacted by the press, ensuring totally uniform communication can be performed only through implementation of measures upstream and downstream of the information transmission: training the experts in mass media communication, limiting the number of speakers and controlling and correcting the information disseminated to the public community.

All the countries test their national emergency response plan, one of whose objectives is public information and communication, to improve this component of the EP&R arrangements. The slightest inconsistency can fuel mistrust and generate anxiety and non-application of the recommendations. Arrangements have been made for providing useful, timely, truthful, consistent and appropriate information to the public in the event of a nuclear or radiological emergency.

In the age of globalization and the Internet, consistency must also be implemented beyond borders, at the international level.

Only half of the respondents stated that they have a communication process which plans for active dialogue between neighbouring countries on EP&R at all levels, local/municipal, regional and national, about public information.

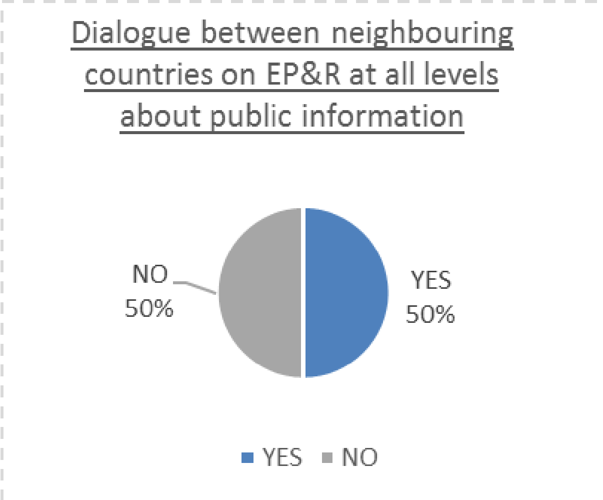



**Figure 47: Ratio of countries implementing dialogue between neighbouring countries on EP&R at all levels about public information**

The trend remains the same whether the country is nuclear or not, member state or not.

Nevertheless, countries stay connected and inform each other.

As a minimum, messages and information posted by other countries and international institutions are monitored during the event. The information and press releases made available by others are at least mentioned on national communication and when relevant supported by their own evaluation of the situation. The national communications are consistent with them to the extent possible. If an emergency occurs abroad and does not have impact on the national territory, they present to the public the same information provided in press releases by the official authorities of the accident country and/or by the international entities. When the threat directly affects a country, they produce their own reports to inform the public. When they exist, bilateral agreements with neighbouring countries provide for cross-border transmission and coordination of information for the public.

EC and IAEA statements are good sources for verifying information because they have direct contacts with accident country. Data and press releases from IAEA and EC are distributed by the USIE and WebECURIE systems. This information can be shared with the national institutions and transmitted to the national press.

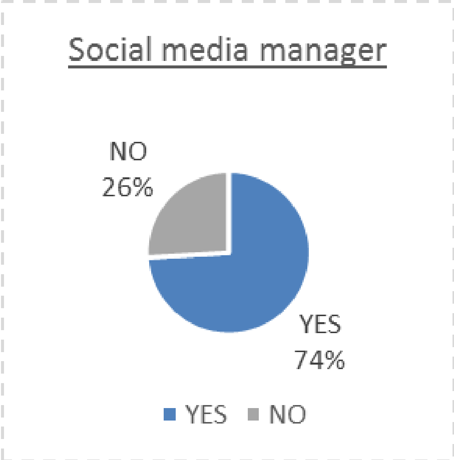
Within the cooperation between the Nordic countries, each country receives major public statements in advance, together with explanations and judgements. The mechanisms are detailed in The Nordic Manual (NORMAN, 2019), which emphases exchange of information regarding communication with the public as well as safety assessments and protective actions. Within this framework, there is a group of communicators who meet a couple of times a year to discuss and draw lessons from each other regarding crisis communication. This group contacts each other regarding press releases before they are published in order to enable the other countries to deal with the current issue in good time. In the event of a radiological emergency, information on press releases is sent via urgent e-mail or in another predetermined manner to the Nordic countries. To some extent, this is also done through the IAEA.

In accordance with regulations, international cooperation has to include exchange of information to the public on the international/bilateral level. In the urgent phase the challenge is twofold: managing internal crisis management and information abroad and ensuring accurate translation in different languages for bilateral /international exchange. One practical implementation is that neighbouring states have mutual access to electronic situation reporting systems, as for the Nordic Countries Group and bilateral cooperation between Switzerland-Germany-Austria.

It should be noted that of the 27 countries which completed the "Public Information" section of the questionnaire, two non-nuclear countries (Latvia and Serbia) do not foresee a situation where it would be necessary to address the information released by other countries.

The provisions are highly focused on measures to protect our environment. But given the short- and long-term impacts of poorly managed communication with the public, institutions have set up communication units to counteract fake news.

The communication cells of the European countries are mainly made up of representatives from all relevant authorities. They gather, in particular, a team of communication specialists for press and media communication as well as with experts for social media. Three quarters of them have a social media manager and a webmaster to inform and control information disseminated from non-official sources.



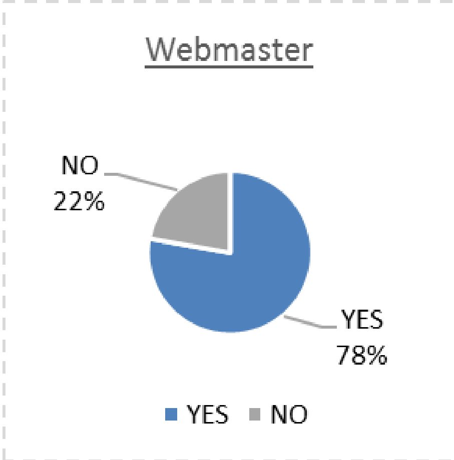




**Figure 48: Ratio of countries having a social media manager and a webmaster in their emergency communication cells**

The general level of anxiety is also studied to adapt the communication. A broad majority of respondents take public opinion into consideration, on subjects such as the population's state of anxiety, the state of rumours and the spread of false information.

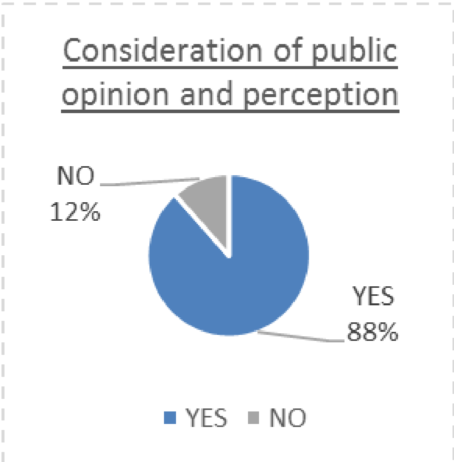



**Figure 49: Ratio of countries considering public opinion and perception on the accident**

During the response phase the reactions of the public and the media are monitored in order to identify inappropriate procedures and identify new questions that need to be answered. The continuous supply of accurate and timely information helps prevent the spread of rumours and alleviate anxiety. The COVID-19 pandemic enabled realization and gaining of experience on how misinformation can be detected with regular social media analysis and counteracted with targeted communication measures.

In Sweden, the population's perception and reaction are an issue that is dealt with within the framework of civil defence. Sweden has just started a new authority responsible for psychological defence. All authorities must, within their area of responsibility, handle these issues with the support of the new authority. The Swedish Civil Contingencies Agency has conducted training at the national level regarding information impact. The Swedish Civil Contingencies Agency has an overall responsibility to work to ensure that national authorities coordinate with regard to rumours and false information. The Swedish Radiation Safety Authority works continuously to identify and, where appropriate, respond to information regarding nuclear facilities and ionizing radiation. This also include rumours and false information. During an incident, horizon scanners are tasked with identifying rumours and false information.

In Hungary, the malignant spread of false information is against the law. In the context of a significant nuclear accident, malevolence could cause serious damage. This is definitely a factor while handling a crisis.

In the field, some respondents indicated that their country dispatches a public information officer/team to assist local officials, providing responders who will have direct contact with the public (e.g. monitoring teams) with instructions on how to interact with the public and media.

A real issue is the manpower available to address the reaction of the public and its behaviour due to anxiety. It is important to have a dedicated unit to receive public requests in order not to saturate services that are highly involved in implementing protective measures and essential communication means. In the event of a crisis, the needs of the population for clarification can be significant. During the first Workshop of the project, Serbia's representative shared his experience during the Fukushima catastrophe. The population, still deeply traumatized by the Chernobyl accident, saturated the phone lines of the safety authority.

The results of monitoring the radiation situation are accessible on national nuclear safety authorities' and international organisations' websites as Internet service and open data. When the radiation accident occurs, access to up-to-date data for the public and the media can be as simple and fast as possible. However, it should be noted that the general public does not have the knowledge to interpret these figures, which can be anxiety-provoking if they are not accompanied with comparative data and information in layman's terms. Misunderstanding of real information is also a source of production of fake news by mass media.

Whatever the level of maturity of the EP&R system and the means of communication implemented, for the behaviour of the public in the event of an accident to be as close as possible to the theoretical projections, the population must have confidence in the information transmitted and the person transmitting it.

In the context of the survey, the participants were requested about the level of distrust of the population towards experts’ discourse and how to make it credible in the event of an emergency.

This shows that the countries believe confidence in the experts is basically high. The population generally accepts the information broadcast in the media; they trust the experts of a given field. The information is often supported by facts, measurement data, credible information and interviews with acknowledged experts. The level of distrust of the population varies widely among the different social groups, but nevertheless the greater part of society accepts the words of experts as credible.

The key factor contributing to building trust in experts’ discourse is to maintain a sustainable transparent policy, equality of all interested parties and open dialog on safety matters at all times in order to ensure that there is public trust in what the experts say.

However, the Covid-19 pandemic revealed a significant distrust of the population in what experts advise the public to do, in particular due to divergent opinions. Unfortunately, too often there are "experts" who would advise the public to act differently than as instructed by the official authorities. There is also a traditional scepticism about the use of nuclear energy and ionizing radiation. In order to counteract it from the outset in the event of an emergency, it is necessary to communicate with the public rapidly, clearly and without contradiction.

Surveys carried out indicated that the public are more likely to trust information delivered by scientific experts rather than that provided by politicians or those with vested interests such as industry representatives.

The credibility of experts has to be built in normal times with regular communication with the public. And this credibility can be strengthened through comprehensible, continuous and transparent communication.

A few respondents answered that they do not have information available on this subject, which reflects the fact of the absence of a measurement tool and a corresponding action plan to improve public confidence based on practical data.

Raising public awareness of risk perception and educating the public in nuclear matters and emergency situations is a key element to build confidence, by sharing and publishing relevant information, in several formats such as websites, videos, speeches, leaflets, reports, and guidance documents.

The current media developed in Europe provide:

- Background information on the EPR system;
- Publication of emergency response plans;
- Catalogue of general protective actions for the population;
- For the population near nuclear power plants, information on the risks, the alarm procedures to be followed in case of an accident at the plant site and a map of the emergency planning zones;
- Protective actions in agriculture, medical diagnoses and treatment of highly exposed persons (under development);
- Educational materials to raise awareness about radiation protection, emergency preparedness and nuclear safety;
- Information on actual radiological events/emergencies;
- Information on the EP&R legal background;
- On-line data and periodic reports on radiation monitoring of the environment and foodstuffs;
- References to international issues like IAEA's website where more information on best international practice and past accidents can be found.

Open-door events for the general public are also held. In Hungary, a public information calendar is distributed among the citizens in the EPZ. A disaster management spokesperson is available 24/7 to deal with questions from the media or the public. Disaster Management regularly organizes camps and competitions for children and teenagers where they can learn about different types of emergencies and the expected behaviour. There are regular exhibitions throughout the year for all age groups to introduce the tasks and equipment of disaster management. For high-school students there is a mandatory public-service course which they can take at fire stations.

The knowledge brought together in a well-developed documentation must be supported by action plans for accompanying the change of perception and behaviour about nuclear EP&R. The greatest impact on building public confidence comes from education towards a better understanding of radioactivity and its associated risks, and from a high degree of transparency on the part of the competent authorities. A lack of clarity and uncertainty about the data that are published contributes to confusing the public and conditioning perception regarding the reliability of those who communicate. On the contrary, when the information is clear, precise, understandable and not contradictory, the population will tend to take the institution as a reference because they will find it to be a reliable source of information.

The Best Practices implemented by the surveyed countries are gathered below:

- To build trust during a normal period;
- To provide fast and consistent information during the crisis situation. Continuous monitoring should be carried out so that any misinformation circulating is covered as early as possible. In case of an event where detailed data are not available, a "holding statement" should be published as early as possible, even if not much is known yet;
- To organise face-to-face public events. Stakeholders organise meetings, open houses, like workshops or desks at science exhibitions, with the general public and residents, on radiation-protection themes that help improve public confidence;
- To enter into dialogue with the population and listen to their questions and concerns;
- To inform the population at a distance via media including printed media (for example, leaflets to be posted via normal mail in mailboxes). Some countries have implemented free disaster-

management applications that are continuously updated based on public reviews;

- To maintain contact with journalists and press agencies (briefings);
- To engage the nearby population in small-scope EPR exercises or drills much more often; that could help remind such populations that arrangements are in place and periodically tested. A good practice would be to carry out a public awareness campaign organised around the holding of a national-level exercise to test some of the practical arrangements for responding to a radiation emergency. More public dissemination of the work that is being done, namely exercises and training of operational personnel, would be profitable.

The biggest challenge remains that of combating the fear and mistrust that the general public might have and disinformation, which may come from the press or other sources. Maintaining the credibility of the authorities and nuclear specialists requires constant effort. To stay abreast of the best means for communication, the influence of social media is a necessity. However, this requires that sufficient communication specialists and experts can be deployed.

A significant number of lessons concerning public confidence and behaviour can be learnt about long-term crises. The EP&R arrangements schedule was highly impacted by the Covid-19 pandemic. The organization of live meetings and exercises has been suspended. An important source of information can be collected about crisis management and the confidence of the population.

### 4.2.10. Quality System

#### 4.2.10.1 Context and regulatory situation

The quality management system provides a framework and a structure for building, deploying, controlling, reviewing and improving the EP&R provisions implemented. It is required at the European level, transposed at the national level and recommended by the international institutions.

The IAEA guide GSR Part 7 advises in general that "The government shall ensure that an integrated and coordinated emergency management system for preparedness and response for a nuclear or radiological emergency is established and maintained" (Requirement 1). "The government shall ensure that a programme is established within an integrated management system to ensure the availability and reliability of all supplies, equipment, communication systems and facilities, plans, procedures and other arrangements necessary for effective response in a nuclear or radiological emergency" (Requirement 26).

The article 97 of the BSS states that:

1. Member States shall ensure that account is taken of the fact that emergencies may occur on their territory and that they may be affected by emergencies occurring outside their territory. Member States shall establish an emergency management system and adequate administrative provisions to maintain such a system. [...].

2. The emergency management system shall be designed to be commensurate with the results of an assessment of potential emergency exposure situations and to be able to respond effectively to emergency exposure situations in connection with practices or unforeseen events.

3. The emergency management system shall provide for the establishment of emergency response plans with the objective of avoiding tissue reactions leading to severe deterministic effects in any individual from the affected population and reducing the risk of stochastic effects, taking account of the general principles of radiation protection and the reference levels [...].

A quality management system is defined as a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives. It helps coordinate and direct an organisation's activities to meet regulatory requirements and improve its effectiveness and efficiency on a continuous basis.

#### 4.2.10.2 Topics studied and input data

All countries participating in the study have implemented a quality management system to optimize an organization's performance, by designing, controlling and improving processes and engaging staff.

The National Safety Authorities and Civil Protection Organizations were surveyed regarding the mechanisms of continued improvement in the EP&R management system, ways of measuring the efficiency of its arrangements and the level of knowledge and readiness of the EP&R teams.

In particular, they reported if indicators are put in place, with their results in terms of the efficiency of the EP&R arrangements concerning:

- Protection strategy;
- Stakeholder organisation;
- Communication organisation and tools;
- Public information;
- EP&R exercise conduct;
- EP&R exercise conclusions integration;
- International cooperation;
- Human resources sizing during an accident;
- Material resources sizing during an accident;
- Radiological measures;
- Sheltering arrangements;
- Iodine intake arrangements;
- Evacuation arrangements;
- Decontamination arrangements;
- Return from evacuation or relocation.

The share of countries implementing specific indicators on the mentioned topics is presented in the Figure 50 below.

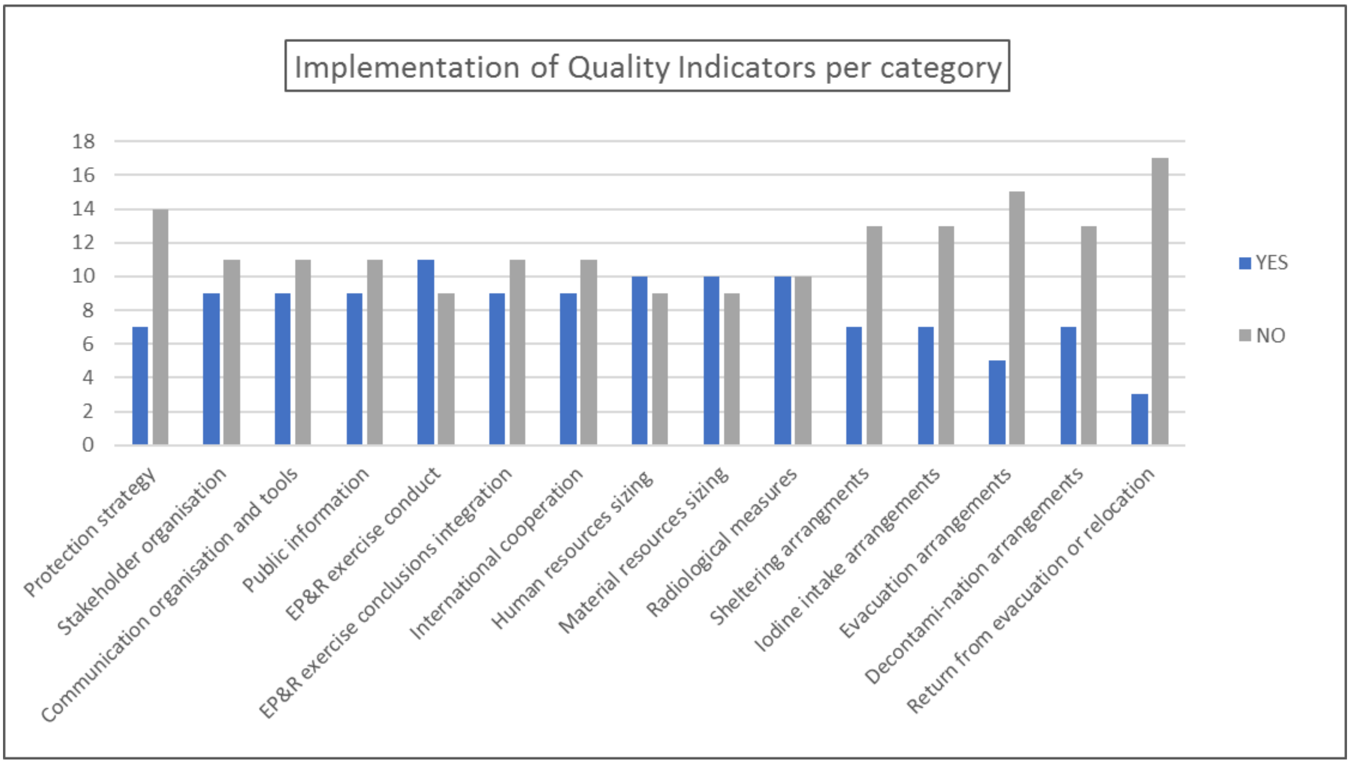



**Figure 50: Number of countries implementing quality indicators per topic**

The self-assessment regarding the efficiency of the corresponding arrangements elaborated is synthesised in the Figure 51 here after.


**Figure 51: Self-assessment regarding the level of efficiency of the EP&R arrangements per topic**

The different items justifying the EP&R arrangements efficiency are indicated in the responses of the participating countries. When experienced a real emergency situation, interviewed organisations shared main key-lessons learnt and implemented to gather the general knowledge and good practices at the European level.

The Covid-19 pandemic provided an opportunity to test the reaction of the countries in a high constrained and uncontrolled environment and the mechanisms for improving the Emergency management system in the face of a new situation with aggravating events.

#### 4.2.10.3 Quality System assessment

All the European countries which responded to the questionnaire keep an emergency management system up to date. Its implementation is required by law with regular review and improvements. The main source that feeds the continuous improvement of the management systems is the crisis exercises and training, reinforced by missions and working groups at the national and international level.

At the national level, organising exercises and operational drills are one of the most effective ways to evaluate the effectiveness of the national EP&R arrangements. Training can include practical exercises to reinforce the theory. Feedback from emergency exercises, and also real events, informs specific indicators or processes and implies the implementation of necessary actions and accomplishment of functions according to the internal procedures and guides. For every exercise or drill conducted, reports provide elements reflecting the activities' performance and any difficulties observed, in order to determine needs for improvement in internal procedures and guides related to the Emergency team.

For an optimal assessment of the level of knowledge and readiness of the EP&R teams, individual evaluations and independent observation are to be put in place.

An example of good practice implemented by Germany is the use of the results of independent evaluations of regular emergency exercises. For each exercise, internal and external evaluators observe the session and assess the performance of the teams involved. Their findings and proposals for improvement are summarized in an exercise evaluation report for action and integration into the management system.

Other countries, such as Romania and the Netherlands, carry out individual evaluations. In Romania, training sessions are designed via individual study of the Intervention Plan and specific working procedures that simulate conditions that would be experienced during an emergency at the Centre. Training includes evaluation of staff performance and a qualification process for each emergency response team position. In the Netherlands, every participant in training and exercises of the Authority for Nuclear Safety and Radiation Protection (ANVS) is required to rate how well prepared they feel for a radiological accident on a scale of 1 to 4 in the evaluation form (1 is very low and 4 is excellent).

At the international level, the following international missions and organisations were specifically mentioned as having strong added value in the improvement of the management system:

- EPREV: Emergency Preparedness Review providing an appraisal by the IAEA and international experts, focusing on preparedness for response to a radiation emergency and assessing the capability to respond to such situations;
- IRRS: Integrated Regulatory Review Service – peer review services proposed by IAEA to its member states is aimed at enhancing the effectiveness of a state’s regulatory infrastructure for nuclear, radiation, radioactive waste and transport safety;
- OSART: Operational Safety Review Team – IAEA audits programme related to operational safety, to strengthen the safety of nuclear power plants during commissioning and operation;
- SARIS: Self-assessment of the Regulatory Infrastructure for Safety – a methodology and tool developed by the IAEA, to assist States in undertaking self-assessment of their national safety framework in accordance with the requirements and recommendations of the IAEA safety standards, and developing an action plan for improvement;
- MENELAS: The Mediterranean Network of Law Enforcement Officials relating to MARPOL within the framework of the Barcelona Convention, whose overall objective is to facilitate cooperation between its members in order to improve the enforcement of international regulations regarding discharges at sea from ships.

The overall method for maintaining a quality management system, allowing EP&R provisions to be built and the corresponding processes, manpower and equipment to be assessed, is based mostly on the existing systems in place and real-event feedback. To strengthen its crisis preparedness capability, Sweden established the Swedish authorities' Risk and Vulnerability Analysis (RSA), which enables testing of the management system facing other hypothetical scenarios. A stated goal is also that these values should be able to be aggregated – collected, compared and weighed together – as a basis for priorities about where preparedness should be strengthened. Estimation of general crisis preparedness capability is carried out with the support of about forty indicators in the areas of management, collaboration, communication, competence and resources.

Within Europe, there are two approaches to improving the management system in place: a systemic approach and an approach by type of provisions and measures. For some countries, "the evolution of the EP&R organisation does not rely on targeted indicators but on a global improvement procedure based on the feedback of exercises." For that reason, in this case no answer about self-assessment questions was provided in the survey. Other countries have to regularly perform national self-assessments. For instance, Hungary conducts self-assessment every 10 years based on the "critical tasks" of the national emergency management system, the latest one being established in the context of the EPREV mission in 2016.

Although significant efforts have been made in the area of radiological crisis management, there is still a lot of room for improvement.

The implementation of EP&R arrangements is challenged by external entities and experts. Audits and peer reviews are important tools used by the European countries, except by a few non-nuclear countries.

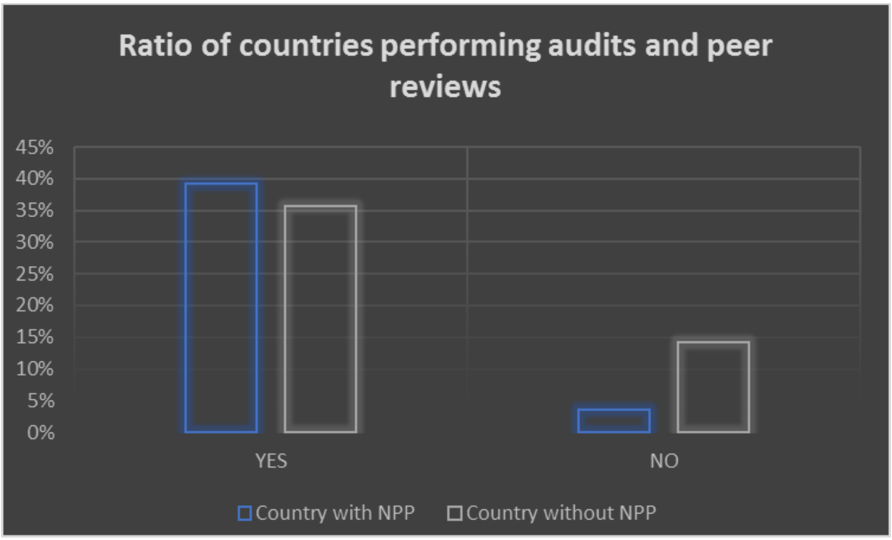



**Figure 52: Ratio of countries performing audits and peer reviews**

These reviews are an integral part of the improvement process which lead to updating of procedures, improvement of training, and additional means to be used in emergency situations. Most countries highlighted recommendations stemming from EPREV[7] and IRRS[8] missions or national audits and implemented roadmaps to be taken into account. Some lessons learnt (between 2015 and 2019) were explicitly reported in the responses of the questionnaire. They deal with the various points, among others:

- Stakeholder organisation:
  - Improvement in the decision process;
  - Defining of operational responsibilities for crisis communications;
- Infrastructure to be improved;
- Human resources:
  - Develop and maintain human resources in general;
  - Size the staff resources to be sufficient for measurements to enable the resumption of normal economic activities in the area of food/feed export in case of widespread contamination;
  - Evaluate the extent of resources needed to prepare for and respond to emergencies within the country but also at foreign nuclear power plants affecting the country;
- Training and exercises: arrange exercises in a real format for site evacuation (plant workers, contractors and visitors) to validate the feasibility of this phase of the emergency plan;
- Public preparedness and confidence:
  - Distribute information on nuclear and radiological emergency planning to the population;
  - Establish a national coordination group to inform the public to ensure consistent information in case of an emergency;

[7] List of the completed and planned EPREV missions: https://www.iaea.org/services/review-missions/calendar?type=3167&year%5Bvalue%5D%5Byear%5D=&location=All&status=All

[8] List of the completed and planned IRRS missions: https://www.iaea.org/services/review-missions/calendar?type=3158&year%5Bvalue%5D%5Byear%5D=&location=All&status=All

  - Include social sciences in the field of risk perception and risk communication in the expert network;

- Recovery phase:
  - Extend preparations to the transition and recovery phase;
  - Elaborate a decontamination strategy if a nuclear accident were to lead to contamination of large areas outside the nuclear facility;
  - Elaborate strategies to limit shortcomings of endurance in the event of a prolonged handling of a nuclear accident.

It is widely recognised that emergency exercises and staff training are the activities that have the most added value in emergency preparedness and improvement of arrangements. Conducting exercises also teaches how to integrate the new measures raised into the EP&R arrangements. They are the site of maximum lessons learned and significantly impact the emergency management system.

The consideration of lessons learned from real emergency events follows the same process as in training.

In the questionnaire, the respondents from Safety Authority and Civil Protection Organisations were requested to share their latest lessons learnt from real emergency situations. The Fukushima disaster has led to a major reconsideration of the arrangements in place. It demonstrated the need for assessment of the situation and protective actions, international cooperation and harmonization of information to the public, including the high information needs of the public even if there is no direct radiological impact on its own territory.

As an example, Austria further developed the program for informing the public and for crisis communication. The country considered the importance of cooperation with the Austrian Ministry of Foreign Affairs to inform persons from Austria in the accident country, including the personnel of the Austrian embassy. Also Italy indicated that it has reviewed and updated its national legislation, and improved multi-sector cooperation. Italy included long-distance accidents in the national plan in order to protect nationals in the accident country and to manage the return of people coming from a contaminated area. In Sweden, the Fukushima accident resulted in a revised national protection strategy and a new national strategy for radiation measurements. In Germany, after the Fukushima accident, the following actions were implemented:

- the potential consequences of a nuclear accident of INES level 7 were investigated in detail and – among other things - emergency planning zones for NPPs were enlarged;
- the (nuclear and radiological) off-site emergency management system in Germany was reviewed in detail by the SSK (German Commission on Radiological Protection) and 76 detailed recommendations were presented by SSK; many of them have been implemented in the following years.

Since Fukushima, the real emergency situations experienced were minor radiological incidents. Nevertheless, these incidents also impact EP&R arrangements and enable better preparation. The main lessons learnt have to do with the need to stress coordination between off-site decision makers to allow for better decision making even if the event at the nuclear facility is not severe.

Finland reported having had a real site area emergency situation in December 2020, which was reduced to an alert situation after two hours. The main lesson was how rapid the political branch was in their response and how to accommodate this properly in the planning. Initial uncertainties and a lot of minor communication problems were observed immediately after the transmission of the news about an accident situation through the system. The initial moments always have many uncertainties, but the value of training and exercises was evident when people were able to overcome the problems after the initial rush.

Incidents regarding overexposure of workers also happen. As an illustration, in 2011, Bulgaria experienced a radiological incident involving overexposure with doses of about 1 Gy and higher. The incident was subject to comprehensive analysis which led to strengthening of the control performed by the licensees regarding activities with high radiation risk, additional radiation safety measures, revising the licensees' internal emergency plans and procedures and increasing the frequency of training and briefings before conducting activities with high radiation risk. In January 2017, in Ireland, the Environmental Protection Agency was notified by one of the licensees (an NDT Company), of a potentially serious incident involving a Gamma Radiography Projector in which the Se-75 source assembly fell out of the exposure device onto the ground. While this incident did not give rise to any excessive radiation doses to the staff involved (approximately 100 micro Sieverts), it had the potential for serious consequences and required the effective deployment of emergency procedures. The incident occurred as a result of a design feature and a design change was proposed by the manufacturer. In addition, the licence conditions were amended to include a condition for mandatory operator training in the specific use of the licensed Projector and in source recovery procedures, for reasonably foreseeable accidents or incidents during routine use. Portugal, for its part, in the context of minor events mainly related to orphan sources, identified the preparedness of response and assessment teams as being of major importance to prevent social disruption. As these events can occur anywhere in the country, it was decided to increase the number of teams with appropriate capacities and their distribution in the country. Even in the absence of adequate capabilities for the detection of radiation sources, an effort has been made and continues to be implemented to raise awareness among those who may be confronted with similar situations.

Recently in France, the occurrence of a small fire involving non-nuclear parts of an NPP and the Le Teil earthquake (which had no impact on safety) underlined what can and cannot be managed at a distance. The main lessons learnt were the possibility of having the on-duty team manage the fire without being physically in the emergency centre (due to Covid). And for the Le Teil earthquake, the importance of being present in case of a multi-hazard event was highlighted.

Experience acquired during disasters of other kinds also directly impacts the organisation and the means of managing emergencies, including radiological ones. In Hungary, after the Danube Flood of 2013, a continuous 24/7 Communication Service was developed to deal with the communication tasks of disaster management. Slovenia suffered an earthquake (located in Croatia) in December 2020, when the Krško NPP was shut down and emergency level 0 (unusual event) was declared. The Slovenian Nuclear Safety Administration (SNSA) was notified about the event and immediately activated a team for monitoring the situation and for informing the public. Due to the Covid-19 pandemic there was limited activation of personnel. Since no damage was detected, the NPP returned to operation. The Krško NPP also prepared an extensive analysis of the event.

