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D 9.24 – Guidelines and recommendations for decision making during the transition phase

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Abstract

This document contains the deliverable D9.24 on “Guidelines and recommendations for decision making during the transition phase” of the work package WP4 “Transition to long-term recovery, involving stakeholders in decision-making processes” of the CONFIDENCE Project (HORIZON 2020 EJP-CONCERT, EC GA 662287).



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Guidelines and recommendations for decision making during the transition phase.

Final
Version 1.0

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Executive Summary

This document contains the deliverable D9.24 on “Guidelines and recommendations for decision making during the transition phase” of the work package WP4 “Transition to long-term recovery, involving stakeholders in decision-making processes” of the CONFIDENCE Project (HORIZON 2020 EJP-CONCERT, EC GA 662287).

This report, summarising the work carried under the Task 4.3 of the WP4 culminates the work done in this work package to address the uncertainties that arise during the decision-making process during the transition phase from the response phase to post-accident recovery in the course of a nuclear or radiological emergency.

The work has been based on the findings from the previous tasks, mainly on the stakeholders’ panels’ results, to elaborate guidelines and recommendations for improving the decision-making process during the transition phase of an emergency.

Chapter 1 presents a background of the WP4, the structure of tasks and a summary of the findings obtained until now. It introduces also the objective and purpose of the work reported.

Chapter 2 details the methodology used. In the first paragraph, the work is framing under the transition phase, with a reminder of the understanding of it as has been used in the WP4. Also, some considerations on the uncertainties in the framework of the decision-making process reviewed from literature, have been included. The third paragraph, then, explains the process to obtain a categorisation system for the uncertainties. In the fourth paragraph, the procedure following to select, summarise and structure the main issues and uncertainties arising in the panels’ discussions is presented. Finally, in a fifth paragraph, a short overview of the generic strategies identified to deal with the different uncertainties are presented.

Chapter 3 aim to present more into details the various types of uncertainties obtained after the analytical structuration and consolidation of results, which have been raised during the panel discussions. These uncertainties are classified regarding the six analytical categories defined previously in the methodology.

Chapter 4 presents the recommendations, elaborated on the basis of the uncertainties detailed in the previous chapter. Each recommendation is presented as a sheet associated with a specific category of uncertainty and with a common structure where the why, how and by whom are specified.

The recommendations presented in this document seek to better guide decision-makers during the transition phase by promoting best practices in both the management of the consequences and planning the establishment of optimal recovery strategies with stakeholder involvement in such processes.

These include also the consideration of the consequences of the decisions taken during the previous early emergency response phase, and, could help also to improve the preparedness for the decisions during this initial phase.

Table of Contents

Document Information	6
Executive Summary	7
Table of Contents	9
1 Introduction.....	11
1.1 Background.....	11
2 Methodology	13
2.1 Scope and considerations on the uncertainty in the decision-making process.....	13
2.1.1 The management of the response and preparedness for the recovery during the transition phase	13
2.1.2 The uncertainty in the decision-making process	14
2.2 Characterisation of the uncertainties.....	14
2.3 Strategies to deal with the uncertainties	17
2.4 Procedure	18
3 Main uncertainties in the decision-making process during the transition phase.....	21
3.1 Governance indicators	21
3.2 Environmental indicators	22
3.3 Human health and safety factors	24
3.4 Social factors	25
3.5 Economic factors	27
3.6 Transversal factors	27
4 Recommendations for the decision making process during the transition phase.....	29
4.1 Governance	30
4.2 Environment.....	34
4.3 Human health and safety	37
4.4 Social.....	39
4.5 Economy	41
4.6 Transversal issues.....	44
5 Conclusions.....	46
6 References.....	47
ANNEXE 1. Form to compile the main results from the national stakeholders’ panels	49
ANNEXE 2. Consolidated results from national stakeholders’ panels	59

1 Introduction

1.1 Background

In the framework of the European project CONFIDENCE², the work package WP4 (*Transition to long-term recovery, involving stakeholders in decision-making processes*) is devoted to improve the preparedness and response during the transition phase after a nuclear accident, identifying and trying to reduce the uncertainties in the subsequent management of the long-term exposure situation, reflecting the requirements of the new European Basic Safety Standards (BSS) [1].

For that purpose, a framework of structured collaboration involving the technical experts (partners) and stakeholders in a sequential process has been established. Three tasks have been distinguished to accomplish the work [2]:

1. Establishment and optimisation of remediation strategies in generic scenarios. (**Recovery scenarios planning**);
2. Involvement of stakeholders in decisions to recover acceptable living conditions (**Scenario-based stakeholder engagement**);
3. Elaboration of guidelines and recommendations to address the planning and decision making during the transition phase. (**Guidelines and recommendations**)

The work of the first task has been able to achieve results contributing to the following objectives:

- to identify and assess the criteria and factors (including the spatial and temporal influence in the establishment of the reference levels and the evaluation of the uncertainties in the optimisation process), that improve/affect the selection, efficiency and ending of remediation strategies, in both urban/inhabited and agricultural areas through modelling and literature review [3], [4].
- to agree on scenarios and identify remediation strategies as well as the questions and issues to be addressed by national stakeholder panels through a structured brainstorming process, concluding with a dedicated workshop [5].

The second task has been approached on a structured process of participation that combines the scientific-technical development with the points of view and interests of the interested parties. This approach is part of the preparation process for consequence management and post-accident recovery, and for this purpose, a stakeholder participation exercise has been designed in decision-making processes, based on a generic action scenario with the following phases:

1. **Scenario analysis:** to establish generic contaminated scenarios. Its main objective is to clarify the context of the decision, collecting important ideas and elements to construct generic scenarios that can be adapted to the specific needs of each national stakeholder panel. An initial questionnaire was launched among experts and interested parties to assist in this purpose. Based on these results and taking advantage of the results obtained in task 1, some generic scenario with the issues that will be used for discussion purposes in the panel has been approached³.

² CONFIDENCE: COping with uNcertainties For Improved modelling and DEcision making in Nuclear emergenCIes. HORIZON 2020 EJP-CONCERT, EC GA 662287. <https://portal.iket.kit.edu/CONFIDENCE/index.php>

³ Different scenarios, prepared by the partners for the purposes of their panels were presented and discussed in the WP4 Meeting with motive of the NERIS Workshop 2018 in Dublin

2. **Stakeholder Discussions Panels⁴**: organized to test and evaluate the national dialogue process with stakeholders during the transition to recovery in the previously defined generic contamination scenarios. The objective of the discussions focussed on what to do and how to proceed in a contaminated scenario and how to assess the potential impacts of their decisions in the course of the actions to be taken to recover acceptable living conditions. Specific consideration has been given to the uncertainties that arise from the different decision criteria and the possible recovery actions planned during this phase [6].
3. **Delphi Study**: a series of three structured surveys have been carried out in parallel with the national stakeholders' discussion panels. The first one was launched in view of preparing questions and issues to be used as a basis for the panel discussions. The others have allowed selecting and prioritising the most relevant preferences and criteria of the different panels so that they can be used by the decision-making tools developed in other work packages of the project [7].

The third task has been based on the findings from the previous tasks, mainly on the panels' results to elaborate guidelines and recommendations for improving the decision-making process during the transition phase of an emergency. The objective was to build best practices in the management of the consequences and planning the establishment of optimal recovery strategies with stakeholder involvement in such decision-making process.

This document compiles the recommendations elaborated with such purpose. As follows, an overview of the methodology used to select, summarise and structure the main issues and uncertainties arose in the panels' discussions is presented. Then, the main common uncertainties identified from the panels' results and the associated recommendations are detailed.

⁴ Hereinafter referred to as panels

2 Methodology

2.1 Scope and considerations on the uncertainty in the decision-making process

According to the main objective of the third task in the WP4, as it has been defined above, this report includes how to deal with the **uncertainties that arise in the decision-making process** during the **transition phase** of a nuclear or radiological emergency.

Next, a short review of the understanding of the transition phase and some considerations on the uncertainty in the decision-making process to frame the scope of the work are described.

2.1.1 The management of the response and preparedness for the recovery during the transition phase

In previous deliverables [3, 4], the scope and understanding of the “transition phase” from emergency response to recovery following the course of a nuclear or radiological emergency⁵ has been explained in detail. Briefly, in accordance with the IAEA [8], it is defined as:

“The process and the time period during which there is a progression to the point at which an emergency can be terminated”.

“... when the source has been brought under control, no further significant accidental releases or exposures resulting from the event are expected and the future development of the situation is well understood”

In a broader operational sense, it is equivalent to the whole “intermediate phase” of the emergency management cycle as is used by other organisations as ICRP [9] and NEA/OCDE [10], Urban and/or agricultural countermeasures, dietary aspects, stakeholder involvement mechanisms and international coordination become increasingly important, and activities addressing the transition to recovery will begin. The situation requires:

- In a first stage of “consequence management”, specific efforts to conclude the emergency response. During this time, characterisation of the contamination, review or lifting of the initial emergency protective actions and consideration of new actions to mitigate the consequences of the emergency on the populations, infrastructures, environment and socio-economic structures are ongoing.
- Finally, a “transition to recovery” stage, where the efforts will be directed to prepare plans and strategies to deal with the management of subsequent existing exposure situation and recovery of the contaminated areas.

It should be noted that, during the transition phase, the actions are not anymore driven by “urgent matter” but rather they are planned and implemented to enable the emergency to be declared terminated looking to achieve the primary objective of to facilitate the timely resumption of normal social and economic activities [478], as far as possible. Therefore, it needs to consider the future long-term recovery of the affected areas embracing all dimensions of daily life (e.g. well-being, socio-economic activities, access to health care, public services, etc.).

⁵ For purposes of this report the term emergency means a nuclear or radiological emergency event

2.1.2 The uncertainty in the decision-making process

The decision-makers have to find solutions to cope with challenges at stake during the transition phase:

- knowledge of the real consequences of an accident;
- planning, selection and implementation of the action alternatives and recovery strategies;
- identification and evaluation of the environmental and socioeconomic impacts;
- involvement of stakeholders in decision-making processes.

Therefore, management efforts during the transition phase, for which the long-term consequences are becoming increasingly important, are complex due to the multiple objectives, actions, and involved actors. It should also be emphasised that the protective actions are implemented in a constrained (location, money, time, resources, knowledge) and changing world. This situation brings multiple sources of uncertainties which should be identified in advance to assure a successful recovery of quality and conditions of life of the affected population and environment. In this context, uncertainties involved in the decision-making process in the transition phase were explored within the WP4 are described.

2.2 Characterisation of the uncertainties

Although there is a vast literature around the concept of uncertainty and on the need to deal properly, a common terminology or agreement on a generic typology of uncertainties are lacking (see [11] for a review). Therefore, before detailing the uncertainties identified in our research, the terminology and classification of the uncertainties, as have been used in W4, are introduced.

Sources of uncertainty

The “source” or location of uncertainties indicates at what knowledge object or on what specific question the uncertainty is related to. Specifically, also it is referred to where the uncertainty is manifest in the various stages of the policymaking processes, e.g., environmental assessment, crisis management, environmental decision-making, and so on [12].

From WP4 point of view, sources of uncertainties have been distinguished according to the different parts /steps of the process of a structured decision making [13]. Notably, three broad groups have been considered:

- the knowledge of the situation, covering the inputs necessary for establishing an initial basis for decisions;
- the decision-making process;
- the outputs and outcomes from the decisions.

Table 1 illustrates these three sources, establishing the relationships with the challenges, identified in the WP4, to face during the transition phase. The classification from Renn, proposed by WP5 [14] is also included only for purposes of comparison.

Table 1. Categorisation of the uncertainties of concern in the decision-making during the transition phase, regarding their source or localisation into the decision-making process.

WP4 Approach			WP5 Approach
SOURCES	CHALLENGES	Steps of Structured Decision Making	Renn Classification
Knowledge of the situation	the knowledge of the real consequences of an accident	<ul style="list-style-type: none"> Define problem Define issues, objectives and evaluation criteria 	Knowing
Decision-making	the involvement of stakeholders in decision-making	<ul style="list-style-type: none"> Develop alternatives Estimate the consequences Make trade-offs and select 	Judging
	selection and implementation of the recovery strategies		Deciding
	identification and evaluation of the socio-economic impact and environmental	<ul style="list-style-type: none"> Implement and monitor 	Implementing
Outcomes	Evaluating		

Typology and categorisation of uncertainties

Considering the nature or typology of uncertainty, this is interpreted differently by different people and disciplines. A recent review, made in the framework of the CONFIDENCE project [15], identifies the classical **stochastic**, **epistemological**, **judgemental**, **computational** and **modelling** uncertainties, but there are also those related to **ambiguity**, **lack of clarity** and **endpoints**, related with the subjective understandings and views of the actors involving in specific decision situation, as well as social and **ethical** uncertainties.

In this report, the generic definition of the uncertainty from Brugnach [15]:

“Uncertainty refers to the situation in which there is not a unique and complete understanding of the system to be managed”,

has been adopted, because it provides a conceptual basis to the systematic treatment of all these types of uncertainties and mainly of those related with the ambiguity. According to this interpretation, the uncertainty is considered as knowledge relationships with a content and a relational aspect. The content refers to “what” is being understood, and the relational aspect refers to “who” is being included or excluded from the problem understanding. In her approach, treating uncertainty as a relation requires three elements:

1. An object of perception or knowledge (e.g. **environmental, social, economic system**)
2. One or more knowing actors for whom that knowledge is relevant (decision-makers and **stakeholders** involving in the decision-making process)
3. Different knowledge relationships that can be established among the actors and the objects of knowledge (according to the nature of the involved **uncertainty**).

Both, the elements of the system framing the scenario and the knowledge relationships constitute two dimensions of the decision situation, with which the uncertainties raised from the WP4 panels’ results

have been categorised. The combination of both dimensions leads to specific uncertainty questions which should be dealt with the decision-making process.

Regarding the **types of knowledge relationship**, Brugnach [15] identified three types based on the differences in the nature of uncertainties, which are defined as follows:

- **Unpredictability.** *“The systems to be managed are complex systems, whose behaviour is variable in space and time. These systems are constantly learning and adapting to new conditions. They express a non-linear and sometimes chaotic behaviour and are very sensitive to initial or boundary conditions. These characteristics make them impossible to predict. With this kind of uncertainty, we accept the unpredictability of the system as something that will not change in the foreseeable future (ontological uncertainty)”*
- **Incomplete Knowledge.** *“This type of relationship refers to situations where we don’t know enough about the system to be managed, or where our knowledge about it is incomplete (epistemic uncertainty). This can be due to a lack of information or data, to the unreliability of the data that is available, to lack of theoretical understanding, or to ignorance”.*
- **Multiple Knowledge Frames.** *“This relationship refers to the situation where there are different, and sometimes conflicting, views about how to understand the system to be managed. It is important to note that these different views may all be plausible and legitimate. Ways of understanding the system can differ in where to put the boundaries of the system or what and whom to put as the focus of attention. Differences can also emerge from the way in which the information about the system is interpreted. Different decision-makers can give different meanings to this information”.*

For WP4 purposes, these types of relationships could be also identified considering the **influence** that the uncertainties have in the decision-making process. According to this criterion, French [17] grouped the uncertainties in two broad groups:

- **External**, related to the acquisition /availability of information and production of data supporting the decisions - State of knowledge and fit to “reality” of the scenarios.
In general, these uncertainties include physical randomness (stochastic/aleatory uncertainties), reliability of the models (modelling uncertainties), lack of scientific knowledge (epistemological uncertainties), errors in calculations (computational uncertainties), setting of default values or parameters in models on the basis of personal knowledge (judgmental uncertainties), etc. In the case of nuclear accident management, these various uncertainties are mainly found in the process of producing data and information (e.g. producing contamination maps from modelling, from field measurements, etc.) which will be used as basis and support for the decision-making process;
- **Internal**, related to the formulation, dissemination and understanding of decisions. Description of objectives and endpoints, points of view and preferences of stakeholders.
In general, these uncertainties can take various forms and are difficult to apprehend and assess. For instance, internal uncertainties can be related to the decision maker’s behaviour given the ambiguity or the lack of clarity of the situation, her/his understanding of the situation, her/his personal judgments, etc. Moreover, the possible impacts of the decision in terms of economy, social reactions or even on the environment can also generate a lot of uncertainties.

