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# D9.27 - Identification of mental models of uncertainty management in emergency situations

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## Abstract

The study on mental models of uncertainties management in emergency situation was carried out in the framework of the European project CONFIDENCE (COping with uNcertainties For Improved modelling and DEcision making in Nuclear emergenCiEs). The methodology included mapping of mental models within several emergency preparedness and response experts and then performing interviews based on structured protocol with lay people in 5 countries: Germany, Greece, Slovakia, Slovenia and Spain. The aim of these investigations was to trace the concepts and understandings of emergency preparedness and responds and to identify possible gaps between experts and lay people models. The report on the mental models was developed with the summary of findings for individual countries, followed by comparison between them.

The collected results showed that participants have a general idea on what are the basic elements of the emergency plan, but only vague knowledge of each specific protective measure. The important inconsistencies present about planned measures shown where the authorities can improve the information and also where better communication is needed. In particular, there are different ideas about sheltering where people understand that special underground bunkers should be used for such case. Also, there is lack of information about the iodine prophylaxes and what it is used for. Interestingly, interviewees differentiate two possible situations: major or minor accident. In case of major accident, we find out a fatalistic belief that nothing would help as the accident would have very rapid and deterministic effects. They imagine a scenario of death and devastation and many times they do not see the utility of emergency plan useful. In case of minor accident, they believe it will be radiation contamination and the emergency plan would be useful. Nevertheless, there is a clear awareness that in case of an accident it would be better to comply with governmental instructions. Main uncertainties identified would be what to do, where to go, and how would they be informed.

Several suggestions were developed to improve the EP&R management and have generic value, as they are not depending of nuclear or socio-cultural situation. There should be in all countries better, more proactive provision of information before emergency. Risk communication activities shall take into account the national (radiological) threat assessment, taking into account also perceived risk by public. Better understanding of the protection measures should be communicated, using modern approaches and also by inclusion of affected population in exercises. Clarification regarding the roles of different emergency response players should be emphasized and resources shall be available in order to support the increased needs of information during emergencies. Building of trust is still among the most important preconditions to assure effective management of real accident.

***Report on mental models of uncertainty management in emergency situations (D9.27) might still be updated to include also the feedback from other participants.***

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## 1. Introduction

Emergency Preparedness and Response (EP&R) plans are prepared for many radiological and nuclear threats at different levels: national, regional, local, off-site, on site, for individual organisation, for facilities etc. All these plans are usually prepared by responsible authorities/institutions and are very rarely developed based on the public involvement or in consultations with public, especially those which could be affected in emergency. As a consequence, the plans are sometimes lacking the appropriate information, not addressing relevant uncertainties and public concerns and are not prepared to fulfil the needs of the possibly affected public in case of nuclear or radiological accident.

In the CONFIDENCE (COping with uNcertainties For Improved modelling and DEcision making in Nuclear emergenCIes) project (CONFIDENCE, 2016) which is aimed to understand, reduce and cope with the uncertainties in modelling and predictions of emergencies, also consideration of social, ethical and communication aspects of emergency management is included to investigate how stakeholders at the various levels deal with uncertainty in their decision making processes. As part of the socio-psychological study of understanding, processing and management of uncertainties therefore an investigation of the mental models of EP&R management was performed with the aim to support and improve communication between involved stakeholders, and in particular potentially affected population.

This particular activity is focused on the investigation of mental models which experts and lay people have regarding the emergency management of nuclear and radiological accidents where the risk is defined with release of radioactivity in the environment and to the human. According to the IAEA Safety glossary (IAEA, 2007), “*Emergency preparedness and response is defined as the capability to take and perform actions that will effectively mitigate the consequences of radiation or nuclear emergency for human health and safety, quality of life, property and the environment. This may also provide a basis for the resumption of normal social and economic activity.*” The research was based on the mental model approach developed by Morgan and co-workers on risk perceived activities (Morgan and all, 2002) in which systematic analyses of what people believes and what information they need to make a decision was applied to the emergency management in case of nuclear and radiological accident. The mental models of lay people<sup>1</sup> for the emergency management is influenced by many factors, among which are intuition and emotions, personal interest and involvement in the topic, existing widespread images (cultural icons) and interpretations (social representations), (mis)understanding of scientific facts, educational background, access to and understanding of information, credibility of information and communication processes, trust in information sources and communication partners, and more broadly, confidence in the governance of ionizing radiation risks. All these factors are inputs for forming of own representations - mental models which are constantly being (re/mis)interpreted, and internalized into explicit or latent insights which, in turn, feed into renewed mental models.

By comparing the emergency response in current EP&R plans which are developed by experts with lay people’s mental models the gaps, misunderstanding, misconception and uncertainties can be revealed. Such information can serve a basis for the future activities of competent authorities to improve the communication and modify the emergency plans to better fulfil expectations and needs of population.