All the participating countries are well aware of the continuing efforts to be made. This is clearly apparent in the results of the indicators used to monitor the performance of the organisation and the self-assessments provided.

The indicators covering emergency preparedness activities are more developed than those for response phases. The further away in time from the trigger of the crisis situation, the more we observe a decrease in the follow-up of the evaluated response activities which are much more complex to test. The role of the population becomes more and more important and the psychological aspects make the task of simulation and evaluation very difficult. Following EP&R exercises conducted, confidence in the arrangements implemented can increase when it can be tested, or it may decrease from "Medium" to "Very low" for topics that are more difficult to assess in the exercises.

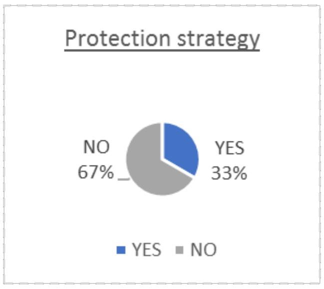
The majority of "Medium"-level confidence expressed regarding the effectiveness of arrangements reflects a management system that is evolving and progressing at the moment.

The percentages shown in the graphs in this chapter do not take blank answers into account. On the whole, the countries surveyed are aiming for an overall improvement in their provisions, particularly on the basis of crisis exercises carried out regularly. They do not all position themselves according to the various indicators listed. This is why it is important to note that almost a third of the respondents did not provide an assessment by type of activity.

The level of effectiveness reported below comes from the self-assessment of the AS/CP indicated in the questionnaire responses.

- Protection strategy

  The two third of the participating countries do not implement specific performance indicators to measure the level of efficiency of their protection strategy according to a defined target.




The main trend is establishing and improving the arrangements via exercises and reviews.
The assessment of the efficiency level provided via relevant indicators or self-assessments is reported below.

All the participants recognize that there are still improvements to be done. More than half of them consider that the measures in place have a medium or low efficiency in case of a radiological accident.

The lack of targets and progress follow-up against objectives set in a monitored and controlled scoreboard contributes to reduced visibility in terms of progress made and to be made.

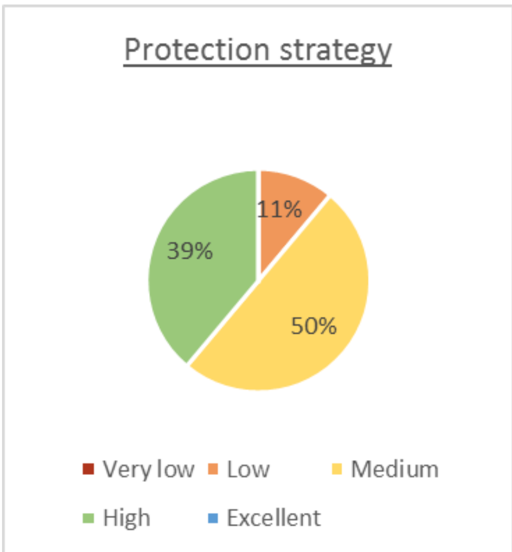
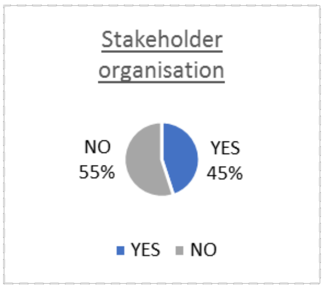



**Figure 53: Self-assessment of the efficiency level for protection strategy arrangements**

- Stakeholder organisation

Half of the entities surveyed have not constructed indicators to measure the effectiveness of the stakeholder organisation in place.




The established organisation in the emergency management sector is historical and strongly connected with the global organisation of the nuclear sector of the country, the civil protection and the governmental structure itself.

As a result, 11% of the respondents state that their organisation is optimal and 22% further are highly satisfied. The majority reports the needs to improve the organisational structure of the different players in the emergency management. 6% recognize that the stakeholder organisation is not adapted to prepare and respond to a radiological accident. This minority is formed by countries which do not have NPP.

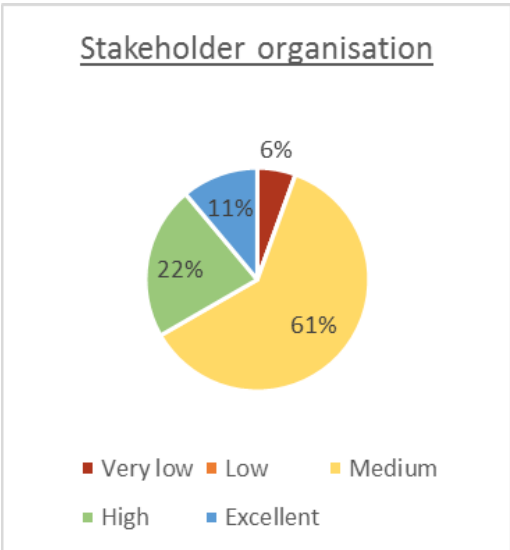



**Figure 54: Self-assessment of the efficiency level for the stakeholder organisation arrangements**

- Communication organisation and tools

  In line with the general trend, half of the security authorities and civil protection organisations have not established indicators to measure the effectiveness of their means of communication.

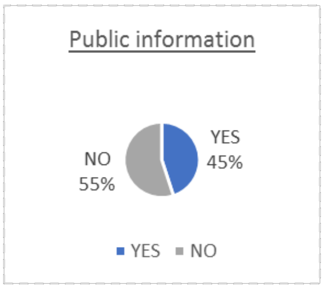

Communication organisation and tools are the activity the easiest to be tested in close real-life conditions. Corresponding exercises are subject to many evaluations at the local and national level.

However, only half of the participating countries are satisfied with the means used. 47% report a need for improvement.


**Figure 55: Self-assessment of the efficiency level for communication organisation and tools arrangements**

- Public information

  55% of the respondents has no specific indicator to follow and estimate the effectiveness of the public information management, the two third being countries with no NPP on their territory.




The relation between the public and players of the nuclear sector is a key element for the deployment of all the decision linked with the nuclear field.

This issue deserves to be further studied and monitored and implement relevant action plan. 45% of the responses reflect a real investment and consideration regarding the communication with the public. 56% state that the actions carried out must be strengthened.

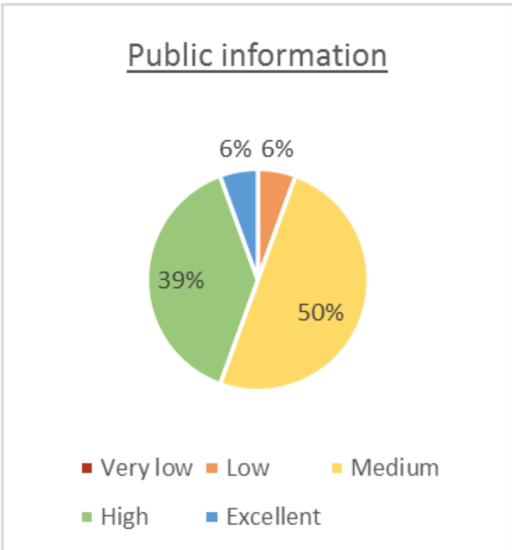
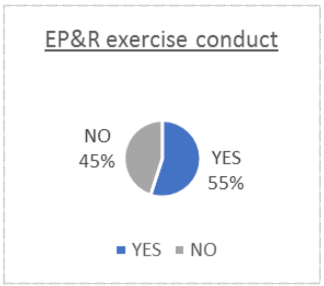



**Figure 56: Self-assessment of the efficiency level for public information arrangements**

- EP&R exercise conduct

The vast majority of countries organise EP&R exercises. Fewer countries have tools to measure the performance of their implementation (55% of the respondents).




Exercises and training are well integrated in the elaboration of the EP&R provisions and its improvements. The process itself of conducting them is mature enough for half of the entities surveyed. 26% report their system has an "Excellent" level of efficiency, which constitutes the highest obtained score in the studied categories of the present Quality System section.

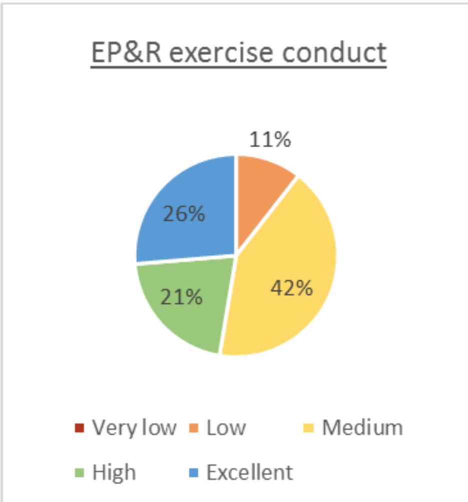
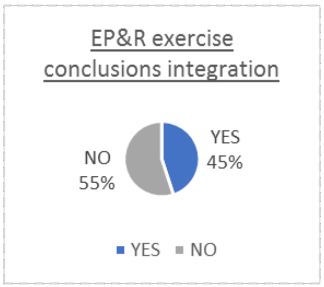



**Figure 57: Self-assessment of the efficiency level for EP&R exercise conduct arrangements**

- EP&R exercise conclusions integration

  As for the exercise conduct, half of the organisations implement performance indicators regarding the integration of EP&R exercises outputs in the management system.




11% (which represent 2 countries with NPP) and 28% (it is to say 3 countries with NPP and 2 without NPP) estimate respectively having an "Excellent" and "High" level of effectiveness regarding the good implementation of the exercise outputs in their EP&R arrangements. 61% states their system in place could be better organised to benefit all the lessons learnt issued from the crisis exercises.

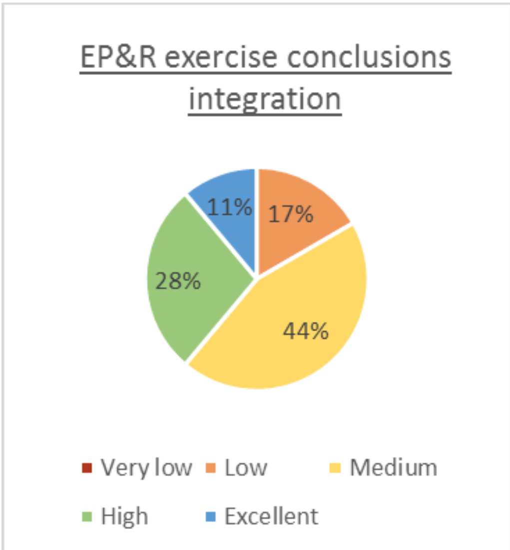



**Figure 58: Self-assessment of the efficiency level for EP&R exercise conclusions integration arrangements**

- International cooperation

  International cooperation and cross-border issue are one of the main topics assessed in the study. Only 45% of the responses report an implementation of elaborated tools to measure the performance of the international cooperation actions.


The high number of "Excellent" and "High" response reflects the importance of the topic and the high investment put in the international exchange collaboration. Thus, 71% express that that their actions are performant and benefit to their EP&R arrangements establishment. The remining 29% of "Medium" and "Low" responses gather countries with or without NPP, European MS or non-MS without specific distinction.

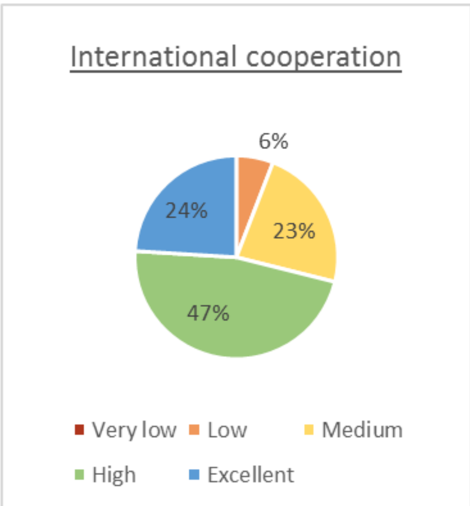
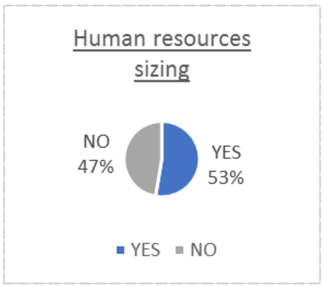



**Figure 59: Self-assessment of the efficiency level for international cooperation arrangements**

- Human resources sizing during an accident

  53% of the participants monitor the appropriate sizing in terms of human resources with relevant indicators.




In case of radiological accident, the manpower necessary to organize the response plan and to support regions lacking resources and skills must be evaluated following the transmitted contextual elements. 78% of responses indicate difficulties to size the appropriate human needs in case of an accident.

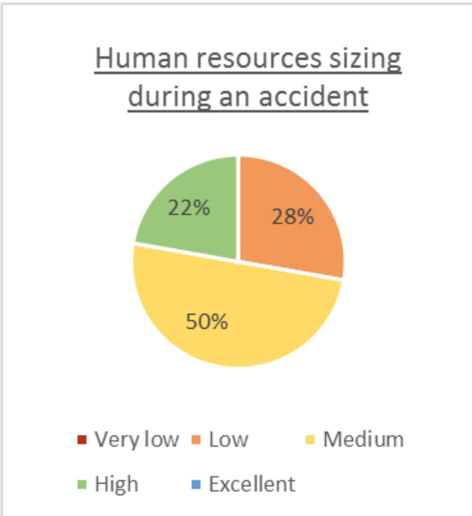
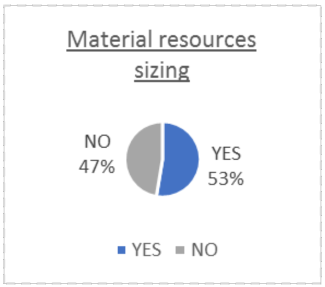



**Figure 60: Self-assessment of the efficiency level for human resources sizing arrangements**

- Material resources sizing during an accident

  As for the human resources, the efficiency of material and equipment forecasted for an intervention is controlled via indicators by 53% of the participants.




The overall results are equivalent to those observed for the human sizing. The material available and prepared appeared not sufficient or not known for 78% of the participating countries.

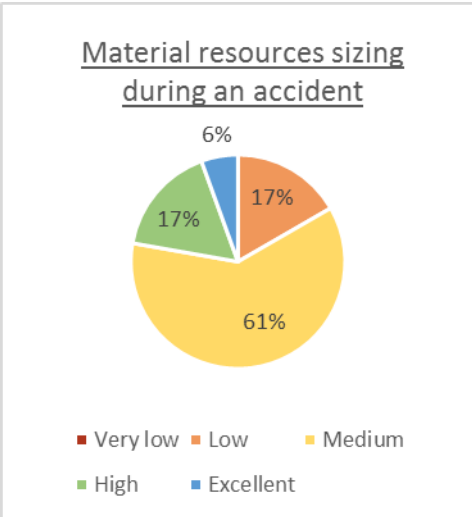
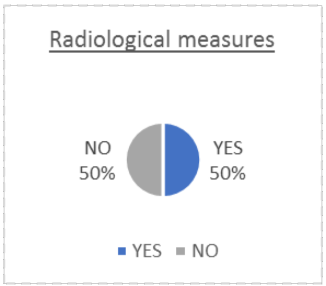



**Figure 61: Self-assessment of the efficiency level for material resources sizing arrangements**

- Radiological measures

  The half of the participating countries do not implement specific performance indicators to measure the level of efficiency of their system of radiological measures according to a defined target.




The radioactivity captors placed on the territory and around the nuclear sites, and their data, are essential to detect and evaluate a crisis situation. The effectiveness of the radioactivity detection and data transmission must be proved. 30% (5 countries including 3 with NPP in operation) raise an issue in their measurement system that must be clarified.

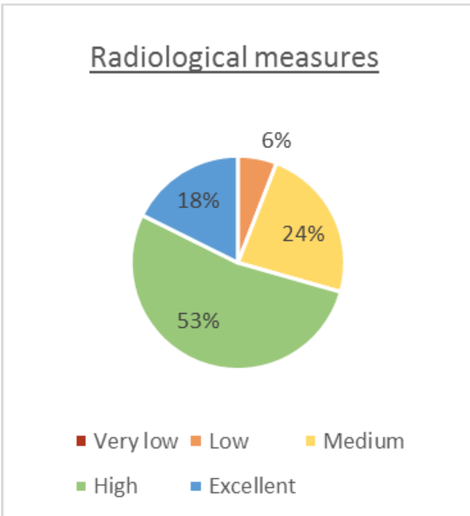
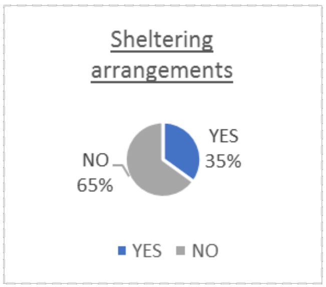



**Figure 62: Self-assessment of the efficiency level for radiological measures arrangements**

- Sheltering arrangements

  65% of the respondents has no specific indicator to follow and estimate the effectiveness of the sheltering arrangements, the half of the countries with NPP and 3 quarter of the countries with no NPP on their territory.




Sheltering arrangements, as for iodine intake, evacuation and return, are difficult to simulate in a real large-scale exercise. Using elaborated tools is decisive. Not only organisations show less use of indicators for sheltering efficiency, but they also report that their provisions do not meet the basic requirements or cannot be evaluated with 68% of the responses expressed.

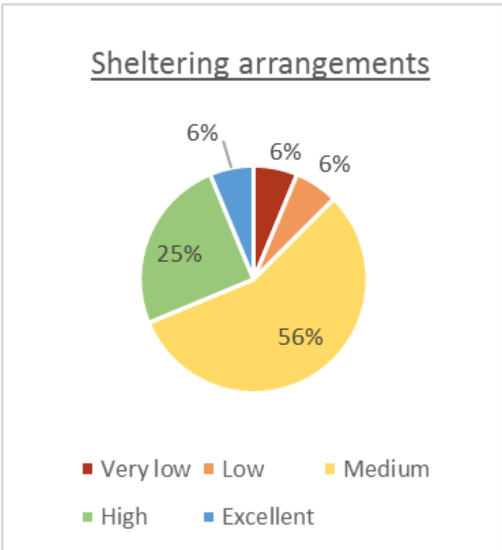
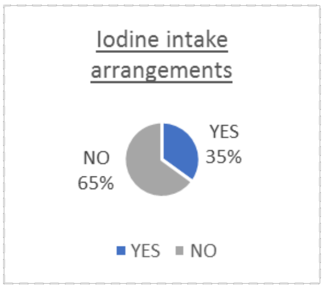



**Figure 63: Self-assessment of the efficiency level for sheltering arrangements**

- Iodine intake arrangements

  The two third of the respondents has no specific indicator to assess the effectiveness of the iodine intake arrangements, including 5 countries with NPP that could face the need to use iodine tablets.




69% of the responses indicate their provisions for distributing iodine and ensuring the population will intake the tablets in case of radiological accident are clearly insufficient.

Ingesting iodine is one of the essential ways to be protected against radioactivity in the early stages of the crisis. 37% report they are not organised to ensure iodine distribution or are not capable to evaluate if they can meet the required needs in case of accident. The 31% which reported a "Very low" efficiency in their iodine arrangements are 5 countries with no NPP in operation which are unlikely to face a need necessitating iodine intake.

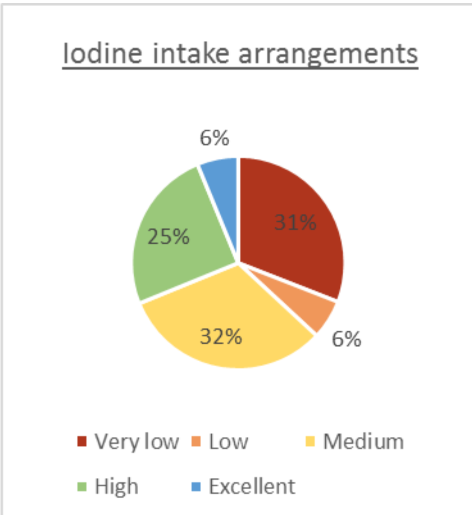
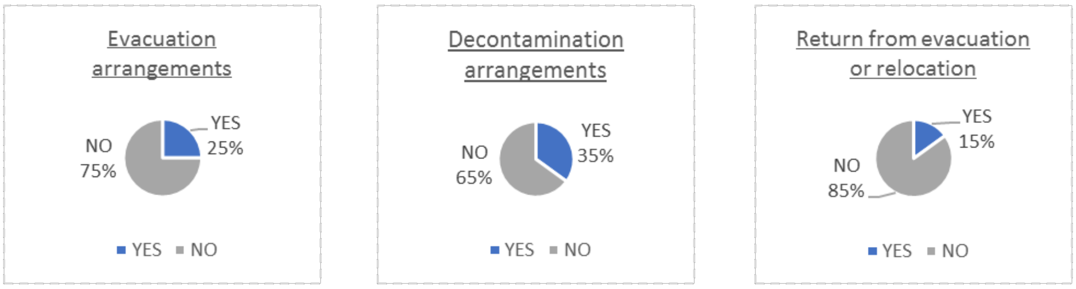



**Figure 64: Self-assessment of the efficiency level for iodine intake arrangements**

- Evacuation, decontamination, return from evacuation or relocation arrangements

  These steps are the most complex ones to simulate and assess. It is why a significant decrease in the number of entities elaborating appropriate indicators can be observed, also with the corresponding estimated levels of efficiency.




The ratio of confidence regarding the arrangements in place falls from 28% up to 14%. A lack of experience and training combined with a lack of targeted objectives and means to assess these essential steps hinder a concrete projection of the situation and translate the low preparation of the public in an emergency case.

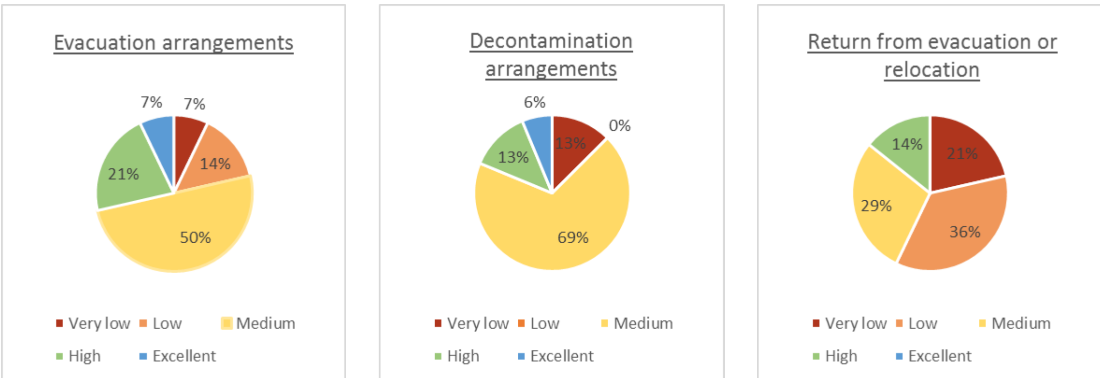



**Figure 65: Self-assessment of the efficiency level for evacuation, decontamination, return from evacuation or relocation arrangements**

All these indicators highlight points of strengths and weaknesses. They emphasize activities that are mastered to some extent and others in which the organisations surveyed express a lack of confidence in the effectiveness of the arrangements in place. It makes sense that this finding can have a direct impact on public confidence.

The points of strength in which the best level of efficiency is attributed are the following:

- International cooperation;
- Communication organisation and tools;
- EP&R exercise conduct;
- Radiological measures.

The points of weakness observed involved sheltering, iodine intake, evacuation arrangements, decontamination, and return from evacuation or relocation arrangements.

Today, international cooperation activities are the field perceived as the most efficient in the context of this survey.

Previous studies in early 2010 identified a real need to reinforce international exchanges and coordination. The ENCO report stated that "some countries see this as a major weakness and impediment to consistent and effective arrangements across European borders" and the HERCA-WENRA approach aims to "provide an overview of the important radiological issues to be considered by radiation protection authorities in the event of a nuclear or radiological emergency in a distant country." From a general point of view, the necessity of increasing international cooperation was pointed out a few years ago and has been the object of regulation within BSS article 99 (International Cooperation):

"1. Member States shall cooperate with other Member States and with third countries in addressing possible emergencies on their territory which may affect other Member States or third countries, in order to facilitate the organisation of radiological protection in those Member States or third countries."

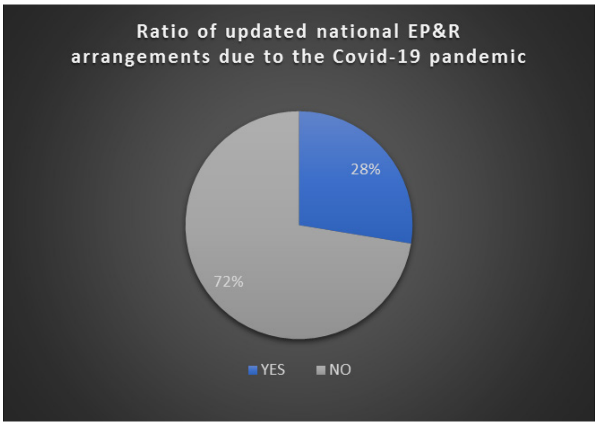
The regulation and recommendations regarding the topic have been successfully understood and adopted. 75% of respondent players state that they are highly satisfied by their actions regarding international cooperation, which constitutes the obligatory first step towards a harmonization of practices and optimisation of the consistency of national decisions.

In contrast, we still observe difficulties in assessing the protection measures until the situation returns to normal. A link can be made between the practical measurability of the effectiveness of an action and its effectiveness rate. The definition of objectives, both global and intermediate, and the possibility of measuring their achievement, makes it possible to better target the actions to be carried out, and to focus on the points to be improved. Implementing effective solutions is facilitated by setting up a well-defined monitoring and performance indicator. An effort should be made to better define the objectives and stages of progress of the protection measures and the mechanisms involved, and thus implement a measurable roadmap on these subjects.

By being able to better measure and quantify the effectiveness of actions taken, it will become easier to display progress, communicate and have a positive impact on public confidence. One aim is to make evaluations more objective than subjective in the absence of real experience.

Furthermore, the case of non-nuclear countries, with borders far from a NPP and who consider protective measures such as sheltering, iodine intake, evacuation and return from evacuation to be "Not applicable," must be considered with attention. These arrangements are not taken into account by these countries and are not integrated into their management system. This positioning automatically implies a different level of maturity and preparedness for facing a radiological accident.

In the last two years, the world has been facing an unprecedented pandemic with Covid-19 that has profoundly changed the way our society functions. The management of planned emergency exercises and incidents encountered has been modified by this aggravating event. Respondent organisations were asked about the impact of Covid-19 on the management system dedicated to EP&R provisions. Only one third indicated having updated their EP&R systems to integrate the lessons learnt from the pandemic. To date, the countries with no NPP on their territory have not considered the pandemic scenario in their EP&R emergency management system. Regarding the nuclear countries, only half of them have updated it.



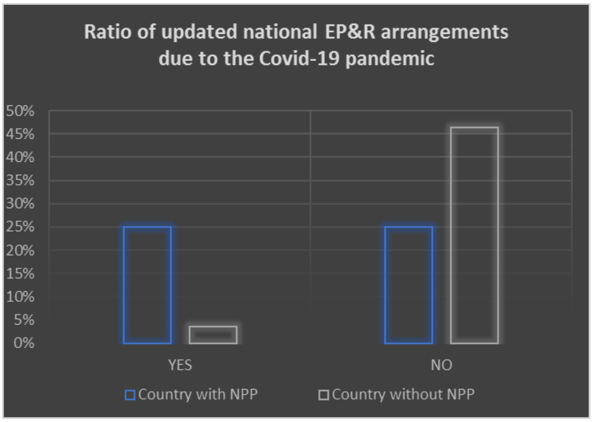




**Figure 66: Ratio of updated national EP&R arrangements due to the Covid-19 pandemic**

It would be appropriate to consider the triggers for updating the emergency management system outside of exercises, workshops and emergencies. It seems of utmost importance that the system integrates the pandemic scenario and the good practices learned, especially since the risk of recurrence is significant.

However, it must be noted that even in the case where there is no change in the EP&R arrangements described in the official documentation as a result of the Covid-19 pandemic, in other fields many evolutions and adaptations have been performed across a large number of sectors (travel, communication, public service, etc.) to ensure future resilience.

The national EP&R arrangements could have been tested during the pandemic to demonstrate their applicability even under such problematic circumstances. The main revisions implemented that were reported are listed hereafter:

- Improvement in processes, staffing and access to decision making people and processes;
- Implementation by involved organizations of a concept of operation adjusted to better consider pandemic circumstances;
- Update in the field of crisis staff meetings and the use of video conferencing;

- Revision of on-site emergency plans with addition of the appendix covering pandemic measures (change of the regime of technical means verification, changes that can be done in the exercise plan, etc.);
- To ensure continuity of equipment supply, use of a coordinated approach for implementing a national supply-chain strategy, including encouraging indigenous manufacturing;
- Preparation of ordinances for the legal implementation of specific protective actions such as in the areas of agriculture, food production and the food industry and sending out these texts for comments and agreement before an emergency.

## 4.3. Analysis of the practical implementation of EP&R arrangements from the perspective of the Nuclear Utilities from the questionnaire to NU

### 4.3.1. Topics studied and input data

The main objective of the questionnaire sent to Nuclear Utilities is to obtain information on good practices from the NPP Management. For countries that are involved with the following list of EP&R topics, information from the corporate level of the NU was also required:

- Responsibility of NPP in EP&R provisions;
- Incident/accident classification for Emergency Off-Site and activation of NPP Internal EP&R organization and where appropriate the activation of off-site EP&R arrangements;
- Communication with Nuclear Safety Authorities and Corporate Level of Nuclear Utilities;
- Mobilization of on-duty staff, expertise (local and national), external support and mobile equipment if needed, support for local and regional authorities;
- Site protective measures for NPP personnel and dispatch of external personnel;
- Measurement, data collection and communication;
- Training of personnel, Emergency Exercise (frequency, reporting, lessons learned);
- Specific arrangements in case of site inaccessibility for rescue purposes and for other personnel;
- Inspection by the Nuclear Safety Authorities;
- Relationship and dialogue with local authorities on a territorial level who are involved in emergency and post-accident management exercises.

The aim was also to get potential information describing significant practical improvements implemented by Nuclear Utilities and NPPs in terms of EP&R organization in the wake of the Fukushima accident.

The questionnaire was sent to 10 Nuclear Utilities (NU) or NPPs: Bulgaria (BG), Czech Republic (CZ), France (FR), Germany (DE), Hungary (HU), Netherlands (NL), Slovakia (SK), Slovenia (SI), Spain (ES), United Kingdom (UK). From the ten targeted NU or NPPs, six complete (Bulgaria (BG), Hungary (HU), Netherlands (NL), Slovakia (SK), Spain (ES), United Kingdom (UK)) and one partially filled survey (Germany (DE)) have been received and further analysed.

The questionnaire covers five basic topics, namely:

1. EP&R Regulatory Framework for NPPs;
2. Emergency planning basis;
3. Relation to the public and civil society living in the Emergency Planning Zone (EPZ);
4. Role and position of TSO (where applicable);
5. The Fukushima event, experience sharing and extraordinary situations.

Topics 1, 2, and 3 are preferentially dedicated to NPPs which could be the origin of any Nuclear and Radiological Emergency.

Topics 4 and 5 are oriented towards Nuclear Utilities corporate organizations, where applicable, depending on the country.

Since each country has its own Nuclear Safety Authority and ministerial organisations with different levels (local, regional, state), the relation with the Nuclear Utility is not identical. Therefore, the questionnaire is more general as a guide for highlighting lessons learned and on-going improvement in EP&R at Nuclear Utility Corporate level.

#### 4.3.2. Analysis of the EP&R Regulatory Framework for NPP's

All participating NPPs have established a national regulatory framework. There is usually one basic act, which is added to by a set of regulations and specific guidelines establishing the licensee's obligation in terms of EP&R.

In addition to the regulatory framework, all Nuclear Safety Authorities conduct regular reviews and inspections of EP&R provisions within NPPs. The latest EP&R inspection of evaluated NUs was performed this year or one year before. Common practice is to perform annual inspections. About 86% of participating countries declare reviews of EP&R by third parties like WANO, IAEA etc. (1 in 7 countries has no review).