It is clear that the unpredictability and incomplete knowledge are related to the external uncertainties, and the multiple knowledge frames are referred, mainly to the internal uncertainties.

In the other way, attending to the other dimension in the decision situation, the context or frame of the scenario can be described in terms of different analytical categories taking into account the indicators or criteria that are important to making the decision (in order to accomplish the overall objectives and to obtain the outcomes pursued). Additionally, they can help decision-makers to organise their knowledge about the system and to consider all aspects of interest for sustainable decision-making and optimisation of the possible recovery alternatives.

The analytical categorisation has been based on the three pillars of the sustainability: **social** (people), **economic** (profit) and **environmental** (planet) [18] to which three additional groups were added:

- **Human Health & Safety issues.** Although these aspects are traditionally included in the dimension social of the sustainability, constitutes a crucial element to take into account in the decisions on proposed remediation or restoration strategy.
- **Governance of the decisions,** including the involvement of stakeholders. Similarly, the indicators related to the governance was initially distributed among the dimension social and economic, but it is another important element by itself as to be considered as an entity separate.
- **Transversal,** will include those indicators without a clear adscription to a particular category, and related mainly to external uncertainties.

These six groups constitute the headline categories related to the main goals in the development and implementation of plans and strategies to the post-accident recovery of quality and conditions of life of the affected population and environment. Each group include the different indicators to take into account in the decision.

In conclusion, the uncertainties that arise from the stakeholders' discussions can be grouped according to:

- From the analytical point of view, in six headline categories: **Governance, Environmental; Human health and safety; Social; Economic;** and **Transversal** indicators,
- From the point of view of **influence** relationships, as **internal** or **external,**
- Additionally, according to their **location** in the **stage of the decision making process** at stake, as uncertainties from the **Knowledge of situation,** the **Decision-making process** or from the **Outcomes.**

2.3 Strategies to deal with the uncertainties

The uncertainties that have been identified in the panels are related to the issues, questions or aspects that may need to be considered in the process of decision-making during the transition phase, in order to manage, in our case, the consequences of the emergency (as lifting of emergency measures, implementation of remediation or protective actions in urban and agricultural environments) and planning the long term recovery. Along in the decision-oriented scenario-analysis, different alternatives have been identified and evaluated. Different potential endpoints with different values according to the criteria considered have arisen. In addition, the construction and selection of strategies have been subject to the ambiguity of the presence of multiple frames of reference, according to the different views and preferences of the stakeholders and on the need to find a workable relationship between the different points of view and actors involved.

According to the different uncertain knowledge relationships found, a range of relevant strategies to deal with uncertainty can be suggested while hindering others:

- Uncertainties related to the information gathering, production of data supporting the decision-making process can be addressed:
 - Improving the acquisition of information and carry out additional studies or research to gain more knowledge.
 - Use a process of expert elicitation to improve subjective judgement.
- Uncertainties related to the ambiguity, lack of clarity, and endpoints during the decision-making process can be dealt:
 - By means of the participation of the stakeholders in discussion panels, the different decision criteria, concerns and viewpoints, can reduce or at least consider the uncertainties in order to foresee the possible changes in the response of the long-term recovery.
 - By means of surveys as complementary methods, allowing to identify the items of interest for discussion purposes and prioritise the preferences of the stakeholders.

While the type of external uncertainties, related to the scientific aspects and research on the development and understanding of the intervention scenarios have been considered in previous tasks [3, 4], within the nine national panels implemented in the framework of the CONFIDENCE WP4, it turns out that the discussions have raised various uncertainties that, mainly correspond to 'internal uncertainties' under relationships with multiple or conflicting views. The procedure to study them is described in the following.

2.4 Procedure

After the separate analysis of each country panel (described in CONCERT D9.22 [6]), and after a first evaluation of the uncertainties in the second round of the Delphi study [7], a cross-country analysis was carried out to obtain joint conclusions across the different countries. These conclusions have helped to elaborate and to derive some recommendations to better address the planning and decision making during the transition phase. The overall procedure has followed the next steps:

1. *Participatory process for discussions and identification of uncertainties*

- Organisation of nine national stakeholders' discussion panels in combination with a Delphi study to identify the main uncertainties at stake in the decision-making process during the transition phase;
- Identification of the main uncertainties raised by the panels;
- Categorisation and evaluation of uncertainties from the national panels through the second round of the Delphi study that leads to the definition of six main categories of uncertainties.

2. *Analytical structuration and consolidation of results*

- Cross country analysis of the results from stakeholders' panels. An analysis grid has been designed (see Annex 1) to **extract some main findings and main uncertainties** on the basis of the classification as explained above.

Each partner was asked to fill in the analysis grid with the results extracted from the national reports of two different countries to own (see Table 2). The idea behind this was to increase the reliability of the analysis in the sense that different experts that were not involved in the panel discussions, could analyse more objectively the results of each country.

Table 2. Assignment of the reviewers to analyse and extract the main results from the national stakeholders' panels organised under the WP4.

Partners - reviewers	National report to be revised		Additional report
CIEMAT (Spain)	Greece	Belgium	Ireland
IRSN/CEPN (France)	Norway	Slovak Republic	France
VUJE (Slovak Republic)	Portugal	The Netherlands	
WFSR/RIKILT (The Netherlands)	Spain	Greece	
EEAE (Greece)	Ireland	Belgium	
EPA (Ireland)	Norway	France	
DSA (Norway)	Slovak Republic	Portugal ⁶	
APA/IST (Portugal)	The Netherlands	Spain	

- Organisation and structuring of the joint results from the cross-country panel's analysis. A final analysis grid was elaborated by each partner unifying and approving the analyses of the own country made by the other partners. In Annex 2, the consolidated results of each panel, structured according to the analysis grid, are included.

3. Elaboration of the recommendations

- Suggestion or association of the recommendations which could help to reduce or consider these uncertainties in the decision-making process. In this step, the work was focused on the **specific analysis of the main uncertainties** raised by each panel.

For each category (environment, economy, social, governance, health, transversal) the main uncertainties which have emerged from panel discussions were selected by each partner. The idea was not to be exhaustive but only to mention the most important uncertainties raised by the panels. At the same time, each partner, based on the uncertainties at stake, suggested some recommendations that could help to reduce or consider these uncertainties in the decision making process in the own country. Partners were invited to suggest broad enough recommendations that can address several uncertainties at once. In general, one (or 2) recommendation(s) per category (environment, economy, social, governance, health, transversal, etc.) were suggested. Depending on the panel discussions, some categories had no uncertainties/recommendations.

- Harmonization of the suggested recommendations. In this step, **working groups (WG)** were created to go in-depth into the different types of uncertainties and **to propose harmonized recommendations** from the nine panels. Volunteers self-proposed to lead the different WG, and other partners self-proposed to be part of the different groups taking into account each partner expertise. Each WG focused on one of the six categories of uncertainties identified. The distribution of the partners in the WG is shown in Table 3:

⁶ Finally, DSA not was able to analyse the Portuguese report

Table 3. Distribution of the WP4 partners in the different working groups established to undertake the analysis of uncertainties and suggest and associate recommendations

Categories of Uncertainties	Leader of the working group	Members of the working group
Environment	APA/IST	CEPN/IRSN
Economy	CEPN/IRSN	RIVM/WFSR
Social	CIEMAT	EEAE, VUJE, CEPN/IRSN
Human Health and Safety	APA/IST	DTU
Governance	CEPN/IRSN	VUJE
Others (e.g. communication, support of information, etc.)	CEPN/IRSN	EPA, CIEMAT

Some partners were observers of the work in other groups or stages, as CEPN/IRSN (in the group of “Human Health and Safety”), or EPA (in the group of “Social”).

In each WG, general uncertainties and recommendations summarizing the different country results were extracted. WG organized their analysis within the group and discussed recommendations by means of Skype meetings. The findings of the WG were shared and discussed with all WP4 partners.

- Presentation and feedback from experts and users. **Recommendations were presented and discussed in the Confidence Dissemination Workshop** [19] that took place in Bratislava, from the 2nd to the 5th of December 2020. WG leaders collected comments from participants in the workshop. Those comments have been considered to improve the recommendations presented in this report.

3 Main uncertainties in the decision-making process during the transition phase

The following paragraphs aim to present more into details the various types of uncertainties, which have been raised during the panel discussions. These uncertainties have been classified regarding the six analytical categories defined previously:

- the **Governance** indicators;
- the **Environmental** indicators;
- the **Human health and safety** indicators;
- the **Social** indicators;
- the **Economic** indicators;
- the **Transversal** indicators.

The series of indicators or criteria included under each category, each one representing a specific aspect to take into account in the decision-making based in the optimisation, have served to situate and organise the variety of uncertainties into each category. The majority of the uncertainties identified were mainly of ‘internal’ character and were categorised in the superior five groups. On contrary to others, the category on Transversal indicators refers more particularly to ‘*external uncertainties*’, and notably issues related to the reliability of the data produced (e.g. contamination maps) and their possible evolution over time.

3.1 Governance indicators

The question of governance of the decision-making process has been tackled several times by the national panels. First, the panels stressed that, since the transition phase, the decision-making process not only rely on national decision-makers and radiological protection experts and authorities, but also on other actors (from local to national levels) who can give support to the decision. However, **the identification of these additional actors, their roles and coordination** have been questioned:

- “What other actors should be included to give support to government bodies? How and when to involve them?”
- How to coordinate the actors involved in the decision-making process over time? Who is responsible for what actions? ”

The **roles and responsibilities of local stakeholders**, who face the reality of the affected territory and who are likely to be in the front line to manage the long-term situation remain also as real challenge according to the national panels:

- “Who, how and when to involve local stakeholders in the decision-making process and in the planning of countermeasure strategies?”

The question of the real weight of local decision-makers facing a national or even international crisis has been also raised by several national panels. For instance, during the debates, none of the participants underestimated the consequences of a possible incoherence between the decisions taken at local and national levels. This highlights a strong uncertainty about the decision process itself, but also on **the way to balance local, national and even international interests**. These elements were reflected by the following panels’ questions:

- “Will this strategy, decided at local level, be validated by higher authorities?”

- Will higher institutional actors/decision-makers change this strategy and implement a new one?
- How suitable are different management strategies from a local perspective?
- How to report information to international organizations? How can we cooperate with other countries?"

In addition, several questions related to the decision-making process itself were also emphasized by the national panels. The first set of questions was about **the best timing to take a decision**. Indeed, as showed by the questions below, participants wondered what could be the time limit to obtain a maximum of reliable information before making a decision:

- "What is the best timing to take a decision? Is it when the results of the model are available or we should wait when the zoning is well established based on field measurements?"
- Should we not wait for the first map of contamination based on field measurements?"
- How do adapt the decisions and communication according to the progress of the situation?
- Aa balance can be found concerning the timing of decisions?"

In addition, participants also tackled the issue of **the criteria or additional information supporting the decision**:

- "What information would be required to reduce uncertainties on the decisions?"
- Should we consider other criteria (geographical, socio-economic) in addition to the radiological ones? How to put into balance these different criteria?"

Indeed, according to the discussions, it seems that criteria specific to the territory, such as the presence of schools or hospitals, the type of occupation of the territory (e.g. agricultural fields, houses, forests) can weight in the decision-making process. However, the way these criteria can be collected and the importance of such criteria in comparison with the radiological ones remains unresolved and creates new uncertainties.

Finally, the question of the **flexibility of the decisions** taken in the early phase and their possible adaptation over time has also been mentioned by several national panels:

- "How to adapt the decisions according to the progress of the situation?"
- How to adjust the strategy for relocation (and the protective actions) according to the evolution of the radiological condition?"

Therefore, in the case of a nuclear accident, decision-making process implies important uncertainties regarding the governance of the decisions to be made and the weight given to each criterion (health, economic, politic, etc.) which could be supported by different decision-makers, as well as the place to be given to local actors.

3.2 Environmental indicators

An extended range of uncertainties regarding the environmental aspects of the affected scenario, as the potential impacts of the consequences of different action alternatives and recovery strategies on the environmental compartment where they are applying; side effects or undesirable on the quality or normal functioning of other compartments; effects in the interactions among organisms and their biophysical environment; or the use or need of resources and waste generated, have been extensively discussed by the national panels. They notably addressed the importance of an adequate and timely

assessment and monitoring of the actual and future environmental radiological situation. Here the more important common questions highlighted by the panels are presented.

Different questions were raised related to the **impact of the contamination on the different natural and human environmental compartments (air, soil, water or urban structures and agricultural systems)**. These can be identified according to the next issues:

- Identification, zoning and mapping of the affected areas.
- Distribution of the contamination (homogenous or inhomogeneous) in the different environmental compartments.
- Temporal evolution of the contamination and which factors would be implicated in. Reliability of the assessment of the radiological situation from both estimations to, of models and incomplete temporal and spatial mapping of the measurements.
- Influence of the seasons and weather conditions on the implementation of actions to protect or recover the normal agricultural production
- How changes in the meteorological conditions are taken into account

Uncertainties associated with the **planning, implementation, evaluation and monitoring of the different possible alternative actions** to mitigate or reduce the adverse consequences on the environment were also identified:

- Preventative measures employed and future consequences Responsibility in monitoring along time
- Reliability of environmental measurements
- Risk assessment (water supply, food contamination, etc.)
- Reference levels (are there adequate? Or need to be changed...?)
- The effect of the recovery strategy on the radiological situation in the long term
- Effectiveness of countermeasures

Additional questions in relation to the **impacts on ecology**, understanding this indicator both from a conservation perspective of biodiversity and from the perspective of providing services necessary for the sustenance of life, were shortly discussed in the panels, mainly regarding:

- Factors implicated in the contamination of aquifers, groundwater
- Additional problems in the fertility of soils from countermeasures as removal of topsoil, or adding of fertilisers
- Possible spread of diseases into livestock and wildlife derived from the use of Cs-binders as salt licks

These issues were also related to the problems of **intrusiveness** in the environment derived from the implementation of some invasive countermeasures or management actions:

Changes in the structure or soil loss, effects on the landscape by removal of topsoil e.g. Finally, another set of questions were directed to the **resource use and waste**:

- Amounts and management of produced waste (disposal of contaminated food)
- Places for waste storage (great amounts)
- Waste facilities acceptance of contaminated soils
- Safe transport of waste
- Adequate/sufficient resources for characterization of the situation and implementation of the recovery strategies

- Farmers acceptance of disposing of soil
- Responsibilities regarding samplings and measurements
- Methods used for characterization of contaminated large areas

3.3 Human health and safety factors

The uncertainties discussed by stakeholder's panels have been focussed on the different health and safety aspects on concern in the planning of post-accident recovery. Aspects related with: the assessment of the radiological effects from the exposure of the population and in the workers involved in the implementation of the protective actions; the assessment of the effectiveness of the such actions to reduce the radiological exposure and impact on the health along time; and the possible disturbances and disrupts in the quality of daily life of people living in contaminated environments, including also the psychological effects and other impacts on the mental health, were included in this paragraph. The uncertainties highlighted by the panels have been grouped according to the next main concerns:

Assessment of impact and doses averted by implementing protective /remediation actions

- What are and how to estimate the level of exposure of the population in terms of doses received and avoided dose?
- What is the risk of exposure at low doses (low doses are expected in relatively large areas, affecting a large fraction of the population)?
- What are the products that have a higher impact (dose) by ingestion?
- There will be health consequences (cancer cases and cases averted)? How to estimate them?