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<sup>1</sup> Defined as a person who does not have specialized or professional knowledge of a subject: here, emergency planning and response of nuclear and radiological accident and risk associated to ionizing radiation.

The mental model research in CONFIDENCE was performed in five countries (Germany, Greece, Slovak Republic, Slovenia and Spain) individually by applying a specific protocol (Annex 1) to allow the organized collection of information as well as comparison of the results and findings. The objectives of investigation were to address the following questions:

- What are the mental models present within the potentially affected public regarding emergency management and associated uncertainties?
- What are the differences, gaps, misunderstandings and perceptions in the public compared with the ones provided by experts in the field?
- What are the similarities and differences on mental models between the countries in which the investigation took place?
- What is lesson learned from the performed investigation and how the findings can be introduced in the improved communication and activities?

The countries involved in the investigation have different nuclear experiences, some with long history of nuclear energy production and many nuclear power plants, some with no nuclear experience and some going into nuclear phase out. There is obviously also different sociocultural context relevant for involved countries. But all have to be prepared for case on nuclear or radiological emergency and approaches of official institutions are similar due to adopted international recommendations and guidelines, like IAEA or HERCA/WENRA.

## 2. Mental models

### 2.1 Theoretical background

Mental models are cognitive schemas through which people explain individual processes or phenomena in which they are participating. All of us have and use many such implicit models. These representations are understood by researchers as helping individuals to better interact with possible situations and also to predict most probable evolution of the events in which they are involved. The investigations on mental models started in 1980's and '90's mainly with studies of how people conceptualize different domains in physics such as moving bodies, liquids or electricity. Later research in other areas sought to elicit and map out mental models in the aim of improving learning processes and adapting information or teaching materials. Studies were related for example to mental models related to farming, economics and planning policies, complex man-machine systems, such as aviation or computers. Mental models research has been used to prepare information strategies in the case of risky perceived installations.

Attention was given to practically all areas in which humans are in contact with complex devices or systems, where mental models are shaped not only by the characteristics of the systems themselves but also other factors like trust and perceived risk or where there may be very serious consequences in the event of an incorrect action or operation. Examples include studies on the mental models involved in catastrophic failures of engineering systems (such as the risks caused by a defect in space rockets with nuclear sources or accidents in the chemical industry), the transmission and risk of infectious diseases (e.g. Lyme Borrelia and AIDS), or related to environmental concerns (climate change, environmental policy making, electromagnetic fields and power lines). In the field of radioactivity, the most relevant examples are the analysis of the mental models of indoor radon (Morgan and all, 2002) and work on mental models of ionizing radiation and radioactive waste as well as attitudes towards these materials (Zeleznik, 2009; Zeleznik and all, 2016).

Through interaction with processes or phenomena, individuals create mental models about issues, their functioning, characteristics and consequences. These models function as small theories with which people explain and forecast events. The main characteristics of mental models are that they are not necessarily physically or technically correct (and usually they are not), but they can function and provide individuals with estimations of the consequences of certain processes. Some of the features recognized in mental models on the basis of the various types of research are as follows:

- Mental models are incomplete and are constantly evolving. They usually are not a fully correct representation of the process or phenomenon and contain errors and contradictions.
- Mental models are often the basis for mental simulations in which people internally play out processes and phenomena and predict the course and outcomes.
- Mental models are unstable: people forget the details of the systems they use, especially if the details or entire systems are not used for long time, they often blend old and new information.
- Mental models have no solid boundaries; models of similar devices or processes are often blended and replaced with each other.
- Mental models do not always have scientific bases (i.e. repeatability, predictability and forecasting capabilities).
- Mental models are limited: they provide a simplified explanation of usually complex phenomena. People often prefer to carry out additional physical activity rather than to improve mental planning to avoid physical actions.

- Mental models are limited and poor in explaining, are full of inconsistencies and gaps in the description. They contain only partial explanations of the functioning of phenomena and have a lot of areas of uncertainty. People are often uncertain about their knowledge, even when it is in fact correct and complete,
- For one area (process, phenomenon or event) people can use even several mental models, which are between themselves inconsistent, but people use them to predict behavior (referred as knowledge in pieces),
- Reasoning on the basis of mental models is grounded on qualitative connections and not on the quantitative relationships.

When examining the mental models we have to take into account in fact four different states in the models (Norman, 1983): the real targeted system (denoted by  $t$ ), which is studying (a device, event, phenomenon, process), conceptual (expert) mental model of the system  $C(t)$  which is developed by experts, user's mental model of the system targeted  $M(t)$ , which is commonly called lay mental model and researcher's conceptualization of user's mental model  $C(M(t))$ . For the purpose of our mental model investigation we will simplify the approach and focus on expert model of EP&R planning and mental models of potentially affected population (lay people) which would need to implement the plans in case of nuclear or radiological accident.