Reviews of EP&R by third parties revealed no serious findings - areas for improvement - (declared by 2 countries) or only minor findings – suggestions - were identified. Most of these findings were related to improvement of emergency procedures, communications, use of portable equipment, definition of the particular radiation response levels, forms for volunteers, Emergency Control Centre habitability criteria, construction of a seismically qualified backup off-site ERC, etc. Measures to eliminate the identified findings have been implemented immediately or implementation is in progress.

All participating countries declare that they carry out EP&R exercises internally and together with external stakeholders. The last exercise was carried out by most countries this year; one country carried out the latest exercise last year. In the coming period, all countries have planned appropriate exercises. The exercises are performed by the NU at least once per year. In general, the exercises are specific for each participating plant. Ongoing exercises follow long-term emergency and staff training plans. Plants usually prepare several exercises with different scopes each year. These exercises involve the participation of army, local and public emergency services as well as small training programs that cover only the response of the unit shift.

The common characteristics of findings within the last three years can be summarized as follows:

- Minor deficiencies of emergency procedures;
- Shortcomings in organization of evacuation and ERO operation;
- Formal administrative deficiencies;
- Insufficient readiness of emergency equipment, including minor problems with communication devices;
- Appropriate involvement of external personnel, including situational awareness.

Existence of an ongoing work plan that is coordinated by regulatory bodies to improve EP&R provisions within NPPs was declared by 71% of participating countries (5 of 7). Based on the wide variety of answers it can be stated that emergency plans are adjusted to reflect actual legislation and new requirements of ministries (Ministry of Health, Ministry of Environment, etc.). In addition to the usual collaboration work with state and regional governments there is also close cooperation with Nuclear Safety Authorities to improve internal (on-site) and external (off-site) emergency preparedness and response, including the NPPs.

In general, work is oriented towards:

- Strengthening the emergency response action in case of a severe accident situation (e.g.: new Backup Emergency Control Centre, new Fire Brigade firehouse);
- Conducting additional training of emergency teams for action in severe weather conditions;
- Conducting training of external emergency teams in case of a severe accident;
- Implementing experiences from foreign countries including good practices;

  Improving operability of emergency centres, achieving availability and capability of emergency devices.

#### 4.3.3. Analysis of the emergency planning basis

Participant answers vary in the extent of described details regarding the basis of the accident scenario(s) used for on-site and off-site emergency planning.

The basis of the accident scenario(s) used for on-site and off-site emergency planning is formed mainly by deterministic and PSA results as well as by using safety report analyses. General emergency plans are focused on the most likely consequences, including off-site releases.

The plant conditions cover a large range of situations that are foreseen from the design basis and beyond design accidents. Plant conditions are reflected by appropriate classification of an emergency. Depending on the degradation of the safety level and the potential radiological consequences, emergencies requiring response are usually assigned according IAEA emergency classification levels: Pre-alert, Emergency Alert, Site Emergency and General Emergency.

The source term and its evolution over time as well as the state of the containment are determined by particular scenarios. Only a few countries consider scenarios with solely intact containment. There is only very little information describing dispersal conditions. Therefore, average dispersal conditions are assumed. However, some countries use sophisticated software to simulate variable dispersal conditions and source terms.

Only rarely do the descriptions of accident scenarios take into account long-term source term evolution. The time window is determined by the nature of the scenario, the magnitude of release and meteorological conditions.

Most of the participating countries use a combination of deterministic and probabilistic analyses.

None of the countries declare usage of PSA (Probabilistic Safety Assessments) Level 3. Based on the majority of answers, PSA Level 2 is used as an aid to:

- Identify possible scenarios including risk magnitude and consequences;
- Justify technical requirement and scope of emergency procedures;
- Identify significant changes in considered scenarios.

#### 4.3.4. Analysis of the Corporate intervention

The Corporate level supports the affected site, providing technical expertise to help mitigate the event, and provides mutual aid if needed. It also considers wider implications and the possible extent of consequences for other sites. The Corporate level takes responsibility for all off-site interactions, reducing the burden on the NPP to enable them to focus on critical safety issues.

All participating countries have a specific National Emergency Centre as well as further specific emergency response facilities to coordinate emergency response activities. The National Emergency Centre is usually activated if the General Emergency is declared or the site declares emergency state and activates its emergency plan. Members of the (national) Emergency Centre are usually specialists of the regulatory authority and corporate level including experts on technical/plant expertise, radiation/health specialists, IT specialists, deputies of selected national ministries (interior, health, traffic, defence, industry, etc.). In addition, media and communication specialists, security and supply-chains experts are included. The security of communication lines is achieved by using several redundant systems including TETRA radio phone, satellite phone communication, videoconference by secured line and a direct line for communication. Specific communication devices used to communicate with national Competent Authorities are formed by direct phone lines, secured videoconference, dedicated systems and networks, TETRA and satellite communication.

#### 4.3.5. Relation to the public and civil society living in the EPZ

The criteria for informing and notifying the local and national stakeholders and civil society are part of the on-site emergency plan. All involved parties are informed in the early phase of any accident. Initial information to alert external emergency structures is sent through dedicated communication channels, such as multi-network pagers, telephone, fax or press releases. If the situation escalates, usage of electronic sirens, radio and TV broadcast are foreseen.

Each ERO has an assigned set of rules, determined subordinations and technical means to provide and disseminate crucial information to the other local and national stakeholders involved in emergency response.

Two countries reported good practices in the "preventive phase":

- The NU and wider company conduct a range of stakeholder engagements - emergency preparedness focussed meetings with the local stakeholders where changes to the on-site and off-site emergency arrangements, training and exercises are discussed.
- Regular meetings with mayors in the EPZ are organised to distribute resident guides related to protective actions in case of nuclear/radiation accident to every household in cooperation with the national and regional government and the municipality.
- A Citizens' Initiative Commission is established to participated in regular meetings with NPP management.

The Nuclear Utilities were surveyed as to whether they have any responsibilities to advise and initiate protective measures off site with regard to:

- Relation with the Nuclear safety authorities (local and/or national);
- Relation with Local and National State Representative;
- Relation with local and national Civil protection organizations;
- Relation with public living in the Emergency Planning Zone (EPZ);
- Relation with the Nuclear Utility Corporate organization.

67% of participating countries declare licensee responsibility to advise and initiate off-site protective measures with regard to the relation with the Nuclear Safety Authorities. 33% countries declare non-responsibility.

67% of participating countries declare licensee responsibility to advise and initiate off-site protective measures with regard to the relation with Local and National State Representative. 33% of countries declare non-responsibility.

71% of participating countries declare licensee responsibility to advise and initiate off-site protective measures with regard to the relation with Local and National Civil Protection Organisations. 29% of countries declare non-responsibility.

57% of participating countries declare licensee responsibility to advise and initiate off-site protective measures with regard to the relation with the public living in the EPZ. 43% of countries declare non-responsibility.

57% of participating countries declare licensee responsibility to advise and initiate off-site protective measures with regard to the relation with the Nuclear Utility Corporate Organisation. 43% of countries declare non-responsibility.

Based on the majority of answers, the licensee is providing qualified information such as radiological assessment, prognosis of accident course as well as recommendations for protective measures for the threatened area. Consequently, the local or government authorities in the affected areas decide on implementation of particular protective measures.

All participating countries perform regular testing of communication devices. Communication means intended for off-site communication are regularly tested in intervals from 1 to 3 months, depending on country policies. The readiness of the means of communication on site is verified and tested more frequently.

The majority of countries / NPPs do not have an obligation to prove physical assistance to the local and regional authorities; however, some countries provide trained personnel to assist in off-site ERO organisation. NPPs assistance usually consists of providing data regarding radiological monitoring and situational information.

Some countries confirm dispatching personnel outside of the NPP to support the Radiological Group from the Off-site Emergency Plan by conducting measurements; to provide experts in the field of nuclear energy to aid regional and national authorities; Operator Teams to off-site multi agency coordination centres; and Off Site Survey Vehicles and Rad monitors to public monitoring centres.

NPPs have an obligation to provide 24/7 technical data and radiation data to local, district and national authorities. The scope of the data provided covers all parameters describing accident progress, radiological measurements, meteorological data etc. Data are sent on-line either in real time or several times per hour via dedicated communication lines.

The transfer of radiation measurements between plant and dedicated external EROs is usually performed on-line through a dedicated information management system (the same way as in the case of providing 24/7 technical data). Written reports and e-mails serve as backup.

Once an Emergency has been activated, plant personnel and other external personnel are usually gathered in dedicated places, which are managed by specific groups that provide personnel with protective equipment (full face mask, aerosol and iodide filter, potassium tablets). The PPE for emergency workers includes additional breathing devices, TLD, and personal electronic dosimeter. ERO members move into sheltered workplaces that provide a high level of protection. Bus transport for evacuation of all personnel located on the plant site and in the PAZ is ensured.

NPPs have to activate mobilization and information of Nuclear Utility Corporate on a 24/7 basis. Each NPP has a well-established cascading system to activate EROs using standard communication channels. Usually the shift supervisor or the on-duty personnel for ERO alerts call-duty TSC members or Head of Corporate Headquarters. Further mobilization of resources is organized by TSC or Head of Corporate Headquarters.

In EP&R countermeasures provisions, all consider aggravating situations such as extreme meteorological conditions (extreme wind, extreme temperatures, snowstorm, heavy rain, external and internal flooding, etc.). In addition, some countries consider specific natural hazards and industrial accidents (earthquakes, fire explosions, wartime, industrial accidents, pandemics).

100% of countries declare possession of "in-house" software tools and expertise to predict the radiological evolution of the incident/accident. Some countries use standard packages like JRODOS or RASCAL that can cooperate with custom software.

The software used usually has on-line access to real time meteorological data. It is capable of assessing the source term and radiological impacts of the release, combining assessed results with the results of real-time radiological monitoring, as well as evaluating and recommending urgent and precautionary protective measures in emergency planning zones and in the area of the NPP. Software is also able to assess transboundary impacts of radiological releases.

83% of participating countries declare that the software tool is benchmarked against software used by the Nuclear Safety Authority or Technical Support Organisation. One country (17%) has not benchmarked software. One country did not provide an answer.

The utilities surveyed were asked about the expertise the operator provides to the group making the assessment to predict the radiological evolution of the accident.

There are two types of answer depending on the understanding of the question:

- Two participating countries responded that operators of software described in Q29 are regularly trained (training sessions, professional seminars, practical exercises, drills and the great scope drill that is performed under the supervision of the regulator) to have appropriate skills to provide qualified results.

- Four participating countries responded that the ERO of the operator provides continuous information (source term, weather condition, real radiological measurements by mobile radiological laboratory and dose rate on the plant site or within PAZ and UPZ) to the collaborating organizations that predict the radiological evolution.

In the event of an incident/accident, the NPP takes actions to inform the public and civil society about EP&R provisions. Two types of answer were provided depending on the understanding:

- ERO of NPPs communicates with off-site ERO (at local, regional and national level) which coordinates all action to announce appropriate level of emergency, to inform public and to introduce countermeasures. Direct activation of the warning system within EPZ (e.g. sirens, local radio broadcasting) by NPP is assumed only exceptionally.
- Two participating countries also described actions in the preventive phase: publishing and updating information about EP&R (basic information about radioactivity and health consequences of radiation; Emergency Classification Levels and associated potential consequences; Emergency measures and provisions for warning, protecting, and helping people living in the surrounding areas of the plant; information about the expected behaviour of the members of the public in case of an emergency). Also regular meetings with mayors in the EPZ are organised; resident guides related to protective actions in case of nuclear/radiation accident are distributed to every household in cooperation with the national and regional government and the municipality; a Citizens Initiative Commission is established and regular meetings with NPP management are organized.

All participating countries/NPPs declared an obligation to provide periodic information intended for the public.

Based on the majority of answers, in the preventive phase, the obligation to communicate emergency preparedness and planned provisions are defined by the legislation. Public communication is held once every 2 or 3 years. Communication consists of public meetings with local self-government and with the state and regional administration involved in the EPR issues. Each household in EPZ is provided with written guidelines and explanatory materials describing the EPR topic, also the use of websites is considered an acceptable method.

Two countries provided answers also for the accident phase:

- media release, SMS message for local majors, message over acoustic loudspeaker system (30 km radius around NPP) in case of radiological or technological situation changes or if any public protective action is required. Media release every two hours if the situation doesn't change.

- local authorities must have arrangements to provide information and advice on the facts, steps to be taken and appropriate protective actions. Timings are not specified but it must be supplied at appropriate intervals and without delay.

Two countries did not provide an answer.

Concerning the exercise implementation, 71% of participating countries declared participation by civil society in EP&R exercises organised by the NPP and Authorities. To the question requesting details about this participation, the answers mention coordination of activity with local self-government, cooperation with civil rescue organization, training on evacuation and logistic tasks, transport and reception of contaminated persons from the NPP to the health centres.

All participating countries except one declare existence of an action plan in relation with the public and civil society living in the EPZ to improve public confidence. Apart from obligatory information, public-relations campaigns such as presentations, plant open-house days, educational programs, communication via social media, distribution of booklets and TV shots dealing with the EPR topic etc. are also available.

The self-assessment about the efficiency of the corresponding action plan provides the output showed in Figure 67.

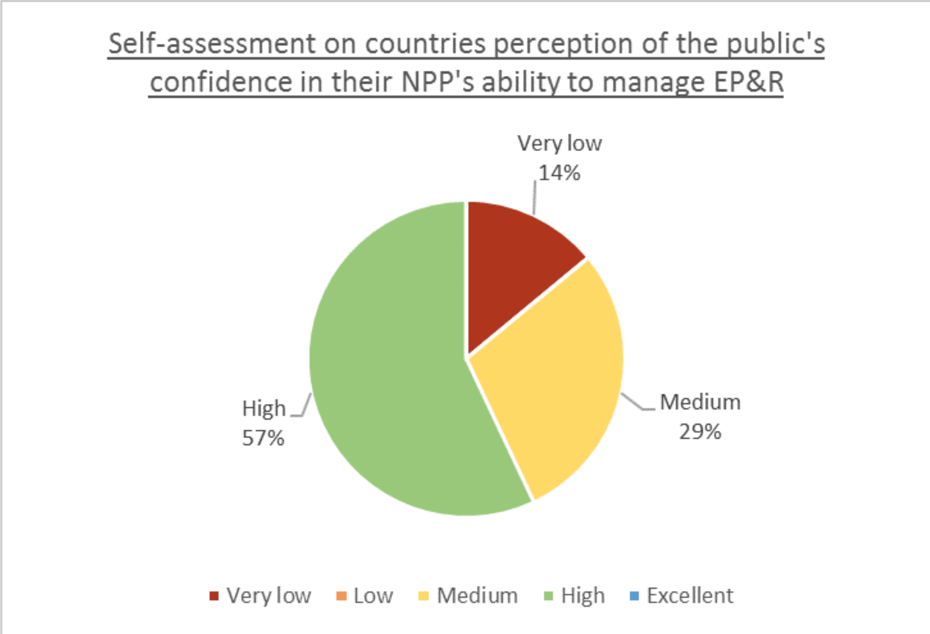



**Figure 67: Level of public confidence in their NPP's ability to manage EP&R**

None of the replying countries selected the answer options "Excellent" or "Low".

#### 4.3.6. Role and position of TSO

The external support mobilized for supporting the NPP in such a prognosis by the TSO reported in the questionnaire responses is as follows:

- Five participating countries responded that external support is provided by TSOs or external engineering companies/services that provide parallel calculations, justification of assessments etc. Also, support from regulatory authority specialists, unaffected NPPs and Technical Support Centre is assumed. Meteorological data are also provided by the National Meteorological Service.
- One country responded that depending on the classification of the emergency either all national first responders are mobilized to support the NPP or only external support from the Ministry of Interior such as plant firefighters, police forces and medical services are allocated into the PAZ.
- One country did not provide an answer.

#### 4.3.7. Fukushima event, experience sharing and extraordinary situations

The nuclear utilities were surveyed on the main lessons learned and improvements from the Fukushima accident with regard to EP&R provisions under NPP’s responsibility (arrangements, capabilities, relation with public living in EPZ) and under Corporate responsibility.

Based on the majority of answers, the main activities consisted of:

- reassessment of safety margins;
- reinforcing backup systems to withstand extreme meteorological and natural hazards;
- improving independency of ERCs and TSCs;
- deep revisions of emergency response procedures and improvement of communication ability. New procedures put stress also on multi-unit events;
- improvement of Emergency Response Exercise and Training programmes to include response to severe accidents and multiunit and long duration events;
- Enhanced Emergency Response arrangements including a review of human and psychosocial aspects to enhance staff welfare, human-factor and emotional aspects associated with emergency response;
- more educated emergency workers: provide workshops with the local and district managers related to the EPR arrangements and provide more information to the public related to the EPR arrangements of the NPP and their capabilities to liquidate the hypothetical emergency.

Sharing of mutual assistance between several NPPs upon request of the affected plant was improved and supported on corporate level.

The same question was asked about the main lessons learned from the COVID-19 pandemic with regard to EP&R provisions. Plants have introduced specific pandemic measures:

- determination of specific intervention levels & determination of pandemic modes/phases, identifying procedures for each mode, including identification of key functions to manage response as pandemic conditions deteriorate;

- identification of critical staffing (necessary to manage safe operations, including emergency);
- material retrofitting of TSCs was performed in order to ensure a sufficient level of personal protection and minimize risk.

COVID-19 has had a significant impact on emergency training, which has led to some adjustments – mostly trying to ensure minimal contact of involved personnel, e.g. only simulating some parts of the scenarios, etc. The same training and exercises were performed using digital tools and video conference software – very positive results.

Some countries improved the crisis management system to be able to manage some parts of ERO in remote mode.

Three countries did not provide an answer.

National experience among NPPs is shared mainly on government and corporate level. The elements of practical measures and good practices provided by the respondents to share experience with other NPPs and utilities abroad are:

- implementation of the radiocommunication system TETRA on the whole territory of EPR zones and connecting the system with the off-site first emergency workers like police forces, firefighters and medical services,
- deployment of off-site back-up equipment - strategically located enabling efficient use of equipment to support multiple sites,
- construction of alternative/backup Emergency Centres supplied with abundant electricity and communication capabilities,
- weekly inspections of EC workplaces and support centres by ERO members on standby to test software tools.

And regarding the pandemic situation, they are:

- developing the Pandemic emergency plan to protect plant workers, applicable to different types of pandemics;
- adopting suitable modular exercises to reduce numbers and allow social distancing; remote training of EPR topics;

using different software tools for training and drills that allow management of a significant part of the emergency remotely; using videoconference lectures for training.

#### 4.3.8. Synthesis of the analysis

Generalization of the EP&R Regulatory Framework topic shows that the regulatory framework is usually formed by one basic legal act, which can be supplemented by a set of regulations and specific guidelines establishing the licensee's obligations.

The topic of EP&R is supervised by national regulatory authorities that conduct regular reviews. Those reviews also involve international-organization observers like WANO and IAEA. Regularly reviews and inspections of EP&R provisions are usually conducted at annual intervals.

An integral part of EP&R is formed by plant and national training plans and practical exercises. No serious deficiencies were identified within the last three years. Ongoing works coordinated by regulatory authorities are oriented toward improving emergency procedures, strengthening emergency preparedness and implementing changes in national legislation as well as the requirements of international standards.

It can be also underlined that EP&R framework, organization and management throughout the participating countries is very similar.

The Emergency planning basis topic shows that the basis of the accident scenario(s) is used for on-site and off-site emergency planning. The scope of scenarios is formed mainly by combination of deterministic and PSA results as well as by using safety report analyses. The plant conditions derived from such scenarios cover a large range of situations that are foreseen from the design basis and beyond design accidents. Plant conditions are reflected by appropriate classification of an emergency. Depending on the degradation of the safety level and the potential radiological consequences, emergencies requiring response are usually assigned according to IAEA emergency classification levels: Pre-alert, Emergency Alert, Site Emergency and General Emergency.

Relations with the public and civil society living in the EPZ is the most complex topic.

The criteria for informing and notifying the local and national stakeholders and civil society are part of the on-site emergency plan. All involved parties are informed in the early phase of any accident.

There are minor differences between countries regarding plant responsibilities to advise and initiate off-site protective measures. All stakeholders (e.g. corporate organizations, regulatory authority, local and national state representatives, public living in the EPZ) are directly informed in most countries. Some countries use specific chain/cascading information systems where the affected plant informs only selected institutions that ensure further information dissemination.

Emergency plans assume that the affected plant provides physical assistance to the local and regional authorities/institutions, enables 24/7 information on the evolution of an incident/accident (radiological situation, technical parameters, specific measurements, etc.) in case of emergency. They also assume involvement of high-level emergency centres, such as the regulatory authority, Civil Protection and national emergency centres, that cooperate with the affected plant. All involved EROs use dedicated communication lines to share information.

All participating countries apply an action plan in relation with the public and civil society living in the EPZ to improve public confidence. There are organized public-relations campaigns such as presentations, plant open-house days, educational programs, communication via social media, distribution of booklets and TV shots dealing with EPR topics, etc. in addition to obligatory information that is provided to the regional and national subjects.

The role and position of TSO is covered only marginally. External support is provided by TSOs or external engineering companies/services to provide parallel calculations, justification of assessments etc.

The Fukushima event, experience sharing, and extraordinary situations such as the COVID-19 pandemic are important sources for improving EP&R provisions.

It is demonstrated that the main activities consist of reassessment of safety margins, reinforcing backup systems to withstand extreme meteorological and natural hazards, improving independence of TSCs, deep revisions of emergency procedures and improvement of communication ability and putting stress on multi-unit events. There was also improved sharing of mutual assistance between several NPPs upon request of the affected plant.

The impact of the COVID-19 pandemic enforced specific pandemic measures - determination of specific intervention levels and determination of pandemic modes/phases, identifying procedures for each mode, including identification of key functions to manage response as pandemic conditions deteriorate, identification of critical staffing (necessary to manage safe operations, including emergency). In addition, material retrofitting of TSCs was performed in order to ensure a sufficient level of personal protection and to minimize risk. Also, work has been done to improve the crisis management system to be able to manage some parts of ERO in remote mode. COVID-19 as such has also had a significant impact on emergency training. The pandemic situation has led to adjustments in practical training, mostly trying to ensure minimal contact of involved personnel, e.g. using digital tools and videoconference software.

National experience among NPPs is shared mainly on the corporate level. In general, there is no practical and regularly applied system enabling evaluation and sharing of international experience.

In conclusion, evaluation of questionnaires demonstrates application of very similar and quite uniform approaches to ensure EP&R activities across participating countries. There are only minor differences regarding local and national institutional arrangements, emergency information chains, legal obligations to civil society and competences among plant, regional and national organizations.

Minor findings regarding TSO and shared international experiences are as follows:

- The topic of TSO should be covered in more detail in the future, e.g. qualification requirements, certification, technology, etc;
- Reconsider the potential benefits of formal evaluation and assessment of international experience sharing including the practical possibility of such activity.

## 4.4. Analysis of the practical implementation of EP&R arrangements from the perspective of the CSOs from the questionnaire to CSO: level of public and Civil Society information and confidence

### 4.4.1. Civil Society organisations

"Civil Society" refers to all non-governmental and non-profit associations that act to influence government policies favourably in terms of the interests of the population they represent.

Regarding the EP&R issue, their main missions are to relay information on the subject of nuclear energy to the public. They bring together local authorities and organise their dialogue with decision-makers. They are in contact with the nuclear operators, organise debate and information sessions, and also carry out complementary expert assessments. Their role belongs to the day-to-day operation of nuclear facilities as well as in times of crisis.

Their works are disseminated to the population and institutional partners via newsletters, public meetings, press articles, reports and websites.

Thus, Civil Society is involved in the level of public knowledge and preparedness in the event of a crisis at the local level.

The Civil Society organisations comprise a majority of volunteers, from local authorities, the health field, the public and private sector and the rural world. While their scope of intervention is linked to their limited level of funding, their inclusion of members of the general public provides them with knowledge of the site, the cities and their environment, the local actors and the population.

At the international level, large civil society organisations can be involved at a higher level and act at European level.

Civil Society organisations involved in the nuclear fields aim to be representative of the population and its interests and provide local support in the event of an emergency by relaying information and intervening according to the means of the organisation and the skills of their members.

### 4.4.2. Context and regulatory situation

The key targets of the EP&R arrangements are naturally the protection of the population, property and the environment.

The goals of emergency response directly and significantly involving the population and its behaviour are reported in the IAEA GSR Part 7 guide:

- To save lives;
- To reduce the risk of stochastic effects;
- To keep the public informed and to maintain public trust;
- To prepare, to the extent practicable, for the resumption of normal social and economic activity.

The preparedness phase aims to ensure that an adequate capability is in place within the operating organisation and at local, regional, national levels and at the international level, for an effective response in a nuclear or radiological emergency.

At the local level, the level closest to the general public is represented by the Civil Society organisations and the mayors. They are consulted for the establishment of the emergency strategy in the framework of emergency preparedness. In the response phase, they have no clear responsibility assigned in the EP&R operational arrangements, besides their proximity with the population.

Public confidence is a major issue for the smooth running of operations. All the states have established an organisation to manage all kinds of emergency crises taking into account this dimension. It is required in BSS Article 102, Implementation of Strategy that "Member States shall assign responsibilities for the implementation of strategies for the management of existing exposure situations, and ensure appropriate coordination between relevant parties involved in the implementation of remedial and protective measures", leaving the choice of the relevant parties at the national level. "Member States shall ensure that those responsible for the implementation of a strategy shall regularly:

(a) evaluate the available remedial and protective measures for achieving the objectives and the efficiency of planned and implemented measures;

(b) provide information to exposed populations on the potential health risks and on the available means for reducing their exposure."

The responsibility to prepare and inform the public lies with all stakeholders. "Arrangements for response to a nuclear or radiological emergency shall be coordinated and integrated with arrangements at the local, regional and national levels for response to a conventional emergency and to a nuclear security event" (IAEA GSR Part 7 guide).

The Civil Society organisations' functions are not explicitly mentioned in the international guidance. They do not belong to the "emergency services." They are assimilated with the category "interested party."

The definitions provided by IAEA are the following:

- Emergency services. The local off-site response organizations that are generally available and that perform emergency response functions. These may include police, firefighters and rescue brigades, ambulance services and control teams for hazardous materials.
- Interested party. The term "interested party" is used in a broad sense to mean a person or group having an interest in the performance of an organization. Those who can influence events may effectively become interested parties — whether their "interest" is regarded as "genuine" or not — in the sense that their views need to be considered.

Civil Society including members of the public and scientific bodies constitutes an example of interested parties, involved in informing the population, and providing knowledge of the field off-site.

It is to be noticed that another category of crisis responder is taken into account in the international guidance. This is the helpers who were not designated as such in advance of a nuclear or radiological emergency and who must be provided with instructions on how to perform the duties under emergency conditions and with protection.

The involvement of the general public and Civil Society is a key element in reducing risks of stochastic effects due to a possible reaction of the population.

### 4.4.3. Topics studied and input data

In order to have an overview of EP&R arrangements issued from all the involved parties, three main Civil Society organisations and local authorities were interviewed.

- GMF (the Group of European Municipalities with Nuclear Facilities. GMF is a not-for-profit association of municipalities and associations of municipalities with nuclear facilities across European countries).
- ANCCLI (the "Association Nationale des Comités et Commissions Locales d'Information" in France. France has 19 Nuclear Power Plant sites; each one has a CLI: "Commission Locale d'Information." ANCCLI represents all CLIs to the national and international bodies involved in nuclear activities.
- NTW (Nuclear Transparency Watch).

Each of these organisations disseminates the questionnaires to their local branches.

A total of 21 questionnaire responses, covering 4 countries, was collected.

They were requested to transmit information about their role and their interaction with the other stakeholders, as well as their practical experience regarding their own level of information and confidence in the established system as well as that of the public.

The topics raised are:

- Involvement in implementation of EP&R arrangements;
- Participation in EP&R exercises;
- Self-assessment of the Organisation;
- Role, responsibilities and main actions carried out during a nuclear accident;
- Practicability of protection strategies:
  - Sheltering in place,
  - Iodine distribution and intake,
  - Evacuation organisation,
  - Food consumption and bans,

- Decontamination,
- Relocation.

One of the main objectives of EP&R provisions that is targeted in this study is public confidence. Civil society organisations and their members represent a cross-section of the population with a higher level of knowledge of nuclear issues than the general public, but are not among the designated workers in the preparation of EP&R provisions.

A better understanding of their position with regard to EP&R arrangements and their daily challenges allows better awareness regarding public concern and risk perception.

The analysis is based on the questionnaire responses from twenty-one entities.

#### 4.4.4. Involvement in Emergency Preparedness and Response

Civil Society organisations and local authorities contribute to reflection on improvement of the existing EP&R alongside the nuclear operators, as observers and influencers. They are globally not part of the decision making. The Civil Society organisations can unite very different profiles representative of the general public and their responsibilities are different depending on the entity in question. The local authorities have more weight because of their position and role than, for example, information cells made up of volunteers.

A small majority of the CSOs surveyed are in fact unsolicited in the definition and implementation of the EP&R arrangements.

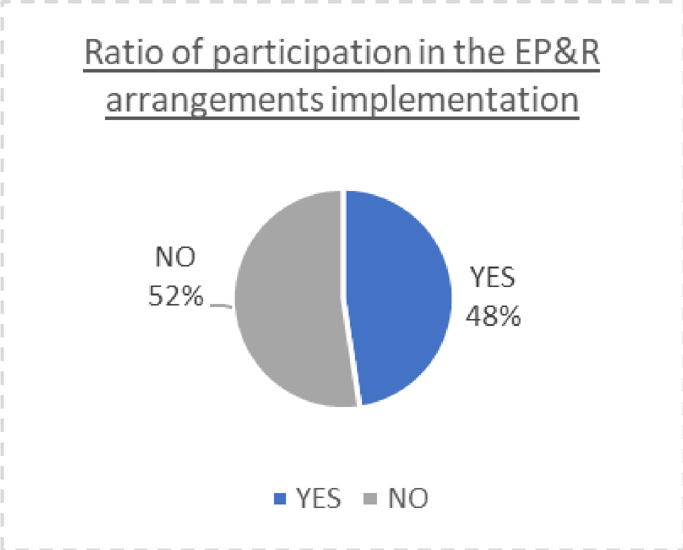



**Figure 68: Ratio of surveyed CSOs participating in the EP&R arrangements implementation**

They are in contact with local and national elected representatives and operators for the preparation of the emergency plan. They are contacted for training and familiarisation with protocols for intervention in CBRN environments, for crisis management exercises and information on prevention mechanisms dedicated to radiological emergencies. In the nearby area of the NPP, CSOs are consulted for planning of emergency measures. Independent companies are also involved to support the EP&R measures, such as independent laboratories which carry out radiological and other environmental monitoring around the nuclear power plants independently and publish results that are consulted and discussed by Civil Society. In the case of NTW, which represents civil society at the international level, it is consulted by the European Commission, national Greenpeace offices, local and regional authorities, other NGOs and the public, not by national authorities, for input on the quality of the content and adequacy of existing EP&R measures and arrangements.

They play an important role in carrying out training and disseminating information to increase the competence of local players.

However, on the whole, the actors who define the EP&R provisions do not sufficiently involve civil society, as the CSO would like. As for NTW, they claim to be asked to review and analyse these provisions, but are not sufficiently heard.