Consequences on the health and safety from the application of the recovery strategies:

- What is the feasibility of distribution of KI tablets, during the pre-distribution campaign, within the emergency planning zone?
- How to evaluate the adequacy of evacuation carried out during the early phase? Have been properly selected the areas and population evacuated (too far away or not far enough?)
- How affects the selection, implementation and control of the protective actions on the affected population and on the people involved in the production/industry chains?
- When and how to impose food restrictions? Are these measures adequate to prevent effects on health?
- How to distribute non-contaminated food as complementary of food ban countermeasures at local level?
- How can disturb to the quality of live application of countermeasures in agriculture to reduce the population's dose (e.g., will farmers accept to use caesium binders in the feed?)

Consequences for those implementing protective/remediation action(s):

- Workers knowing about the risks involved in the decontamination work and what is the relation with the informed consent
- The volunteers' knowledge of the risks they are exposed when involved in the decontamination work and on their skills to perform the work
- How to deal with the fear of non-radiation personnel to perform sampling in contaminated areas?

Control and long term health monitoring of the affected population:

- Estimation of site-specific levels of contamination of agricultural products (inconsistency of contamination distribution)
- How to estimate, measure the overall-effectiveness of countermeasure strategies?
- Will be necessary extensive monitoring programs for live animals and food to ensure products below specified intervention levels
- How to manage and provide measurements of radioactivity concentrations within a reasonable timeframe? Are we ready to deliver dose rate measurements in due time for the whole country?
- The results of the health surveillance program (are model calculations adapted to reality?)
- How it could be designed and implemented a successful health surveillance plan that avoids negative reactions among the population?
- Do exist adequate/sufficient control systems?
- How to assess the risk for human health through the food chain (national laboratory capacity for sample analysis)?

Psycho-social impacts of the emergency/protective actions:

- What are the psychological, social and economic effects suffered by the population affected by the emergency?
- There will be psychosocial effects on decision making (how to calculate this or get information using DALYs)
- How devising countermeasure strategies that consider wider societal and psychological factors (impact of the loss of livelihoods, stigmatisation, loss of jobs, additional work, etc.)
- How to assure the consumers' trust in the safety of the products in the market?

3.4 Social factors

The national panels have also addressed social aspects several times. In the nine countries, many social issues causing uncertainty in the decision-making process were highlighted.

Information and communication: How to better inform/communicate with the population?

One first repeated issue has to do with the communication, in the sense of how to better inform and communicate with the affected population about the levels of contamination and the selected countermeasures. Different aspects of communication were tackled:

- How to inform the public and consumers on the radioactivity concentrations in food?
- What are the effective communication channels that consumers/public/farmers/producers/retailers will trust?
- What experts' voices should be involved in the communication and information of the public?

Population response and compliance with countermeasures: Will people in the affected areas comply with instructions? Will they understand the proposed measures? Will they accept it?

A second issue that was raised in many of the national panels is population acceptance and compliance with countermeasures. For instance, during the debates, participants pointed out that the follow-up of the recommended measures by the affected population was a very important uncertainty. Some stakeholders' groups were of special interest, such as the compliance by farmers or industry (producers, retailers). The issue of compliance is linked to public understanding, acceptance, compensations, and perception of efficiency. The question if will different regions will react differently was raised by some of the national panels. Other national panels highlighted the issue of the

consequences of different emergency preparedness zones in the sense that it could cause conflict when applying the protective measures (e.g. evacuation in one town and no evacuation in a very close one that is part of another zone).

- What will be the level of compliance when taking protective actions?
- How the population is going to respond to governmental control (countermeasures implemented, waste storage issues, etc.)
- Are they going to be accepted?
- Will people understand measures?
- Will depends on acceptance and compensations?
- Will the distinctions between unaffected, orange and red zones cause conflict?

Trust in authorities: Will the population trust the competent authorities? Will the population trust information have provided?

A third social aspect that repeated in the national debates is public trust in authorities and the related legitimacy of the selected measures. Both appeared as very relevant topics, closely connected to communication, compliance and acceptance of countermeasures. Trust in authorities is particularly important in relation to food safety, as a way to avoid panic:

- How to reach a fair set of countermeasures (balanced between population groups, regions etc.)?
- Will the public trust the government enough to accept their decisions and implement their recommendations?
- How will stakeholders and the public be confident that the correct decisions have been made on protective actions?
- How to convince consumers that the safety of the food supply is assured and to avoid panic?

Psychological and social consequences of countermeasures: What are the social consequences of countermeasures? (e.g. relocation) How to manage stigmatization of the relocated individuals and affected territories?

The fourth group of social aspects are the impacts and consequences that the adopted measures could have on the affected population. Indeed, aspects such as the potential problems of relocation, potential stigmatisation and psychological effects of it are clearly mentioned. A good communication strategy is proposed as a way to overcome stigmatisation and minimize those negative impacts.

- How will the strategy affect the community?
- What will be the impact of the loss of livelihoods and knock-on effects on communities?
- Where and how is the population going to be relocated?
- How would they be integrated into their new residence locations?
- Willingness to house people from affected areas after the relocation.
- Willingness to return.
- What will be the psychological impacts?
- How to outreach the general population and the hosting territories in particular, so as not to generate stigmatization of the relocated individuals and affected territories?

Awareness and responsibility: How to cope with the indifference of people in peacetime in order to improve preparedness plans?

Finally, the fifth group of social uncertainties highlighted in some countries has to do with population awareness and responsibility to be better prepared for a potential nuclear emergency. In some countries, a sense that there is a certain degree of the indifference of people in peacetime to contribute to better emergency preparedness is seen as a difficulty that causes uncertainty in the decision-making.

3.5 Economic factors

Regarding the economic dimension, the national panels raised various uncertainties. For instance, the **direct and indirect costs** associated with a decision and the implemented strategies have been the subject of many questions:

- “What are the costs of the envisaged protective measures?”
- Who will pay for the human resources and technical equipment required? (e.g. cost on accommodation during relocation, collection and analysis of environmental samples, etc.)
- What about the indirect costs of protective actions? (e.g. health care, compensation of loss of productivity, etc.)”

The impact of an accident on the economy of the affected region has also raised several questions from the national panels, particularly regarding the possible **loss of the image of local products**:

- “What about the brand damage/loss for the products? How can we evaluate the impacts?”
- What will be the impacts on the economic activities of the affected region?
- What are the economic losses for each food production sectors if they are « stigmatized »?
- How to maintain activity in the affected territories over the long-term?”

Facing these issues, many national panels have pointed out the need to implement **financial support mechanisms** which are also tainted of uncertainties:

- “Is the compensation policy clear enough?”
- Who will pay for compensations? Are there enough resources available?”

However, it should be stressed that the economic dimension cannot be considered during the emergency phase, during which decisions must be taken rapidly. In the transition phase, on the other hand, economic impacts can be further assessed and anticipated. Therefore, to limit significant long-term economic consequences following early decisions, it would be appropriate to introduce scalability of the decision over time and an ability to modify these decisions after the introduction of additional criteria (e.g. eco criteria).

3.6 Transversal factors

Although the national panels didn't focus so much on these types of uncertainties, some questions were raised and referred directly to **stochastic, epistemological, modelling or computational uncertainties**. For instance, panel members questioned the reliability of the contamination maps given to them to make their decision:

- “What is the level of reliability of the measurements? What is the level of conservatism?”
- What is the level of reliability of the probability maps?
- What if the release occurs during a longer time frame?
- How do you consider the meteorological forecast (wind)?”

These external uncertainties, directly related to the production of information, can have direct impacts on decisions and their evolution in the long-term phase. Therefore, the whole question remains to know how much trust can be placed in these data. And, despite these inherent uncertainties, how informed decision can be taken by decision-makers. However, it should be highlighted that these types of uncertainties didn't constitute real brakes for the panels to make their decisions. In fact, these uncertainties are outside their direct area of responsibility. Indeed, in the case of an emergency, decision-makers will have to take a decision on the basis of this information, whether they are tainted by uncertainties or not. However, this should not stop thinking about how to improve the production of information by seeking to better reflect the inherent uncertainties in models and measurements, while better guiding decision-makers.

4 Recommendations for the decision making process during the transition phase

Based on the different categories of uncertainties raised by the national panels, various recommendations have been prepared to try to improve the decision-making process in the transition phases considering them. 14 recommendations have been elaborated in accordance with the 6 categories of uncertainties detailed in the previous section. **Fehler! Verweisquelle konnte nicht gefunden werden.** illustrates the distribution of the 14 recommendations which are further detailed in the following paragraphs.

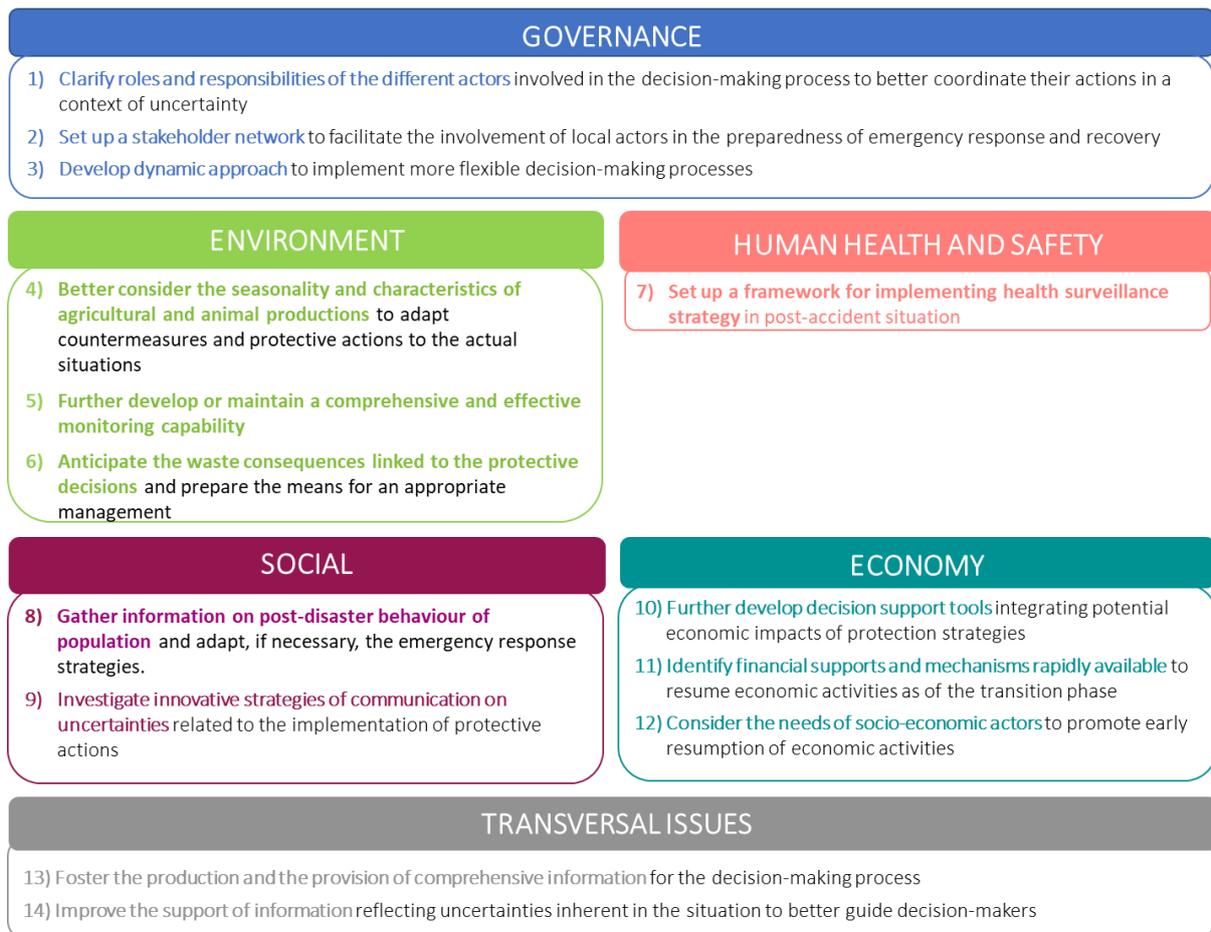


Figure 1. The overall structure of the recommendations to promote best practices in the decision-making process addressing the six uncertainties categories raised by the national stakeholders` panels.

4.1 Governance

(1) Clarify roles and responsibilities of the different actors involved in the decision-making process to better coordinate their actions in a context of uncertainty

Why?

- In case of a nuclear crisis, **decisions are complex in nature** and cannot rely only on decision-makers working on RP field. Therefore, the **decision-making process involves many actors** (e.g. national and local elected people, socio-economic actors, health professionals, health/food/environmental agencies, population, operators, neighbouring countries, etc.);
- In most of the countries, **roles and responsibilities** of the stakeholders to be involved in the decision-making process for the early phase are relatively well defined. However, for transition and longer-term, this is generally less clear. In any case, **the articulation between the different stakeholders, including different levels of decisions, needs to be better characterised** and would benefit for further development.
- National panels also highlighted that during the emergency phase, **strategies envisaged at the local level may not be implemented by decision-makers at the national level**. In addition, in the transition phase, the roles between local and national decision-makers and potential transfers of responsibility are not well **anticipated**.



To improve the decision-making process notably during the transition phase, it seems necessary to clarify the roles and responsibilities of the different actors involved from both local and national levels. This would help to better coordinate the protective actions and their continuity and consistency over time.

How? / By whom?

- Through feedback from crisis management (nuclear or others) **challenge the roles and responsibilities of the different actors** and how actions have been coordinated according to existing emergency and response national plans, focusing particularly on the transition phase



Local and national public authorities, experts, local and national institutions.

- Based on the outcomes of the previous analyses, **enlarge the sphere of actors to be involved and specify how and when they should intervene** (e.g. food/labour/environment/agriculture/... agencies, health professionals, social operators, etc.);
- **Design and conduct national exercises** that really challenge local and national decision-makers on their roles and responsibilities and update practical arrangements with lessons learned. More particularly, **ensure to better define and strengthen the coordination** between decision-makers, notably during the transition phase. Focus on particular decisions that could significantly impact the future of the affected communities (e.g. implementation and lifting of evacuation and food restriction orders);



Local and national public authorities, experts, local and national institutions, emergency teams, health professionals, health/food/environmental agencies, operators, stakeholder network.

- **Set up cross-border exercises** with neighbouring countries to converge on population protection strategies, land management strategies and information processes.

(1) Clarify roles and responsibilities of the different actors involved in the decision-making process to better coordinate their actions in a context of uncertainty



International organizations (OECD, IAEA), domestic and foreign local and national public authorities, emergency teams, experts, stakeholder network.

(2) Set up a stakeholder network to facilitate the involvement of local actors in the preparedness of emergency response and recovery

Why?