## 2.2 Previous related investigations

Some similar studies were already performed with regards to other related topics, such as mental models of radioactivity and radioactive waste management. In addition, also investigation of lay public mental models of ionizing radiation in four European countries have been conducted, therefore some related experiences already exist.

Investigation conducted in Slovenia during 2005 to 2008 focused on mental models of radioactivity, radioactive waste and waste repository (Zeleznik, 2009) and was performed as a method for development better risk communication strategies with local communities during radioactive waste repository site selection. The expert mental models were created based on documents' analyses and discussion with experts on the main properties of radioactivity and functioning of radioactive waste repository. To derive lay people mental models the open-ended interviews were conducted with some individuals and then tested on representative sample of Slovenian population included 1000 participants, among them 200 persons living in municipality with NPP operation for 30 years, which enable statistical and quantitative analyses. The main findings from research which are interesting for the EP&R investigation are presented in table 1. It can be seen that mental models of lay people on radioactivity, radioactive waste and the LILW repository are mostly irregular and differ from the experts' models. Analysis of the responses showed that the lay public especially has misconceptions about the structure of matter, the phenomenon of ionizing radiation, radiation properties and biological effects of radiation on humans. The basic components of matter are viewed as more substantial (i.e. metals, plastics, wood, liquid) and models do not specify constituent components such as molecules, atoms, the nucleus, an electronic cloud, and the like. The general public does not distinguish between different types of radiation and their characteristics (e.g. the penetration of radiation dependent upon its nature, the interaction with barriers...) or between different types of radioactive waste. Very few know something about radioactive waste in general; respondents often describe it by a negative comparison ('slimy, toxic substance, dirty things in the chemical industry, something that cannot be monitored, gases' ...). Some believe that there is a distinction between

natural and artificial ionizing radiation. Natural ionizing radiation is not so dangerous, because people are accustomed to it. Artificial radiation is always dangerous, accumulates with time and has fatal consequences, with the exception of medicine applications perceived as not so dangerous. Some view that radiation can cause such injuries as vaporization of the body, which stems from the still images of victims of the (Hiroshima) atomic bomb or from science fiction movies.

*Table 1: Findings on mental models from experts and lay people*

Topic	Expert models	Some of lay mental models that differ from the expert model
Radioactivity, time dependence, process	Nuclei are unstable and decay exponentially with various half life, they gradually become stable, not radioactive after 300 years, natural and man-made process	Radioactivity is an artificial process Radioactivity increases with time or is not time dependent Natural radiation is different to artificial radiation, since people are used to it. There is no radiation in nature
How radiation effects humans,	High doses can kill or modify living cells, but there are repair mechanisms that correct the damage. Doses compared with natural background (low doses) have no effect. Late (stochastic) and acute (deterministic) effects.	Irradiated objects become radioactive themselves All radiation, even low doses, causes cancer, Hiroshima effect Radiation influences fertility, genetic changes, it stays for many generations A person disappears and burns down, There is a chain reaction of contamination in the cells – like viruses
Processes in the LILW repository,	No active processes in the repository, decay of radioactive waste, possible chemical disintegration, very slow degradation of the barriers, corrosion, then possible release through water and air, ingestion, inhalation, direct contact, all accidents studied and protected ...	Processes like earthquake, war, terrorist attack may release inner forces with possibility of atomic bomb, Waste emits radiation which is then transported through the barriers to humans, Psychological consequences, A stroke of lightning that can release radiation, Plants absorb radioactivity, Radiation evaporates from repository
Transport of radioactive waste,	Transport by road or rail, use of special packages and containers with pre-testing. Normal procedure with licensing.	Transport only with special vehicles with police escort In case of accident total contamination of land with many people irradiated, injured or dead Many accidents but not openly reported

General mental models of ionizing radiation among the lay public in four countries (France, Poland, Romania and Slovenia) involved in the investigation of ionizing radiation was also reported (Zeleznik and all, 2016): collectively, members of the lay public (independently of their education or background) possess a non-negligible amount of knowledge on the topic of ionizing radiation and its risks, and they hold strong views on related concepts. However, formal, organized knowledge about ionizing radiation is rather low. The compound term 'ionizing radiation' is extremely unfamiliar, while 'radiation', 'radioactivity' etc. in contrast are linked to extensive sets of ideas. The structure of matter, particularly the structure of the atomic nucleus, is rather unclear; the process and outcomes of the decay of a nucleus are very little known. Up to eight different models of the form and propagation of radiation could be identified. Most people know that natural radiation can be found in various places in the

environment. The majority does not know that natural and artificial radiation result from the same physical process, believing too that there is a basic difference between them: at the outset, it is mostly thought that natural radiation is absolutely harmless while artificial radiation is always dangerous. However, further probing shows that most persons know that any type of radiation may vary in intensity and consequentially in the potential damage caused.