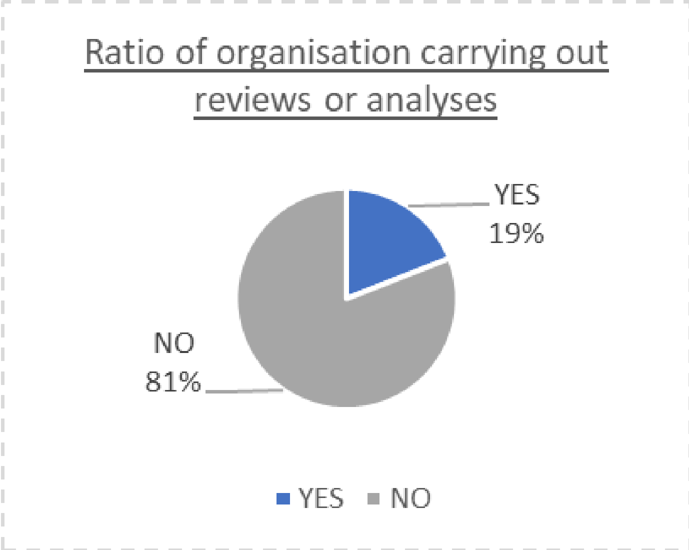



**Figure 69: Ratio of surveyed CSOs carrying out reviews or analyses of EP&R arrangements**

On the basis of the reviews and analyses it carried out, NTW highlights the issue that EP&R arrangements are inadequate, as they are virtually not based on worst case scenarios and built upon too low source-terms concerning severe accidents. NTW proposes to develop EP&R arrangements not only for incidents up to INES 5, but also for INES 7 and using realistic worst case source terms for that. It mentions external models for development of EP&R than can be included in the process (e.g. the FLEXRisk scenarios – http://flexrisk.boku.ac.at/ - a publicly accessible dispersion model). NTW points out non-harmonisation and unclarity about issues like measures in agriculture, economy, prophylaxis intake, evacuation plans, but also long-term arrangements, and a general lack of transparency and public participation in development of EP&R measures.

According to the CLIs and GMF, the organisations are efficient and well-adapted overall, but what is most lacking are the human and material resources to target the highest level of safety and security. The fact that they are more involved in the EP&R system today constitutes important progress over the last decade.

Regarding their involvement in EP&R exercises, it is observed that two thirds of the respondents participate in crisis exercises:

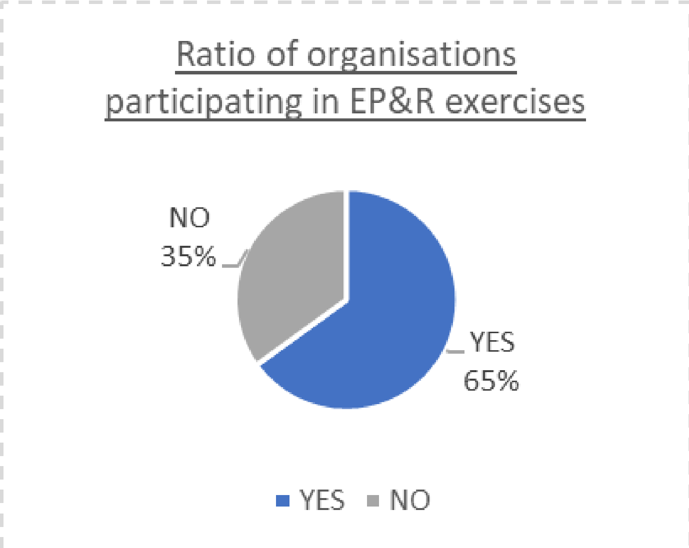



**Figure 70: Ratio of surveyed CSOs participating in EP&R exercises**

The frequency of their participation varies significantly between organisations. The particular nature of the pandemic situation disrupted the scheduling of EP&R exercises and does not allow us to conclude on this point.

The main outputs shared by CLIs and GMF from the last exercises they participated in are a positive feedback on the preparation and deployment of operational decision-making centres. Exercising was an important opportunity for CSOs to work with external parties such as local and national authorities, as well as intervention forces and fire brigades, to familiarise them with intervention equipment. In contrast, the implementation of communication and organisation of population evacuation was identified by almost all the respondents as weak points.

It is to be noted that some organisations or individuals interviewed did not receive the conclusions stemming from the exercises they were involved.

NTW conducts its own international emergency exercises within the organisation. NTW together with Greenpeace is equipped to handle situation assessment and monitoring, assessment of the necessary instrumentation, staff duty of care, internal organisation, preparedness for outward communication. The last NTW exercise took place in 2018. The next one had to be cancelled due to COVID. One important finding of the last NTW nuclear emergency exercise was that people in the field had difficulties in finding adequate information in the public domain and confused shielding and prophylaxis arrangements for protection against nuclear attacks and protection against nuclear accidents.

With regard to participation in national and international exercises, NTW's intervention has so far been refused. Recent examples include Belgium (Tihange) and the IAEA (CONVEX-3, 2021, based in the UAE). Consistently, the exercises are too focused on top-down communication, taking too little account of the dynamics of horizontal communication within society (including social media).

On the involvement side, as part of a response to a crisis situation, the potential offered by Civil Society is multiple. The local authorities constitute the local level of emergency preparedness and response as defined in the national plans. The other CSOs can provide their support and knowledge to guide the local decision-makers and support the population, but have no official role in the intervention process.

Once the local protection plan is activated following information transmitted by the competent organisations, additional measures may be decided on the triggering of other cells (support, logistics, communication, security, reception). CSOs help to inform citizens about the follow-up of the accident, the protective measures to be taken in homes, schools, retirement homes, companies, precautions concerning food and water, evacuation, accommodation and nutritional issues.

During a nuclear accident, NTW is in charge of the following tasks:

- Duty of care to personnel;
- Assessment of the situation (including 24/7 monitoring with adequate tools);
- Support and capacity building of local citizens / direct victims to understand the situation, including the provision of local measures;
- Quality control of authorities' communication to the public;
- Focusing the attention of the authorities on overseen situations (example: the case of Iitate during the Fukushima disaster);

- Countering and balancing in a scientifically justified way over-soothing or incomplete information streams from local, regional, national and international authorities and institutions like the IAEA and UNSCEAR;
- Support to other NGOs (incl. humanitarian NGOs) and authorities with quality information, skill sharing;
- Support to authorities in establishing the situation (example: the recent measurement work by Greenpeace in the Chernobyl Closed Zone in cooperation with the Ukrainian authorities).

Health professionals collaborate for assistance operations and setting up of protection of the population in conjunction with the operator. They ensure dissemination of prevention information and relay it between different sites. Independent laboratories can be tasked with communicating the readings of the beacons, the results of samples analysis and dose estimates to the stakeholders in time.

Everyone can also get involved on a voluntary basis. In France, ANCLI and the Information Local Commission are part of working groups at the national level in the framework of the reform of the post-accident doctrine (Codirpa).

With their good knowledge of the terrain, CSOs could be a stronger relay of information between the different local levels and the population and could channel rumours.

The opinion of the French CSOs and the municipalities of the GMF about the practical implementations of protective strategies during an emergency crisis and their level of efficiency was collected and reported by category:

- Sheltering in place;
- Iodine distribution and intake;
- Evacuation organisation;
- Food consumption and bans;
- Decontamination;
- Relocation.

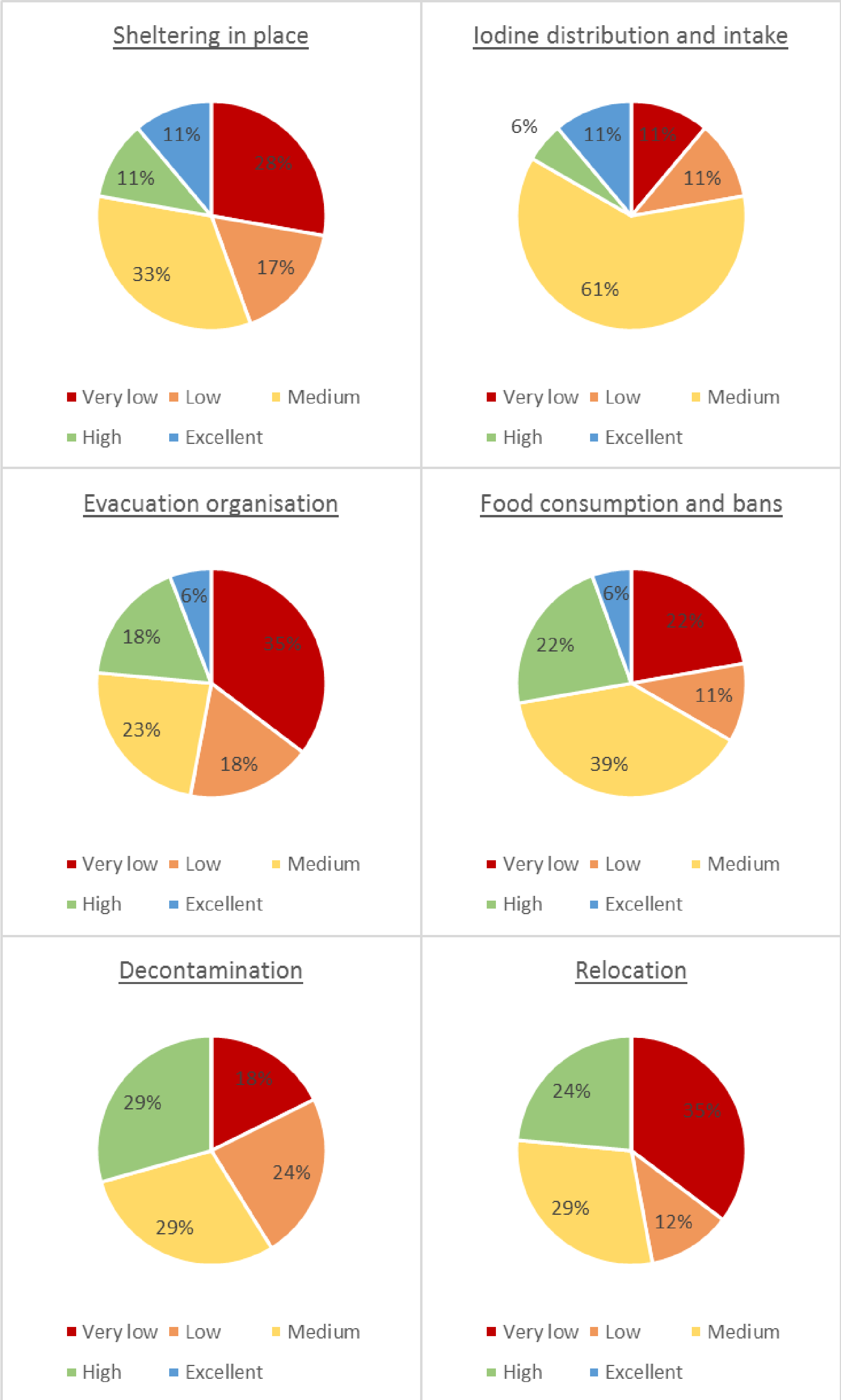



**Figure 71: Assessment of the protective measures efficiency by CSOs**

The graphs illustrate the limited confidence of CSOs in the EP&R arrangements in place.

Comparing the ratio of positive ("Excellent" and "High" responses) and negative ("Very low" and "Low" responses) assessments, provisions for sheltering, evacuation, and relocation are perceived as the most critical ones, because they depend on the behaviour of the public which is not involved in the preparation, as well as the decontamination issue. A contrario, iodine, food and decontamination issues are better perceived in terms of the effectiveness of the provisions, without being very high either.

It is to be noted that the problem of distribution and intake of iodine tablets is not identified as a key-issue to be improved significantly, whereas it is one of the most effective ways to be protected from the effects of radioactivity. Their point of view differs from that of Safety Authorities, who clearly point out the consequent lack regarding the iodine topic.

These outputs show that the assessment of the EP&R arrangements is different depending on whether a theoretical or practical point of view is taken. The perception of relevance in implementing sheltering and evacuation measures is more pessimistic from the CSOs and their point of view than the more theoretical vision of the Competent Authorities. Regarding the relocation phase, the assessment from the Safety Authorities and Civil Protection Organisations are even lower than the CSOs', as the least likely situation to occur and the most difficult one to predict and simulate.

Depending on the points of view and interest, the perception of the level of preparedness and thus the confidence attributed to the EP&R system diverges. To obtain a global view and an optimal provision, the EP&R arrangements must be built with the totality of the players.

In the framework of the present project, a workshop was held on November 17$^{th}$ and 18$^{th}$, 2021, to disseminate the major changes and improvements in the EP&R field ten years after the Fukushima nuclear accident. One of the strengths of the workshop was that it brought together all levels of responsibility. Inviting all the stakeholders involved in the EP&R field, including NPP operators, Civil Societies, municipalities, and international entities, beyond the circle of Safety Authority and Civil Protection organisations, was highly appreciated by all the attendees.

### 4.4.5. Public confidence and behaviour

Local Authorities and CSOs represent the level closest to the population. Due to their proximity with the practical field and the general public and, conversely, their distance from the establishment of the EP&R strategy and the Safety Authorities, the opinion of the CSOs is primordial in evaluating the level of involvement and confidence of the population.

The level of knowledge of the population and their interest in the EP&R arrangements directly impact the practical implementation of a response to a significant accident.

The position of the CSOs is unanimous as to the fact that the population is not informed and sufficiently involved in EP&R matters. Furthermore, only the population close to a nuclear facility is targeted to receive the information needed. Beyond the Emergency Planning Zone, the population has no access to specific information without a personal will to get it.

Today, the scenarios of EP&R exercises involve the population in a very limited way. The part involving the general public is hardly testable and realistic. The behaviour of the population in a real case can be predicted at best only if it strictly follows the national and local requirements. Unfortunately, previous major nuclear accidents and the attitude of the general public towards its leaders are barriers to building trust.

The scenarios are designed to be as operative as possible and realistic for the players. Nevertheless, the implementation of the exercises is not pushed to its maximum, i.e. a scenario is not rehearsed to the point of involving the population. For instance, sheltering and evacuation are difficult to simulate, but it would help the population to develop appropriate reflexes. The realism of the exercises is aligned with the organisational constraints imposed. But, as long as no full-scale exercise is carried out, it is difficult to assess the readiness status of the population.

Crisis exercises simulate what society could be confronted with. However, they will never integrate the human reaction aspect faced with impossible choices to make during a real nuclear catastrophe, when one's life and one's family's life are on the line.

Some respondents of CSOs highlight the issue that they are not informed enough about the scenarios tested, and feedback on the exercises is very limited. The issue of lack of debriefing is regularly raised in the questionnaire responses. This failure contributes to decreasing the knowledge of the CSOs and the population regarding EP&R arrangements and appropriate behaviour in case of an emergency.

The lack of citizen participation and involvement in the exercises and EP&R is also an issue of risk perception. The exercises are seen as constraints and not as an opportunity to train and to learn. The world of nuclear power is both anxiety-provoking and abstract for non-experts. Except for the inhabitants located in the first protection perimeter of the power plants, the culture of nuclear risk and the measures to adopt in the event of an incident are not known.

Developing a risk culture is one of the possible approaches to increase the sensitivity and receptivity of the population. Education on prevention of major nuclear risks and the number of information campaigns must be strengthened for a wider network of citizens.

Lack of involvement and information can lead to poor behaviour in practical implementation through attitudes that contradict the expectations of public authorities. Theoretical reactions of the population may not take place, while other reactions may take place without having been anticipated by the decision-makers, creating an additional constraint during a time of crisis. The practical and recurring example raised is the behaviour of parents regarding their children as a major obstacle to proper implementation of evacuation. The evacuation of people is intrinsically linked to the fact that parents do not pick up their children from school. Nevertheless, the first reflex will be to go and fetch the children, creating traffic jams in the presence of potential discharges. And this could not be avoided to the extent that no information on the regrouping centres is given to the parents beforehand.

In all cases, an informed and prepared citizenry contributes to reducing risk and panic in the event of an accident.

CSOs were requested to share their opinion about the factors that lead people to distrust the decisions of the authorities and thus amplify the seriousness of a crisis situation at national level.

NTW provides a non-exhaustive list of these factors: insufficient information provision, information in expert language, denial of justified concerns, insufficient preparation for worst-case scenarios (e.g. Fukushima), lack of transparency (e.g. the Ru-106 incident).

The distorted information from Chernobyl given at the governmental level is still remembered and suspicion has set in. Reinforced by the calculated catastrophism of all the media, the fear of disinformation creates strong resistance to the requirements of representatives, in particular in the nuclear sector. The lack of information and of interest in it on the part of the population amplifies the phenomenon. Even independently of nuclear history, the deficiency of trust in public authorities and the lack of contact with the representatives of public authorities is factual.

In the context of a cross-border crisis, a high degree of coordination and coherence between the decisions of each country involved is necessary, in order to manage, in addition, the language barriers and behavioural barriers. Cross-border exercises must be organised.

Stakeholders as a whole, including CSOs, are trying to defuse the suspicion through public meetings by explaining, in an instructional way, the risks and the reflexes to acquire.

The proposals mentioned by the CSOs for improving public confidence and for strengthening people's commitment to follow the instructions of the Government deal with:

- Concrete exercises involving the population to enlighten citizens;
- Information/teaching for children to continue educational work;
- Teaching the basics of risk culture to the civilian population, at school, in institutions, in professional circles, etc.;
- No absolute reliance on instructions alone - without explaining, without going to the people;
- Diversification of information media, to face the predominance of Internet-based information, a situation which is harmful for people not yet connected;
- Creation of a code of ethics for journalists;
- Demonstration of openness from our leaders about the minor and major nuclear events towards the general public;
- Communication to the population coming directly from the State, even if local authorities such as the municipalities can be a relay;
- Creation of additional services in independent monitoring.

The more citizens are trained, the better they will adhere to the instructions given, through proper justification of the constraints imposed.

### 4.4.6. Self-assessment

The Civil Society Organisations and local authorities are essentially a relay for information, application and implementation of decisions at the local level. Their role in the establishment of the EP&R arrangement is limited. Nuclear expertise and emergencies management is handled by the competent authorities, the nuclear operators and their experts in these fields. Because of their functional distance from national and international bodies and the competencies involved, the dominant management model followed is top-down, from the national to the local level, from the competent authorities to the operational staff in times of crisis, but also in the preparation phase.

The responses to the questionnaires confirm the low representation of the local level in the decision-making and organisational chain. The CSOs surveyed provided the current self-assessment of their organization on the following actions:

- Raise awareness of policy makers and the European society;
- Support and assist national and local initiatives and Civil Society Organizations;
- Demonstrate the ability to enhance the quality of decision-making processes;
- Participate in European working groups;
- Improve the practicability of the EP&R arrangements.

The response "very low" to qualify their weight in the actions mentioned above is highly represented.

At the international and strategic level, the trend is towards under-representativeness of the CSOs. By definition, their role is to raise awareness among local decision-makers. And municipalities are not the appropriate level to communication with the national sphere and beyond. But it must be noted that depending on the countries, the municipalities can have a stronger participation in the EP&R strategy management.

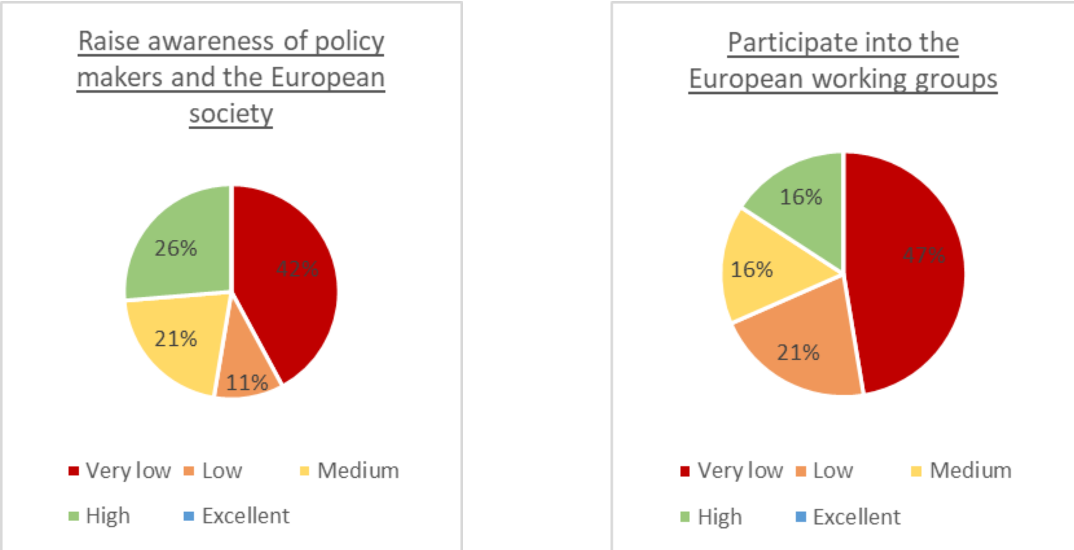



**Figure 72: Level of representation of CSOs at the national and international levels**

Regarding their ability to enhance the quality of decision-making processes, the majority of the respondents feel that their participation has a positive, even if minor, impact. CSOs are engaged in disseminating neutral information and organising debates on the nuclear subject. They thus contribute to the knowledge of Civil Society, and thus enlighten it, with a pedagogical will, to influence the decision-making process.

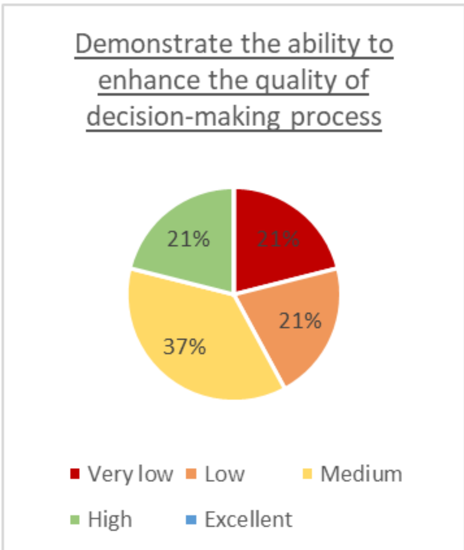



**Figure 73: Self-assessment regarding the level of the CSO to enhance the quality of decision-making progress**

CSOs intervene in areas close to sites at risk, in proportion to their funding. They provide their help to local authorities to elaborate their local emergency plan and propose tests of this plan. However, they point out that their exchanges with national and local initiatives are limited.

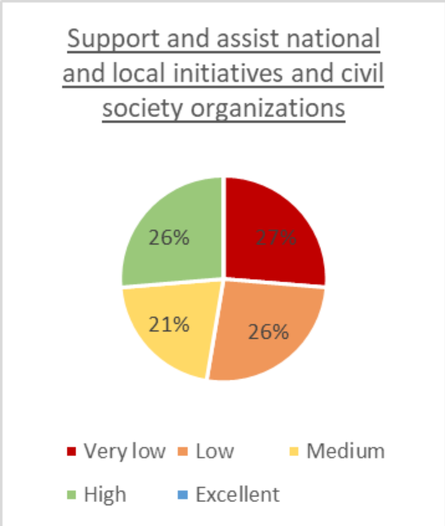



**Figure 74: Self-assessment of the CSO in supporting and assisting national and local initiatives**

Whether at the international, national or even local level, the potential of CSOs is not fully exploited according to them.

There is a feeling that their participation does not sufficiently influence the improvement of EP&R schemes and especially the practical aspects of the field. Some CSOs participate in exercises and provide a practical and distanced view for the improvement of EP&R provisions, at local level.

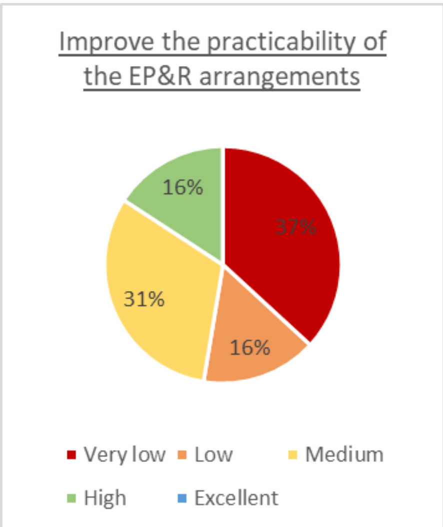



**Figure 75: Self-assessment of the CSO in improving the practicability of the EP&R arrangements**

This resource exists and is available to contribute to the global effort, but its role needs to be clarified and legitimised. NTW states its disagreement with the authorities on the lack of openness to civil society regarding the development of EP&R arrangements and exercises.

CSOs are in contact with the public. Working on their involvement in the EP&R system and developing their confidence is working to improve public confidence.

Because of its regular work with local representatives and players in the Emergency Planning Zone, the CSOs have the knowledge and competencies to play a role that goes beyond observation tasks in the event of a crisis, on a daily basis. Examples of actions to increase their participation to obtain a better preparation and confidence of the local people, provided by the respondents, are as follows:

- Develop understanding of the public and civil society and their roles in EP&R;
- Understand and overcome the fear for transparency;
- Carry out a structural inclusion of civil society in the set-up and planning of EP&R;
- Develop ongoing contact with civil society on developments;
- Launch an investigation about the potential participation of the CSOs in campaigns to distribute stable iodine tablets, to increase the ratio of people receiving their tablet;
- Better inform the medical community on the radiological medical consequences and the feedback from Chernobyl and Fukushima;
- Improve citizen participation in the conduct of exercises;
- Participate in regular exercises with dissemination of feedback;
- Involve a network of independent laboratories in addition to Safety Authorities and Technical Support Organisations;
- Restore trust in public authorities by providing more information on the merits of decisions by explaining the expected effects;

- Improve preventive information for exposed populations with awareness-raising sessions and the dissemination of information via digital tools;
- Instil the basics of risk culture in the civilian population.

# ANNEX 1: List of the participating countries

| Country | | Nuclear Safety Authority (SA) | Civil Protection (CP) | Nuclear Utility (NU) |
|---|---|---|---|---|
| AM | Armenia | ANRA<br>Armenian Nuclear Regulatory Authority | | |
| AT | Austria | BMK | Bundesministerium für Inneres / Federal Ministry of the Interior | |
| BE | Belgium | FANC<br>Federal Agency for Nuclear Control | FANC Coordinates both SA and CP | |
| BG | Bulgaria | BNRA<br>Nuclear Regulatory Agency | Fire Safety and Civil Protection Directorate-General, | Kozloduy NPP |
| CH | Switzerland | IFSN<br>Inspection Fédérale de la Sûreté Nucléaire | Federal Department of Defence, Civil Protection and Sports Federal Office for Civil Protection<br>National Emergency Operations Centre | |
| CY | Cyprus | Ministry of Labor, Welfare and social Insurance<br>Radiation Inspection and Control Service | Coordinated by SA | |
| CZ | Czech Republic | State office for Nuclear Safety | Ministry of the Interior - General Directorate of Fire Rescue Service of the Czech Republic - Operation and Information Centre | CEZ |
| DE | Germany | BMU | Coordinated by BMU | Preussen Elektra (Grouping German utilities) |
| DK | Denmark | DEMA<br>Danish Emergency Management Agency | | |
| EL | Greece | Greek Atomic Energy Commission (EEAE) | | |

| Country | | Nuclear Safety Authority (SA) | Civil Protection (CP) | Nuclear Utility (NU) |
|---|---|---|---|---|
| ES | Spain | CSN | | ENDESA |
| FI | Finland | STUK<br>Emergency Preparedness | | |
| FR | France | ASN<br>DEU (Direction de l'Environnement et des situations d'Urgence) | MARN<br>(Mission National d'Appui à la Gestion du Risque Nucléaire) | EDF |
| HR | Croatia | Ministry of the interior civil protection operations centre Ms Dept for radiological& Nuclear Emergency | SA-CP coordinated by SA | |
| HU | Hungary | HAEA | | Paks NPP |
| IE | Ireland | EPA<br>Office of Radiation Protection and Environmental Monitoring, Dublin | | |
| IS | Iceland | IRSA<br>Icelandic Radiation Safety Authority | | |
| IT | Italy | ISIN<br>National Inspectorate for Nuclear Safety and Radiation Protection | Presidenza del Consiglio dei Ministri<br><br>Dipartimento della Protezione Civile | |
| LT | Lithuania | VATESI<br>The State Nuclear Power Safety Inspectorate | Fire and Rescue Department<br>Ministry of the Interior | |
| LU | Luxembourg | Radiation Protection Department | SA-CP coordinated by the radiation Protection Department | |
| LV | Latvia | RSC SES<br>The Radiation Safety Centre of the State Environmental Service | | |

| Country | | Nuclear Safety Authority (SA) | Civil Protection (CP) | Nuclear Utility (NU) |
|---|---|---|---|---|
| ME | Montenegro | Ministry of Interior Affairs | Head of Department of Risks management Directorate for protection and rescue Ministry of interior affairs | |
| MK | Republic of North Macedonia | Radiation Safety Directorate | | |
| NL | The Netherlands | ANVS<br>Authority for Nuclear Safety and Radiation Protection | | BORSELLE NPP |
| NO | Norway | DSA<br>Norwegian Radiation and Nuclear Safety Authority | SA and CP coordinated by Ms Astrid Liland | |
| PL | Poland | Radiation Emergency Centre CEZAR, National Atomic Energy Agency | | |
| PT | Portugal | APA<br>Division<br>Emergency Preparedness and Response Unit (EPRE)<br>Department of Emergencies and Radiation Protection | Directorate for risks and Planning | |
| RO | Romania | CNCAN<br>National Commission for Nuclear Activities Control | General Inspectorate for Emergency Situations<br>National Operational Centre | |
| RS | Serbia | Srbatom<br>Serbian Radiation and Nuclear Safety Directorate<br>unit of monitoring, control and Emergency Situations | SA-CP coordinated by SA | |
| SE | Sweden | SSM<br>Swedish Radiation Safety Authority | Swedish Civil Contingencies Agency (MSB) | |

| Country | | Nuclear Safety Authority (SA) | Civil Protection (CP) | Nuclear Utility (NU) |
|---|---|---|---|---|
| SI | Slovenia | Slovenian Nuclear Safety Administration Emergency Preparedness Division | Ministry of Defence Administration for Civil Protection and Disaster Relief<br>Notification Centre of the Republic of Slovenia | Krsko NPP |
| SK | Slovakia | UJD<br>Public Health Authority of Slovak Republic | | Slovenske Elektraerne |
| UA | Ukraine | SNRIU<br>State nuclear regulatory inspectorate of Ukraine<br>Division on Emergency Preparedness and Radiation Protection | | |
| UK | United Kingdom | BEIS<br>Department for Business, Energy& Industrial Strategy | SA-CP coordinated by BEIS | EDF Energy |

# ANNEX 2: Questionnaire for EP&R Competent Authorities

Safety Authorities and Civil Protection Organisation survey for "Implementation of Nuclear and Radiological Emergency Preparedness and Response Requirements in EU Member States and Neighbouring Countries"

## Introduction to the questionnaire to Safety Authorities and Civil Protection Organisations

The European Commission selected the Consortium composed by NucAdvisor (France), as the leader, ENEA (Italy), EK (Hungary) and VUJE (Slovakia) for the implementation of the contract referenced N°ENER/D3/2020-245.

The general objectives of the project are to:

- (1) Review and evaluate the practical implementation of national emergency preparedness and response arrangements, emergency management systems and emergency plans in all EU Member States and participating countries in line with the provisions of the BSS and Nuclear Safety Directives. Provide information on the effectiveness of existing arrangements and capabilities in practice; review to what extent existing international and European standards, guidance and approaches are applied in practice; share national experiences amongst the relevant authorities and highlight effective practices that would improve public confidence.
- (2) Review and analyse the coherence of these arrangements in a cross-border context for EU Member States and participating countries in a number of scenarios. In this context, review implementation of coordination approaches developed by the competent authorities, and the outcomes of previous international exercises and European research projects. Through a series of case studies, identify specific actions and initiatives to increase mutual understanding of national arrangements and improve their coherence, harmonisation and their implementation in practice.
- (3) Facilitate cross-discipline discussion, technical exchanges, and sharing of experience amongst decision-makers, expert groups, civil society, licensee associations, regulatory bodies, health and civil protection authorities through a series of activities in order to achieve wider awareness of national and transboundary arrangements and to highlight effective implementation practices.
- (4) Develop recommendations for future policy actions at the EU-level, and identify broadly supported and practical proposals to improve implementation practices.

To reach the objective 1), different questionnaires was prepared. The present questionnaire is adressed the EP&R competent authorities namely SA (Nuclear safety Authorities) and CP (Civil Protection Organisations).

The questionnaire was prepared with 3 objectives:

- 1. Describing on a national basis, how European legislation (for EU Member Sates) or national legislation (for Non-EU countries) is practically implemented in the field of EP&R;
- 2. Allowing transnational comparisons, through both open/close-ended questions;
- 3. Ensuring the continuity with previous studies (with questionnaires) funded by the European Commission on EP&R arrangements.