- CONFIDENCE national panels have highlighted that during the decision-making process, uncertainties can arise regarding the **adequacy between envisaged protective actions and the specificities of the territory**. This calls for opening discussions on the emergency preparedness and response to local stakeholders;
- In that sense, by **providing local knowledge to decision-makers**, the involvement of stakeholders allows implementing protection strategies reflecting local needs and expectations. This is how the decision-making process can get **greater credibility and legitimacy**, bearing in mind that, anyhow, for transition and long-term phases, there is a need to include other categories of actors than radiation protection authority.
- In that respect, **it is important to involve local stakeholders since the preparedness phase**. Some countries have already tried to organize discussions on these topics by implementing local-national stakeholder panels in the framework of former European projects (e.g. SAGE, EURANOS, FARMING, NERIS TP, PREPARE, etc.), but it is not so trivial and these panels have not been sustained over time.



To facilitate the involvement of local actors in the preparedness of emergency response and recovery, and their interactions with national decision-makers, it is important to set up a sustainable network of local and national stakeholders. This will help to reduce some uncertainties in the decision-making process.

How? / By whom?

- **Identify the different local actors** who have the interest to discuss specificities of their territory and that would be important to consider for the management of an accident (e.g. local socio-economic actors, locally elected people, environmental NGOs, etc.). It is worthy to mention that the targeted stakeholders depend on the political and cultural context of each country and their involvement should be on a voluntary basis;



National and local institutions and public authorities.

- Following this identification, **set up a stakeholder network** which includes different categories of actors (e.g. institutional and non-institutional organisations, international, national and local public authorities, local socio-economic actors, locally elected people, environmental NGOs, etc.) and covers the breadth of emergency response and recovery management topics. This network could integrate stakeholders involved in previous research projects and could rely on other structures involving local actors (e.g. site stakeholders groups or Local Liaison Committee in France);
- The management of the stakeholder network implies:

(2) Set up a stakeholder network to facilitate the involvement of local actors in the preparedness of emergency response and recovery

- **Establish pluralistic governance** that provides all types of actor access to expertise on emergency response and recovery issues and thus, create locals/experts/decision-makers' partnerships;
- **Clarify in advance the role and the influence of this network** in the preparedness of emergency response and recovery as well as in the decision-making process in case of an accident;
- **Organise periodic meetings** to gather the needs and expectations of the local actors and arrange some discussions dedicated to the preparedness of emergency response and recovery with national decision-makers and institutional organisations;
- **Mobilize all or part of the actors according to the subjects to be discussed.** For instance, only local socio-economic actors of this network could be mobilized to discuss their needs about financial supports and mechanisms (see [recommendation n°12](#));
- **Improve the consideration of stakeholders' needs** to limit uncertainties in the decision-making process during the emergency response and recovery management.



Institutional and non-institutional organisations, international, national and local public authorities, local socio-economic actors, local elected people, environmental NGOs, etc.

(3) Develop a dynamic approach to implement more flexible decision-making processes

Why?

- CONFIDENCE national panels highlighted some **uncertainties related to the decision-making process itself**: although it is difficult to take decisions relying only on first model assessments, in most of the cases, it could not be more relevant to wait for the first monitoring results;
- Panels also raised that decisions taken during the emergency phase can have consequences on the long-term management of the situation. Therefore, **one of the challenges of the transition phase is to adapt these early decisions by considering the potential evolution of the situation** and changes of decision-makers.



To limit uncertainties related to the decision-making process itself (e.g. timing of the decision, consequences in the long-term, etc.), it seems important, during the transition phase, they have more flexibility in order to adapt over time decisions taken during the emergency phase, in accordance with the evolution of the situation and the involved actors.

How? / By whom?

- In line with **recommendation n°1**, **adapt the organisation of the decision-making processes** (at local, regional, national, international levels) for emergency and transition phases and **their evolution over time** (evolution of the actors involved). On this basis, **develop new approaches of cooperation** for strengthening the dynamics between the different actors involved;



Local, national and international public authorities, experts, local, national and international institutions, stakeholder network.

- **Develop tools facilitating dynamic approaches** in the decision-making processes and helping decision-makers to have a comprehensive vision of the on-going situation and to formulate flexible decisions during the transition phase:
 - **Encourage and facilitate up-to-date local information feedbacks** (see recommendation n°13);
 - **Provide maps projecting the evolution of the radiological contamination over time**;
 - **Investigate mechanisms of “options thinking”** whose specific purpose is to enable delaying final decisions up to the point where better information is available: development of tools anticipating potential –radiological and non-radiological – impacts of a decision?



Experts, modellers.

- **Challenge the developed operational tools and the dynamics approach** of the decision-making process through exercises, practical case studies, etc.



Local and national public authorities, experts, local and national institutions, emergency teams, health professionals, health/food/environmental agencies, operators, stakeholder network.

4.2 Environment

(4) Better consider the seasonality and characteristics of agricultural and animal productions to adapt countermeasures and protective actions to the actual situations

Why?

- CONFIDENCE national panels highlighted that **agricultural productions calendar can differ from the real state of the productions** (due to the meteorology for example) at the accident time. In addition, they raised that **characteristics of animal production systems** (type, size, outdoors/indoors times) **vary widely over time**;
- To reduce these uncertainties and to assess the radiological impact, **it is necessary to have a realistic characterisation of the affected zones**



To establish the realistic impact of the accident on agriculture areas and to set up appropriate countermeasures and protective actions, it is necessary to consider the seasonality and characteristics defining agricultural productions and animal productions.

How? / By whom?

- **Study in-depth the characteristics of the area** to select and model countermeasures (identify sensitive and less sensitive areas, etc.);
- In line with the recommendation n°14, at the preparedness phase, **create a knowledge database of land uses, agricultural and husbandry productions and feedstuff calendars**;
- Based on these two points, **establish a metafile with the countermeasures adapted to the type of soil and crops and protective actions associated with animal productions**;
- **Develop a mechanism** in order to be able to acquire quickly the real development state of agricultural productions during crisis management.



Experts, modellers, local and national public authorities, local and national organisations.

(5) Further develop or maintain a comprehensive and effective monitoring capability

Why?

- Feedbacks from past nuclear accidents highlighted **the complexity to identify the impacted communities**;
- **Uncertainties concerning the understanding of the accident and its releases** could lead to major discrepancies between protective measures and the reality without monitoring results;
- **Available measurements will help to improve the modelling assessment** at a period where models are necessary to provide a whole understanding of the actual and future situation.



Monitoring measurements are the ultimate proof of the reality of the contamination. So it is necessary to maintain/develop a capability able to provide such crucial information.

How? / By whom?

- **Establish a national capacities register**, harmonize procedures and maintain homologated control of the quality of the measurement requirements;
- Introduce **direct measurement equipment's** to make a rapid screening of contaminated zones;
- Establish an effective **monitoring mechanism** for the effective radiological characterisation of large geographical areas.



Experts, measurers, local and national public authorities, local, national and international organisations.

(6) Anticipate the waste consequences linked to the protective decisions and prepare the means for an appropriate management

Why?

- CONFIDENCE national panels identified many **uncertainties in the decontamination and waste management due to protection strategies which could be implemented** (amounts and management of produced waste, places for waste storage, waste facilities acceptance of contaminated soils, safe transport of waste, etc.).



To make waste issues associated with the decontamination strategies manageable, it is necessary to anticipate the environmental consequences of the protection strategies which could be implemented.

How? / By whom?

- Implement studies linking protection strategies and waste production;
- Put in perspective the **costs/benefits of the waste generation** with radiological protection targeted by a decision.



Experts, local and national authorities and organisations, waste management facilities, operators.

4.3 Human health and safety

(7) Set up a framework for implementing health surveillance strategy in a post-accident situation

Why?

- Following a nuclear accident, there is a strong concern of local populations about the potential health consequences of living in the affected territories, especially for children. Their concern is not limited to the potential health effects due to exposure to ionising radiation: **the presence of radioactivity in their environment creates strong disturbances in their daily life inducing social and psychological concerns.**
- **The emergence of the health consequences could occur several years and decades following the exposures**, first of all for thyroid cancers but also for other effects and are not limited to radiation-induced cancers.
- In addition, in the transition phase and the long-term phase, there is generally a significant modification of the demography of local communities **requiring an evolution** or a least an adaptation of the healthcare infrastructure and organisation **to cope with the needs of the current communities** (e.g.: predominance of elderly people in some communities, presence of workers involved in the dismantling of the damaged nuclear installation,...).
- Generally, **the national public health surveillance systems are not well fitted to cope with the post-accident context**: the priorities and human and financial resources allocation are not focused on the main issues at stake to respond to the concerns of local populations living in affected areas. Notably, the long-term follow up of health consequences of exposures to low doses is generally difficult to address for both local populations and health professionals: **need to adapt the health surveillance to assess the potential effects.**
- Furthermore, the consequences of the accident on the well-being of the population **require putting more efforts such as devising countermeasures strategies that consider wider societal and psychological factors**, allowing the population to recover their autonomy in their daily life.
- **Preparing in advance the key issues** to be addressed in the health surveillance strategy for the post-accident situation and identifying the available and needed resources for its implementation would contribute to better cope with the health issues at stake if an accident occurs.



A well-established national health plan would assure the local populations that the protective actions are adequate and would contribute to their autonomy of decision and to their well-being.

How? / By whom?

- In preparedness, **establish a dialogue with health professionals** and local stakeholders to identify the key issues at stake in case of an accident.
- **Identify and set up the overall objective of the health surveillance strategy** for post-accident situations and share this strategy with health professionals and local stakeholders around nuclear installations.
- **Enable health care facilities with psychological and social care capabilities** to support the population.
- **Identify the available resources** at the local and regional levels for the implementation of this strategy and define the needs for their adaptation in case an accident occurs.

(7) Set up a framework for implementing health surveillance strategy in a post-accident situation

- **Identify the role and responsibilities of the different stakeholders** (including local, regional and national health agencies and professionals, NGOs, local populations...).
- **Favour the development of the radiological protection culture** by training and sharing information with the different stakeholders.



Health and social care professionals, health organizations/agencies at the local, regional and national levels, local populations, NGOs, radiological protection experts.

4.4 Social

Three main recommendations were derived from the social uncertainties raised in the different panel discussions. Two of them are presented in this section. The third one overlapped with Governance recommendations and it is contained in that section as n° 2 (Set up a stakeholder network to facilitate the involvement of local actors in the preparedness of the emergency response and recovery).

(8) Gather information on post-disaster behaviour of the population and adapt, if necessary, the emergency response strategies.

Why?

- In real nuclear accident situations, the **affected community may not necessarily comply with instructions given by the authorities** (e.g. self-evacuation, refusal of local food by consumers and retailers, stigmatization of evacuees etc.). This leads to **uncertainties on the implementation of the decisions** to be taken at the time of an accident.
- CONFIDENCE national panels highlighted **uncertainties regarding the specific behaviours of the local decision-makers and the population** at the border of the emergency response zones (e.g. evacuation zone, food restriction areas, etc.).



In order to limit such social uncertainties, it seems important to perform studies to gather evidence-based information on post-disaster behaviours of impacted communities. If necessary, these results could lead to adapt emergency response strategies.

How? and By whom?

- **Perform in-depth analysis of the behaviours of populations affected** by the Chernobyl and Fukushima accidents or other catastrophes;
- Based on these analyses, **carry out psychosocial studies** to go in-depth into the potential community (living in the vicinity of an NPP) reactions in case of an accident, adapted to national contexts and cultures in collaboration with the stakeholder network;
- **Adaptation of the EP&R plans** taking into account the evidence from those studies



Researchers, experts, NERIS and SHARE platforms, stakeholder network, local and national public authorities.

(9) Investigate innovative strategies of communication on uncertainties related to the implementation of protective actions

Why?

- CONFIDENCE national panels pointed out that, in a context of uncertainty, **it is difficult to communicate clear and audible messages to the population**. Many uncertainties related to communication arise from panel discussions: How to improve transparency; How to ensure understanding, acceptance and compliance with protective measures; How to overcome the stigma of the contaminated regions and relocated people?
- CONFIDENCE outcomes also highlight that **some innovative communication tools can improve communication with the population**.



In this context, it is important to investigate innovative strategies and practical implementation actions of communication on uncertainties related to protective actions.

How? and By whom?

- **Initiate brainstorming between experts, decision-makers and local stakeholders** to agree on the information needed to allow the population better catching the complexity of the situation as well as the related decisions taken by the authorities and to better adapt their behaviours;
- Based on these discussions, continue **testing new communication tools** (such as SMS of floating messages) **and strategies** that better reflect uncertainties (e.g. content, the timing of communication, relevant communicators, etc.);
- In order to limit rumours, fake news or confusion related to the difficult notion of “uncertainties” and to avoid panic reactions, it is necessary **to work in advance on uncertainties in emergency situations** by developing education and training and equipping potential communicators;
- **Test innovative strategies of communication** during media-training, practical case studies and exercises involving experts, decision-makers, and if possible journalists and the population.



Experts, experts in communication, potential communicators, local and national public authorities, nuclear operators, stakeholder network.

4.5 Economy

The WP4 proposes three recommendations associated with economic aspects (see recommendations n°10 to 12).

(10) Further develop decision support tools integrating potential economic impacts of protection strategies

Why?

- Past experiences have shown that the occurrence of a nuclear accident creates **strong disturbances**, which have long-term effects **on the socio-economic situation** and the **interactions between the various actors**;
- Currently, there are many **uncertainties in the cost estimations of countermeasures** both for the **direct** and the **indirect costs**. Examples are the effects on loss of the image of local products, the impact of selling prices, costs of countermeasures (e.g. food ban, decontamination works and management of decontaminated wastes, additional equipment and measurement laboratories, etc.) and costs of health follow-up, etc.



Feedback shows that the economic impact of protection strategies should be taken into account in the decision-making process. To that extent, in the preparedness phase, it is necessary to improve decision support tools to integrate potential economic impacts and better guide decision-makers.

How? and By whom?

- **Prepare feedback analyses on economic impacts of protection strategies** implemented following the Chernobyl and Fukushima accidents as well as technological accidents (e.g. SEVESO sites) which may be more relevant in terms of the economy from a European perspective;



Experts, economists, public authorities, international organizations (e.g. OECD)

- **Estimate the costs** associated with the implementation of protective actions following an accident in accordance with the local and national frameworks (e.g. increasing laboratory capacity, monitoring equipment and manpower, etc.) and the evolution over time;



Experts, economists

- **Further develop models** to calculate direct and indirect costs and **further elaborate risk/benefit analysis** elements for various sets of rehabilitation scenarios (decontamination strategy, food restrictions, etc.) taking into account local and national sensitive issues.



Experts, modellers, economists, local and national public authorities, socio-economic actors

(11) Identify financial supports and mechanisms rapidly available to resume economic activities as of the transition phase

Why?

- Acknowledgement that **protection actions have strong economic consequences**, both at local and national levels;
- CONFIDENCE national panels highlighted **uncertainties related to existing financial supports mechanisms**, which could be implemented following a nuclear accident, both for accelerating the resumption of activities and compensating economic damages and losses



CONFIDENCE national panels question if the financial supports would be substantial enough and could be rapidly available to avoid financial gaps and resume economic consequences. Therefore, it is necessary to identify financial resources and mechanisms that can be rapidly raised and available, as of the transition phase.

How? and By whom?