All of the interviewees are aware that radiation may cause different types of damage to health, in the worst-case death. When prompted to describe consequences of exposure, some respondents unfold a narrative of severe, immediate or deferred impacts (radiation sickness or death) – a narrative that may contradict the same respondents' belief that natural radioactivity is benign. Many persons assume some kind of proportional dose-response relationship, explaining e.g. that longer exposure to radioactivity in the mountains produces graver somatic consequences. A small number, however, voice an all-or-nothing model: they state that appalling physical damage and suffering must follow any ingestion of radioactive material.

## 2.3 Mental models of uncertainty management in emergency situation

### 2.3.1 The approach

The mental model approach was used also for the investigation of uncertainty management in emergency situation in case of nuclear or radiological accident. The focus of investigation was on how plans are developed including what is associated risk, what are the typical elements and what protective measures are foreseen. In addition, also issues of information, notification and trust was analyzed. The research was performed in several stages:

- Firstly, the expert model was created, based on the available expert knowledge of emergency preparedness and management, its planning, international recommendations and guidelines, and improvements based on experiences. The discussions with several experts from different countries helped to point out also major uncertainties of emergency management and check the consistency of general EP&R.
- Secondly, mental models of lay people were obtained through the individual open-ended interviews following the prepared protocol, eliciting people's beliefs about the hazard, expressed in their own terms, understanding of protective measures and how transfer of information they imagine. The responses were analyzed in terms of how well these mental models correspond to the expert models.
- Thirdly, based on captured beliefs expressed in the open-ended interviews and in the expert model the main differences are pointed out and the risk communication is developed and evaluated in support to the EP&R management, specially identifying the uncertainties.

The mental model research was conducted in various national contexts (Germany, Greece, Slovenia, Slovakia, Spain) and enable to assess differences between countries, the relevant nuclear context with or without nuclear power plants and other sociocultural background.

### 2.3.2 Protocol

The English-language protocol for open-ended interviews (Annex 1) with lay people was developed and included several sections which follows the captured mental models of experts on EP&R management. Section 1 (Warming up) is devoted to start the discussion on the EP&R in case of radiological or nuclear accident but also experiences with some other accidents which would call for immediate reaction, like fire, flooding, earthquake or similar. Section 2 represents the kernel of the investigation and is aimed to give detailed information for mental model investigation. This section

requires detail discussion with the interviewees in order to recognize their understanding of EP&R plans, main uncertainties of emergency management and associated elements (protective measures, their characteristics, risks and related uncertainties). Section 3 includes supplementary questions like experiences and memories from major nuclear accidents (like Fukushima and Chernobyl accidents, rated level 7 on IAEA International Nuclear and radiological Event Scale - INES) where the questions are aimed to obtain broader prospective. Section 4 consists of socio-demographics data. As support to leading questions there are also one or more additional questions aimed to help to reformulate (if needed) or to extract more details. Protocol to be implemented in non-nuclear country was accordingly modified and questions which were not relevant were omitted from interviews.

In the mental model approach, interviews are intended to be very open, the questions being indicative and subject to reformulation as appropriate. Priority is given to revealing the interviewee's own line of reasoning. Interviews are conducted face-to-face in a semi-directive manner. For each theme, simple prompts are proposed, and responses with their spontaneous vocabulary are patiently explored before posing, if necessary, more explicit questions or suggesting terminology. Questions can be added to clarify aspects or to deeply investigate interesting issues that emerge during the interview. The interviewer may return to themes several times in order to ensure that all questions are covered, which also allows the respondent to establish links between topics and to deepen the reflection.

The protocol was idiomatically translated by a native speaker and adapted for use in each country context. In each one-on-one interview, the respondent was first informed of the overall aims of CONFIDENCE project, and assured that any opinion or view is important and that there are no 'wrong' answers. Permission was obtained to record the interview anonymously (on paper or by audio). Interviews varied from 30 to 90 minutes and most covered (to different depths) the full range of agreed protocol themes.

### 2.3.3 Sample

For expert mental model creation discussions with several experts from Ireland, Slovenia and France took place. They are all very involved in EP&R activities in their countries, being responsible for development of plan, their improvement and also responding in case of emergencies. Some experts are involved in EP&R as a member of expert groups for assessment of the consequences of accident, or also as members of special units, performing radiological and environmental monitoring as part of regular or emergency monitoring.

For collection of lay people mental models, the sample of 15 to 20 different individuals in each country was used, tracing the concepts and understandings, but also other important points of their mental models. This number for found in many studies to be sufficient to obtain new concepts. The interviewees are preferably people who live near nuclear facility (nuclear power plant, research reactor, and other nuclear or radiological facility for which Emergency preparedness and response plan is developed). The sample participants for mental model interviews of uncertainty management in emergency situation should be from target audience: in this case they should be representative members (related to gender, age, education) living in the areas for which the EP&R plans are developed and where in general they would be more informed. In case of no nuclear country, the sample participants should be from areas which are also involved in planning, based on the IAEA category V (areas within emergency planning zones and distances in a country for a facility in category I or II located in another country). The samples for individual countries are presented in chapter 4. The total sample was 82 lay responders plus one student for testing of protocol.