This questionnaire is intended to be sent to all countries participating to the study (36 countries), asking to provide information allowing to describe with enough details the EP&R arrangements in place in the country, along with transborder considerations.

| # | Question | Text |
|---|---|---|
| 1 | Which organisation do you belong to? | |

| # | Question | Text |
|---|---|---|
| 2 | Could you indicate your name and position? | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | Text |
|---|---|---|
| 3 | Could you indicate your email? | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 4 | Is your country a EU Member State? | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 5 | Could you inform us about the progress status of the transposition of the BSS and NSD published in 2013 and 2014 in the National Law? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.1 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 7 Reference levels | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.2 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 69 Emergency exposure situation Emergency response | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.3 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 70 Information to the members of the public likely to be affected in the event of an emergency | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.4 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 71 Information to the members of the public actually affected in the event of an emergency | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.5 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 73 Contaminated areas | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.6 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 97 Emergency exposure situations Emergency management system | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.7 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 98 Emergency preparedness | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.8 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 99 International cooperation | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.9 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 100 Programmes on existing exposure situations | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.10 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 101 Establishment of strategies | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.11 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Directive 2013/59/Euratom (BSS Directive) - Article 102 Implementation of strategies | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.12 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - DIRECTIVE 2014/87/EURATOM Article 6 Licence holders | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.13 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - DIRECTIVE 2014/87/EURATOM Article 8d On-site emergency preparedness and response | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.14 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 3 | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.15 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 7 Emergency Response Coordination Centre | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.16 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 9 General preparedness actions of the Member States | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.17 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 10 Planning of operations | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.18 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 11 European Emergency Response Capacity | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.19 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 13 Training, exercises, lessons learnt and knowledge dissemination | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.20 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 14 Notification of disasters within the Union | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.21 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION ON UNION CIVIL PROTECTION MECHANISM Article 15 Responding to disasters within the Union | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.22 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL CONCLUSIONS 2015 Off-site nuclear emergency preparedness and response | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.23 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Commission Implementing Decision 2019/570 laying down rules for the implementation of Decision No 1313/2013/EU of the European Parliament and of the Council as regards rescEU capacities and amending Commission Implementing Decision 2014/762/EU | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.24 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Commission Implementing Decision 2021/88 amending Implementing Decision (EU) 2019/570 as regards rescEU capacities in the area of chemical, biological, radiological and nuclear incidents | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.25 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - COUNCIL DECISION of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency (87/600/Euratom) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.26 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - REGULATION 2016/52/EURATOM Article 1 Food and feed | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.27 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - REGULATION 2020/1158/Commission Implementing Regulation Article 3 Food and Feed | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.28 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - REGULATION 2017/2058/Commission implementing regulation Food and Feed | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 6.29 | For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - For each of these regulatory articles, could you indicate if the practical implementation of the provisions in the Emergency Management System is completed? - Council Directive 2013/51/EURATOM Drinking Water | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 7 | If you have answered one or several "No" to the previous question, could you list the main deviations? | |

| # | Question | Text |
|---|---|---|
| 8 | Which European Directives and/or Decisions were the most difficult to be considered and why? | |

| # | Question | Text |
|---|---|---|
| 9 | Regarding the Europeans Directives and Decisions that still need work to be satisfactory implemented, is a schedule established? What are the remaining main deadlines? | |

| # | Question | Text |
|---|---|---|
| 10 | Could you indicate the main international guidances you use to establish your Emergency System? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.1 | **For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Preparedness and Response for a Nuclear or Radiological Emergency - IAEA GSR Part 7** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.2 | **For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series N°GSG-11** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.3 | **For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.4 | **For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Arrangements for Preparedness for a Nuclear or Radiological Emergency - Safety Guide No. GS-G-2.1, IAEA (2007)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.5 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency IAEA Safety Standards Series No. GSG-14 (2020) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.6 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - ICRP Publication 109: Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.7 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - ICRP Publication 111: Application of the Commission's Recommendations to the Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.8 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - ICRP Publication IXX: Radiological Protection of People and the Environment in the Event of a large Nuclear Accident - Update of ICRP Publication 109 and 111 | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.9 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Emergency Preparedness - Practical proposals for further harmonisation of the reactions in European countries to any distant nuclear or radiological emergency, HERCA (2013) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.10 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - HERCA-WENRA Approach for a better cross-border coordination of protective actions during the early phase of a nuclear accident (2014) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.11 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Guidance for Bilateral Arrangements HERCA (2015) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.12 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Review of Current Off-site Nuclear Emergency Preparedness and Response Arrangements in EU Member States and Neighbouring Countries, ENER/D1/2012-474 (ENCO) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.13 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Proposal for guidelines for the transposition and implementation of the provisions of Directive 2013/59/Euratom on EP&R, Catalogue number MJ-02-17-387-EN-N, VNS, (2017) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 11.14 | For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - For each of these international guides and studies, could you indicate if you have implemented it in your Emergency arrangements? - Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive, Catalogue number MJ-03-19-143-EN-N, SCK-CEN-Merience, (2019) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | Partly | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 12 | Could you describe briefly the main deviations observed in your Emergency Management System with the international guides and studies mentioned above. What are the deadlines for completion if it applies ? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.1 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 1. Assessment of potential emergency exposure situations and associated public and emergency occupational exposures | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.2 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 2. Clear allocation of the responsibilities of persons and organisations having a role in preparedness and response arrangements | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.3 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 3. Establishment of emergency response plans at appropriate levels and related to a specific facility or human activity | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.4 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 4. Reliable communications and efficient and effective arrangements for cooperation and coordination at the installation and at appropriate national and international levels | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.5 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 5. Health protection of emergency workers | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.6 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 6. Arrangements for the provision of prior information and training for emergency workers and all other persons with duties or responsibilities in emergency response, including regular exercises | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.7 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 7. Arrangements for individual monitoring or assessment of individual doses of emergency workers and the recording of doses | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.8 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 8. Public information arrangements | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.9 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 9. Involvement of stakeholders | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 13.10 | Does your Emergency management system include the following elements? - Does your Emergency management system include the following elements? - 10. Transition from an emergency exposure situation to an existing exposure situation including recovery and remediation | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |
| | In progress | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 14 | How is organized the documentary base establishing the EP&R system? Could you provide the list of the corresponding documents (process, procedure, plan, etc..) at the different levels of the operational organization and the last date of update? | |

| # | Question | Text |
|---|---|---|
| 15 | Is the civil society consulted when developing process of emergency management systems and how? | |

| # | Question | Text |
|---|---|---|
| 16 | What were/are the main challenging elements of the Emergency Management System to be implemented practically and what were/are the main obstacles? | |

| # | Question | Text |
|---|---|---|
| 17 | Would you need a specific additional international guide? What would be the topic? | |

| # | Question | Text |
|---|---|---|
| 18 | Is your organisation involved in European and international cooperations in EP&R matters? Does it lead to significant impacts on your EP&R provisions? Is there any recommendation for more cooperation initiative at the EU or international level? | |

| # | Question | Text |
|---|---|---|
| 19 | Could you describe the stakeholders involved in the EP&R arrangement, public and private bodies, at all levels of the organisation (national, regional, local, off-site, in-site), positions and main responsibilities? | |

| # | Question | Text |
|---|---|---|
| 20 | Who are the stakeholders involved in the emergency cross-border arrangements? | |

| # | Question | Text |
|---|---|---|
| 21 | What are the main emergency situations categories considered in your Emergency response plan? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.1 | **Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (i) nuclear accidents: Situation of uncertainty** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.2 | **Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (i) nuclear accidents: Different severity classes** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.3 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (i) nuclear accidents: Different kinetics classes (related with the speed of process and release) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.4 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (i) nuclear accidents: Accident occurring abroad and with a potential significant impact in your country (requiring public-protection measures) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.5 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (i) nuclear accidents: Accident occurring abroad and having little impact in your country (not requiring public-protection measures in principle) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.6 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (ii) transport accidents | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.7 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (iii) offshore accident with a potential release | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.8 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (iv) accidents involving sources from industry and hospitals | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.9 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (v) malicious uses of radioactive materials | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 22.10 | Do you consider the following typical emergency exposures in the EP&R arrangements? - Do you consider the following typical emergency exposures in the EP&R arrangements? - (vi) other events | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 23 | If one of the emergency exposures above is not considered in the national EP&R arrangements, could you elaborate why and indicate if you have planned to update your arrangements to include it and when? | |

| # | Question | Text |
|---|---|---|
| 24 | Do you consider the IAEA emergency preparedness categories (IAEA GSR Part 7 Table 1)? Please elaborate. | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 25 | **Are you a "nuclear country"?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 26.1 | **The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - Precautionary action zone (PAZ)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 26.2 | **The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - Urgent protective action planning zone (UPZ)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 26.3 | **The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - Extended planning distance (EPD)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 26.4 | **The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - The IAEA GSR Part 7 requires specific intervention areas to be specified. Did you define the following areas? - Ingestion and commodities planning distance (ICPD)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 27 | At which distance of the nuclear facility are located the intervention areas mentioned above? | |

| # | Question | Text |
|---|---|---|
| 28 | Are the size and boundaries of the emergency planning zones specific for each site individually? Specific by type of nuclear installations (NPP, research reactor, waste management facility, etc)? Please describe. | |

| # | Question | Text |
|---|---|---|
| 29 | What are the criteria triggering the off-site response related with nuclear installations? | |

| # | Question | Text |
|---|---|---|
| 30 | Depending on the reactor technology, what do you explicitly consider as accident scenario to develop the Emergengy Response Plan? | |

| # | Question | Text |
|---|---|---|
| 31 | Do you foresee in your response plan to activate the EUCPM (EU Civil Protection Mechanism)? Please describe. | |

| # | Question | Text |
|---|---|---|
| 32 | What are the criteria triggering the off-site response related with nuclear transport? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.1 | **In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - The people to be evacuated** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.2 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Vectors necessary for the evacuation of vulnerable people | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.3 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - The medical transport capacities of the departments | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.4 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Available means of transport | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.5 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Farms | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.6 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Sensitive installations | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.7 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Pharmacies and laboratories | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.8 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Drinking water resources | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.9 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Electricity and telephone networks | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 33.10 | In the risk areas, do you assess the total inventory of: - In the risk areas, do you assess the total inventory of: - Other inventory | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 34 | When was done the last inventory? How often the inventories are carried out? | |

| # | Question | Text |
|---|---|---|
| 35 | **What is the public-protection strategy and the corresponding criteria regarding:**<br>Sheltering in place: when the release occurs quickly and is of short duration<br>Stable iodine prophylaxis: in the event of the release of radioiodine<br>Evacuation: from most contaminated areas from the fallout<br>Food bans<br>Control of person, vehicle and consumption<br>Decontamination<br>Relocation | |

| # | Question | Text |
|---|---|---|
| 36 | What is your strategy for distributing iodine tablets in the frame of the emergency preparedness? What is the ratio of the population which gets iodine tablets today in the targeted areas? How do you follow the number of people having received iodine tablets? | |

| # | Question | Text |
|---|---|---|
| 37 | **Could you specify the recommended dosage (mg iodine) for different population groups, and the recommended frequency for repeated intakes if needed?**<br>Infants<br>Children<br>Adults<br>Pregnant women<br>Others | |

| # | Question | Text |
|---|---|---|
| 38 | Where stable iodine is not pre-distributed, what arrangements are made to ensure its timely distribution following an emergency (how and how fast)? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 39 | **Are the evacuation routes defined?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 40 | How do you ensure the complete evacuation of the population? | |

| # | Question | Text |
|---|---|---|
| 41 | In an emergency situation requiring "constraints" for the population, how can the refusal of the populations to follow the Government's injunctions be managed? | |

| # | Question | Text |
|---|---|---|
| 42 | Which ratio of the EPZ population can be accomodated in pre-designated reception centres ? | |

| # | Question | Text |
|---|---|---|
| 43 | In case of contamination of areas, could you briefly describe the national ressources to operate the decontamination phase in terms of manpower, knowledge and technology? Is there specific area of technology for which you need international support? Which kind of support? | |

| # | Question | Text |
|---|---|---|
| 44 | Has a strategy for the return of those evacuated or relocated from contaminated areas been developed and provision made (in terms of criteria, health care, environmental monitoring, etc) for its implementation? | |

| # | Question | Text |
|---|---|---|
| 45 | Could the pandemic affect the protection strategy? How so? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 46 | **Did you develope a strategy for economic and social continuity?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 47 | What are the main points of your strategy for economic and social continuity? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 48 | **Do you have an action plan for the preparation of the population in the peace period in case of an accident?** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 49 | What are the main principles of this action plan for the preparation of the population in the peace period in case of an accident? | |

| # | Question | Text |
|---|---|---|
| 50 | Do you plan to consider a citizen participation in preparedness for and recovery from a radiation accident? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 51.1 | **Did you attend international workshops and/or conferences regarding: - Did you attend international workshops and/or conferences regarding: - Protection strategies and optimization approaches, including the use of reference levels** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 51.2 | **Did you attend international workshops and/or conferences regarding: - Did you attend international workshops and/or conferences regarding: - Generic criteria, operational criteria, default triggers** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 51.3 | **Did you attend international workshops and/or conferences regarding: - Did you attend international workshops and/or conferences regarding: - Arrangements for the transition from emergency to existing exposure situations** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 52 | If you answered a "Yes" to the previous question, could you inform us if these meetings impact the emergency arrangements of the country? If you answered a "No", could you provide us the reasons? | |

| # | Question | Text |
|---|---|---|
| 53 | What are your best practices and Areas For Improvement regarding protection strategy? | |

| # | Question | Text |
|---|---|---|
| 54 | Could you describe the principles and tools for diagostis/prognosis and assessing the possible consequence during an emergency situation used? Who is in charge of their implementation? | |

| # | Question | Text |
|---|---|---|
| 55 | Could you describe the organisation and the tools used to measure the level of radioactivity? How are the measurements transmitted and used? | |

| # | Question | Text |
|---|---|---|
| 56 | **Could you provide the number of the measure means and tools set in place?** | |
| | Laboratories for sample analysing | |
| | Fixed radioactivity control device around the site | |
| | Mobile means of monitoring radioactivity in the environment | |
| | Mesuring device for Gamma dose rate (with automatic real time data transmission) | |
| | Mesuring device for Gamma spectrum (with automatic real time data transmission) | |
| | Mesuring device for Gamma spectrum (delayed data transmission) | |
| | Air samplers (with automatic pseu-do real time data transmission | |
| | Air samplers (with delayed data transmission) | |
| | Water catchment points | |
| | Food sample points | |
| | Others | |

| # | Question | Text |
|---|---|---|
| 57 | Which kind of monitoring provide real time data transmission? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 58 | **Are you a member of the ECURIE agreement?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 59 | Why are you not a member of ECURIE? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 60 | **Do you use the EURDEP data (European Radiological Data Exchange Platform data)?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 61 | Who is in charge of the tasks related with the EURDEP tool and its data? | |

| # | Question | Text |
|---|---|---|
| 62 | What use do you do with the EURDEP data of the other countries? | |

| # | Question | Text |
|---|---|---|
| 63 | Did you already postpone the transmisson of data to EURDEP? For what reasons? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 64 | **Do you use the IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE)?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 65 | For which purposes do you use the USIE system? | |

| # | Question | Text |
|---|---|---|
| 66 | Do you find it time consuming and redundant to report emergency data in several different platforms, like ECURIE and USIE, during an emergency situation? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 67 | **Are you a "Nuclear country"?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 68 | What is the time interval between the emergency notification in-site and the information towards the off-site team? | |

| # | Question | Text |
|---|---|---|
| 69 | What are the means of communication used by the in-site teams to inform the off-site teams? | |

| # | Question | Text |
|---|---|---|
| 70 | What is the frequency for sharing information on the progression of the accident between the in-site teams and the off-site teams? | |

| # | Question | Text |
|---|---|---|
| 71 | Do you have EP&R template already prepared, ready to be used in case of emergency, for national communication and alert? What kind of information do the templates contain? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 72 | **Does your communication process plan an active dialogue between neighbouring countries on EP&R at all levels, local/municipal, regional and national levels, about the progression of the accident?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 73 | What is the time interval between the emergency notification in-site and the information towards the cross-border countries? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 74 | **Do you have an updated national contact list with position, name and the contact details?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 75 | **Do you have an updated contact list with position, name and the contact details regarding the cross-border countries entry contact?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 76 | What is the update frequency of the contact lists, at national and international levels? | |

| # | Question | Text |
|---|---|---|
| 77 | How do you ensure the efficiency of the communication channels with the cross-border countries? | |

| # | Question | Text |
|---|---|---|
| 78 | Are you informed about the ways of exchanging massive data and compatibility between data types and data formats with the cross-border countries? | |

| # | Question | Text |
|---|---|---|
| 79 | What are your best practices and Areas For Improvements regarding communication? | |

| # | Question | Text |
|---|---|---|
| 80 | What is the frequency of the EP&R exercises you carry out at national level? | |

| # | Question | Text |
|---|---|---|
| 81 | Do these exercises have specific issues to be tested? Could you provide examples of the topics tested? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 82 | **Are there some international observers during exercising?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 83 | **Does your organisation participate in exercises involving other countries?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 84 | What is the frequency of bi-lateral comprehensive exercises conducted by the involved countries? | |

| # | Question | Text |
|---|---|---|
| 85 | What are the lessons learnt and the action plan resulting from the previous EP&R exercise at the national level? | |

| # | Question | Text |
|---|---|---|
| 86 | What are the lessons learnt and the action plan resulting from the previous EP&R exercise at the international level? | |

| # | Question | Text |
|---|---|---|
| 87 | When will occur the next EP&R exercise, and what will be tested in particular? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 88 | **Does your organisation plan to increase the number of EP&R exercises in the coming years?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 89 | Could you explain why do you increase the number of exercises, at national and/or international level? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 90 | **Does your organisation participate to UCPM training cycle (MODEX)?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 91 | **Does your organisation participate to a Chemical, biological, radiological and nuclear detection (CBRN) training cycle of the UCPM training cycle?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 92 | Which type of profile participated in CBRN exercises? | |

| # | Question | Text |
|---|---|---|
| 93 | Is there any recommendation and/or suggestion to the European Commission for additional trainings (MODEX)? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 94 | **Does your organisation attend specific trainings on radiological-nuclear field organised by a CBRN Centres of Excellences (EU CBRN CoE)?** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 95 | What is your feedback on these specific trainings on radiological-nuclear field organised by EU CBRN CoE? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 96 | **Does your organisation participate in ConvEX exercices?** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 97 | What are the main challenges and lessons learnt from the last ConvEX exercise? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 98 | **Does your organisation participate in INEX exercices?** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 99 | What are the main challenges and lessons learnt from the last INEX exercise? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 100 | **Does your organisation participate in ECUREX exercices?** | **0** | 100% | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 101 | What are the main challenges and lessons learnt from the last ECUREX exercise? | |

| # | Question | Text |
|---|---|---|
| 102 | What are your best practices and Areas For Improvement regarding testing and exercising? | |

| # | Question | Text |
|---|---|---|
| 103 | The HERCA-WENRA approach adopt the principle "We do the same as the accident country" in the first hours of the accident. To what extent are you in line with this concept? Which could be the obstacles to apply this specific approach? | |

| # | Question | Text |
|---|---|---|
| 104 | In case of an accident impacting your country and multiple neighbouring countries, how do you ensure the compatibility of the response? How do you ensure an alignment of the protection measures along borders? Do the parties consider the whole affected area, independent of a national border, when making decisions? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 105 | **Do you know the resources available in the neighbouring countries?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 106 | **Do you have EP&R agreement with all your neighbouring countries?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 107 | Could you list the countries with which there is a bilateral agreement? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 108 | **Do you have multilateral EP&R agreement?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 109 | With which countries do you have multilateral EP&R agreement? | |

| # | Question | Text |
|---|---|---|
| 110 | Have you ever tested the contents of the bilateral and multilateral agreements? What about the means of communication? What are the key outputs? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.1 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Information exchange (what kind of information, ways to exchange it during the accident and the deliverables (contents and frequency) | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.2 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Short message information exchange system for the response | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.3 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Direct bilateral requests for assistance | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.4 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Automated transfer of measurement data | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.5 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Organisation of joint exercises and drills | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.6 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Joint public communication campaigns | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 111.7 | Do you have arrangements with the neighbouring countries, regarding: - Do you have arrangements with the neighbouring countries, regarding: - Mechanisms for rapid exchange of relevant information between appropriate authorities in case of a severe accident requiring rapid decisions for protective actions | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 112 | **Do you organise some exchanges session with other countries on EP&R issue?** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 113 | Could you present these exchange sessions with other countries on EP&R issue? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 114 | **Are you a member of the RANET IAEA network?** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 115 | Could you explain why are you not a member of the RANET IAEA network? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.1 | **Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - PREPARE: Innovative integrated tools and platforms for radiological emergency preparedness and post-accident response in Europe** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.2 | **Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - EU-OPERRA SHAMISEN: recommendations that would contribute to health surveillance and related communication with affected populations after nuclear accidents** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.3 | **Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - ENGAGE: to improve the governance of radiological risks by strengthening and enhancing stakeholder engagement processes in relation to radiation protection policy and practice** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.4 | **Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - TERRITORIES: aims "To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations"** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.5 | **Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - Confidence: is performing research focused on uncertainties in the area of emergency management and long-term rehabilitation** | **0** | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.6 | Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - SHAMISEN-SINGS: aims of enhancing Citizen Participation in preparedness for and recovery from a radiation accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.7 | Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - FASTNET: Tool for the fast and reliable prediction of severe accident progression and anticipation of the source term of a nuclear accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 116.8 | Do you know the outputs of the following European projects in the EP&R field? - Do you know the outputs of the following European projects in the EP&R field? - HoNESt: takes a new and transnational look at how nuclear power has been used and its relationship to society | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.1 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - PREPARE: Innovative integrated tools and platforms for radiological emergency preparedness and post-accident response in Europe | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.2 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - EU-OPERRA SHAMISEN: recommendations that would contribute to health surveillance and related communication with affected populations after nuclear accidents | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.3 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - ENGAGE: to improve the governance of radiological risks by strengthening and enhancing stakeholder engagement processes in relation to radiation protection policy and practice | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.4 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - TERRITORIES: aims "To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations" | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.5 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Confidence: is performing research focused on uncertainties in the area of emergency management and long-term rehabilitation | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.6 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - SHAMISEN-SINGS: aims of enhancing Citizen Participation in preparedness for and recovery from a radiation accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.7 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - FASTNET: Tool for the fast and reliable prediction of severe accident progression and anticipation of the source term of a nuclear accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 117.8 | Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - Do you implement action plans to integrate the outputs of these European projects in your EP&R arrangements? - HoNESt: takes a new and transnational look at how nuclear power has been used and its relationship to society | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 118 | If you answered a "Yes" to the previous question, could you indicate which outputs do you take into account? | |

| # | Question | Text |
|---|---|---|
| 119 | What are your best practices and Areas For Improvement regarding international cooperation? | |

| # | Question | Text |
|---|---|---|
| 120 | Who is in charge of provinding information towards the public and the press release in case of radiological emergency, even if the accident occurs abroad? | |

| # | Question | Text |
|---|---|---|
| 121 | How does your organisation ensure that the fast and right information is dispatched to the public in case of emergency? | |

| # | Question | Text |
|---|---|---|
| 122 | What are the means of communication used to inform the public? | |

| # | Question | Text |
|---|---|---|
| 123 | What is the frequency of sharing information with the public on the progression of the accident? | |

| # | Question | Text |
|---|---|---|
| 124 | Are experts in the field prepared to deal with questions from media and the press? | |

| # | Question | Text |
|---|---|---|
| 125 | Who is responsible for sharing of dispersion predictions and monitoring data with the public? | |

| # | Question | Text |
|---|---|---|
| 126 | How is composed the crisis communication cell of the EP&R competent authority? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 127 | **Does the crisis communication cell of the EP&R competent authority contain a social media manager?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 128 | **Does the crisis communication cell of the EP&R competent authority contain a webmaster?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 129 | **Do you take into consideration the public opinion and perception on the accident?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 130 | Do you study the public opinion on subject such as the population's state of anxiety, the state of rumours and the spread of false information? Please elaborate. | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 131 | **Does your communication process plan an active dialogue between neighbouring countries on EP&R at all levels, local/municipal, regional and national levels about the public information?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 132 | How do you foresee to manage press-releases and information to the public in relation to what is provided by other countries or by other regional or international entities? | |

| # | Question | Text |
|---|---|---|
| 133 | What is the level of the distrust of the population towards the words of the experts? How to make it credible in the event of an emergency? | |

| # | Question | Text |
|---|---|---|
| 134 | In the preparedness phase, what do you publish regarding emergency situations in destination to the public (guidance, report, booklet, etc)? Do you refer to the international issues? | |

| # | Question | Text |
|---|---|---|
| 135 | In your opinion, what could help to improve public confidence in arrangements? What are your best practices and your current challenges to increase public confidence? | |

| # | Question | Text |
|---|---|---|
| 136 | Could you describe the mechanisms of continued improvement in the EP&R management system? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 137 | **Have the national EP&R arrangements been revised because of the pandemic ?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 138 | Could you please describe the EP&R arrangements revised because of the pandemic ? | |

| # | Question | Text |
|---|---|---|
| 139 | How do you measure the level of knowledge and readiness of the EP&R teams? What are your indicators, targets and results? | |

| # | Question | Text |
|---|---|---|
| 140 | How do you measure the efficiency of the national EP&R arrangements? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.1 | **Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Protection strategy** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.2 | **Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Stakeholder organisation** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.3 | **Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Communication organisation and tools** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.4 | **Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Public information** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.5 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - EP&R exercise conduct | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.6 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - EP&R exercise conclusions integration | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.7 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - International cooperation | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.8 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Human resources sizing during an accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.9 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Material resources sizing during an accident | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.10 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Radiological measures | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.11 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Sheltering arrangments | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.12 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Iodine intake arrangements | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.13 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Evacuation arrangements | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.14 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Decontamination arrangements | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 141.15 | Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Do you have specific indicators to assess the efficiency of the EP&R arrangements regarding the following topics? - Return from evacuation or relocation | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.1 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Protection strategy | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.2 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Stakeholder organisation | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.3 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Communication organisation and tools | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.4 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Public information | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.5 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - EP&R exercise conduct | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.6 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - EP&R exercise conclusions integration | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.7 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - International cooperation | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.8 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Human resources sizing during an accident | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.9 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Material resources sizing during an accident | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.10 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Radiological measures | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.11 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Sheltering arrangments | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.12 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Iodine intake arrangements | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.13 | What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Evacuation arrangements | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.14 | **What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Decontamination arrangements** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 142.15 | **What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - What are the current results of your indicators about the efficiency of the EP&R arrangements regarding the following topics? If you do not have specific indicators, could you self-assess for each of the following topics? - Return from evacuation or relocation** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 143 | Could you provide elements of justification regarding the assessment done in the above question? | |

| # | Question | Text |
|---|---|---|
| 144 | If your organisation has experienced a real emergency situation, could you briefly describe and highlight the main lessons learnt and implemented? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 145 | **Do you perform audits and peer reviews of the EP&R management system and arrangements?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 146 | What are the main last outputs from these audits and peer reviews? | |

| # | Question | Text |
|---|---|---|
| 147 | What are your best practices and Areas For Improvements regarding EP&R system quality? | |

| # | Question | File upload |
|---|---|---|
| 148 | You may upload any document that may support your previous answers: | |

# ANNEX 3: Questionnaire for Nuclear Utilities

Nuclear utilities and Nuclear Power Plants survey for "Implementation of Nuclear and Radiological Emergency Preparedness and Response Requirements in EU Member States and Neighbouring Countries"

## Introduction to the questionnaire to Nuclear Power Plants and Utilities in the European Union

Nuclear Power Plant personnel play a key role to maintain a high level of Emergency Preparedness and Response (EP&R), under the supervision of National Competent Authority. This capability relates to an integrated set of infrastructural elements that include but are not limited to authority and responsibilities; organization and staffing; coordination; plans and procedures; tools, equipment, and facilities; training, drills and exercises; and a management system.

The government and authorities (Nuclear Safety Authority) shall ensure that arrangements are in place for the coordination of preparedness and response for a nuclear or radiological emergency between the operating organization (licensee) and authorities at the local, regional, and national levels, and, where appropriate, at the international level coordinated by relevant organizations.

The objective of this study, regarding the licensee, **is not focused on the nuclear safety in terms of design, features, systems, or other possible external additional mobile devices,** but mostly to the **EP&R practical arrangements**, criteria incident/accident classification for activating Nuclear and Radiological Emergency actions, and timely liaison and communication to those responsible for off-site EP&R.

The objective of this questionnaire is to get "first-hand information" from the Nuclear Power Plant Management, and where appropriate from the Corporate level of the Nuclear Utility in the country with regards to:

- Responsibility of NPP in EP&R provisions;
- Incident/accident classification for Emergency Off-Site and activation of NPP Internal EP&R organization and where appropriate the activation of off-site EP&R arrangements;
- Communication with Nuclear safety Authorities and Corporate Level of Nuclear Utilities;
- Mobilization of on-duty staff, expertise (local and national), external support and mobile equipment if needed, Support to local and regional authorities;
- Site protective measures for NPP personnel and dispatch external personnel;
- Measurement, data collection and communication;
- Training to personnel, Emergency Exercise (frequency, reporting, lessons learnt);
- Specific arrangement in case of site inaccessibility for rescue and other personnel;
- Inspection from the Nuclear Safety Authorities;
- Local relationship and dialogue with territorial level for emergency exercise and post-accident management exercise.