- In the preparedness phase, **review existing financial supports and mechanisms** that can be implemented following an accident. This review should:
 - Consider financial mechanisms implemented following **natural or technological disasters** (e.g. solidarity funding, risk pooling within professional sectors, etc.);
 - Identify which **organisations are involved** in providing financial supports;
 - Make a distinction between **compensation** (e.g. loss of real property, loss of profit) and **indemnification** (e.g. cost of remediation activities) processes.
- Based on the review, **investigate the financial resources and mechanisms** that could be **rapidly available** and **ensure transparency** about the related amounts allocated.



Experts, economists, national and local public authorities (chambers of commerce, etc.), insurers and mutual insurances, trade unions, agricultural cooperatives, etc.

(12) Consider the needs of socio-economic actors to promote an early resumption of economic activities

Why?

- Socio-economic actors **are unaware of the possible financial supports** that could be provided and by whom;
- Therefore, socio-economic actors **would face uncertainties for taking decisions** related to the resumption of their activity and its sustainability.



To cope with these uncertainties, it is necessary to make the financial supports and mechanisms to promote the early resumption of economic activities more efficient and accessible. This should be in line with the expectations and needs of the socio-economic actors.

How? and By whom?

- Based on the financial supports review suggested in the [recommendation n°11](#), **develop practical case studies** illustrating different possibilities for the resumption of economic activities following a nuclear accident (considering different accident scenarios, various economic activities and different types of financial supports);



Experts, economists

- **Discuss these case studies with the stakeholder network** (see [recommendation n°2](#)), to gather the expectations and the needs of socio-economic actors to better support the resumption of their economic activity;



Experts, economists, stakeholder network (notably socio-economic actors)

- Explore the possibility of **crowdfunding mechanisms** to restart an economic activity;



Experts, economists, social media

- In line with expectations raised by the stakeholder network (see [recommendation n°2](#)), **develop infrastructures** (e.g. single window) **that could help socio-economic actors to make informed decisions** on the future of their activity. For instance, these infrastructures can provide:

- information on the situation of their activities in relation to the ongoing risks, their obligations and the possible impacts of the risks;
- information on the financial supports available and the conditions/processes for obtaining this.



Experts, economists, stakeholder network (notably socio-economic actors), local and national public authorities, insurers and mutual insurances, trade unions, etc.

4.6 Transversal issues

For this category, two recommendations are proposed.

(13) Foster the production and the provision of comprehensive information for the decision-making process

Why?

- **Information not only focused on radiological impacts**, such as geographical, environmental, socio-economic data of the local territory help decision-makers to make informed decisions;
- Decision-makers **need up-to-date local data** during the crisis management to adapt their decisions and strategies;
- Feedback from post-accident situations shows that it is crucial to get detailed **information about the behaviours of the population** at the time of the accident (see recommendation n°8).



To help the decision-making process, it is crucial to foster the provision and the production of comprehensive and up-to-date information which not only rely on radiological issues.

How? and By whom?

- In the preparedness phase:
 - **Establish/reinforce “reference” status of the territory**: reference levels (background levels maps), cancer registry, local data (population ages, location of public-access buildings, etc.), endangered species, protected areas, socio-economic issues, population food dietary, etc.;
 - Based on this collection of data, **set up a metafile** aggregating all the data of the territory: create databases that are not yet available (cancer registry, epidemiological data, agricultural productions database, etc.);
 - **Develop a dedicated tool for automatic updating regular databases** (e.g. agricultural productions database, administrative data, etc.);
 - In collaboration with the stakeholder network (see [recommendation n°2](#)), **prepare survey questionnaires** to be given to the affected population following the accident and which will help to set up adapted health, social and financial supports;
 - **Identify actors** who might be involved for specific issues following the accident (e.g. qualified companies for decontamination).



Experts, local and national public authorities, institutional organizations

- During the emergency phase:
 - **to ensure the periodic integration** of local situation inputs in assessments, it is necessary to provide periodical up-to-date data:
 - **on agricultural production** (livestock, harvesting crops / imminent date on the market);
 - **on the accurate level of self-consumption of people** (including individuals living in extremely precarious conditions);
 - **on socio-economic activities** (e.g. non-interruptible activities, tourism, etc.)

(13) Foster the production and the provision of comprehensive information for the decision-making process

- **to get information on seasonal activities** (e.g. social events, tourism, etc.) from local decision-makers.



Experts, local and national public authorities, institutional organizations

(14) Improve the support of information reflecting uncertainties inherent in the situation to better guide decision-makers

Why?

- CONFIDENCE national panels discussions raised the fact that **probability maps** are good support of information which **can very well reflect uncertainties related to modelling and measurement processes**.
- **Maps providing gathered environmental, social and economic issues** of affected territories help decision-makers to better catch the strengths and vulnerabilities at stake.



CONFIDENCE national panels highlighted that innovative visualizations of uncertainties (e.g. map view) help decision-makers to better catch the issues at stake and anticipate the potential consequences of the envisaged protective actions. Therefore, to better guide decision-makers, it is necessary to improve the support of information reflecting the associated uncertainties.

How? and By whom?

- Work on the **support of information that well reflects uncertainties** (e.g. probability maps). More particularly, ensure to:
 - reflect uncertainties related to the boundaries of the zoning;
 - compare data resulting from modelling and from measurements;
 - anticipate the spatial and temporal evolution;
 - in line with recommendation n°2, identify with stakeholders the more relevant representations of uncertainties to better guide the decision-makers.
- In line with recommendation n°13, **create a geographical information system** which integrates the useful data for the decision-making process.



Experts, modellers, local and national public authorities and decision-makers

5 Conclusions

This report culminates the work done in WP4 to address the uncertainties that arise during the decision-making process during the transition phase from the response phase to post-accident recovery in the course of a nuclear or radiological emergency. It highlights twelve recommendations to improve such decision-making process and to promote best practices in the management of the consequences and planning the establishment of optimal recovery strategies with stakeholder involvement in such processes.

These recommendations are established taking into account the views and opinions of several stakeholders that attended nine national panels. In that sense, discussions in the panels have been the raw material to elaborate this guidance. A categorisation of the uncertainties identified was developed based in three dimensions related to the source of the uncertainty, to the situation to understand and to the actors involved in the decision-making. In such a way, the first dimension is referred to its location into the stages of the decision-making process, the second is based in six analytical headline categories that framing the context of the decision situation and the goals to cover, and the third, finally, is based on the typology and its relationship of knowledge with the actors and influence respect to the own decision-making process.

In the basis of this categorisation, national results have been elaborated, compared and combined to extract general patterns at the European level. The task has been carried out through a structured analysis involving dedicated working groups, composed by the partners of the work package. Finally, these recommendations have also been contrasted/checked with experts during a Dissemination Workshop of Bratislava (in December 2019).

This research represents the first intend to structure and derive some general guidance to face the main uncertainties in a practical way, establishing how to do it and who should be involved in. As a first intend, it requires further research on it, surely, to refine the conceptual basis for the systematic treatment of the uncertainties in the framework of the management of response and post-accident preparedness. In the other way, probably, the first step for the implementation would be to discuss these recommendations at different levels:

1. Discussions with public authorities would help to further explore the governance associated with the decision-making process. For instance, the idea would be to better clarify the roles and responsibilities of the involved actors and to set up a sustainable network of stakeholders that would be involved in the preparedness of emergency response and recovery.
2. Work with international organizations (e.g. OECD, European platform) would help to benefit from their expertise on specific elements, such as the economic impacts of past nuclear accidents, social behaviours following disasters, etc.
3. Further research activities to be developed with experts and researchers have been also pointed out by WP4 CONFIDENCE panels, concerning more particularly the need to develop tools that can better guide decision-makers (e.g. visualizations of uncertainties, calculation of economic or environmental impacts, "option thinking" tools, etc.).

Nonetheless, it would be also important to maintain country stakeholders' networks (already established with the panels) to consult these recommendations, to improve them and to start applying them. Limitations as the different level of stakeholders' involvement and process of stakeholders' engagement in each country or the lack of representativeness of some types of stakeholders should be improved. Some international initiatives and the results from European projects as ENGAGE could be valuable to close such gaps.

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ANNEXE 1. Form to compile the main results from the national stakeholders' panels

Partner name:		Country:		
MAIN FINDINGS AND CONCLUSIONS ACCORDING TO THE SPECIFIC ISSUES IN THE TRANSITION PHASE				
ISSUE	FINDINGS AND CONCLUSIONS	CRITERIA	COUNTRY SPECIFICITIES or OTHER ASPECTS TO HIGHLIGHT	OTHER COMMENTS or OBSERVATIONS
Management of consequences arising from decisions taken during the emergency (Evacuation and food restrictions)				
Protective or remediation actions to carry on during the transition phase in urban environments				
Protective or remediation actions to carry on during the transition phase in agricultural environments				
Protection and management of consumption, and food and other goods trade				
Preparedness for the post-accident recovery				

Partner name:		Country:			
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ⁷	INFLUENCE ON THE DECISIONS ⁸	Cross-reference to other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)				
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste				
ECONOMIC					
ECON 1	Direct cost and direct economic benefits				
ECON 2	Indirect costs and indirect economic benefits				
ECON 3	Employment /human capital				
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)				
HEA 2	Health safety regarding population/workers during the application of the recovery strategies				
HEA 3	Doses to those implementing protective/remediation action(s)				
HEA 4	Long term health monitoring of the affected population				

⁷ This part is optional

⁸ This part is not required

HEA 5	Psycho-social impacts of the emergency/protective actions				
SOCIAL					
SOC 1	Community involvement and satisfaction				
SOC 2	Ethical and equity considerations				
SOC 3	Impacts on neighbourhoods or regions				
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)				
GOVERNANCE					
GOV1	Life-span and “projects risks”				
GOV2	Flexibility				
GOV3	Involvement of stakeholders				
GOV4	Fit with planning and policy strategies and initiatives				
GOV5	Uncertainty, evidence and verification				
OTHERS (To identify if it is of interest)					
OTH1	Communication				
OTH2	Support for information				
OTH3	Evolution of the time				

OBSERVATIONS

CRITERIA: To evaluate the decisions taken along the time - taking into account objectives and outcomes: The criteria are going to help the decision-makers to determine that a successful decision has been made. The decision criteria are those variables or characteristics that are important to making the decision in order to accomplish the overall objectives and to obtain the outcomes pursued. They should help to evaluate the possible strategies/countermeasures alternatives to address the issues of concern. They include criteria for both implementation and termination of the protective/remediation strategies, and also for tracking the progression and effectiveness of the measures taken along the time. In a process of optimisation, different criteria to evaluate all aspects of concern (e.g., impacts on health, economic, social, environmental aspects, etc.) should be considered.

UNCERTAINTIES: According Brugnach⁹ “Uncertainty refers to the situation in which there is not a unique and complete understanding of the system to be managed”. For WP4 purposes, they would be related with the issues, questions or aspects that may need to be considered in the process of decision-making during the transition phase, in order to manage, in our case, the consequences of the emergency (as lifting of emergency measures, implementation of remediation or protective actions in urban and agricultural environments) and planning the long term recovery. They will be subject to the ambiguity of the presence of multiple frames of reference to construct and select the strategies and the need to find a workable relationship between the different points of view and actors involved.

INDICATOR: An indicator is a single characteristic or a criterion that represents an aspect to take into account in the decision-making based in the optimisation, which can be compared across options to evaluate their relative performance. The indicators included in the template have been extracted from the SURF-UK's approach for the use of sustainability criteria in a Sustainable Remediation Framework. For a detailed description of such indicators, see in the reference below¹⁰. We have taken advantage of this categorisation to identify the groups of indicators which could be of interest for purposes of WP4, in order to help us to classify the uncertainties obtained from the discussions over the national stakeholder panels. Therefore, the initial list of indicators and their classification into the headline categories were tentatively and it is open to include other indicators we think are not considered or were underplayed. The present template shows the categories agreed in the last WP4 meeting and it includes the newly proposed indicators by the partners.

HEADLINE CATEGORY: Grouping the indicators or criteria according to the three pillars of the sustainability, **social** (people), **economic** (profit) and **environmental** (planet). For the purposes of the WP4, three additional groups of indicators are specifically identified at the level of the category:

⁹ Brugnach, M., A. Dewulf, C. Pahl-Wostl, and T. Taillieu. 2008. Toward a relational concept of uncertainty: about knowing too little, knowing too differently, and accepting not to know. *Ecology and Society* 13(2): 30. [online] URL: <http://www.ecologyandsociety.org/vol13/iss2/art30/>

¹⁰ [Bardos et al, A Review of Published Sustainability Indicator Sets: How applicable are they to contaminated land remediation indicator-set development?](#)

- **Human Health & Safety.** The criteria related to Human Health are specifically distinguished from the specific aspects related to the **social perception and behaviour** of the stakeholders regarding a proposed remediation or restoration strategy.
- **Governance of the decisions,** including the involvement of stakeholders. The indicators related with this are specifically distinguished from the economic (GOV1 and GOV2) and social elements (GOV3, GOV4 and GOV5) where they were included in the list from SURF-UK.
- **Others,** where will be included those indicators without a clear adscription to a category, at least, in this stage of the study.

SOURCE OF UNCERTAINTY: Source refers to the reference point of uncertainty. It indicates at what knowledge or what concrete question the uncertainty is related. The sources can be useful for a first description and “localisation” of uncertainty in the decision-making process. Therefore, from WP4 point of view, we can relate them to the different challenges, identified in the WP4, to face in the recovery process, including the management of consequences and planning of the long term recovery during the transition phase. Additionally, they could be identified with the different parts /steps of the process of decision making. For our purposes, we could consider three broad groups, covering the inputs necessary for establishing an initial basis for decision (“knowledge of the situation”), decision-making process, and the outputs and outcomes from such decision, as shown the table 1. Also, the classification from Renn, proposed by WP5 is included only for purposes of comparison.

Table 4. Categorisation of the uncertainties of concern in the decision-making during the transition phase, regarding their source or localisation into the decision-making process. The classification proposed by the WP5 is included with purposes of comparison.

WP4 Approach			WP5 Approach
SOURCES	CHALLENGES	Steps of Structured Decision Making	Renn Classification
Knowledge of the situation	the knowledge of the real consequences of an accident	<ul style="list-style-type: none"> • Define problem • Define issues, objectives and evaluation criteria 	Knowing
Decision-making	the involvement of stakeholders in decision-making	<ul style="list-style-type: none"> • Develop alternatives • Estimate the consequences • Make trade-offs and select 	Judging
	selection and implementation of the recovery strategies		Deciding
Outcomes	identification and evaluation of the socio-economic impact and environmental	<ul style="list-style-type: none"> • Implement and monitor 	Implementing
			Evaluating

INFLUENCE ON THE DECISIONS: Can be:

- **External**, related to the acquisition /availability of information and production of data supporting the decisions - State of knowledge and fit to “reality” of the scenarios.
- **Internal**, related to the formulation, dissemination and understanding of decisions – Description of objectives and endpoints, points of view and preferences of stakeholders

HOW TO PROCEED

The template is generic and has been designed trying to cover all topics/issues addressed in the panels. The idea is that only the cells of the respective topics addressed in each specific panel analysed will be filled.

In the column “**Criteria**”, the criteria identified in the panel as useful to assess the strategies of action to deal the specific (or general) issues addressed in the national panel, should be included. See the example with the analysis of the Slovak panel. The criteria could be assigned to a specific row in the template or leave it as general criteria.

The columns “**Source of uncertainty**” are referred to the first column in table 1 in the point of OBSERVATIONS. The column of “**Influence on the decisions**” is defined in the OBSERVATIONS point. Both classifications **are not required in this stage of the study**.