### 3. The expert model of EP&R

The expert model of EP&R was created based on the available expert knowledge of emergency preparedness and response for management of radiological or nuclear accident. The expert model is an attempt to pool in a systematic manner everything known or believed by the community of experts that is relevant for the area and risk decisions the audience faces. Analyses of national EP&R plans<sup>2</sup> were performed in order to obtain the information what is the concept of emergency management, what is included and how different areas are addressed. In addition, the discussions with several experts from different countries (Ireland, Slovenia, France) were performed to obtain the information on the approach to the preparedness and response, topics which should be covered in plans, which then determine response in emergency and post-accident situations, from the early phase to recovery. The participants were asked to briefly describe the structure of EP&R plans, what is most important for individual elements and what uncertainties could be associated with actions/activities/topics within different EP&R areas.

The EP&R plans for nuclear and radiological accidents usually include different topics and cover all different possible accidents in nuclear and radiation facilities in the country, but also nuclear and radiological accidents abroad with a potential impact on country, and other radiological accidents involving ionising radiation sources. They are based on threat and risk assessments which consider all different nuclear and radiological accidents with a major release of radioactive substances into the environment or the irradiation of people with precise descriptions, possible reasons for accidents, their probability, level of threat, course and possible extent of the accidents, identification of endangered inhabitants, possible consequences and plans for protection measures. The results of the analyses are summarized in risk matrix for individual scenario with impacts on humans and environment and its probability.

The national EP&R plan normally include following elements:

- **General information about accidents** with the legal basis for EP&R plans, the short summary of possible nuclear and radiological accidents in the country, the characteristics of ionizing radiation with external and internal radiation, the consequences with stochastic, deterministic and hereditary effects, likelihood of a chain reaction accident and general assessment for possible accidents with radiation substances release in the country.
- **Scope of planning** with information of levels of planning, responsible authorities and institutions for the elaboration of plans and their content. Beside national EP&R plan there should be also plans at involved ministries, regional and local (municipal) plans and plans for nuclear/radiological facilities and activities which must comply with national EP&R plan.
- **Concept of protection, rescue and relief (assistance)** in case of accident include basic assumption of the plan, like the main points of contact for the reception of initial incident report, pre-determined intervention level, levels of risk at NPP (from 0 – unusual event, 1 - alert, 2 - site emergency, 3 – general emergency), pre-determined protective measure emergency planning zones for NPP. The response concept is based on the risk level classification at NPP and based on consultation with nuclear regulatory body for other incidents and includes:

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<sup>2</sup> IAEA Safety Glossary, 2007, Emergency plan: A description of the objectives, policy and concept of operations for the response to a nuclear or radiological emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response. The emergency plan serves as the basis for the development of other plans, procedures and checklists. Emergency plans are prepared at several different levels: national, local and facility. They may include all activities planned to be carried out by all relevant organizations and authorities, or may be primarily concerned with the actions to be carried out by a particular organization.

- Notification and warning (reception of information and notification of all necessary to be involved),
- National plan activation by incident commander (depending on the risk level at NPP or based on consultation with nuclear regulatory body) and its extent,
- Initial notice for the public at national level to be published,
- Implementation of protective measures and tasks for bodies involved,
- Declare withdrawal of protection measures and termination of risk by incident commander in consultation with nuclear regulatory body.
- **Forces, materials, technical and financial resources** for the implementation of the plan specify the bodies and organisations involved in the implementation of tasks under national jurisdiction, like governmental bodies (including nuclear regulatory body), civil protection bodies, other units and services (fire-fighting units, army, police, ...). Material, technical and financial resources are also identified and described.
- **Notification and warning** in case of accident provide the mode of initial notification for accident in NPP or in any other case and the times when information must be sent to general public and to population in the area of risk, and to organisations abroad (IAEA, EU and neighbouring countries). The responsible bodies are defined. Also, public media (national and local) which are responsible for release of emergency information are defined. In case of risk level 2 or 3, the local population would be warned by voice messages or alarm signal and instructions on the implementation of protective measures.
- **Activation of forces and resources** to react as soon as possible, prescribe the activation of competent authorities, services and other operational structure in the event of nuclear or radiological emergency. They are defined in advance or in consultation with nuclear regulatory body depending on risk level. Material assistance include equipment, financial resources, food, water, medicine, clothing, animal feed and livestock care, temporary accommodation. Based on the convention on assistance in the case of a nuclear or radiological emergency international assistance may be requested.
- **Governance and management** with description of tasks for all involved governmental bodies and other competent municipal bodies, like, government, civil protection commander, ministry of defence (civil protection administration, armed forces), ministry of environment (meteorological office), ministry of interior (police) ministry of health, ministry of foreign affairs, ministry of finance, ministry of agriculture, other ministries, NPP and also municipalities (like draw up of EP&R plans, participate in the planning and management of the evacuation, involved in the implementation of the use of iodine tablets,...).
- **Monitoring of radioactivity** in environment in emergency to provide information for dose calculations as basis for the recommendation of protective measures, for the withdrawal of measures and rehabilitation, to assess emergency personnel doses and radioactive contamination of environment. The activity is coordinated by mainly by nuclear regulatory body with inclusion of several national competent bodies.
- **Protective measures** are taken to reduce or prevent the exposure of individuals to ionizing radiation. There are several types:
  - Immediate protective measures:
    - Sheltering: means keeping people and animals inside to avoid external radiation and intake doses, a regular building with windows closed and ventilation turned off or closed space. Sheltering may last up to 24 hours.