Taking into consideration of the Fukushima Tsunami and subsequent accident in the NPP, it would be appreciated to get significant improvements implemented by Nuclear Utility and NPP in terms of EP&R organization on a practical standpoint.

| # | Question | Text |
|---|---|---|
| 1 | Which organisation do you belong to? | |

| # | Question | Text |
|---|---|---|
| 2 | **Could you indicate your name and position?** | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | Text |
|---|---|---|
| 3 | **Could you indicate your email?** | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | Text |
|---|---|---|
| 4 | Could you briefly describe the regulatory framework, which set up the licensee's obligation in terms of EP&R? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 5 | **Do Nuclear Safety Authorities conduct regular reviews and inspections on EP&R provisions within NPPs and/or other Corporate Organisations?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 6 | When was the last EP&R inspection at your Plant by the Nuclear Safety Authority or other bodies? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 7 | **Are there other reviews (WANO, IAEA...) that were performed on EP&R?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 8 | What are their main findings? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 9 | **Do you perform on a periodic basis EP&R exercises (internally and with external stakeholders)?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 10 | When was the last exercise? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 11 | **Do you plan exercises in the coming period?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 12 | Could you give details on this coming exercise ? | |

| # | Question | Text |
|---|---|---|
| 13 | Could you provide with the main findings of performed exercises in the last three years? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 14 | **Is there an ongoing work plan coordinated by regulatory bodies to improve EP&R provisions within NPPs?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 15 | Could you give details on this ongoing work plan? | |

| # | Question | Text |
|---|---|---|
| 16 | Could you describe the basis of the accident scenario(s) used for on-site and off-site emergency planning, including assumptions about the plant state, containment integrity, dispersal conditions, and the estimation of the source term and its evolution over time? | |

| # | Question | Text |
|---|---|---|
| 17 | Could you describe whether the accident scenarios considered for emergency planning purposes are determined based on a deterministic/probabilistic analysis or a combination of both? Please elaborate. | |

| # | Question | Text |
|---|---|---|
| 18 | Could you describe how the outcomes of the plant level 2 (and if applicable level 3) Probabilistic Safety Assessments (PSA) have been used to inform the criteria used to determine emergency planning measures (e.g. initiating event, likely magnitude of radioactive release, time and duration of release, size of zoning for protective countermeasures)? | |

| # | Question | Text |
|---|---|---|
| 19 | Could you briefly describe EP&R criteria and actions made by the NPP for informing local and national stakeholders? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.1 | **Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Relation with the Nuclear Safety Authorities (local and/or national)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.2 | **Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Relation with Local and National State Representative** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.3 | **Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Relation with Local and National Civil Protection Organisations** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.4 | **Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Relation with public living in the Emergency Planning Zone (EPZ)** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.5 | **Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Does the licensee have any responsibility to advise and initiate off-site protective measures with regards to: - Relation with the Nuclear Utility Corporate Organisation** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 21 | Could you describe the corresponding licensee responsibilities to advise and initiate off-site protective measures? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 22 | **Are communicating devices such as alert siren, phone calls or other regularly tested?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 23 | What is the frequency for testing these communicating devices? | |

| # | Question | Text |
|---|---|---|
| 24 | **Could you briefly describe the NPP obligations in contributing to off-site EP&R implementation with regards to:** | |
| | Providing physical assistance to the local and regional authorities | |
| | Dispatching personnel outside the NPP | |
| | Providing 24/7 information on the evolution of incident/accident (parameters, measurements, etc…) | |
| | Communicating on radiation measurements (how and to whom) | |

| # | Question | Text |
|---|---|---|
| 25 | Once an Emergency has been activated, what are the main actions in terms of health and radioprotection measures (apparatus devices, iodine tablets, sheltering, etc…) regarding NPP personnel or other external personnel requiring site access? | |

| # | Question | Text |
|---|---|---|
| 26 | Could you briefly describe how the NPP activate mobilization and information of Nuclear Utility Corporate on a 24/7 basis? | |

| # | Question | Text |
|---|---|---|
| 27 | Could you briefly describe any aggravating situations such as weather conditions, site access, etc, which are taken into account in EP&R countermeasures provisions? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 28 | **Does the NPP have "in-house" software tools and expertise to predict the radiological evolution of the incident/accident (prognosis)?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 29 | Could you describe this software tools used to predict the radiological evolution of the incident/accident? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 30 | **Is this software benchmarked with other software used by Nuclear Safety Authority or Technical Support Organisation ?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 31 | What expertise does the operator provide to the group making the assessment to predict the radiological evolution of the accident? | |

| # | Question | Text |
|---|---|---|
| 32 | Could you briefly describe what external support might be mobilized for supporting the NPP in such a prognosis? | |

| # | Question | Text |
|---|---|---|
| 33 | Could you briefly describe any actions taken by the NPP to inform the public and the civil society about EP&R provisions in the event of an incident/accident? | |

| # | Question | no. | no.(%) | Score value |
|---|---|---|---|---|
| 34 | **Are there any legal obligation on the periodic information given to the public?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 35 | Could you give more details on the legal obligation to communicate to the public (periodicity, content, means of communication, etc.)? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 36 | **Do the public and the civil society participate to EP&R exercises organised by the NPP and Authorities?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 37 | Could you give details on the participation of the public and civil society to EP&R exercises organised by the NPP and Authorities? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 38 | **Is there any action plan in relationship with the public and the civil society living in the EPZ for improving public confidence?** | **0** | **100%** | **-** |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 39 | Could you give details on this action plan? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 40 | **Could you make a self-assessment on your perception of the public's confidence in your NPP's ability to manage EP&R ?** | **0** | **100%** | **-** |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 41 | **Could you briefly describe the EP&R organisation at the Corporate level when a Nuclear Emergency is to be triggered:**<br>Do you have a specific National Emergency Centre or similar?<br>What are the criteria to activate the National Emergency Centre?<br>What are the members of the Emergency Centre (technical, experts, media for external communication)?<br>Do the NPP and the Emergency Centre have a secured line for their communication or do they have any other means of communication dedicated to emergencies ?<br>Are there specific communication devices used to communicate with National Competent Authorities<br>Other information at your convenience to give more details on responsibilities and obligation between NPP and the Nuclear utility Corporate level | |

| # | Question | Text |
|---|---|---|
| 42 | What are the main lessons learnt from the Fukushima accident with regards to EP&R provisions under NPP's responsibility (arrangements, capabilities, relation with public living in EPZ) and under Corporate responsibility? | |

| # | Question | Text |
|---|---|---|
| 43 | Do you have practical measures and good practices to share with other NPPs and utilities abroad? | |

| # | Question | Text |
|---|---|---|
| 44 | What are the main lessons learnt from the COVID-19 pandemic with regards to EP&R provisions? | |

| # | Question | Text |
|---|---|---|
| 45 | In this respect of COVID 19, do you have practical measures and good practices to share with other NPPs and nuclear utilities abroad on matters of EP&R? | |

| # | Question | File upload |
|---|---|---|
| 46 | You may upload any document that may support your previous answers: | |

# ANNEX 4: Questionnaire for Civil Society Organisations

Civil Society and local authority organisations survey for "Implementation of Nuclear and Radiological Emergency Preparedness and Response Requirements in EU Member States and Neighbouring Countries"

## Introduction to the questionnaire to Civil Society and local authority organisations (GMF, NTW, ANCCLI)

The European Commission selected the Consortium composed by NucAdvisor (France), as the leader, ENEA (Italy), EK (Hungary) and VUJE (Slovakia) for the implementation of the contract referenced N°ENER/D3/2020-245.

The general objectives of the project are to:

- (1) Review and evaluate the practical implementation of national emergency preparedness and response arrangements, emergency management systems and emergency plans in all EU Member States and participating countries in line with the provisions of the BSS and Nuclear Safety Directives. Provide information on the effectiveness of existing arrangements and capabilities in practice; review to what extent existing international and European standards, guidance and approaches are applied in practice; share national experiences amongst the relevant authorities and highlight effective practices that would improve public confidence.
- (2) Review and analyse the coherence of these arrangements in a cross-border context for EU Member States and participating countries in a number of scenarios. In this context, review implementation of coordination approaches developed by the competent authorities, and the outcomes of previous international exercises and European research projects. Through a series of case studies, identify specific actions and initiatives to increase mutual understanding of national arrangements and improve their coherence, harmonisation and their implementation in practice.
- (3) Facilitate cross-discipline discussion, technical exchanges, and sharing of experience amongst decision-makers, expert groups, civil society, licensee associations, regulatory bodies, health and civil protection authorities through a series of activities in order to achieve wider awareness of national and transboundary arrangements and to highlight effective implementation practices.
- (4) Develop recommendations for future policy actions at the EU-level, and identify broadly supported and practical proposals to improve implementation practices.

To reach the objective 1), different questionnaires were prepared. The present questionnaire is addressed to the following Civil Society Organisations/local authorities (CSO):

- GMF: the Group of European Municipalities with Nuclear Facilities. GMF is a not-for-profit association of municipalities and associations of municipalities with nuclear facilities across European countries.
- ANCCLI: the « Association Nationale des Comités et Commissions Locales d'Information » in France. France has 19 Nuclear Power Plant sites; each one has a "CLI: Commission Locale d'Information. ANCCLI represents all CLI towards national and international bodies involved in nuclear activities.
- NTW: Nuclear Transparency Watch.

The questionnaire was prepared with 3 objectives:

- 1. Describing on a national basis, how European legislation (for EU Member Sates) or national legislation (for Non-EU countries) is practically implemented in the field of EP&R;
- 2. Allowing transnational comparisons, through both open and close-ended questions;
- 3. Ensuring the continuity with previous studies funded by the European Commission on EP&R arrangements.

| # | Question | Text |
| --- | --- | --- |
| 1 | Which organisation do you belong to? | |

| # | Question | Text |
| --- | --- | --- |
| 2 | **Could you indicate your name and position?** | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | Text |
| --- | --- | --- |
| 3 | **Could you indicate your email?** | |
| | Participant 1 | |
| | Participant 2 | |
| | Participant 3 | |
| | Participant 4 | |
| | Participant 5 | |
| | Participant 6 | |
| | Participant 7 | |

| # | Question | no. | no. (%) | Score value |
| --- | --- | --- | --- | --- |
| 4 | **Is your Organisation consulted for the implementation of EP&R arrangements, at national and international levels?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
| --- | --- | --- |
| 5 | Who consults you for the implementation of EP&R arrangements, at national and international levels? | |

| # | Question | Text |
| --- | --- | --- |
| 6 | Which type of input or support is requested from you? | |

| # | Question | no. | no.(%) | Score value |
| --- | --- | --- | --- | --- |
| 7 | **Does your Organisation conduct reviews and analyses on EP&R provisions?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
| --- | --- | --- |
| 8 | What are the main findings raised from the reviews and analyses you conducted related with EP&R? | |

| # | Question | no. | no.(%) | Score value |
| --- | --- | --- | --- | --- |
| 9 | **Do your members participate in EP&R exercises, at the national and international levels?** | 0 | 100% | - |
| | Yes | 0 | - | 0 |
| | No | 0 | - | 0 |

| # | Question | Text |
| --- | --- | --- |
| 10 | When was the last exercise you attended? | |

| # | Question | Text |
|---|---|---|
| 11 | Could you provide the main findings of performed exercises? | |

| # | Question | Text |
|---|---|---|
| 12 | Do you plan to participate in any exercises in the coming period? | |

| # | Question | Text |
|---|---|---|
| 13 | In your opinion, what are the elements of the current EP&R arrangements which can be improved in practice and why? | |

| # | Question | Text |
|---|---|---|
| 14 | Do you think that EP&R exercise scenarios are realistic enough today and why? | |

| # | Question | Text |
|---|---|---|
| 15 | Do you think citizens are sufficiently informed and involved in EP&R and why? | |

| # | Question | Text |
|---|---|---|
| 16 | How could it impact the practical implementation of an Emergency response during an accident? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 17.1 | **Could you provide the current self-assessment of your Organization on the following actions? - Could you provide the current self-assessment of your Organization on the following actions? - Raise awareness of policy makers and the European society** | **0** | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 17.2 | **Could you provide the current self-assessment of your Organization on the following actions? - Could you provide the current self-assessment of your Organization on the following actions? - Support and assist national and local initiatives and civil society organizations** | **0** | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 17.3 | **Could you provide the current self-assessment of your Organization on the following actions? - Could you provide the current self-assessment of your Organization on the following actions? - Demonstrate the ability of civil society to enhance the quality of nuclear decision-making process** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 17.4 | **Could you provide the current self-assessment of your Organization on the following actions? - Could you provide the current self-assessment of your Organization on the following actions? - Participate into the European working groups** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 17.5 | **Could you provide the current self-assessment of your Organization on the following actions? - Could you provide the current self-assessment of your Organization on the following actions? - Improve the practicability of the EP&R arrangements** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 18 | **Could you provide elements of justification about your current self-assessment on the following actions (steps forward and difficulties)?** | |
| | Raise awareness of policy makers and the European society | |
| | Support and assist national and local initiatives and civil society organisations | |
| | Demonstrate the ability of civil society to enhance the quality of nuclear decision-making process | |
| | Participate into the European working groups | |
| | Improve the practicability of the EP&R arrangements | |

| # | Question | Text |
|---|---|---|
| 19 | Once an Emergency has been activated, what are your role and responsibilities and the main actions you carried out during the nuclear accident? | |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.1 | Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Sheltering in place | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.2 | Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Iodine distribution and intake | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.3 | Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Evacuation organisation | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.4 | Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Food consumption and bans | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.5 | Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Decontamination | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | no. | no. (%) | Score value |
|---|---|---|---|---|
| 20.6 | **Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Based on the experience of your members, what is your opinion regarding the practical implementation during an Emergency of the following protection strategies? Could you assess their level of practicability? - Relocation** | 0 | 100% | - |
| | Very low | 0 | - | 0 |
| | Low | 0 | - | 0 |
| | Medium | 0 | - | 0 |
| | High | 0 | - | 0 |
| | Excellent | 0 | - | 0 |

| # | Question | Text |
|---|---|---|
| 21 | **Based on the experience of your members, could you please justify your above self-assessment regarding the practical implementation during an Emergency?**<br>Sheltering in place<br>Iodine distribution and intake<br>Evacuation organisation<br>Food consumption and bans<br>Decontamination<br>Relocation | |

| # | Question | Text |
|---|---|---|
| 22 | What does lead to distrust population in the decisions of the authorities and amplify the seriousness of a national crisis situation? Of a cross-border crisis? Do you have practical proposals to face it? | |

| # | Question | Text |
|---|---|---|
| 23 | In an emergency situation requiring "constraints" for the population, do you have practical proposals to strengthen the populations adhesion to follow the Government's injunctions? | |

| # | Question | Text |
|---|---|---|
| 24 | The HERCA-WENRA approach adopt the principle "We do the same as the accident country" in the first hours of the accident. What is your positioning regarding the practical implementation of this principle? | |

| # | Question | Text |
|---|---|---|
| 25 | For the previous 10 years, what have been the main progresses observed regarding the Civil Society Organisations/local authorities involvement to make the EP&R arrangements more realist and practical? | |

| # | Question | Text |
|---|---|---|
| 26 | How representative do you feel is your organisation in reflecting the public perception and point of view of civil society/local authorities on the topic of EP&R? What actions can be taken to strengthen representation in the future? | |

| # | Question | File upload |
|---|---|---|
| 27 | You may upload any document that may support your previous answers: | |

European Commission

# Implementation of nuclear and radiological emergency preparedness and response requirements in EU Member States and neighbouring countries

Contract ENER/2020/NUCL/SI2.838109

## Final Report - PART B

## Case Studies presentation, analysis and themes for recommendations and suggestions

| Reference | EC-07-EP&R-28-A-22/02/2023 – Final Report – PART B | | |
|---|---|---|---|
| Accessibility | | ***Public*** | ***Restricted*** | ***Confidential*** |
| | ***Internal*** | *X* | | |
| | ***External*** | *X* | | |

| Revision | Prepared by the Consortium | Reviewed by NucAdvisor | Approved by NucAdvisor |
|---|---|---|---|
| *A*<br>*22/02/2023* | *Compilation made by*<br>*Roger Seban (signed)*<br>*Federico Rocchi*<br>*Antonio Cervone)*<br>*Tamas Pazmandi*<br>*Jarmila Bohunova*<br>*Tatiana Duranova* | *Sarah Madureira* | *Roger Seban* |
| | | Madureira | |

## Acknowledgements

This report provides a consolidated analysis of 9 case studies and is based on the answers received from the participating Accident Countries ("ACs"), Neighbouring Countries ("NCs") and Observers ("OTs") to a series of questionnaires.

## Disclaimer

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

## Table of contents

# 1. Introduction

This report presents the complete analysis performed by the Consortium of the implemented case studies and identifies the themes for potential recommendations and suggestions.

It describes the stakeholders involved and the overall methodology used for implementing the case studies, based on an accident scenario developed in three steps, with results obtained via a series of related questionnaires sent to the stakeholders. The stakeholders are defined as follows:

- Accident countries (termed "ACs"). There are 9 AC case studies (Sweden, Finland, France, Belgium, Switzerland, Bulgaria, Romania, Slovenia, and Hungary)
- Neighbouring countries (termed "NCs") located close to the border of the relevant AC. The detailed list of NCs is given in section 3
- Observers of an AC case study: these observers can be countries located far away from the Accident Country (and therefore not involved in implementing specific measures), International Organisations, Civil Society organisations and Nuclear Utilities. Two International organisations, IAEA and NERIS, opted to participate in all the AC case studies and have each provided a single consolidated answer covering all the AC case studies. In both cases, their conclusions merit a specific separate report.

Each case study is a "non-real time" exercise based on a series of questionnaires covering the actions of the different stakeholders (the Accident Country, its Neighbouring Countries, and the Observers).

Each AC case study has been analysed separately, based on the answers given by the stakeholders involved. A specific analysis of each case study has been conducted with the aims of identifying best practices and defining themes for recommendations.

All the themes for recommendations derived from the various reports are summarised in chapter 2, to provide an easy overview, with the possibility to refer to the corresponding reports for further details.

The chapter 3 presents the case studies.

The chapter 4 presents the accident scenario divided into 3 steps.

The chapter 5 is the content of the questionnaires.

Appendices A, B, C gives the respectively the detailed description of scenario: step 0, step 1 and step 2.

Appendix D gives the corresponding individual detailed AC case study reports as follows:

- Appendix D1: Sweden (SE)
- Appendix D2: Finland FI)
- Appendix D3: France (FR)
- Appendix D4: Belgium (BE)
- Appendix D5: Switzerland (CH)
- Appendix D6: Hungary (HU)
- Appendix D7: Slovenia (SI)
- Appendix D8: Bulgaria (BG)
- Appendix D9: Romania (RO)
- Appendix D10: IAEA
- Appendix D11: NERIS

These detailed reports have been sent to stakeholders in a draft version. When appropriate, comments received from stakeholders are fully included in the relevant detailed reports in a specific "coloured box".

Insights from the results of case studies were discussed in the 2nd Workshop held in Luxembourg on 13th and 14th December 2022 gathering 46 representatives from European countries.

# 2. Themes for potential recommendations and suggestions from the analysis of the case studies

This chapter brings together all the themes for potential recommendations identified from analysis of the 9 Accident Country case studies. The statements are coming from the analysis of the 9 case studies, and two additional analyses for IAEA and NERIS responses to the questionnaire, made by the members of the Consortium in charge of the Project implementation.

Some stakeholders have made comments when receiving the draft of this report. All these comments are faithfully reported in a specific box to the relevant AC case.

Insights from the results of the case studies were submitted to the participants of the 2nd Workshop (in Luxembourg on 13$^{th}$ and 14$^{th}$ December 2022) discussed and challenged in specific working sessions.

**Cross-border cooperation - Bilateral Agreements between Safety Authorities**

- To include officially in the Bilateral Agreements immediate interactions and discussions also for the types of accidents, which does not imply off-site releases to the atmosphere, but that could later result in severe accidents with important off-site consequences
- To include officially in the Bilateral Agreements the sharing of the complete Source Term and the most important plant data necessary to assess the current situation, to correctly diagnose the plant status, to make prognoses on the accident evolution
- To include in the Bilateral Agreements ways of coordination and preliminary sharing of information to the public, press, social network, prior official releases
- The coordination mechanisms for the alignment of protective actions along a border should be defined in the Bilateral Agreements
- To include in the Bilateral Agreements the practical arrangement with other countries to manage the timely evacuation of their own citizens
- Coordination with neighbouring countries should be foreseen before officially transitioning from the emergency phase to the existing exposure situation.

## Communication towards the public

- Mechanisms should be established to encourage enhanced coordination in communication towards the public as sharing of official press-releases, also in terms of content and timing
- To organize joint or coordinated press releases with the AC or other NCs
- Enhanced mechanisms should be envisaged to contrast the spreading of fake news through social media. A clear policy should be agreed upon to intervene directly through the managers of the social networks.

## Approach to Response

- Discussion should be encouraged to increase harmonization in the approach to response for highly uncertain situations, especially for those in which the decision-making process should decide between relatively unlikely scenarios with large consequences, or very likely scenarios but with more limited consequences. This is a task which could be taken in charge by HERCA/WENRA processes
- AC indicated that even if the situation would not imply off-site consequences, it would share with SAs of the Neighbouring Countries the necessary information for the assessment of the situation as soon as the prognosis was prepared (=good practice to be shared)
- To share Source Term and its time dependence in an internationally recognized format including hypothesis or models used for source term estimation. This point might be discussed in bilateral agreement if it is relevant
- The dialogue channels should be opened by NCs with the AC and they should try to reach a consensus on the prognosis if their prognosis of the accident would differ from that produced by the AC. This point might be part of bilateral agreement if relevant
- To pre-plan procedures for requesting for RANET assistance in preparedness phase
- The common planning of coordination between AC and NCs before lifting of countermeasures by AC near border with NCs should be foreseen with clear criteria to declare the end of the emergency
- To plan for coordination with NCs before officially transitioning from the emergency phase to the existing exposure situation

- 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.

**Scientific and technical resources**

- IAEA is encouraged to increase as much as possible the awareness of its Member States of the technical and scientific help possibly provided directly by the IAEA Incident and Emergency Centre (IEC) to Accident Countries and Neighbouring Countries This might include all novel tools and databases developed or under development by IAEA to help Member States to cope with accidents, especially in the understanding of the accident evolution, its Source Term, and its consequences.

**HERCA-WENRA (HWA) approach**

- HERCA/WENRA to initiate a process for reaching the objective of a harmonization in the approach to response in those cases in which some NCs decide not to follow the HWA and decide to implement more conservative countermeasures than those foreseen in AC
- Looking how HWA approach has been implemented in all cases it appears that some NCs would like to use the HWA, but cannot because of external conditions that prevent that specific NC to adopt the countermeasures from AC. The problem is not disagreeing on the countermeasures proposed by AC, but more on their implementation. Like to say: "I wish, but I cannot". Need to find mechanism how to deal with cases in which it is practically difficult to have full coherence and harmonization of responses
- to get from HERCA their views on results of the case studies and inform of any action plan for any adaptations of HWA approach for resolving situations where Neighbouring Countries, also they wish to do, cannot implement HWA approach for whatever reason.

The following sections 2.1 to 2.11 gives a synthesis analysis on the 9 AC Case studies, IAEA and NERIS responses to the questionnaire.

## 2.1. AC: Sweden (SE)- NCs: Finland (FI), Denmark (DK), Norway (NO)

Communication between the Accident Country (AC) and Neighbouring Countries (NCs)

Individually all the countries have a policy of communication to with their various national stakeholders (press, social media, citizens, etc.) using different means of communication. However, apparently, there is no sharing of official information releases (content, forms) prior to publishing., This may create some confusion. In a real accident situation, social networks and TV news channels, even though using different languages, will undoubtedly pass on all information, wherever it comes from, with potential misinterpretations. The recent COVID crisis showed how different countries communicate to their citizens using different approaches. It is difficult to issue identical information in all countries (after translation) because the official national bodies have the final responsibility for the management of information inside their country. But there is room for improvement.

One theme for recommendation would be:

- For the bilateral agreements to include various means of coordination and preliminary sharing of information to the public, press and social media by means of initial official releases.

Best practice on Civil Society involvement in EP&R in Sweden

In Sweden, municipalities having a NPP on their territory are grouped together in the "KSO" association. At European level, such associations exist in many countries having NPPs. These associations are brought together in the GMF (Group of European Municipalities with Nuclear Facilities, a not-for-profit association of municipalities and associations of municipalities with nuclear facilities across European countries). France has a similar organisation to the KSO termed the CLI "Commission Locale d' Information" – Local Information Commission).

A representative from the GMF/KSO took part in the Sweden case study. He pointed out that all Swedish Nuclear Municipalities have duties at local level in the National EP&R/Civil Protection Organization. This Organization is based on cooperation between National, Regional and Local Authorities and organizations. At regional level, the County Administrative Board has a central role in decision-making. The personnel trained to take part in emergencies in Sweden are trained to deal with multiple accidents. At local level, they comprise personnel from the Municipal Rescue Services, and they are responsible for handling any aggravating events in these scenarios.

## 2.2. AC: Finland (FI)-NC's: Sweden (SE), Lithuania (LT), Latvia (LV)

Communication

This case study involved one accident country, Finland, and three neighbouring countries Lithuania, Latvia and Sweden. The distance of the borders of these NCs to the virtual accident NPP in Finland is quite large, ranging from 200 km to 400 km.

These distances should be evaluated as a function of the severity of the accident and therefore of releases into the atmosphere. Even in the case of neighbouring countries located far away from the accident country's NPP, good communication and proper sharing of information is vital. If a real nuclear accident occurs, the perception of citizens, wherever they live, is that distance offers no protection. On the contrary, both traditional news media and social media may "overestimate" the risk and not relay the scientific communications from the Safety Authorities or other official bodies but instead contribute to spreading panic among the population.

One theme for recommendation from this case study is that communication to the public is an essential key to ensuring the "right decisions at the right time", irrespective of the severity of the nuclear accident and the distance of the impacted countries from the accident NPP. In a nuclear emergency, the authority in charge of communication to the public will be continuously solicited by various media, such as TV news, written press, social media, etc.

Many experts from various official authorities (state, nuclear safety authority, civil protection, etc.) will be solicited. Official "spokespersons" having both technical knowledge and communication skills will be mobilized.

The theme for recommendation is that all official bodies ensure full preparedness for these communication requirements. Official authorities must be prepared to communicate via the various social networks to whatever extent is necessary to respond to fake news and misinformation.

## 2.3. AC: France (FR)-NC's: Belgium (BE), Luxembourg (LU), Germany (DE), Switzerland (CH)

Bilateral Agreements between Safety Authorities

- Safety Authorities are encouraged to ensure that immediate interactions and discussions are officially included in their Bilateral Agreements, even for the types of accidents described in Scenario Step "S0", which does not involve off-site releases to the atmosphere but could later result in severe accidents with major off-site consequences. This immediate response could improve the understanding of the situation on the part of neighbouring countries and subsequently speed up the dialogue related to any successive developments of the accident. A criterion for defining the minimum threshold that triggers bilateral interaction should be devised and agreed upon.

Communication to the public

- Mechanisms should be established to encourage enhanced coordination in communication to the public. Almost no countries have provisions in place to share a press release to the public or to deliver joint press releases. However, some countries do believe that the sharing of official press releases, including in terms of content and timing, could be very beneficial. Joint press releases, at least in cases of severe accidents, could yield effective benefits in terms of the public perception of a high level of coordination between neighbouring countries. Some neighbouring countries stated their willingness to publish their own press releases even if the accident country has not yet issued its own press release, and this can create a situation of confusion in the public. This also applies to the publication by neighbouring countries of situation analyses on issues of protection, communication, or transparency before the publication of similar results by the accident country.

- Enhanced mechanisms should be envisaged to counter the spread of fake news via social media. A clear policy should be agreed upon to intervene directly through the managers of the social networks, as occurred, for example, in some cases during the Covid-19 crisis.

Approach to Response

- Discussion should be encouraged in order to increase harmonization in the approach to the response to highly uncertain situations, especially situations where the decision-making process must decide between relatively unlikely scenarios with major consequences and scenarios that are more likely but have more limited consequences. The role of sudden and rapid cliff-edge effects in the development of accidents, such as those in Scenario Step S2, must be treated as uniformly as possible.

## 2.4. AC: Belgium (BE)-NC's: Luxembourg (LU), The Netherlands (NL)

Source term

We should recognise that in emergency planning, response and recovery there may be many things that we do not know and many issues that remain unclear. Managers may need the aid of decision support systems and processes to deal with these uncertainties in a variety of ways. "Uncertainty" is an umbrella word with many implications. It relates to being unable to provide precise answers to certain questions such as:

- What is the source term, its composition and strength, and how will these factors vary over time?
- How will the public respond in terms of self-evacuation, taking stable iodine tablets and generally following advice and thus conforming to the fundamental assumptions underlying the choice of adopted protective measures?

These are just two examples of the many uncertainties that emergency managers and their analysts must consider. Therefore, it is necessary to minimize the sources of uncertainties, if possible from the very beginning of an accident.

Sharing the Source Term in an internationally recognized format (e.g. IAEA IRIX format) could help its utilization. Source Term sharing without information about its time dependence could be critical because the timing of e.g. the release peak can significantly influence the potential protective actions, especially for neighbouring countries. The countries shall consider providing the data with at least the basic hypotheses/models used to estimate the Source Term, because the lack of this information can lead to divergent interpretations.

Communication

Examples of nuclear and radiological events in Europe and neighbouring countries have shown that regular communication, even for incidents of limited safety significance, helps to build trust in public institutions at critical moments. Some EU MSs take care to identify in advance the challenges for transparency in the event of a nuclear or radiological emergency and to develop approaches for dealing with these challenges during an emergency.

Coordination of communication to the public between the neighbouring countries by means of press releases should be established as soon as possible. Press releases should be shared before publication. Cases could occur in which coordinated trans-border actions are taken and, in this case, any divergent or contradictory press releases could reduce the credibility of SAs.

Although international standards and guidance exist and all EU MSs are signatories to the Convention on Nuclear Safety, these standards are often implemented differently in different countries. This can lead to differences in, for example, the sizes of detailed planning zones or the criteria for implementing protective measures. These differences may reflect differing judgements regarding e.g. what can reasonably be planned in detail, and they can often be justified from a radiological protection perspective. However, they contribute to reduced public confidence. Resolving some of these differences will require action at a political level. Other differences could be addressed by the establishment of formal guidance or Codes of Practice on best practices at European level.

Therefore, joint coordination planning with the NCs is recommended before lifting any countermeasures near the borders with these NCs, including clear criteria for declaring the end of the emergency situation.

<u>Harmonization</u>

In the preparedness phase, increased harmonization between common strategies and arrangements for longer term protective measures and for the return to normal living conditions following an emergency is recommended. This should include joint planning and coordination of remediation activities (land decontamination), mainly near the border with the neighbouring countries. These activities must comply with the harmonized remediation criteria established by internationally recognized recommendations/requirements.

The aggravating events considered in national emergency plans could include adjusted responses to specific aggravating conditions, and step-by-step evacuation procedure could be considered with maintained sheltering in place as alternative countermeasure.

## 2.5. AC: Switzerland (CH)-NC's: Italy (IT), France (FR), Germany (DE)

Bilateral Agreements between Safety Authorities (Interaction with NC's and source term)

- Safety Authorities are encouraged to ensure that immediate interactions and discussions are officially included in their Bilateral Agreements, even for the types of accidents described in Scenario Step "S0", which does not involve off-site releases to the atmosphere but could later result in severe accidents with major off-site consequences. This immediate response could improve the understanding of the situation on the part of neighbouring countries and subsequently speed up the dialogue related to any successive developments of the accident. A criterion for defining the minimum threshold that triggers bilateral interaction should be devised and agreed upon.

- Safety Authorities are also encouraged to include officially the sharing of the complete Source Term, rather than only the total amount of released radioactivity, in their Bilateral Agreements. Although the unavailability of a complete Source Term can be offset by full adoption of the HWA, the Source Term in its entirety remains part of the background information needed for accurate evaluation of the radiological risk. It also improves the understanding of the situation on the part of neighbouring countries. Safety Authorities should initiate discussions on the minimum information that must be included in a shared Source Term.

Communication to the public

- Mechanisms should be established to encourage enhanced coordination in communication to the public. Almost no countries have provisions in place to share a press release to the public or to deliver joint press releases. Joint press releases, at least in cases of severe accidents, could provide effective benefits in terms of public perception of a high level of coordination between neighbouring countries.

- Enhanced mechanisms should be envisaged to counter the spread of fake news via social media. A clear policy should be agreed upon to intervene directly through the managers of the social networks, as occurred, for example, in some cases during the Covid-19 crisis.

Approach to Response

- Discussion should be encouraged to increase harmonization in the approach to the emergency response in cases where some NCs decide not to follow the HWA and instead opt to implement more conservative countermeasures than are envisaged in the AC. If the HWA is not followed by a given NC, and at the same time the AC is not providing a complete Source Term, the rationale behind the countermeasures of the NC in question may not be wholly consistent with the ongoing accident and could generate confusion in the populations of the two countries. This is even more problematic if no sound explanations are provided concerning the reasons for the potential lack of cohesion in the response.

## 2.6. AC: Hungary (HU)-NC's: Austria (AT), Slovakia (SK), Croatia (HR), Czech Republic (CZ), Serbia (RS)

This section contains a list of the key potential theme for recommendations, grouped by themes, resulting from analysis of the answers to the questionnaires concerning the Hungarian Case Study. In summary, we can confirm that the countries concerned are coordinating their activities well on most issues and are taking the necessary actions to ensure a harmonized response. The different NCs recommend different countermeasures, possibly because of their different distance from the "virtual accident NPP". The main fields where harmonisation can and should be strengthened are as follows:

Bilateral Agreements between Safety Authorities

- All NCs have bilateral agreements with the AC to receive the most important plant data needed to assess the current situation, diagnose the plant status accurately and make prognoses on the accident evolution. To enable the NCs to evaluate the situation and prepare the countermeasures relevant for their country, the AC has also stated that it would share all of its own diagnoses/prognoses, complete with different probabilities and a broad range of potential radiological consequences. However, neither AC nor NCs have any practical arrangement with other countries to manage the timely evacuation of their citizens.

Communication to the public

- The AC will not share its official press releases about the accident with the NCs before publication. All NCs replied that they plan to publish their own press releases about the incident/accident, but that they did not expect to be notified of AC official press releases concerning accidents before their publication. The AC does not intend to ask NCs to refrain from publishing their individual diagnoses and prognoses of the situation before it has published its own. The AC does not plan to organize joint or coordinated press releases with any NC.

Approach to Response

- NCs will be informed about the countermeasures, but the AC does not intend to verify whether the NCs are implementing any countermeasures in their own countries to protect their population. The NCs will consider the diagnoses and prognoses made by the AC in their own analysis, but the AC will not take into consideration any diagnoses/prognoses made by NCs. Different NCs will recommend different countermeasures. The reason for this could be the different distances from the "virtual accident NPP". These recommendations may be based on measurements, the radiation situation and the meteorological conditions. The NCs would base their protective actions on their own assessment, but the results of the ACs' assessments would certainly be taken into account. If the accident prognosis of the NCs differs from the prognosis issued by the AC, the NCs would open a dialogue channel with the AC and would try to reach a consensus on the prognosis.

- NC3 stated that it did not have enough expertise to analyse the situation in neighbouring countries and specifically to estimate the source term.