The distribution of the national reports among the partners will be as follows:

Partners - reviewers	National report to be revised		Additional report
CIEMAT (Spain)	Greece	Belgium	Ireland
IRSN/CEPN (France)	Norway	Slovak Republic	France
VUJE (Slovak Republic)	Portugal	The Netherlands	
RIVM/RIKILT (The Netherlands)	Spain	Greece	
EEAE (Greece)	Ireland	Belgium	
EPA (Ireland)	Norway	France	
DSA (Norway)	Slovak Republic	Portugal	
APA/IST (Portugal)	The Netherlands	Spain	

DEADLINE EXTENDED to 31 August 2019

ANNEXE 2. Consolidated results from national stakeholders' panels

Only the tables regarding the uncertainties are included in this annexe

Partner name: EEAE / CIEMAT		Country: BELGIUM		Consolidated/Accepted: CIEMAT ¹¹	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)	Is there an acceptable level of contamination?	Knowledge of the situation	External	
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste	Waste management difficulties Will it be surface conditioned disposal? How to decide on the disposal site? Who will pay for compensations?	Outcomes Knowledge Judgement	External	
ECONOMIC					
ECON 1	Direct cost and direct economic benefits	Who will pay for compensations?	Outcomes	External	
ECON 2	Indirect costs and indirect economic benefits				
ECON 3	Gearing				
ECON 4	Employment /human capital	Willingness to work in the contaminated areas is not guaranteed	Outcomes	External	
HUMAN HEALTH AND SAFETY					
HEA 1	Radiation doses impact	What is the effect at low doses? Is there enough knowledge to make decisions? Is there an acceptable level of contamination?	Knowledge of the situation Knowledge Decision	External	

¹¹ The results are the combination of the those obtained by EEAE and CIEMAT

Partner name: EEAE / CIEMAT		Country: BELGIUM		Consolidated/Accepted: CIEMAT ¹¹	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference Indicators
HEA 2	Health safety regarding population/workers during the application of the recovery strategies	Willingness to work in the contaminated areas	Judgement		
HEA 3	Doses to those implementing protective/remediation action(s)	What are the effects of low doses? (e.g. 10mSv) Uncertainty resulting from setting limits based on purely radiological criteria	Knowledge Decision		
HEA 4	Long term health monitoring of the affected population				
HEA 5	Psycho-social impacts of the emergency/protective actions	How can we deal with stress?	Decision making	External	
SOCIAL					
SOC 1	Community involvement and satisfaction	Willingness to participate by other emergency responders and persons involved in decontamination practices	Decision making	External	
SOC 2	Ethical and equity considerations	The willingness of people to house people from the affected areas. Finding an equilibrium between economic, social and ethical aspects	Implementation		
SOC 3	Impacts on neighbourhoods or regions				
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	Will people in the affected areas want to take the recommended actions? (i.e. leave the children at school) Willingness to return after a temporary relocation	Evaluation/monitoring Evaluation/monitoring		

Partner name: EEAE / CIEMAT		Country: BELGIUM		Consolidated/Accepted: CIEMAT ¹¹	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference Indicators
GOVERNANCE					
GOV 1	Life-span and “projects risks”				
GOV2	Flexibility	Finding a balance concerning the timing of decisions	Decision making	External	
GOV3	Involvement of stakeholders	Difference between communication and stakeholder involvement How to include stakeholders in the preparedness phase?	Implementation Decision making	External	
GOV4	Fit with planning and policy strategies and initiatives	How will the decision making be organised?	Decision making	Internal	
GOV5	Uncertainty, evidence and verification	Is there enough knowledge to make decisions?	Knowledge of the situation	Internal	
TRANSVERSAL (To identify if it is of interest)					
TRV 1	Communication	• Differences between communication and stakeholder involvement	Knowledge?		
TRV 2	Support for information				
TRV 3	Evolution of the time				

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)	What is the level of reliability of the measurements? What is the level of conservatism? What if the release occurs during a longer time frame? How do you consider the meteorological forecast(wind)?	Knowledge		TRV 3, ECON 1 &2, SOC 5, GOV 1
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste	How do we manage contaminated wastes? Where will this waste be stored?	Outcomes		ECON 1 & 2, SOC 1, 3 &5, GOV 1
ECONOMIC					
ECON 1	Direct cost and direct economic benefits	What will be the socio-economic impacts on the affected territories? How to maintain activity in these territories over the long term?	Outcomes		ENV 1 & 4, ECON 2, ECON 3, HEA 4, HEA 5, GOV 4

¹² This part is optional

¹³ This part is not required

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
ECON 2	Indirect costs and indirect economic benefits	<p>What about the brand damage/loss for the products and for the (affected) territories? How can we evaluate the impacts?</p> <p>What will be the situation for the affected territories?</p> <p>What will be the socio-economic impacts on each of the production sectors (considering the added value of the sector and the actors)?</p> <p>What are the economic losses for each food production sector if they are stigmatized?</p> <p>Which agricultural sectors are most impacted?</p>	Outcomes		ENV 1 & 4, ECON 1, ECON 3, HEA 1, HEA 4, HEA 5, GOV 4
ECON 3	Employment /human capital				ECON 1, ECON 2, HEA 4, HEA 5

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
HUMAN HEALTH AND SAFETY						
HEA 1	Doses averted by implementing protective/remediation action(s)	<p>How do we know if we are evacuating the appropriate areas – i.e too far away or not far enough?</p> <p>Will the control systems be adequate and sufficient?</p> <p>What are the products that have a higher impact (dose) when it comes to ingestion?</p> <p>What is the level of exposure of the population?</p>	Outcomes		HEA 2, HEA 5, SOC 1, SOC 2, SOC 3, SOC 4, GOV 1, GOV 3, GOV 4 GOV 5, ECON 2, TRV 1, TRV 3	
HEA 2	Health safety regarding population/workers during the application of the recovery strategies					
HEA 3	Doses to those implementing protective/remediation action(s)					
HEA 4	Long term health monitoring of the affected population					
HEA 5	Psycho-social impacts of the emergency/protective actions					
SOCIAL						

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
SOC 1	Community involvement and satisfaction	To what extent will the messages be understood? In particular for the individuals living outside the zoning borders?		Decision-making and outcomes		ENV 4, HEA 1, TRV 1
SOC 2	Ethical and equity considerations	How to outreach the general population and the hosting territories in particular, so as not to generate stigmatization of the relocated individuals and affected territories?		Outcomes		SOC 3, HEA 1
SOC 3	Impacts on neighbourhoods or regions	How to outreach the general population and the hosting territories in particular, so as not to generate stigmatization of the relocated individuals and affected territories?		Outcomes		ENV 4, SOC 2, HEA 1, GOV 5, TRV 1
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<p>Will the military be able to contain potential panic?</p> <p>What are the options at our disposal if the first responders/bus drivers etc. use their right to withdrawal?</p> <p>What is the sociological profile of the population?</p>		Decision-making		GOV 1, GOV 2, HEA 1, TRV 1

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
SOC5	Reactions and behaviours of local inhabitants	<p>What will be the reaction of the local population and the participants to the 'festival' (occurrence of self-evacuation)?</p> <p>To what extent does the population understand and respect the evacuation procedures and the doctrine?</p> <p>To what extent do first responders/actors understand the evacuation procedures?</p>	Outcomes		
GOVERNANCE					
GOV1	Life-span and "projects risks"	<p>How do we know if we are evacuating the appropriate areas – i.e too far away or not far enough?</p> <p>Will the control systems be adequate and sufficient?</p>	Decision-making		

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
GOV2	Flexibility	<p>How do we adjust the strategy for relocation (and the protective actions according to the evolution of the radiological conditions?)</p> <p>How do we link the evolution of the restrictions with the calendars of harvest and effective consumption of the products?</p>	Outcomes and decision-making		SOC 4, TRV 3
GOV3	Involvement of stakeholders	<p>How will the food restrictions be controlled and managed at the farm level?</p> <p>To what extent do first responders/actors understand the evacuation procedures?</p>	outcomes		HEA 1, GOV 5

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
GOV4	Fit with planning and policy strategies and initiatives	<p>Should we make a distinction between consumption and commercialization or link by others?</p> <p>Which needs more protection - food intended for distribution or food intended for self-consumption?</p> <p>Which strategy should we adopt? Create an extended restriction zone to be reduced progressively according to on-the-field measurements (“from big to small” approach) or instead, a small restriction zone that could be expanded if necessary (“step by step” approach)?</p> <p>Taking into account the “Safety Contingency Plan” at a communal level, is it possible that mayors decide evacuation by themselves?</p>	Decision-making		ECON 1, ECON 2, HEA 1, TRV 3
GOV5	Uncertainty, evidence and verification	<p>How much can the data be trusted?</p> <p>What is the level of reliability of probability maps and measurements?</p> <p>What is the level of conservatism?</p> <p>How do you consider the meteorological forecast?</p>	Decision-making		HEA 1, TRV 1, TRV 2, TRV 3, SOC 3

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
		<p>Is it possible to merge the field measurements with the estimation from the model?</p> <p>How long before the field measurements are available?</p> <p>What is the comparison of these zones with the situation in the field?</p> <p>Will this strategy for evacuation, decided at local level, be validated by higher authorities?</p> <p>Will higher institutional actors/decision-makers change this strategy and implement a new one?</p> <p>Will this zoning for food restrictions be agreed and validated by higher authorities?</p>			

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
GOV6	Implementation of the decision itself	<p>Are there means to implement the decision?</p> <ul style="list-style-type: none"> • How long will it take to mobilize enough buses? • What about the retro-planning (are we able to start evacuation at 19:00 and having communicated about the strategy for evacuation before)? <p>Will the agenda and timing be followed taking the uncertainties into account?</p>	Decision-making		SOC4, GOV 1&2, TRV 1
GOV7	Criteria based on the decision-making itself	Should we consider other criteria (geographical, socio-economic) in addition to the radiological ones? How to put into balance these different criteria	Decision-making		TRV4
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication	<p>Will prior communication (by social media, traditional media, etc.) be able to broadcast the “right” messages and prevent panic?</p> <p>Besides traditional media (TV, radio), what can be done to limit the spread of</p>	Outcomes and decision-making		SOC 1, SOC 3, SOC 4, HEA 1, HEA 5, GOV 5 TRV 2, TRV 3

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
		<p>rumours and broadcast reliable information on social media?</p> <p>When should we communicate about relocation? When the results of the model are available or after a few days when the zoning is well established based on field measurements?</p> <p>What are the best messages given the circumstances?</p> <p>Which zones should be alerted/which should not?</p> <p>Will the strategy (which is phased in time with the releases i.e. people are not immediately evacuated) be understood and accepted?</p> <p>Will the iodine thyroid blocking intake instructions be followed?</p> <p>To what extent does the population understand the evacuation procedures and the doctrine?</p> <p>How will the messages be understood?</p>			

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
		<p>What information is clear and concrete enough to reassure on the effectiveness of protective actions and provide support to the individuals according to their situation?</p> <p>If a distinction is made between restriction for consumption and restrictions for commercialization, how to adjust the messages to the individuals: the general population, the clients, the sellers and distributors etc.?</p>			
TRV2	Support for information	<p>What is the reliability of the boundaries proposed for the relocation zone?</p> <p>What will be the radiological measurements performed at the boundaries of the zoning for relocation?</p> <p>How to ensure that the boundaries of the zoning for relocation actually protect the individuals living nearby?</p>	Decision-making		GOV 5, TRV 1
TRV3	Evolution of the time	What if the release occurs during a longer time frame than predicted?	Knowledge, outcomes and decision-making		GOV 2, GOV 4, GOV 5, HEA 1, TRV 1

Partner name: EPA / IRSN & CEPN		Country: FRANCE		Consolidated/Accepted: IRSN & CEPN	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
		<p>What will be the evolution of the radiological situation in the next hours?</p> <p>Is it possible to anticipate the zonings that may be affected by relocation, based on the distance to the NPP?</p> <p>What will be the evolution of the zoning for relocation in the next months?</p> <p>What is the level of reliability of this evolution?</p> <p>How do we adjust the strategy for relocation (and the protective actions according to the evolution of the radiological conditions?</p> <p>How do we link the evolution of the restrictions with the calendars of harvest and effective consumption of the products?</p>			

Partner name: EPA / IRSN & CEPN		Country: FRANCE	Consolidated/Accepted: IRSN & CEPN		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹²	INFLUENCE ON THE DECISIONS ¹³	Cross-reference to Other Indicators
TRV 4	Information to produce	<p>What are the agricultural characteristics (flowering date, harvest date, etc.) of the affected sectors?</p> <p>What is the level of self-sufficiency of the population (consumption of the food produced in the garden, harvest in the forest, hunting, etc.)?</p>	Decision-making		

Partner name: WFSR & RIVM / CIEMAT		Country: GREECE		Consolidated/Accepted: EEAE	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁴	INFLUENCE ON THE DECISIONS ¹⁵	Cross-reference to Other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)	<ul style="list-style-type: none"> Mapping of the radiological contamination is time-consuming and uncertain for a long time 	Knowledge of the situation		ENV2
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste	<ul style="list-style-type: none"> What are the appropriate means and methods to use for the characterization of contamination in large areas? 	Decision-making		
ECONOMIC					
ECON 1	Direct cost and direct economic benefits	<ul style="list-style-type: none"> Actual costs of protective measures cannot be estimated in advance. What are the costs? Is the compensation policy clear enough? Are enough resources available? 	Knowledge of the situation		
ECON 2	Indirect costs and indirect economic benefits	<ul style="list-style-type: none"> What is the impact on the economic activities in the affected region? 	Knowledge of the situation Judging		

¹⁴ This part is optional

¹⁵ This part is not required

Partner name: WFSR & RIVM / CIEMAT		Country: GREECE		Consolidated/Accepted: EEAE	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁴	INFLUENCE ON THE DECISIONS ¹⁵	Cross-reference to Other Indicators
ECON 3	Employment /human capital	<ul style="list-style-type: none"> Are there enough resources (are dose measurements available for the whole country in due time)? 	Knowledge of the situation		
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)	<ul style="list-style-type: none"> When the food restrictions are imposed? Under which circumstances? 	Decision-making		
HEA 2	Health safety regarding population/workers during the application of the recovery strategies	<ul style="list-style-type: none"> To what extent the protective actions will be implemented by the producers and the population? How the control of protective actions implementation will be organized? 	Decision-making		
HEA 3	Doses to those implementing protective/remediation action(s)	<ul style="list-style-type: none"> How we will deal with the fear of non-radiation personnel to perform sampling in contaminated areas? 	Judging		
HEA 4	Long term health monitoring of the affected population	<ul style="list-style-type: none"> Are we ready to deliver dose rate measurements in due time for the whole county? 	Knowledge of the situation		
HEA 5	Psycho-social impacts of the emergency/protective actions	<ul style="list-style-type: none"> What is the impact on the affected population? 	Decision-making		

Partner name: WFSR & RIVM / CIEMAT		Country: GREECE		Consolidated/Accepted: EEAE	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁴	INFLUENCE ON THE DECISIONS ¹⁵	Cross-reference to Other Indicators
SOCIAL					
SOC 1	Community involvement and satisfaction	<ul style="list-style-type: none"> Level of compliance is uncertain when taking protective actions (depends on acceptance and compensations). Acceptance is unknown 	Decision-making		
SOC 2	Ethical and equity considerations				
SOC 3	Impacts on neighbourhoods or regions				
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<ul style="list-style-type: none"> Will people accept the recovery actions? Will people/companies implement recovery actions? The link between OILs (e.g. OIL3) and the reference level is difficult to communicate and understand Psychological impact is unknown 	Decision-making Implementing		
GOVERNANCE					
GOV1	Life-span and “projects risks”				
GOV2	Flexibility				
GOV3	Involvement of stakeholders	<ul style="list-style-type: none"> How can we cooperate with other countries? 	Decision-making		
GOV4	Fit with planning and policy strategies and initiatives				