- Iodine prophylaxis (ingestion of potassium iodine tablets): ingestion of stable iodine immediately following occurrence of an accident to protect the thyroid gland against radioactive iodine accumulation, distributed in advance to local population.
- Evacuation: coordinated relocation of inhabitants by their own vehicles or organised by competent institutions (schools, kindergartens, hospitals, nursing homes, tourists...) via evacuation routes to reception areas.
- Accommodation and care of evacuated population: provision of shelters and other emergency care (health care, provision of food and water, clothing, infrastructure, education, ....) for relocated population.
- Area surveillance: control of areas with protective measures by police and other units.
- Decontamination of people, animals and equipment: examination and if needed decontamination in special control points outside protective measures area.
- **Food security measures:** prohibition of the use of contaminated food (crops, fruits, vegetables, milk and dairy products) and water, contaminated feed, could last for several decades, restrictions on products, grazing, wild game and provision of safe food.
- **Long-term measures:**
  - Temporary transfer of population
  - Permanent transfer of population
  - Environmental decontamination

The discussions with several experts from different countries revealed that the basic elements of EP&R plan are very similar and universal. The differences occur due to country specific situations. One particular case is situation without nuclear power plant in operation, where all related activities for NPP accident management in the country are not part of the plans, although planning is adopted for situation of NPP accident abroad. Less differences occur between plans for countries with many nuclear facilities or with only one nuclear power plant. However, differences were observed between the provisions on zones, reference levels, intervention levels and similar. The differences between countries are of course also due to different organisation of government with specific administrations, but what is relevant almost for all is the fact that the lead for response is not nuclear or radiation protection regulatory body but civil protection or disaster protection authorities with inter-ministerial committee. Such organisation would mean that very good communication should exist between involved to assure effective decision making. Besides, a very large number of institutions, services and other involved would represent a big challenge for effective implementations of protective measures.

The experts also pointed out several areas which to them would be source of uncertainties in nuclear or radiological emergency and would need to be properly addressed:

- The knowledge on ionizing radiation, consequences, associated hazard and real impacts is relatively low within institutions and services foreseen to manage the emergency situation and therefore training and education would be very needed.
- The development of accident is quite unpredictable, like what meteorological factors to be used for modelling, how the radioactive plume will be dispersed and where it will be deposited, therefore it is very difficult to foresee the preventive measures.
- The impact of accident in the areas which are foreseen for relocation of population and could not be used for the purpose.

- A big uncertainty how people would actually react in nuclear emergency: would they follow the assumptions from EP&R plans, like to evacuate themselves without children, would they follow the evacuation routes and relocate to reception areas. This is linked with trust of people to information where it is important who delivers the data.
- There are no exercises and drills on local level with involvement of all services, institutions (schools, hospitals, nursing homes,...) and population.
- Desk exercises are implemented by competent authorities but with only few field exercises. The response in real environment is not practiced.
- There are no agreements for some services foreseen in the EP&R plans, like use of mobile unit for radiological accidents. Also, the number of experts which could perform such services is limited in the country (lack of capacity).
- The food security measures are seen as particular challenging, as it is very difficult to harmonise the reference levels and limitation, also due to export and import of products, and would be a big source of uncertainties.
- Communication with public (general and local) and with media would present a big source of uncertainty: there would be many sources of information including social media, also those with wrong information, which could be source of panic and chaos.

## 4. The lay models results

### 4.1 Germany

#### 4.1.1 Introduction

Project partner DIALOGIK Stuttgart Germany guided the German case study on mental models, examining the images people have in case of a nuclear emergency and interviewed 15 persons aged between 35 and 67, all living a maximum of 25 km distance of a nuclear power plant which is operated in Germany.