## 2.7. AC: Slovenia (SI)-NC's: Austria (AT), Hungary -HU), Italy (IT), Croatia (HR), Slovakia (SK)

<u>Bilateral Agreements between Safety Authorities</u>

- According to the answer provided by the AC, it has bilateral agreements with all of its neighbouring countries on notification and information exchange. Special attention is given to NC4, because its territory is within the Emergency Planning Zone of the "virtual accident NPP". All NCs have confirmed to have a bilateral agreement with the AC. Fruitful and active meetings between competent authorities are conducted on a regular basis between AC and all NC's.

- The AC stated that it would share its estimates of the radiological consequences with NCs but does not intend to share the Source Term. At the same time, all of the NCs expect to receive from the AC its estimates of the Source Term and radiological consequences. The NCs added that an internationally recognized file format should be used. It is essential to resolve this contradiction. This is an important field for potential improvement.

- Coordination with neighbouring countries is not envisaged before officially transitioning from the emergency phase to the existing exposure situation. However, NCs can be involved in the process if they are recognized as "interested parties". In the case of interested parties, cooperation and consultations are planned and take place all through the process. Harmonization can be improved in this field.

<u>Communication to the public</u>

- Communication to the public is a key element for coordinated responses between neighbouring countries. However, the AC does not share its official press releases about the accidents with the NCs that may be affected before publishing them. The NCs also do not expect the AC to share press releases with them before publication. At the same time, all of the NCs answered that they intend to publish their own press releases about the incident. On the basis of these answers by the NCs and AC, the current situation may give cause for concern because there is a possibility of uncoordinated communication actions in the NCs.

- Although the AC will ask NCs to refrain from publishing their own diagnoses and prognoses of the situation before it has published its own, the NCs intend to issue additional press releases. Only one NC (NC4) intends to organize joint or coordinated press releases with the AC or other NCs. The AC and other NCs do not intend to do so.

Approach to Response

• The AC indicated that even if the situation would not have off-site consequences, it would share with the SAs of the Neighbouring Countries all necessary information for the assessment of the situation as soon as the prognosis was prepared. This is in line with the HWA, which states that "The accident country should provide and update information required for the understanding of the situation and make available on-site and off-site assessments, using bilateral, multinational and international arrangements". However, only NC1 and NC4 would generally adopt the HERCA/WENRA Approach. NC3 added that it adopts a more conservative approach than the accident country.

Harmonization and coordination of plans with NCs before lifting the countermeasures and transitioning from the emergency phase to the existing exposure situation is another field where improvement is possible.

## 2.8. AC: Bulgaria (BG)-NC's: Romania (RO), Serbia (RS)

Communication

Examples of nuclear and radiological events in Europe and neighbouring countries have shown that regular communication, even for incidents of limited safety significance, helps to build trust in public institutions at critical moments. Some EU MSs take care to identify in advance the challenges for transparency in the event of a nuclear or radiological emergency and to develop approaches for dealing with these challenges during an emergency.

Coordination of communication to the public between the neighbouring countries by means of press releases should be established as soon as possible. Press releases should be shared before publication. Cases could occur in which coordinated trans-border actions are taken and, in this case, any divergent or contradictory press releases could reduce the credibility of SAs.

Arrangements for cross-border communication in nuclear or radiological emergencies present a challenge for many reasons, including different European languages, different protective actions, the lack of collaboration between the persons responsible for public information in the different member states and the different nature of arrangements.

The additional publication of all information about radiological or nuclear emergencies in English, or in the languages of the neighbouring countries, could contribute to better information of the citizens of other countries living in the area affected by accident.

Coordination

Although international standards and guidance exist and all EU MSs are signatories to the Convention on Nuclear Safety, these standards are often implemented differently in different countries. This can lead to differences in, for example, the sizes of detailed planning zones or the criteria for implementing protective measures. These differences may reflect differing judgements regarding e.g. what can reasonably be planned in detail, and they can often be justified from a radiological protection perspective. However, they contribute to reduced public confidence. Resolving some of these differences will require action at a political level. Other differences could be addressed by the establishment of formal guidance or Codes of Practice on best practices at European level.

Therefore, joint coordination planning with the NCs is recommended before lifting any countermeasures near the borders with the NCs, including clear criteria for declaring the end of the emergency situation.

The internationally agreed approach to determining the maximum distance for food restrictions should be harmonized at European level in the preparedness phase.

<u>Sharing of the source term and reducing uncertainties for decision</u>

We should recognise that in emergency planning, response and recovery there may be many things that we do not know and many issues that remain unclear. Managers may need the aid of decision support systems and processes to deal with these uncertainties in a variety of ways. “Uncertainty” is an umbrella word with many implications. It relates to being unable to provide precise answers to certain questions such as:

- What is the source term, its composition and strength, and how will these factors vary over time?
- How will the public respond in terms of self-evacuation, taking stable iodine tablets and generally following advice and thus conforming to the fundamental assumptions underlying the choice of adopted protective measures?

These are just two examples of the many uncertainties that emergency managers and their analysts must consider. Therefore, it is necessary to minimize the sources of uncertainties, if possible from the very beginning of an accident.

It would be beneficial for the AC to share more than one possible future scenario with the NCs (best estimate/most probable/worst case), specifying the different radiological consequences (especially a worst case scenario with a non-neglectable probability).

Sharing the Source Term in an internationally recognized format (e.g. IAEA IRIX format) could help its utilization. Source Term sharing without information about its time dependence could be critical because the timing of e.g. the release peak can significantly influence the potential protective actions, especially for neighbouring countries. The countries shall consider providing the data with at least the basic hypotheses/models used to estimate the Source Term, because the lack of this information can lead to divergent interpretations.

## 2.9. AC: Romania (RO)-NC's: Bulgaria (BG), Ukraine(UK)

Harmonization

Although international standards and guidance exist and all EU MSs are signatories to the Convention on Nuclear Safety, these standards are often implemented differently in different countries. This can lead to differences in, for example, the sizes of detailed planning zones or the criteria for implementing protective measures. These differences may reflect differing judgements regarding e.g. what can reasonably be planned in detail, and they can often be justified from a radiological protection perspective. However, they contribute to reduced public confidence. Resolving some of these differences will require action at a political level. Other differences could be addressed by the establishment of formal guidance or Codes of Practice on best practices at European level.

Therefore, harmonization of the criteria for implementing protective actions based on internationally established recommendations/requirements would bring better efficiency and would increase public confidence in the decisions of each SA.

Information exchanges and cooperation

Information exchange and cooperation agreements exist between many neighbouring countries, and there are some good examples of multilateral agreements in Europe. However, in practice, there is considerable variability in the nature of these arrangements, and some countries see this as a major weakness and obstacle 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.

The NCs should aim for greater alignment with the AC in their recommendations for decisions on protective actions. Despite different criteria for intervention levels triggering the introduction of protective actions, the aim of the coordination mechanism is to achieve alignment between protective actions according to the principle of "we do the same as the accident country". In this case, the coordination mechanisms should achieve alignment between protective actions along a border defined in the bilateral arrangements.

Communication and public confidence

Examples of nuclear and radiological events in Europe and neighbouring countries have shown that regular communication, even for incidents of limited safety significance, helps to build trust in public institutions at critical moments. Some EU MSs take care to identify in advance the challenges for transparency in the event of a nuclear or radiological emergency and to develop approaches for dealing with these challenges during an emergency.

Coordination of communication to the public between the neighbouring countries by means of press releases should be established as soon as possible. Press releases should be shared before publication. Cases could occur in which coordinated trans-border actions are taken and, in this case, any divergent or contradictory press releases could reduce the credibility of SAs and could reduce the efficiency of countermeasures.

Sharing of source term and reducing uncertainties for decision

We should recognise that in emergency planning, response and recovery there may be many things that we do not know and many issues that remain unclear. Managers may need the aid of decision support systems and processes to deal with these uncertainties in a variety of ways. "Uncertainty" is an umbrella word with many implications. It relates to being unable to provide precise answers to certain questions such as:

- What is the source term, its composition and strength, and how will these factors vary over time?
- How will the public respond in terms of self-evacuation, taking stable iodine tablets and generally following advice and thus conforming to the fundamental assumptions underlying the choice of adopted protective measures?

These are just two examples of the many uncertainties that emergency managers and their analysts must consider. Therefore, it is necessary to minimize the sources of uncertainties, if possible from the very beginning of an accident.

Sharing the Source Term in an internationally recognized format or format (e.g., IAEA IRIX format) could help its utilization and could contribute to faster incorporation of the shared data into NC analyses and therefore prevent misinterpretation.

## 2.10. IAEA

Scientific and technical resources

- The IAEA is encouraged to try to maximize the awareness of its Member States regarding the technical and scientific help that can be provided directly to Accident Countries and Neighbouring Countries by the IAEA Incident and Emergency Centre (IEC). This should include all the new tools and databases developed or under development by the IAEA to help Member States to cope with accidents, especially in the understanding of the evolution of an accident, its Source Term, and its consequences. This could contribute to attaining the goal of a common and shared perception of an ongoing accident.

Communication to the public

- The IAEA is encouraged to disseminate potential best practices on effective, failsafe, and efficient coordination arrangements and mechanisms already in place with some Member States regarding Communication to the Public. This should provide a background for strengthening and ensuring the consistency of the information conveyed to the public during an accident, as well as correct timing for delivering such information, so that optimal alignment is achieved between the information provided by the Accident Country, the Neighbouring Countries, and the IAEA. This enhanced coordination can help to prevent any misunderstandings and/or confusion that may arise due to differences in content of information and delay in press releases.

## 2.11. NERIS

Note: NERIS is a platform designed "to establish a forum for dialogue and methodological development between all European organisations and associations taking part in decision making of protective actions in nuclear and radiological emergencies and recovery in Europe".

NERIS, as observer, has provided responses based on all nine case studies.

The countries in question are generally well-coordinated. They are taking most of the necessary actions to ensure harmonized response, and the approach is mainly consistent with best practices.

The following generic themes for recommendations were derived from the analyses provided by the NERIS platform:

1. The Source Term and its time dependence should be shared in an internationally recognized format, including the hypotheses or models used for source term estimation.

2. The procedures for requesting RANET assistance should be pre-planned during the preparedness phase., This could significantly speed up the process of requesting assistance.

3. Coordination between AC and NCs should be planned before the AC lifts the countermeasures near its borders with NCs.

4. It might be worthwhile to discuss internationally whether a recommendation should be issued, for example by international organizations to their members, to establish plans for coordination between AC and NCs in transitioning from the emergency phase to the existing exposure situation.

# 3. Presentation of the case studies

## 3.1. Involved Countries and Stakeholders

Nine EU countries containing a "virtual accident NPP" have been defined as the case study countries. These countries are termed "ACs" (Accident Countries).

The following 9 ACs have been defined:

- Nordic Region: Sweden (SE) and Finland FI)
- Northwestern Region: France (FR), Belgium (BE) and Switzerland (CH)
- Central Eastern Region: Hungary (HU) and Slovenia (SI)
- Southeastern Region: Bulgaria (BG) and Romania (RO)

Neighbouring countries ("NCs") located close to the border of the relevant AC (or at a distance implying Emergency & Preparedness Responses) have been defined for each case study.

The AC country and its NCs are examined together in the case study, which is not conducted in real time. Each case study is developed according to an accident scenario comprising three consecutive steps, termed S0, S1 and S2, representing the development of a virtual accident from an initial event to an INES level 6 or 7 accident in an NPP.

Each case study is based on three questionnaires corresponding to the three steps of the accident scenario. At each step, all 9 ACs receive the same AC questionnaire, and each NC also receives the same NC questionnaire as the other NCs of the same AC.

In addition to the ACs and NCs "playing out" the case studies according to the three steps, a group of "Observers" has been defined. These Observers are divided into different categories:

- Other countries (OTs) located far away and not involved in any Emergency & Preparedness Responses during the accident
- International organisations (IOs) such as HERCA, NERIS and IAEA
- Civil Society[1] organizations (termed CSs) such as GMF and CLI
- Nuclear Utilities (NUs)

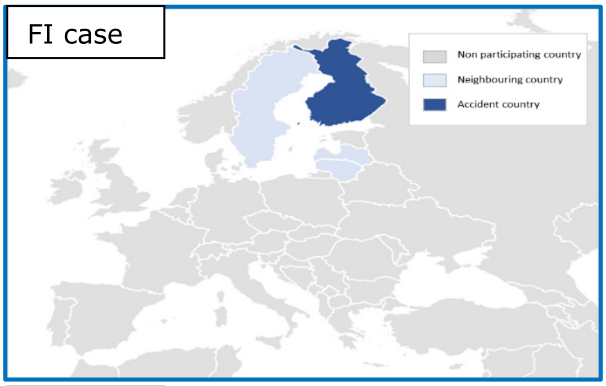
During the three steps, all the Observers received the responses to the questionnaires from their AC and its NCs. So, the Observers were provided

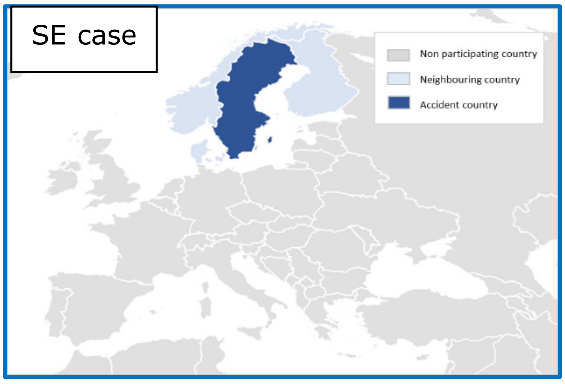
[1] NTW (Nuclear Transparency Watch) declined to participate to the exercise

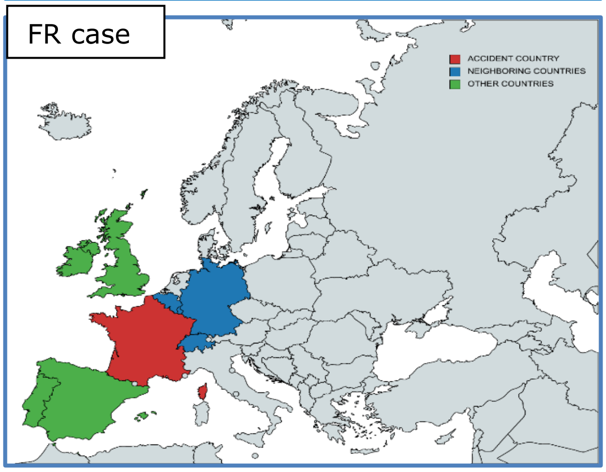
with information on how the AC and NCs reacted to the evolution of the scenarios.

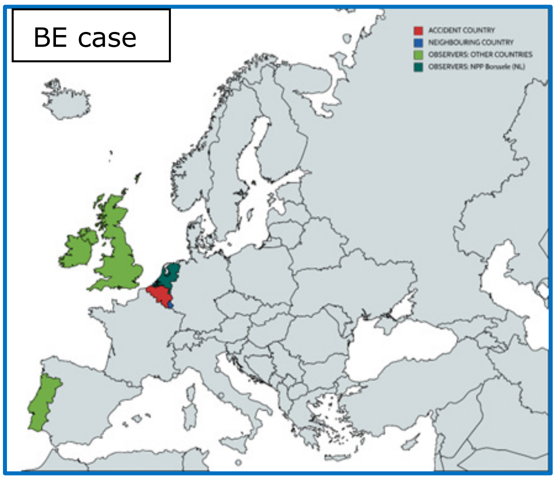
Then after completion of the last step, S2, all Observers received a questionnaire adapted to their observer category.

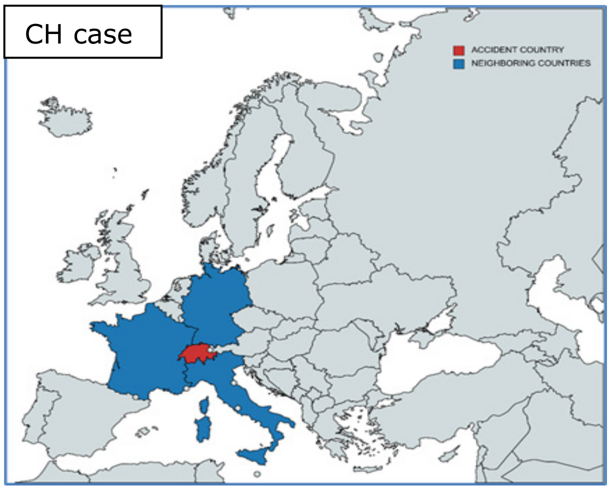
The figures below show the countries participating in the 9 case studies, together with their neighbouring countries.

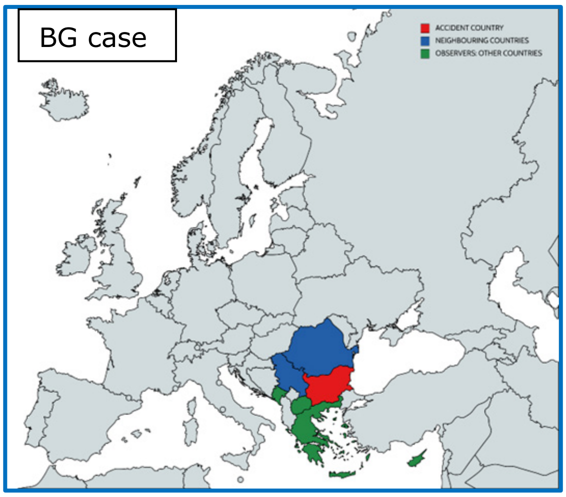


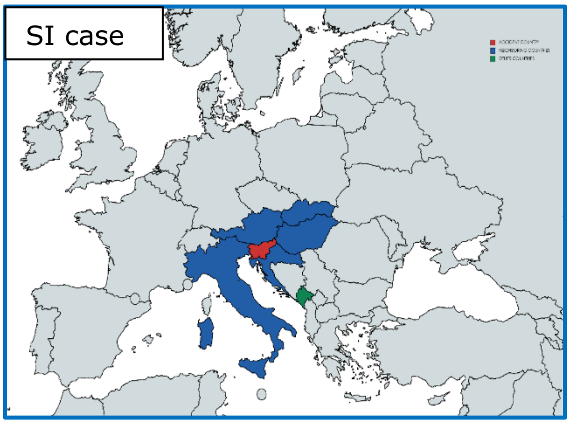



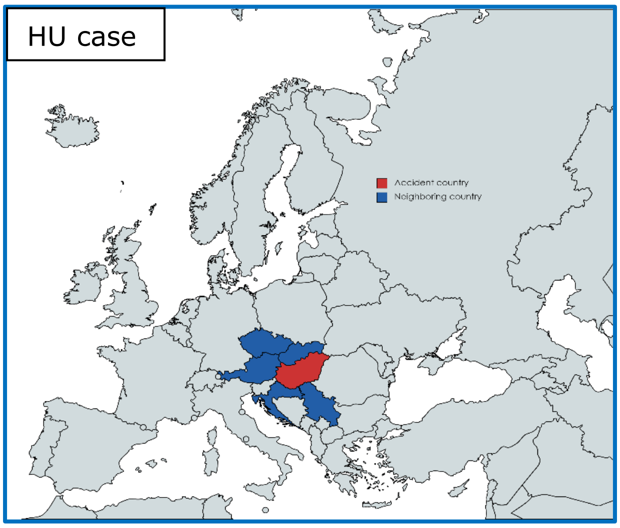




Inside the AC and NCs, the stakeholders include the Nuclear Safety Regulators, in the case of "nuclear countries", or the equivalent authorities in "non-nuclear countries".

## 3.2. Localization of the Virtual Accident NPP in different ACs

The objectives of the case studies are to:

- Review and analyse the consistency of EP&R in a cross-border context with different configurations of paired AC/NC
- Facilitate cross-discipline discussion, technical exchanges, and sharing of experience among decision-makers, expert groups, civil society, licensee associations, regulatory bodies, and health and civil protection authorities to highlight effective implementation practices.

In this context, depending on the AC/NC couple, the selected "virtual accident NPP" in the accident country should be realistically located as close as possible to each NC.

This principle will ensure a more realistic case study, with potential impacts on NC territory in the event of a nuclear accident and will enable consideration of the existing EP&R provisions specific to each AC/NC couple. In this context, the following table defines the different "virtual accident NPPs" selected to localize the accident.

| Accident Country | Neighbouring Countries | Virtual Accident NPP |
|---|---|---|
| BE | LU | Tihange |
| BG | RO, RS | Kozloduy |
| CH | IT, FR | Goesgen |
| | DE | Leibstadt |
| FI | SE | Olkiluoto |
| | LT, LV | Loviisa |
| FR | BE | Chooz |
| | LU, DE | Cattenom |
| | CH | Bugey |
| HU | AT, SK, HR, CZ, RS | Paks |
| RO | BG, UA | Cernavoda |
| SE | DK, NO | Ringhals |
| | FI | Forsmark |
| SI | AT, HU, IT, HR, SK | Krsko |

So, certain ACs will have to consider more than one "virtual accident NPP" in conducting the case study, depending on the different NCs. If necessary, the ACs can freely extend or duplicate the answer sections that they consider relevant for addressing any specificity induced by the location of the "virtual accident NPP".

For ACs having only one NPP in their territories, there is no ambiguity in the location of the "virtual accident NPP".

## 3.3. Overall view of Stakeholders involved in the case studies

The following tables 1 and 2 specify the countries participating in the implementation of the case studies:

-9 countries as AC

-28 countries as NCs (certain countries are NCs in two different AC case studies and are counted as a separate NC for each study).

-17 countries as observers (again, these countries may act as Observers in two case studies).

In addition, the following other Observers participated in the case studies:

-4 International organisations: HERCA, NERIS, IAEA, NEA (OECD)

-2 Civil society associations (GMF and CLI)

-2 Nuclear Utilities: Borsele (NL) and ENDESA (Spain)

**Table 1: Overall view of case studies Stakeholders' participation**

| **9 Accident Countries AC** | **Belgium** | **Bulgaria** | **Switzerland** | **Finland** | **France** | **Hungary** | **Romania** | **Sweden** | **Slovenia** |
|---|---|---|---|---|---|---|---|---|---|
| **28 Neighbouring Countries NC** | Luxembourg | Romania<br>Serbia | Italy<br>France<br>Germany | Sweden<br>Lithuania<br>Latvia | Belgium<br>Luxembourg<br>Germany<br>Switzerland | Austria<br>Slovakia<br>Croatia<br>Czech Republic<br>Serbia | Bulgaria<br>Ukraine | Finland<br>Denmark<br>Norway | Austria<br>Hungary<br>Italy<br>Croatia<br>Slovakia |
| **Observers: Other countries** | Portugal<br>Ireland<br>UK | Cyprus<br>Greece<br>Montenegro<br>North Macedonia | | | Spain<br>Portugal<br>Ireland<br>UK | Montenegro | Cyprus<br>Greece<br>Montenegro<br>North Macedonia | | Montenegro |
| **Observers: International organisations** | HERCA<br>NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA<br>NEA | HERCA<br>NERIS<br>IAEA | NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA | HERCA<br>NERIS<br>IAEA |
| **Observers: Civil Society** | | | CLI[2] (Cattenom) | | CLI (Cattenom - 2 members) | | | GMF[3] | GMF |
| **Observers: Nuclear utilities** | Borsele NPP-NL | | | | -Borsele NPP in the Netherlands<br>-Endesa in Spain | | | | |

[2] CLI: Commission Locale d'Information: In France there is one CLI per NPP site (18 CLIs)
[3] GMF: **Group of European Municipalities with Nuclear Facilities** is a not-for-profit association of municipalities and associations of municipalities with nuclear facilities across European countries.

**Table 2-Organisations participating in the case studies in the EU and other countries**

| **27 EU MSs** | **Country code** | **Organisation** |
|---|---|---|
| Austria | AT | Radiation Protection, Federal Ministry for Climate Action |
| Belgium | BE | Federal Agency for Nuclear Control (FANC)/National Crisis Centre (NCCN).<br>National Crisis Centre/ CBRNe expertise centre |
| Bulgaria | BG | Nuclear Regulatory Agency |
| Croatia | HR | Ministry of Interior |
| Cyprus | CY | Radiation Inspection and Control Service |
| Czech Republic | CZ | State Office for Nuclear Safety |
| Germany | DE | Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) |
| Denmark | DK | Danish Emergency Management Agency |
| Estonia | EE | Crisis Management Climate and radiation Safety Department |
| Greece | EL | Greek Atomic Energy Commission (EEAE) |
| Spain | ES | CSN |
| Finland | FI | STUK |
| France | FR | ASN- Autorité de Sûreté Nucléaire |
| Hungary | HU | Hungarian Atomic Energy Authority |
| Ireland | IE | Environmental Protection Agency |
| Italy | IT | ISIN |
| Lithuania | LT | -VATESI<br>-Fire and Rescue Department-Ministry of the Interior of the Republic of Lithuania |
| Luxembourg | LU | Directorate of Health, Division of Radioprotection |
| Latvia | LV | State Environmental Service Radiation Safety Centre |
| Malta | MT | Commission of the protection from ionising radiation. |
| The Netherlands | NL | ANVS |
| Poland | PL | National Atomic Energy Agency |
| Portugal | PT | Portuguese National Authority for Emergency and Civil Protection (ANEPC)<br>Portuguese Environment Agency. |
| Romania | RO | CNCAN |
| Slovenia | SI | EIMV |
| Slovakia | SK | Nuclear Regulatory Authority of the Slovak Republic |
| Sweden | SE | Swedish Radiation Safety Authority |

| **Non-EU Countries** | **Country code** | **Organisation** |
|---|---|---|
| United Kingdom | UK | ONR |
| Switzerland | CH | National Emergency Operations Centre |
| Norway | NO | DSA (Norwegian Radiation and Nuclear Safety Authority) |
| Montenegro | ME | -Ministry of Ecology, Spatial Planning and Urbanism.<br>-Protection and rescue directorate. |
| North Macedonia | MK | Radiation Safety Directorate. |

| | | |
|---|---|---|
| Serbia | RS | Serbian Radiation and Nuclear Safety and Security Directorate |
| Ukraine | UK | State Nuclear Regulatory Inspectorate of Ukraine<br>State Scientific and Technical Centre for Nuclear and Radiation Safety |

## 3.4. Implementation of the case studies - Scheduled timing of the exercise

The case studies exercise was originally scheduled to begin in early March 2022, but in view of the exceptional external circumstances (Ukraine war), many Nuclear Safety Authorities suggested postponing it, because they were very busy supporting their government in analysing a potential nuclear incident/accident in the Ukrainian NPP Zaporijiia. This suggestion was agreed by the European Commission.

This is the schedule which was implemented in 2022:

| | S0 | S1 | S2 | Comments |
|---|---|---|---|---|
| Sending Date of questionnaires to ACs & NCs | 27th April | 11th May | 25th May | All responses were received in due time, except in the case of Germany (NC) which did not return its answers to the S2 questionnaire (Responses to S0 and S1 were received) |
| Sending date of questionnaires to Observers | | | 13th June | - |

# 4. Presentation of accident scenario divided into 3 steps

The scenario has been divided into three steps S0, S1, S2.

Note: all the times specified in the Scenario are AC local times and, unless otherwise specified, all the time intervals are relative to the time of the reactor shutdown.

Detailed descriptions are provided in Appendix A, B, C for S0, S1 and S2 respectively.

# 5. Contents of the questionnaires

All questionnaires and answers were transmitted via email and supervised by the Consortium in charge, to ensure due receipt and timely answering, thereby avoiding any delay which would have impeded the overall exercise.

Scenario step S0 covers questions on "Communication" and "Protective actions".

Scenario step S1 covers questions on "Communication" and "Organisational aspects".

Scenario step S2 covers questions on "Communication", "Organisational aspects", and "protective actions".

During the time allocated for answering the questionnaire, direct communication between AC and NCs was permitted for any clarification or dialogue. The Consortium was copied in these email exchanges.

The questionnaires are the same for all ACs. For NCs, but the questionnaires have been adapted to each step scenario S0, S1, S2.

A unique questionnaire to observers has been provided only after the last step scenario(S3). But this questionnaire was adapted depending on observers' status (other countries, international organisations, civil society, and nuclear utilities).

Appendix D contains all 9 AC case reports (Appendix D1 to D9) and the reports for IAEA and NERIS (Appendix D10 to D11) Each report contains questions and responses got from all stakeholders during the time of case studies implementation. Note that all stakeholders remained mobilised and have provided in due time their responses.

# Appendix A - Accident scenario step S0

On xx/xx/2022, a PWR-type reactor (or VVER type) of Country XX is in operation at full nominal power with a normal activity level in the coolant.

At 7:15 a fire occurs in the electrical building and destroys several electrical panels.

At 7:30 the reactor site emergency plan is activated, and the reactor trip is automatically implemented.

At 8:00 the NPP site emergency centre informs the local Nuclear Safety Authority (SA) of the incident. Although the fire was immediately extinguished, the destruction of most of the electrical panels has resulted in the unavailability of all Train B Safety Systems (including the Safety Injection System). One further piece of equipment is under repair, namely the Train A Containment Spray System (CSS), and is scheduled to restart at 14:00.

Table 1 shows the conditions of the NPP Safety Systems at 8:00

**Table 1: Safety Systems not available at 8:00.**

| Train A Safety Systems | Train B Safety Systems |
|---|---|
| CSS: Under repair; availability scheduled at 14:00; | Completely unavailable due to fire at electrical panels; |

At 8:30 the first reports are sent to the ECURIE[4] system.

At 9:00 the containment pressure detectors measure a slow but constant increase of pressure. Consequently, the NPP staff determines that a very Small-Break Loss Of Coolant Accident (SBLOCA) is occurring in one of the cold legs of the reactor primary system.

At 9:10 the High-Pressure Safety Injection System (HPSIS, Train A) starts to operate to maintain the water level in the primary system at the correct set point level. At the same time the Containment is successfully isolated.

At 9:25 the emergency centre of the reactor site informs the SA that a SBLOCA event was detected at 09:00. The SA is also informed that the

[4] The European Community Urgent Radiological Information Exchange (ECURIE) is the European early notification system. The ECURIE system has two message types: an *ECURIE Alert message*, which implies an emergency notification under EURATOM, and an *ECURIE Information message*, which is a voluntary notification of smaller events and incidents. The possibility of sending ECURIE Information messages was introduced by the Commission in 2001.

operator has shut down the NPP and that the available emergency systems have already been activated. The situation at the NPP is under control.

The provisional INES rating[5] of the incident is 1,[6] based on the prognosis analyses conducted concerning the progression of the incident (emission of Noble Gas 1.5E+09 Bq, Iodine 9.7E+08 Bq, Caesium 1.8E+08 Bq during the first 24 hours).

Table 2 gives a summary of the events up to 13:00.

**Table 2: Summary of events up to 13:00.**

| Time since shut-down | Real Time | Event |
|---|---|---|
| - | 7:00 | NPP operating at full power |
| - | 7:15 | Fire starts in electrical building, unavailability of Train B Safety Systems |
| 0 | 7:30 | Activation of site emergency plan. Reactor trip. |
| 0h30 | 8:00 | The site emergency centre informs the SA of the incident |
| 1h00 | 8:30 | First reports sent to ECURIE and Emercon systems (USIE)[7] |
| 1h30 | 9:00 | Slow increase of containment pressure |
| 1h40 | 9:10 | Start of High-Pressure Safety Injection (HPSI, Train A) |
| 1h55 | 9:25 | The NPP emergency centre informs the SA of a SBLOCA incident |
| 5h30 | 13:00 | First official press-release |

In Table 3, an estimate of the Source Term is reported on the basis of the emissions to the atmosphere in step S0, as prepared at 11:00.[8]

This Source Term is determined by the amounts of material released from the reactor containment (at its "natural" or design leak-rate): this release consists of a proportion of the radionuclides present in the cooling water that has leaked from the primary circuit to the containment due to the SBLOCA.

The amounts released reflect the normal activity of the primary water without core degradation. By its nature, this Source Term has totally negligible radiological consequences off-site. Furthermore, the habitability of the NPP control room is not at risk.

[5] The INES rating is directly provided here since not all the necessary information to calculate it is given. While recognising that INES rating could in practice be re-evaluated during and after the scenario's evolution, the value given is to be considered as final for the purposes of the Case Studies
[6] INES 1: anomaly that exceeds the safety levels of the reactor's normal operating regime
[7] The IAEA Unified System for Information Exchange in incidents and emergencies (USIE) is a secure IAEA website for emergency contact points in States Party to the Conventions on early notification and assistance.
[8] This action by the AC is a necessary hypothesis for the Case Study. However its validity will be tested in a specific question of the Questionnaire.