Partner name: WFSR & RIVM / CIEMAT		Country: GREECE		Consolidated/Accepted: EEAE		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹⁴	INFLUENCE ON THE DECISIONS ¹⁵	Cross-reference to Other Indicators
GOV5	Uncertainty, evidence and verification	<ul style="list-style-type: none"> The compensation policy is currently unclear. How to organise the control of implemented protective actions? 		Knowledge of the situation		
TRANSVERSAL (To identify if it is of interest)						
TRV1	Communication	<ul style="list-style-type: none"> It may be difficult to communicate about dose reference levels The terminology used to describe radiological and nuclear emergencies is often different from the one used in national civil protection, would this create communication problems? 		Decision-making Knowledge of the situation		
TRV2	Support for information					
TRV3	Evolution of the time					

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁶	INFLUENCE ON THE DECISIONS ¹⁷	Cross-reference to Other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)	<ul style="list-style-type: none"> How to assess the risk? e.g. water supply, food contamination. As agricultural processes are inextricably linked to seasons and weather conditions, the consequences and preventative measures employed as a result of an accident would vary. 	Knowledge of the situation	External	
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste				
ECONOMIC					
ECON 1	Direct cost and direct economic benefits				
ECON 2	Indirect costs and indirect economic benefits	<ul style="list-style-type: none"> What would be the impacts on the whole economy in Ireland? What would be the costs due to the quality assurance and information campaigns for the Irish products to export? 	Outcomes	External	

¹⁶ This part is optional

¹⁷ This part is not required

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁶	INFLUENCE ON THE DECISIONS ¹⁷	Cross-reference to Other Indicators
ECON 3	Employment /human capital	Following a nuclear emergency abroad affecting Ireland, there would be a great demand for sample analysis. It would be very challenging to sustain such an increase in long term throughput.	Decision-making	Internal	
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)				
HEA 2	Health safety regarding population/workers during the application of the recovery strategies	<ul style="list-style-type: none"> How to assess the risk of human health through the food chain? This includes questions about national laboratory capacity for sample analysis. 	Knowledge	External	
HEA 3	Doses to those implementing protective/remediation action(s)				
HEA 4	Long term health monitoring of the affected population	<ul style="list-style-type: none"> How to manage and provide measurements of radioactivity concentrations in due time? 	Outcomes (evaluating)	Internal	
HEA 5	Psycho-social impacts of the emergency/protective actions				

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹⁶	INFLUENCE ON THE DECISIONS ¹⁷	Cross-reference to Other Indicators
SOCIAL						
SOC 1	Community involvement and satisfaction	<ul style="list-style-type: none"> The farmers, producers and retailers will be effective channels to communicate and give trust to the consumers and the public? There is a communication plan for different groups of the stakeholders and the general population? This needs to be further investigated. What experts' voices should be involved in the communication and information? Consideration should be given to providing major retailers with a direct line of communication to the relevant experts. 	Decision-making	Internal	GOV3	
			Knowledge of the situation	External	TRV1	
SOC 2	Ethical and equity considerations					
SOC 3	Impacts on neighbourhoods or regions	<ul style="list-style-type: none"> How would coordination with the other regions in the UK and Northern Ireland? – These communication channels are already open but could be further exercised. 	Decision-making	Internal	GOV4	

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁶	INFLUENCE ON THE DECISIONS ¹⁷	Cross-reference to Other Indicators
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<ul style="list-style-type: none"> Stakeholders and the public will be confident that the correct decisions have been made? How reassuring to the public that the food currently in their homes and in the Irish shops is safe to eat? How give trust to the consumers that the foods supply is assured? How inform the public and consumers on the radioactivity concentrations in food avoiding the possible panic? Decisions being made that involve uncertainty should assume a 'worst-case scenario' approach' until the situation evolves and this can be scaled down. 	<p>Outcomes</p> <p>Decision making</p>	Internal	SOC1
GOVERNANCE					
GOV1	Life-span and "projects risks"	<ul style="list-style-type: none"> How to sustain the monitoring plans along the time? What other actors should be included to give support to governmental bodies? 	Outcomes (implementing)	Internal	
GOV2	Flexibility	<ul style="list-style-type: none"> How to adapt the decisions and communication according to the progress of the situation? 	Outcomes (implementing and evaluating)	Internal	ENV1

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁶	INFLUENCE ON THE DECISIONS ¹⁷	Cross-reference to Other Indicators
GOV3	Involvement of stakeholders	<ul style="list-style-type: none"> How to involve the stakeholders related to the food production and distribution chain to apply and manage the protective actions? 	Decision-making	Internal	SOC1
GOV4	Fit with planning and policy strategies and initiatives				
GOV5	Uncertainty, evidence and verification	<ul style="list-style-type: none"> What information would make the assessment of the situation clearer? What information would be required to reduce uncertainties on the decisions? 	Knowledge	External	
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication	<ul style="list-style-type: none"> What are the key messages for the public? What are the key messages for those involved in the food industry and agriculture? Who must communicate? <p>These issues may be addressed by a broad communication strategy.</p>	Knowledge	Internal	
TRV2	Support for information	<ul style="list-style-type: none"> Images are a valuable tool in communicating information. How to avoid misinterpretations? Could advance preparation of food labelling assist with this? 	Decision-making	Internal	

Partner name: CIEMAT / EEAE		Country: IRELAND		Consolidated/Accepted: EPA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY¹⁶	INFLUENCE ON THE DECISIONS¹⁷	Cross-reference to Other Indicators
TRV3	Evolution of the time				

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS		Consolidated/Accepted: WFSR & RIVM	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)	<p>There is uncertainty in the assessment of the radiological situation from models and incomplete temporal and spatial mapping of measurements.</p> <p>The effect of the recovery strategy on the radiological situation in the long term.</p>	<p>Knowledge of the real consequence of the accident. Uncertainty in the conceptual models and mapping techniques.</p>	<p>External.</p> <p>Possibly large in early phases.</p> <p>Smaller at the time the recovery program is constructed</p>	ENV2
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste	<p>Required technical resources for implementing the recovery strategy is not well known.</p> <p>How much waste is produced in the various countermeasures and what to do with the waste?</p>	<p>Knowledge of the real consequence of the accident</p>	<p>External.</p>	ECON1
ECONOMIC					
ECON 1	Direct cost and direct economic benefits	<p>Many factors complicate the calculation of cost: (e.g.) cost recovery strategy, infrastructure</p>	<p>Knowledge of the real consequence of the accident</p>	<p>External</p>	ECON2, ECON3

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS		Consolidated/Accepted: WFSR & RIVM	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
ECON 2	Indirect costs and indirect economic benefits	Uncertain estimates for consequential damage. How to calculate this as there are many indirect costs and benefits: (e.g.) health costs, export loss, waste storage	Knowledge of the real consequence of the accident	External	ECON1, ECON3
ECON 3	Employment /human capital	Continuity of the functioning of society (e.g. loss of jobs). Uncertainty in future employment		External	ECON1, ECON2
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation actions	The actual received and averted dose depends is uncertain. Risk at low dose is not well known. Low doses are expected in relatively large areas, affecting a large fraction of the population in the affected areas	Knowledge of the real consequence of the accident	External	ENV1
HEA2	Health safety regarding population/workers during the application of the recovery strategy				
HEA3	Doses to those implementing protective/remediation action(s)				
HEA4	Long term health monitoring of the affected population				HEA5

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS		Consolidated/Accepted: WFSR & RIVM	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
HEA 5	Psycho-social impacts of the emergency/protective actions	Although many psychosocial effects are generally known, the effect on decision making is not well defined. How to calculate this or get information (use DALYs)?	Decision-making	Internal	HEA4
SOCIAL					
SOC 1	Community involvement and satisfaction	<ul style="list-style-type: none"> -Ability to cope with the situation -The population may become critical towards the government -acceptance of large waste storage in the region -communication/transparency is vital -various organisations are involved. It will be difficult to reach consensus. -how will people respond to countermeasures? Will they follow the action guidelines? -who is going to pay for the costs? 	Decision-making	Internal	All other SOC's
SOC 2	Ethical and equity considerations	<ul style="list-style-type: none"> -Any protection and recovery strategy will be experienced unequal. How to prevent unbalanced pros and cons between population groups -Transparency is important, can it be reached? 	Decision-making	Internal	All other SOC's

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS		Consolidated/Accepted: WFSR & RIVM	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
SOC 3	Impacts on neighbourhoods or regions	-Do neighbouring countries/regions trust the CM strategy enough to allow e.g. export? -Does the population accept consuming contaminated food under MPL limits? -Different municipalities may come up with different choices of CM strategies for their own population	Outcomes	Internal	All other SOCs
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	-acceptance of the strategy -the trust of consumers and population -what will be the role of fear and social unrest? Can it be avoided? -it is important that the exact consequences of the clean-up and details of who is cleaning the interior houses are known.	Outcomes	Internal	
GOVERNANCE					
GOV1	Life span and "project risks"	-Uncertainty is the risk and reaction of people on the CM strategy proposed.	Decision-making	Internal	GOV2
GOV2	Flexibility	-Not all information may be available at first. Strategies may, therefore, need to be adjusted.	Decision-making process	Internal	GOV1

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS		Consolidated/Accepted: WFSR & RIVM	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
GOV3	Involvement of stakeholders	-stakeholders should be involved, also before which may not be easy to interest stakeholders before an accident. Also, the communication with agricultural sectors and retail sector is important during preparations	Decision-making	Internal	
GOV4	Fit with planning and policy strategies and initiatives	-administrative dilemmas (review of legal framework/international guidelines, (inter)national image, administrative complexity, preventing unrest, communication strategy all add to an uncertain risk governance process -all parties should have a common view and agree on the action program -who is actually implementing the countermeasures? - it is not very clear what part needs to arrange national and what part locally?	Decision-making	Internal	
GOV5	Uncertainty, evidence and verification	-Do consumers/population accept the CM strategy -Effect of the CM strategy on the long term is unclear	Outcomes	Internal	
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication	--communication during preparation could influence the perception of people -initial communication message is crucial; can it be delivered?	Decision-making	Internal	

Partner name: VUJE / APA & IST		Country: THE NETHERLANDS	Consolidated/Accepted: WFSR & RIVM		
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
TRV2	Support for information	-unclear what the people and producers expect from the government.	Decision-making	Internal	
TRV3	Evolution of the time				

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA		
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
ENVIRONMENTAL						
ENV 1	Impact on environmental compartments (air, water, soil)	<ul style="list-style-type: none"> Distribution of the contamination in the environment will be inhomogeneous as well as the estimation of the level of contamination in agricultural products. Effectiveness of countermeasures Effects of climate change on availability of feed etc. 		Knowledge		TRV 3
ENV 2	Impacts on ecology	<ul style="list-style-type: none"> Countermeasures like removal of topsoil, use of additional fertilisers may create additional problems for the environment. Use of Cs-binders as salt licks may spread diseases 		Knowledge and outcomes		
ENV 3	Intrusiveness	<ul style="list-style-type: none"> Removal of topsoil is an invasive action (soil is an important resource). Will farmers accept a high level of intrusiveness? 		Knowledge		ECON 1 ENV 4
ENV 4	Resource use and waste	<ul style="list-style-type: none"> Who will dispose of contaminated milk yield? Farmers acceptance of disposing of soil Removal of topsoil might produce a lot of waste. Waste facilities acceptance of contaminated soil? 		Outcomes		ENV 1 ENV 3 ECON 2

¹⁸ This part is optional

¹⁹ This part is not required

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
ECONOMIC					
ECON 1	Direct cost and direct economic benefits	<ul style="list-style-type: none"> Cost of disposing of soil and how much landowners will be prepared to dispose of. 	Outcomes		ENV 3 ENV 4
ECON 2	Indirect costs and indirect economic benefits	<ul style="list-style-type: none"> Will consumers trust in the safety of the products reaching the market? 			HEA 5
ECON 3	Employment /human capital	<ul style="list-style-type: none"> Will farmers lose their livelihood? Agriculture is an important source of workplaces in many areas in Norway and if agricultural activities would be stopped, it might be hard to find alternative jobs, especially in rural areas. 	Outcomes		SOC 2, HEA 5 HEA 5
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)	<ul style="list-style-type: none"> Application of countermeasures in agriculture should ensure that the end-product reaching consumers is safe and thus, resulting in the dose reduction to the population. Inconsistency of contamination distribution Estimation of site-specific levels of contamination of various agricultural products Will farmers respond to directions to use caesium binders in the feed? 	Outcomes		SOC 1
HEA 2	Health safety regarding population/workers during the application of the recovery strategies				

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
HEA 3	Doses to those implementing protective/remediation action(s)				
HEA 4	Long term health monitoring of the affected population				
HEA 5	Psycho-social impacts of the emergency/protective actions	<ul style="list-style-type: none"> Consider wider societal and psychological factors when devising countermeasure strategies (loss of jobs, additional work, etc.) Will there be stigmatisation? What will be the impact of a loss of livelihoods? Will consumers trust in the safety of the products reaching the market? 	Outcomes		ECON 3 ECON 2
SOCIAL					
SOC 1	Community involvement and satisfaction	<ul style="list-style-type: none"> Remediation strategies will have to be developed and implemented in extensive cooperation between scientists, authorities, producers and other stakeholders in order to be accepted. Is there enough trust built between the public and authorities for the public to accept countermeasures? 	Decision-making		GOV 6 HEA 1 SOC 4
SOC 2	Ethical and equity considerations	<ul style="list-style-type: none"> Farming has an important traditional and cultural value Will the distinctions between unaffected, orange and red zones cause conflict? 	Outcomes		ECON 3 HEA 5

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
SOC 3	Impacts on neighbourhoods or regions	<ul style="list-style-type: none"> What will be the impact of a loss of livelihoods and knock-on effects on communities? Stigmatisation Mental Health issues 	Outcomes		HEA 5
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<ul style="list-style-type: none"> How will consumers react to the choice of management strategies? Will they accept them? See them as effective and trust that products reaching the market are safe? Will farmers accept to implement the selected countermeasures? Do the public trust the government enough to accept their decisions and implement their recommendations? Will different regions react differently? 	Decision-making		TRV 2 HEA 1, SOC 2, SOC 3
GOVERNANCE					
GOV1	Life-span and “projects risks”	<ul style="list-style-type: none"> Will the countermeasures be effective? Will the countermeasures vary depending on the local conditions? Legal challenges – how many and what will they be? 	Outcomes		TRV 2

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
GOV2	Flexibility	<ul style="list-style-type: none"> Will the countermeasure strategies be adaptable and applicable in the local conditions (ploughing impossible in the mountain areas, potassium fertilization will not apply in certain soil)? With the ongoing climate changes which result in an increased number of extreme weather events, will alternative (clean)feed be available? 	Knowledge and outcomes		TRV 2, GOV2
GOV3	Involvement of stakeholders	<ul style="list-style-type: none"> Will stakeholders be willing to engage? Consumer response to products from affected areas 			
GOV4	Fit with planning and policy strategies and initiatives /	<ul style="list-style-type: none"> Will countermeasures be in line with legal issues (pasture right regulations, animal welfare, etc.)? Will farmers be included in and engage with the planning of countermeasures? 	Knowledge and outcomes		GOV 5
GOV5	Uncertainty, evidence and verification				GOV 4
GOV6	Implementation of the decision itself	<ul style="list-style-type: none"> Will the resources be available (fertilizers, Cs-binders, monitoring tools, etc.)? With the ongoing climate changes which result in an increased number of extreme weather events, will alternative (clean)feed be available? 	Decision-making		GOV 2, SOC 1
TRANSVERSAL (To identify if it is of interest)					