This case study and the interview results should be seen in light of a huge transformation process in the energy sector Germany is facing at present. The German government and several ministries have started a challenging development by transforming the whole economy with a move away from fossil fuels and nuclear towards an energy system that reduces carbon dioxide emissions by at least 80 %, uses energy more efficiently, and supports the shift to a high share of renewables.

Renewable energy focuses in Germany on wind, solar, biomass and hydropower. Experts predict this transformation will last for decades. As a direct consequence of the Fukushima nuclear accident, the phase-out of nuclear power and closure of all nuclear power plants will be finalised in 2022. At present, seven nuclear power plants are still in operation and produce appr. 10.000 MW (BMW, 2018a; BMW, 2018b).



Figure1: Nuclear power plants in Germany, decommissioned and scheduled for decommissioning (Source: BMWI 2018c).

#### 4.1.2 Interview conduction and data collection

##### Method of data collection

For the German case study, total 15 interviews with lay persons were conducted. Out of these, 10 were female, and 5 were male, aged between 35 and 67 years. All interviewees live in an area of app. 25 km distance from a German nuclear power plant. These persons fit into the principle selection criteria given by the approach of this cross-country study.

The interviews lasted between 25 and 50 minutes each. Researchers followed the interview guidelines but rearranged the questions for a better flow of information. All interviews were held in German language. Some questions were only indirectly addressed when it turned out that no background knowledge to refer to did exist. Interviewees looked at selected photographs (from a German nuclear power plant) and maps to encourage free thinking about the topic and to point to key issues (for example potential evacuation routes). The results from interviews were first summarised and after that analysed to obtain key results.

Although the topic and the interview questions looked complex and out of normal live experience, people attended the interviews did well, reflected a lot about outcome and successfully answered most of the key questions.

### Sociodemographic data

The following table gives an overview of the socio-demographic data of 15 persons being interviewed.

*Table 2: German case study, sociodemographic data of interviewees*

Case study	Germany
Number of interviews	15
Age	35 to 56 years
Gender	Female: 10 Male: 5
Education (last achieved education)	Tertiary qualification mostly
Profession (area of education: humanistic, social, natural, technical)	Widespread, mostly academic jobs, jobs that require a high qualification
Living in village/city	City
Living near nuclear installation	All within 25 km radius of an existing German nuclear power plant

#### 4.1.3 Mental model: Results of the interviews

##### Section 1 – Warming up

When asked if interview attendees know that nuclear power plants operate with an emergency plan in the case of an emergency (Q1.1) where also release of radioactivity can occur, knowledge is generally very low. Nearly all interviewees stated that they had never read or studied any information about measures or the response when something serious happens in the power plant nearby. No person ever searched in the internet for emergency or response plans, and no one ever was in touch in the print version of the emergency plan of the existing power plant the respondents live nearby. Some of the respondents mention to have examined general plans of what to do in an emergency, and read pamphlets accordingly.

Nearly all interviewees indicate that one or more nuclear power plants do exist and produce power in their region where they live and work (Q1.2), and nearly all know the name and can locate them correctly. The upcoming phase-out and stop of nuclear power production in Germany are well known due to the consequences of the Fukushima accident.

Some even mention names of several nuclear power plants, German ones and also from neighbouring countries that are 100 km and up to 500 km away from the home town they live in. Respondents also indicate and remember minor accidents of nuclear power plants that were published in newspapers in recent years.

Also, well known is the development that some of the existing nuclear power plant has stopped producing power due to the phase-out of Germany, while others still in operation.

Similar to the answers above, interview participants express that a plan for emergency might exist for nuclear power plants (Q1.3), but not more details are given. The knowledge is again generally very low, but some respondents that an emergency might exist at the operators' website, and that they will find when needed.

When replying to question about experiences with similar accidents (Q1.4) interviewees mentioned a specific incident of an evacuation that they and their family experienced recently. A bomb from World War II was found during building works, and this caused an immediate evacuation of an area of app. 3 km<sup>2</sup> and around 3000 people living closely where the bomb was found. Respondents clearly remember the way the evacuation was carried out, police officers knocked on every door, and guided the people to save places till experts disarm the bomb, and the families returned to their homes. This was seen as an extraordinary and very rare incident but did not cause much anxiety. All clearly followed the instruction given by police and fire fighters. One female interviewee left the area to spend an afternoon off with the children and returned to the home when all was clear, but most just waited in designated areas at safe places of the district, and returned immediately to their homes once the official bodies allowed to.

Apart from this incident, people being interviewed did not personally experience major accidents like earthquakes, fires or flooding.

## **Section 2 – Mental models of emergency management and related uncertainties**

### **EP&R plan and risks**

According to the interviews, people indicate the elements (Q2.1) what should be outlined in a plan for emergency in the case of an accidents. Basic elements are: information about what happened, countermeasures, instruction what to do, like sheltering and evacuation, guidance to pick up children from school or kindergarten, channels of reliable information, sources with regular updates of the situation, and additional precautionary recommendations.