**Table 3: S0 Source Term estimate.**

| Radionuclide family | Noble gases | Iodines | Caesium | Tellurium |
|---|---|---|---|---|
| **Cumulated released activity [Bq], 24 hours** | 1.5E+09 | 9.7E+08 | 1.8E+08 | - |

A first official press release is planned for 13:00[9].

[9] The term "official press release" is used here to refer to the set of communications through which information is conveyed to the public, including, for instance, radio, television, telephone, computer networks, social media, etc.

## Appendix B - Accident scenario step S1

At 13:40 a sudden increase of the containment pressure is detected; the operator hypothesizes and verifies that an enlargement of the break size has occurred from a SBLOCA up to a MBLOCA.

At 13:50 the Low-Pressure Safety Injection System (LPSIS) of Train A is activated and a water make-up from the Reactor Water Storage Tank (RWST) is planned.

At 14:50, however, the LPSIS stops functioning due to a failure of its pumps.

The containment pressure increases to levels close to, or slightly above, the design values, but for a limited amount of time; this might have increased the leak-rate from the containment to the atmosphere. However, there is no need for containment venting.

At about 15:50, functioning of the HPSIS of Train A is also lost, due to damage to the pumps.

The provisional evaluation of the scenario involves a core dewatering, with core melt predicted for between 16:00 and 16:15, resulting in expected releases equivalent to INES 6[10], which could imply off-site emergency protective actions for distances up to 30 km from the NPP. The diameter of the hole in the primary circuit is estimated to be at least 6 inches.

At 16:00 the operator activates the SAMG procedures.

At 16:10 the SA sends an information message to the ECURIE and EMERCON systems on the evolution of the incident[11].

At 16:10 the National Emergency Plan is activated[11].

At 16:15 the cabinet of the Prime Minister announces a television press release at 16:30.

At 16:30 the Prime Minister speaks to the nation about the situation[11].

[10] The INES rating is directly provided here since not all the necessary information to calculate it is given. While recognising that the INES rating could in practice be re-evaluated during and after the scenario evolution, the value given is to be considered as final for the purposes of the Case Studies. INES 6: "An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of thousands to tens of thousands of terabecquerels of 131I".

[11] This action by AC is a necessary hypothesis for the Case Study. However, its validity will be tested in a specific question of the Questionnaire.

Unfortunately, the operator is not able to complete the operability rescheduling of the Train A CSS, which therefore becomes completely unavailable, due to unforeseen technical difficulties related to the priority of managing the LOCA.

At about 17:00, false news is deliberately circulated via social media and messaging apps and very quickly causes the spread of inaccurate information about the number of dead people to be expected due to radiation sickness over the next few days. False information is also spread regarding what actions people need to take to avoid the effects of radioactivity; additionally, fake news is spread via social media and messaging apps, encouraging people not to take stable iodine pills and advising against sheltering in place. The mass media start to interview pseudo-experts, who give contradictory opinions on the event. National authorities start to provide the population with correct information, in the attempt to dissuade people from paying attention to fake news. Cyber-attacks from abroad are repeatedly attempted against the information systems of national authorities, but without success.

Table 4 summarizes the conditions of the plant safety systems at 17:00. Table 5 provides elements of the Source Term evaluated at 15:55 cumulated up to 54 hours from the reactor shutdown.

Figure 1 provides dose curves as a function of distance from the NPP along the shortest transboundary distance path[12]. Figure 2 and Figure 3 provide cumulated dose curves for three distances (10, 30 and 40 km) from the emission points along the shortest transboundary distance path.

Table 6 summarizes events up to 17:00.

*Table 4: Safety Systems not available at 17:00.*

| Train A Safety Systems | Train B Safety Systems |
|---|---|
| **CSS: Not available;**<br>**LPSIS: Lost due to pump failure;**<br>**HPSIS: Lost due to pump failure;** | Completely unavailable due to fire at electrical panels; |

*Table 5: S1 Source Term estimate.*

| Radionuclide family | Noble gases | Iodine | Caesium | Tellurium | 131I | 137Cs |
|---|---|---|---|---|---|---|
| **Cumulated released activity [Bq], 48 hours** | 1.2E+17 | 1.2E+16 | 9.9E+14 | 3.3E+15 | 2.9E+15 | 3.3E+14 |

[12] **Total Effective Dose Equivalent** (TEDE): The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). It includes cloud shine dose and inhalation committed effective dose equivalent and ground shine dose. **Thyroid Committed Dose Equivalent** (TCDE): a 50-year committed dose to the thyroid of an adult man.

The curves in Figure 1, Figure 2 and Figure 3 can also be interpreted as a kind of 1D approach to the problem and a simplification of real 2D maps.

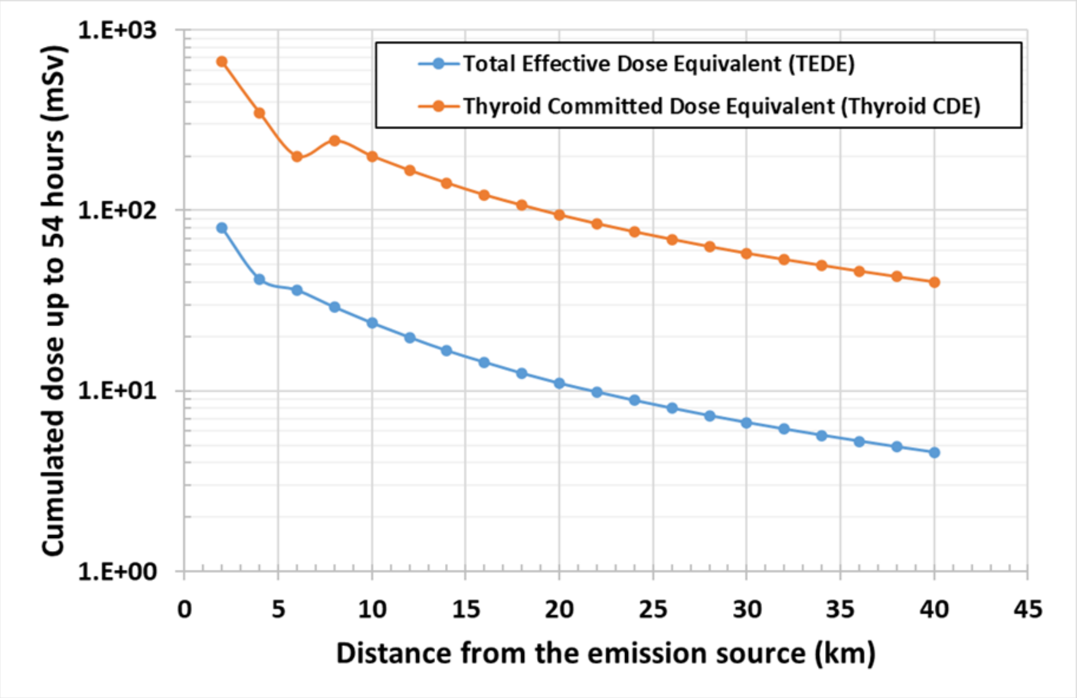



*Figure 1: Dose projections along shortest transboundary distance path for S1.*

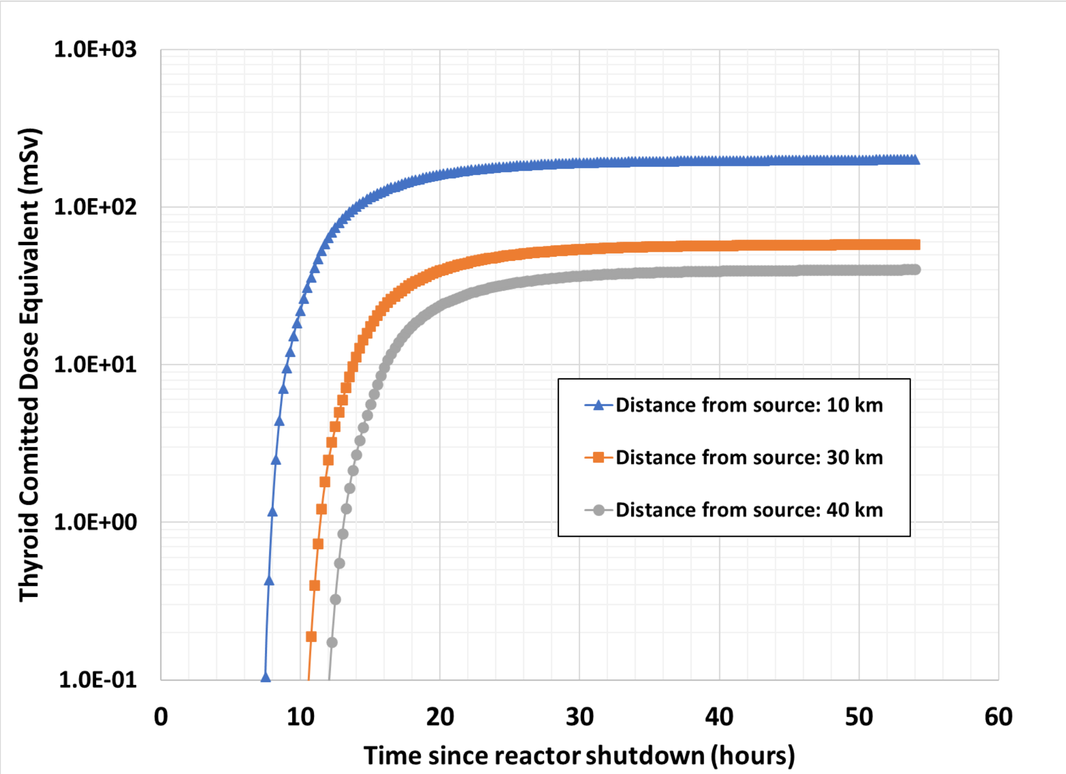


*Figure 2: Thyroid CDE at different distances from the emission source for S1.*

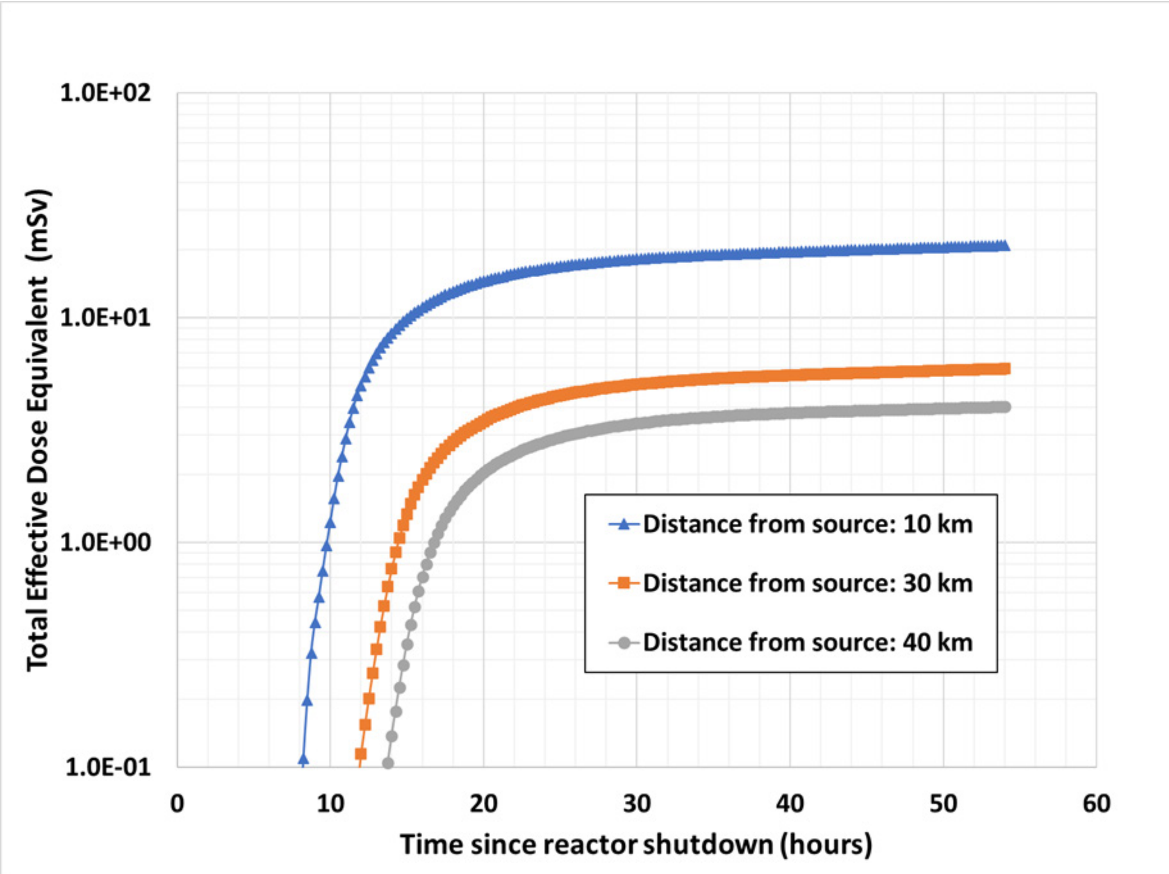



*Figure 3: TEDE at different distances from the emission source for S1.*

*Table 6: Summary of events up to 17:00.*

| Time since shut-down | Real Time | Event |
|---|---|---|
| **6h10** | 13:40 | Increase in the reactor pressure level, enlargement of the LOCA |
| **6h20** | 13:50 | Activation of the Low-Pressure Safety Injection System |
| **7h20** | 14:50 | LPSI loses its function due to a break of the pumps |
| **8h20** | 16:00 | The provisional rate for INES is 6 |
| **8h40** | 16:10 | SA sends an information message to the ECURIE and EMERCON systems (USIE)[11] |

# Appendix C - Accident scenario step S2

Note: all the times given in the Scenario are AC local times and, unless otherwise specified, all the time intervals are relative to the reactor shutdown time.

At about 18:40, the operator informs the SA of a failure of the vessel lower head. Unfortunately, the material released from the vessel clogs the sump and inhibits any water recirculation. Molten Core-Concrete Interaction (MCCI) is expected to occur very soon; this can increase H2 and steam production inside the containment, with an increased risk of containment damage[13]. Rupture of the lateral walls of the cavity is predicted within about 12 hours. The situation is clearly worsening. Within about 24 hours, the probability of a raft break-through event could be very high. A new prognosis of the Source Term in case of raft break-through is prepared[14].

The predicted Source Term in case of raft break-through, evaluated at 19:00 and cumulated up to 102 hours, is summarized in Table 7.

Figure 4 provides dose curves as a function of distance from the NPP along the shortest transboundary distance path[15].

Figure 5 and Figure 6 provide cumulated dose curves at three different distances (10, 30 and 80 km) from the emission source along the shortest transboundary distance path.

The curves in Figure 4, Figure 5 and Figure 6 can also be interpreted as a kind of 1D approach to the problem and a simplification of real 2D maps.

Two of the three barriers are already lost, and within 24 hours it is possible that the third and last barrier, the containment, will also be lost. The Government orders the Army to give full and complete on-site support to the operator, and to assist Civil Protection in implementing the countermeasures to protect the population.

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[13] Please note that, by hypothesis, this NPP is not provided with containment air coolers or, if present, they are not credited with the capability to provide proper reduction of containment pressure.
[14] This action by AC is a necessary hypothesis for the Case Study. However its validity will be tested in a specific question of the Questionnaire.
[15] Total Effective Dose Equivalent (TEDE): The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). It includes cloud shine dose and inhalation committed effective dose equivalent and ground shine dose. Thyroid Committed Dose Equivalent (TCDE): a 50-year committed dose to the thyroid of an adult man.

**Table 7: S2 Source Term estimate for the raft-breakthrough case.**

| Radionuclide family | Noble gases | Iodine | Caesium | Tellurium | 131I | 137Cs |
|---|---|---|---|---|---|---|
| Cumulated released activity [Bq], 96 hours | 5.7E+18 | 5.7E+16 | 1.1E+15 | 3.4E+15 | 2.0E+16 | 3.4E+14 |

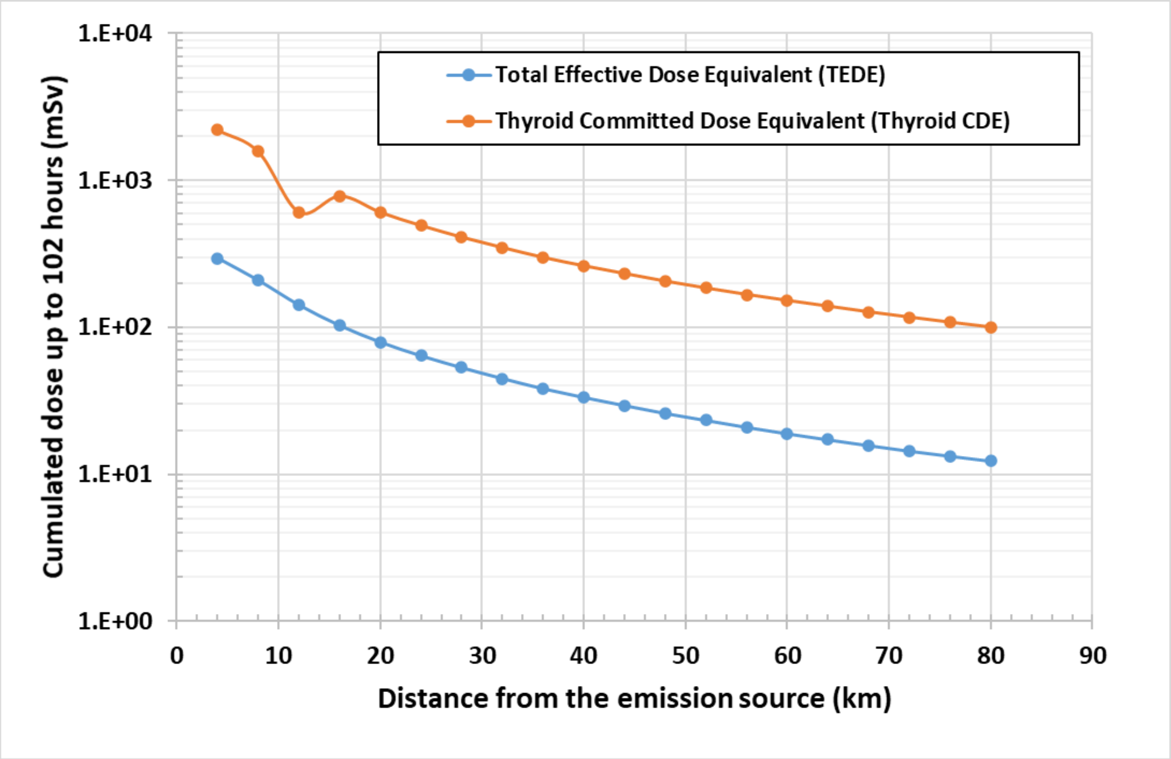


**Figure 4: Dose projections along shortest transboundary distance path for S2.**

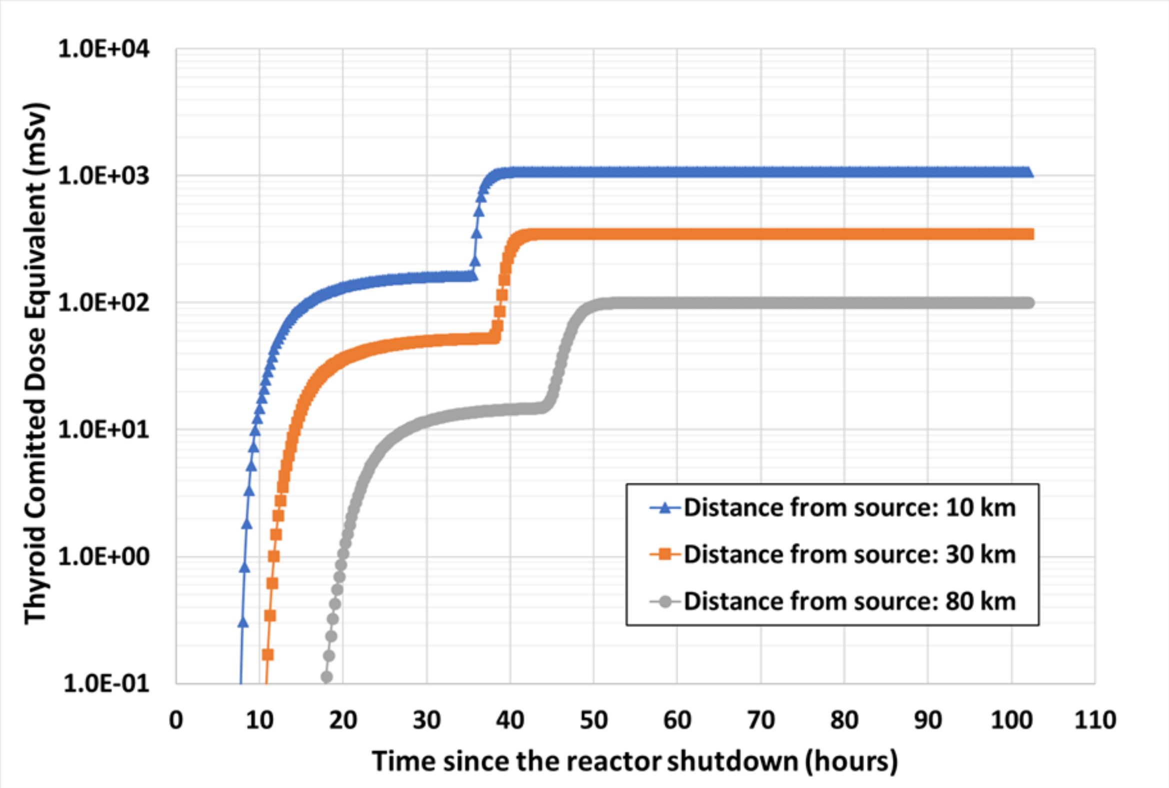


**Figure 5: Thyroid CDE at different distances from the emission source for S2.**

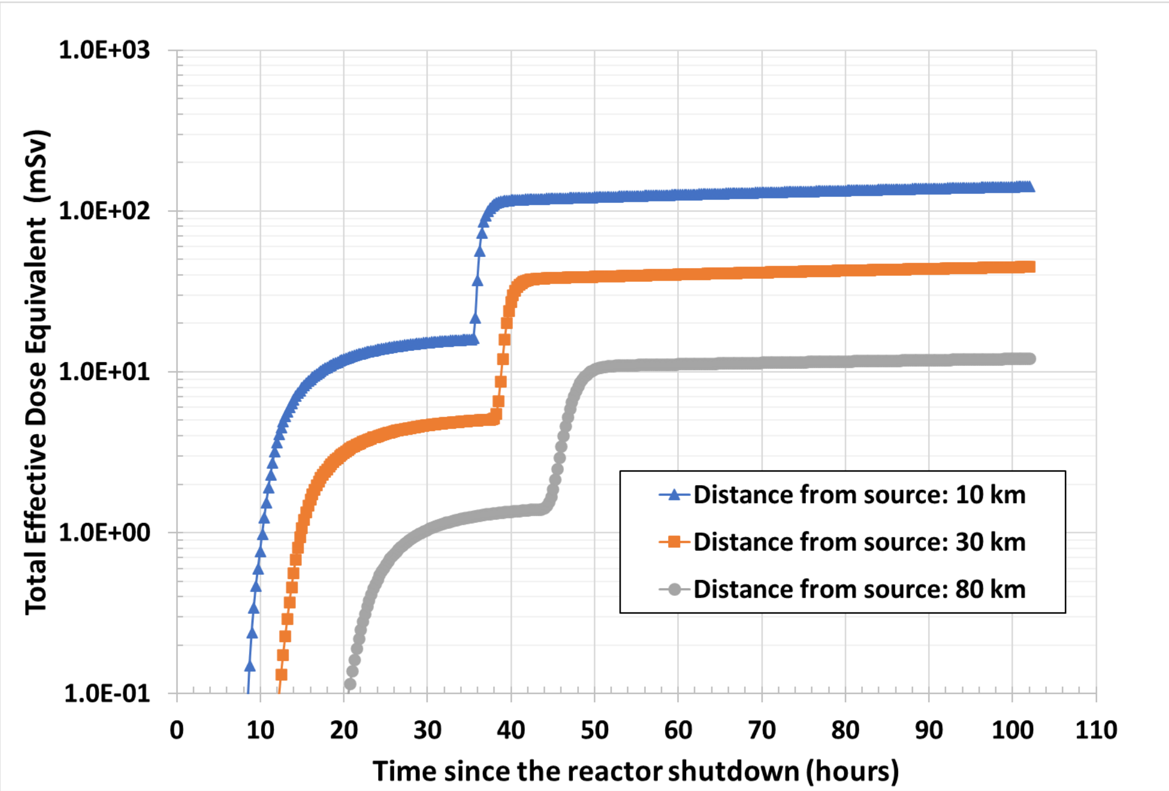


**Figure 6: TEDE at different distances from the emission source for S2.**

At about 19:15, the Train A CSS is partially recovered, and it becomes possible to keep the containment pressure below the failure limits through forced condensation of the water vapour, thereby enabling the operator to attempt to avoid venting operations. The NPP utility has in fact installed Reinforced or Hardened Filtered Containment Vent Systems but considers them to be less effective than specified under the current accident conditions. The operator also estimates that ordinary venting through the stack could severely damage the stack, with higher radiological consequences.

Notwithstanding the core melt and the start of the MCCI, the risk of hydrogen explosions is calculated to be very low, thanks to the PARs installed in the containment and/or igniters. Analyses of measured data indicate that the Spent Fuel Pool is not damaged and is not at immediate risk of dewatering.

Since this type of NPP allows for freshwater injection from outside the reactor building, two possible developments of the scenario are considered.

The first alternative envisages the successful implementation of this provision, so that within about another 24 hours the risk of raft break-through can be averted.

The second scenario alternative envisages failures or problems in the external cooling; in such a case, raft break-through cannot be avoided, and the associated release of radioisotopes to the atmosphere could be sudden and rapidly increase, so that the decision whether to implement further countermeasures must be taken well in advance.

The probability of success of the first scenario alternative is judged to be much higher than the probability of failure[16].

If raft break-through is avoided, the Source Term is only slightly higher than evaluated in S1 (roughly 10% higher), except in the case of Noble Gases.

If raft break-through cannot be avoided, the increase in the Source Term compared to step S1 would be due to the loss of the third barrier

[16] It is assumed that the AC can estimate the relative probabilities of the two possible developments of the scenario.

(containment), with only a partial filtering of some nuclides[17] by the surrounding terrain.

Meanwhile, at about 19:40, many automated messages from the EURDEP network are reporting that several monitoring stations are measuring anomalous and high gamma dose-rates, probably correlated with the emissions initiated a few hours earlier.

Cooling operations on-site continue for the whole night without major problems.

At about 21:30 of the next day, less than 40 hours since the beginning of the accident, the situation seems to be stabilized and the potential risk of raft break-through avoided.

The SA issues messages through the ECURIE and the EMERCON systems to notify that the situation seems to be stabilized and under control[14].

Table 8 summarizes the events of S2, up to 21:30 of the next day.

**Table 8: Summary of events up to 21:30 of the next day.**

| Time since shutdown | Real Time | Event |
|---|---|---|
| 11h10 | 18:40 | Vessel lower head failure |
| 12h10 | 19:40 | Many ECURIE system messages report anomalous and high gamma dose-rate measurements from monitoring stations of the EURDEP network |
| 12h15 | 19:45 | Start of external cooling operations |
| 36h10 (next day) | 19:40 | Predicted raft break-through if cooling operations fail |
| 38h00 (next day) | 21:30 | Cooling operations conducted successfully and raft break-through avoided without the need of containment venting. |

Once the risk of raft break-through has been avoided and the situation is stabilized, the ground deposition of long-lived radionuclides can be evaluated to assess the degree of soil contamination.

The weather forecasts used to draw up the prognosis of the radiological consequences for the population have been confirmed to be correct *a posteriori*, so that the same weather data can also be used for a preliminary assessment of the ground depositions.

[17] Note that both Source Terms are to be considered as best-estimate evaluations, independently of the relative probabilities of their occurrence.

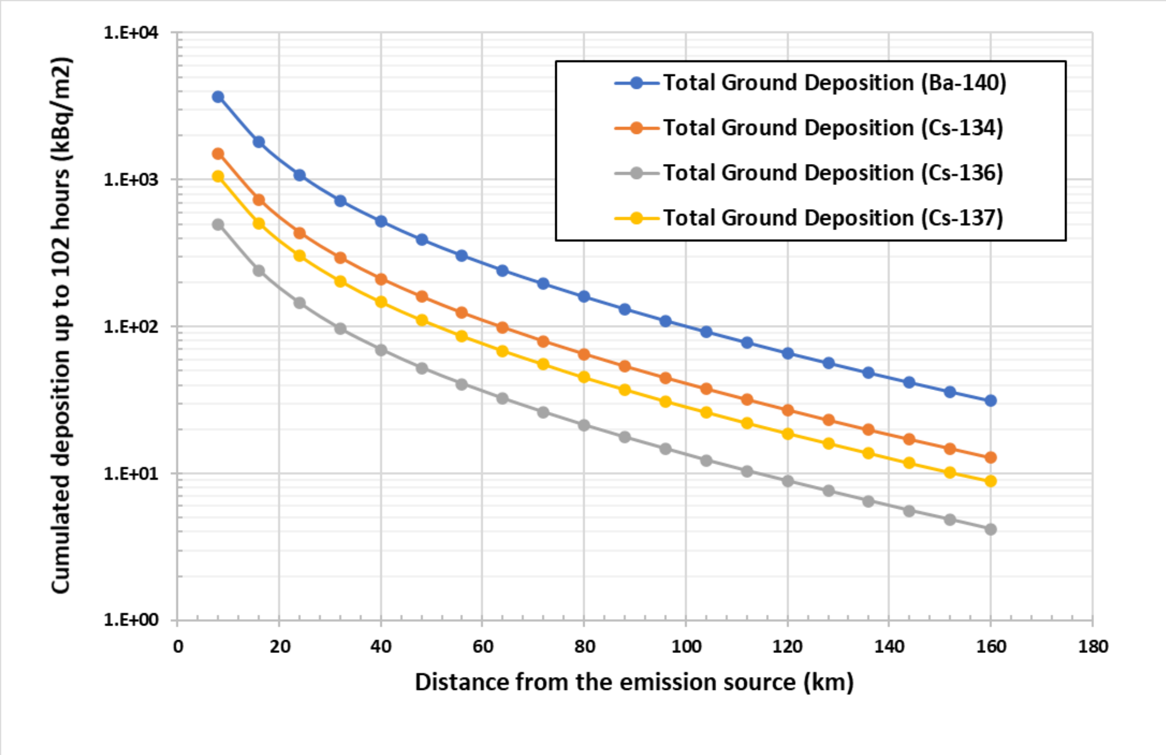


**Figure 7: Ground depositions of some radionuclides.**

Figure 7 shows the cumulated ground depositions, at 102 hours since reactor shutdown, for the radionuclides that together account for up to 85% of the ground shine dose and that have half-lives longer than 10 days.

Aggravating External Conditions

Starting at about 17:30 of the accident day, many traffic jams are reported, caused by the panic among citizens living near the NPP, as people try to flee as far as possible from the accident site. Additionally, road accidents resulting in many injured people occur. This in turn creates obstacles to the correct and timely implementation of evacuation, if needed, and to the distribution of iodine tablets over longer distances. Also a precise and detailed breakdown of the number of persons in given areas is no longer known.

Massive and disordered cross-border movement of persons towards neighbouring countries is observed.

## Appendix D - Detailed case study reports for the 9 AC case studies and 2 International Organisations

- Appendix D1: Sweden (SE)
- Appendix D2: Finland FI)
- Appendix D3: France (FR)
- Appendix D4: Belgium (BE)
- Appendix D5: Switzerland (CH)
- Appendix D6: Hungary (HU)
- Appendix D7: Slovenia (SI)
- Appendix D8: Bulgaria (BG)
- Appendix D9: Romania (RO)
- Appendix D10: IAEA
- Appendix D11: NERIS

## Getting in touch with the EU

### In person

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