Partner name: IRSN & CEPN / EPA		Country: NORWAY		Consolidated/Accepted: DSA	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹⁸	INFLUENCE ON THE DECISIONS (Internal/external) ¹⁹	Cross-reference to Other Indicators
TRV1	Communication	<ul style="list-style-type: none"> Will countermeasures be easy to communicate and contribute to building trust (in an open and transparent way)? 	Decision-making		
TRV2	Support for information	<ul style="list-style-type: none"> Monitoring/measurement programs are extremely important for mapping contamination, identifying sensitive or less sensitive areas, documenting the effect of countermeasures and building trust to the strategy and products. How information can help to adapt countermeasures strategies to local needs? Has enough trust in the authorities been built within the community to accept their direction? 	Decision-making		SOC 4, GOV 1, GOV2
TRV3	Evolution of the time	<ul style="list-style-type: none"> What other issues will become apparent in the future regarding current countermeasures e.g. availability of feed may not be guaranteed as part of an ongoing feed-related countermeasure - e.g. rainy summer of 2018, followed by extremely dry summer of 2018 resulted in a feed shortage all over the country. 			ENV 1

Partner name: VUJE		Country: PORTUGAL		Consolidated/Accepted: APA & IST	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ²⁰	INFLUENCE ON THE DECISIONS ²¹	Cross-reference to Other Indicators
ENVIRONMENTAL					
ENV 1	Impact on environmental compartments (air, water, soil)				
ENV 2	Impacts on ecology				
ENV 3	Intrusiveness				
ENV 4	Resource use and waste	<ul style="list-style-type: none"> How much waste will be produced and how safe is to transport it? Are there places to store the great amounts of generated wastes? 			
ECONOMIC					
ECON 1	Direct cost and direct economic benefits				
ECON 2	Indirect costs and indirect economic benefits	<ul style="list-style-type: none"> How will the economy be affected, if the regional products are not accepted/not trusted by the population 			
ECON 3	Employment /human capital				
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)				
HEA 2	Health safety regarding population/workers during the application of the recovery strategies				

²⁰ This part is optional

²¹ This part is not required

Partner name: VUJE		Country: PORTUGAL		Consolidated/Accepted: APA & IST	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ²⁰	INFLUENCE ON THE DECISIONS ²¹	Cross-reference to Other Indicators
HEA 3	Doses to those implementing protective/remediation action(s)				
HEA 4	Long term health monitoring of the affected population				
HEA 5	Psycho-social impacts of the emergency/protective actions				
SOCIAL					
SOC 1	Community involvement and satisfaction				
SOC 2	Ethical and equity considerations	<ul style="list-style-type: none"> Special attention should be given to schools and hospitals when choosing for a specific strategy 			
SOC 3	Impacts on neighbourhoods or regions	<ul style="list-style-type: none"> Uncertainty regarding the stigmatization of the affected area was a factor of concern 			
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<ul style="list-style-type: none"> More information is needed to make decisions (compared to the information that was made available to the panel participants) How to re-establish consumer trust?; 			
GOVERNANCE					
GOV1	Life-span and “projects risks”	<ul style="list-style-type: none"> How will the strategy impact the community 			

Partner name: VUJE		Country: PORTUGAL		Consolidated/Accepted: APA & IST	
CATEGORISATION OF UNCERTAINTIES AS RELATED THEIR IMPACT ON THE ELEMENTS FOR A DECISION BASED ON THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ²⁰	INFLUENCE ON THE DECISIONS ²¹	Cross-reference to Other Indicators
GOV2	Flexibility	<ul style="list-style-type: none"> Difficulties in defining an effective strategy that can be understood and accepted once the results are not immediate 			
GOV3	Involvement of stakeholders	Uniformed or badly informed people may refuse to consume the products from the affected region. How will this affect the local and regional economy?			
GOV4	Fit with planning and policy strategies and initiatives	<ul style="list-style-type: none"> Public acceptance of the strategy and its credibility 			
GOV5	Uncertainty, evidence and verification	<ul style="list-style-type: none"> Uncertainties related to the effectiveness of the strategy to implement, logistic constraints and costs need to be taken into account 			
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication	<ul style="list-style-type: none"> How to communicate? 	The population should be involved and understand the message	Communication strategies should be developed	
TRV2	Support for information				
TRV3	Evolution of the time	<ul style="list-style-type: none"> Phased planning for implementation of measures 			

Partner name: DSA / IRSN&CEPN		Country: SLOVAKIA		Consolidated/Accepted: VUJE		
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
ENVIRONMENTAL						
ENV 1	Impact on environmental compartments (air, water, soil)	<ul style="list-style-type: none"> • Are reference levels well established? • Is the change in meteorological situation appropriately taken into account? 		Reference levels Knowledge		TRV 3
ENV 2	Impacts on ecology					
ENV 3	Intrusiveness					
ENV 4	Resource use and waste	<ul style="list-style-type: none"> • Amounts of waste • Places for waste storage 		Reference levels Criteria for implementation of countermeasures		ECON
ECONOMIC						
ECON 1	Direct cost and direct economic benefits	<ul style="list-style-type: none"> • Will the army cooperate with their resources? Who will pay? • Financial security for all measures and action, e.g., who will pay for the human resources and technical equipment required? Will insurance of population valid? What about the insurance of NPP? 		Outcomes		ECON 2 GOV 4

Partner name: DSA / IRSN&CEPN		Country: SLOVAKIA		Consolidated/Accepted: VUJE	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
ECON 2	Indirect costs and indirect economic benefits	<ul style="list-style-type: none"> • Indirect costs of all measures and actions. <i>Will the army cooperate with their resources? Who will pay?</i> • The financial security of implementation of all measures and actions is the key issue. <i>Who will pay? Will insurance of population valid? What about the insurance of NPP?</i> • Monitoring network 	Outcomes		ECON 1 GOV 4
ECON 3	Gearing	<ul style="list-style-type: none"> • Availability of technical resources, e.g., monitoring network 			ECON 1
ECON 4	Employment /human capital	<ul style="list-style-type: none"> • Availability of human resources • <i>Are personal resources of trained and prepared professional at Public Health Authority SR sufficient?</i> • <i>Are the available personal resources adequate?</i> 			GOV 4

Partner name: DSA / IRSN&CEPN		Country: SLOVAKIA		Consolidated/Accepted: VUJE		
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
HUMAN HEALTH AND SAFETY						
HEA 1	Doses averted by implementing protective/remediation action(s)	<ul style="list-style-type: none"> • Are KI tablets taken by all members of the population within the emergency planning zone during the pre-distribution campaign? • Is immediate/quick evacuation feasible? • Food security measures. Food ban countermeasure dealing with food, milk, drinking water and food chain and water supply are implemented when clean substitute food, milk, drinking water or other alternatives are available • Health consequences (cancer cases and cases averted) 		Decision making and outcomes		SOC 4
HEA 2	Health safety regarding population/workers during the application of the recovery strategies	<ul style="list-style-type: none"> • Are food security measures ensured adequately? • Will volunteers do engage themselves in the decontamination work and will be informed about the risks? Will they have particular skills? 		Decision-making and outcomes		GOV 8 SOC 4
HEA 3	Doses to those implementing protective/remediation action(s)	<ul style="list-style-type: none"> • Workers participating in the decontamination should give informed consent taking into account risks which can occur during the decontamination. 		Decision-making and outcomes		
HEA 4	Long term health monitoring of the affected population					

Partner name: DSA / IRSN&CEPN		Country: SLOVAKIA		Consolidated/Accepted: VUJE	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
HEA 5	Psycho-social impacts of the emergency/protective actions				
SOCIAL					
SOC 1	Community involvement and satisfaction	<ul style="list-style-type: none"> • Are national emergency plans available and up-to-date, and personnel trained? • Public acceptance and cooperation • population acceptance and willingness to cooperate in the realization of options of particular restoration strategies (self-help) • the indifference of people in peacetime and during the emergency preparedness process 	Decision-making Knowledge		GOV 8
SOC 2	Ethical and equity considerations	<ul style="list-style-type: none"> • attitude to the property and home 			
SOC 3	Impacts on neighbourhoods or regions	<ul style="list-style-type: none"> • relation to receiving society during the relocation (stigmatization) 			

Partner name: DSA / IRSN&CEPN		Country: SLOVAKIA		Consolidated/Accepted: VUJE	
CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY					
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	<ul style="list-style-type: none"> • Are KI tablets taken by all members of the population within the emergency planning zone during the pre-distribution campaign? • Are there enough resources to secure evacuated/relocated areas? • During evacuation/ relocation: How to ensure operation of factories/ objects which could not be closed? • It should be considered that volunteers/responders can refuse to perform decontamination work • Animal welfare (husbandry and pets) 	Decision-making Outcomes Knowledge		HEA 1 GOV 8
GOVERNANCE					
GOV1	Life-span and “projects risks”	<ul style="list-style-type: none"> • Is immediate evacuation ensured and feasible? 	Decision-making		GOV 2 et GOV 4
GOV2	Flexibility	<ul style="list-style-type: none"> • Are competences of regions/districts flexible in using of the evacuation routes? • Is there preparedness on flexible change of evacuation plans at the place? 	Knowledge and decision-making		GOV 1 TRV 3
GOV3	Involvement of stakeholders	<ul style="list-style-type: none"> • Population acceptance and willingness to cooperate in the realization of options of particular restoration strategies (self-help) 			

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HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY	INFLUENCE ON THE DECISIONS	Cross-reference to Other Indicators
GOV4	Fit with planning and policy strategies and initiatives	<ul style="list-style-type: none"> Is there a gap between legislation and reality? Are personal resources of trained and prepared professional at Public Health Authority SR sufficient? Is National emergency plan available and up-to-date? Are there backup office places of the Crisis Staff at the regional or District level available? 		Knowledge, outcomes and decision-making		ECON 1 ECON 2 ECON 3 GOV 1 TRV 3
GOV5	Uncertainty, evidence and verification					
GOV6	Reliability of tools	<ul style="list-style-type: none"> Is competence in the use of complex decision support system for preparation of later phases of accident countermeasure advice adequate? Is radiation monitoring network sustainable? 		Decision-making, outcomes		
GOV7	Criteria based on the decision-making itself	<ul style="list-style-type: none"> Are reference levels well established? Is the period of time identifying the transition phase after an accident unequivocal? Are the criteria for implementation and withdrawal of countermeasures in transition phase unequivocal? 		Decision-making		

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GOV8	Implementation of the decision itself	<ul style="list-style-type: none"> Will the army cooperate with their resources? Are the available resources (personnel and technical) adequate? Will they be enough trained and prepared professionals at all levels? The areas where evacuation or temporary relocation will take place should be secured by police; the area should be defined and closed to avoid plundering. Will there be enough of personal and technical resources? In the case of animals die, the place for their burial should be established. The question of valuable animals and what to do with them is open. Uncertainty is also in the responsibility, who will do it. How to manage during the evacuation the maintenance and operation of factories/objects which could not be closed. 	Outcomes and decision-making		HEA 1 HEA 2 SOC 4 TRV 3
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication issues	<ul style="list-style-type: none"> Is the information on iodine prophylaxis and its effectiveness sufficient? Information of the population is a key issue. The population should be informed about advised countermeasures, about possibilities and procedures of decontamination. 	Decision-making		

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TRV2	Support for information	<ul style="list-style-type: none"> It is necessary to know the level of contamination, the effectivity of countermeasure implementation and in answering the questions if citizens could come back home. 	Decision-making		
TRV3	Evolution of the time	<ul style="list-style-type: none"> Is the change in meteorological situation appropriately taken into account? 	Decision-making		GOV 2 GOV 4 GOV 8 ENV 1

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CATEGORISATION OF UNCERTAINTIES REGARDING THEIR IMPACT ON THE ELEMENTS FOR A DECISION-BASED IN THE PRINCIPLES OF SUSTAINABILITY						
HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED		SOURCE OF UNCERTAINTY ¹	INFLUENCE ON THE DECISIONS ²	Cross-reference to Other Indicators
ENVIRONMENTAL						
ENV 1	Impact on environmental compartments (air, water, soil)	How to identify and zoning the affected areas? How does the contamination change along the time and what factors could be implicated in?				
ENV 2	Impacts on ecology	How it could affect the contamination of aquifers, groundwater?				
ENV 3	Intrusiveness					
ENV 4	Resource use and waste	Are resources for characterizing the situation sufficient? Who will be in charge and how will be taken the measurements?				
ECONOMIC						
ECON 1	Direct cost and direct economic benefits	How will it be financed? Will there be enough resources - material or technology, people and funding - to face the recovery actions, the collection and analysis of environmental samples and the monitoring of the affected people? Financial resources to implement sufficient measures? Is there a capacity to decontaminate the affected populations? And to manage the waste generated?				

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HEADLINE CATEGORIES and INDICATORS		UNCERTAINTIES ASSOCIATED	SOURCE OF UNCERTAINTY ¹	INFLUENCE ON THE DECISIONS ²	Cross-reference to Other Indicators
ECON 2	Indirect costs and indirect economic benefits				
ECON 3	Employment /human capital	How many laboratories are available to give results in time? Should they know each other a priori?			
HUMAN HEALTH AND SAFETY					
HEA 1	Doses averted by implementing protective/remediation action(s)	Are the results of the health surveillance program and model calculations adapted to reality?			
HEA 2	Health safety regarding population/workers during the application of the recovery strategies	How it could be designed and implemented a successful health surveillance plan that avoids negative reactions among the population?			
HEA 3	Doses to those implementing protective/remediation action(s)				
HEA 4	Long term health monitoring of the affected population				
HEA 5	Psycho-social impacts of the emergency/protective actions	What are the psychological, social and economic effects suffered by the population affected by the emergency?			
SOCIAL					
SOC 1	Community involvement and satisfaction	Who, how, when and why to involve stakeholders?			

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SOC 2	Ethical and equity considerations	Where and how is the population going to be relocated? How would they be integrated into their new residence locations?			
SOC 3	Impacts on neighbourhoods or regions	What will be the impact and reaction of the population to the measures taken?			
SOC 4	Social uncertainty (stakeholder concerns and confidence, access to information)	How to ensure the follow-up of measures? Do people understand the measures? Are they going to be accepted? Will public trust?			
GOVERNANCE					
GOV1	Life-span and “projects risks”				
GOV2	Flexibility				
GOV3	Involvement of stakeholders	Who, how, when, why?			
GOV4	Fit with planning and policy strategies and initiatives	Who is in charge? How do address the preparedness and coordination of the actions during the transition phase and for long-term recovery? How to report information to international organizations? Who prepares and coordinates the Recovery Plan and the Transition Plan? Who will be responsible for the management?			

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GOV5	Uncertainty, evidence and verification				
TRANSVERSAL (To identify if it is of interest)					
TRV1	Communication	What (messages), Whom, How (mass media, social networks) and When to communicate? How will the population react or respond to the messages?			
TRV2	Definition of the transition phase	What is the transition phase? Definition, timing, and coherence among international organism regarding the transition phase			
TRV3	Legal aspects	Lack of a legal framework			