Respondents show a high awareness that accidents with nuclear material can happen in Germany (Q2.2), although some express that the likelihood is still low. Major accidents in a nuclear power plants in Germany or in neighbouring countries are mostly mentioned here, with tremendous consequences to the area around the power plants. Some people express also that accidents might happen while transporting radioactive material, at intermediate waste disposals, or release of material in research centres. Also, people mention the risk of permanent waste disposal of nuclear material can have concerning accidents.

Participant were asked what according to them could happen during radiological or nuclear accident (Q2.3). Interview partners comment like "major melt down", "explosion" and "uncontrolled release of radioactivity", as well as "huge area contaminated by radioactive particles", "huge region that nobody can live in for years". People also link the nuclear accident to images of "fallout and cloud" and "houses contaminated with radioactive particles". All these images that people have in mind show that according to their perception a nuclear accident would cause serious consequences, would get out of control, and would damage the whole region and infrastructure.

No interview data is available in relation to more details about which nuclear or radiological accidents are covered by EP&R plans (Q2.4) due to the flow of interview and the given background knowledge of the interview participants.

On question who is responsible for reaction in case of accident (Q2.5), the main institutions like the Federal government of Germany, the state government of the region, and specialized public institutions on the local level of municipalities are mentioned, as well as agencies for emergency management. People mention THW, fire brigade, police, as well as support by the army. The respondents do not stress that only one institution is responsible for the organisation of handling a nuclear accident.

All interviewees clearly remember the two accidents of Chernobyl and Fukushima (Q2.6), as well as other accidents that did not cause such high damages, for instance the accident in Three Mile Island.

Specifically, for the Chernobyl accident, most people describe how their parents and other family members react, how it effects their daily live in a shorter and a longer term, and how it forms their opinion about the production of power via nuclear sources. Some indicate that they stopped consuming mushrooms and deer meat, milk and fresh fruits, and kids were not allowed to play outside for a couple of weeks. Due to the age structure of the participants, most were at children's or teenagers' age, and the accident during this time in 1986 formed their image of this type of technology, and the safety. Nearly all indicated the correct year when the accident in Chernobyl happened. The interview partners perceived this accident as a big catastrophe that goes beyond many borders, which effected whole Europe till today.

Although farer away, the Fukushima accident appear still very fresh in people's memory, and their consequences to the sea, the people being affected and the long-term damages to the region and the society. Similar to the memories to Chernobyl, an accident can get uncontrollable very quickly.

Also, very highly perceived by the interviewees was the important decision of the German government to start the phase-out of nuclear power production, and the close-down of all nuclear power plants, as a direct consequence of the Fukushima accident.

Although no respondent has ever accessed and read emergency plans of the nuclear power plant, ideas do exist of what to do in the case of an emergency and what kind of measures are foreseen for radiological and nuclear accident (Q2.7). This means: stay inside of the house, shelter in the basement, avoid staying outside, eat and drink only what is stored, and stay informed what the public sources publish. One of the respondents described of measures of leaving clothes outside, wash and take shower after contamination. Some of the interview participants stress that some specific areas inside the cities should be available as collecting points and sheltering (like town halls and sports halls).

### **Understanding of measures**

Concerning the concept of sheltering (Q2.8), most people will stay home and close all windows, and shut down ventilation and air conditioning. Here, people tend to follow official advice and stay inside homes as long as needed.

Regarding the use of potassium iodine tablets (Q2.9) not many of the respondents store iodine tablets at home, but some indicate to get them from pharmacies or other stores nearby where they live when needed. No specific knowledge could be identified about the correct timing of the intake, and the doses per day.

The interview answers regarding the concept of evacuation (Q2.10) were very widespread here. In case of an emergency in a nuclear power plant, some persons indicate to leave the effected region as quickly as possible, and to move as far as possible, to reach their second home or to live with other family members. Most likely they will gather children and other family members beforehand, take their private car, and take the route via motorways. One respondent expressed clear plans to first check the

weather forecast and the wind direction, pack in passports and other important items, and escape with the family with own car into the direction less effected by radioactive outfall.

Two interview partners will clearly not follow advise of sheltering, but will leave the effected region with their family members immediately. Here, the respondents do not to trust official recommendations, and take action, to avoid any kind of contamination in an effected area.

In case of an evacuation, people will take only what is needed, a small suitcase, money and passports, and medicine, and will leave the area.

Concerning the direction the answers differ as well. Some indicate to drive into the direction of the nuclear power plant, to avoid traffic and escape as quickly as possible, some will check the weather forecast, and the wind direction, and will avoid being exposed of the nuclear fall-out depended on the weather and the rain estimation.

The participants answered the question about accommodation and care (Q2.11) of evacuated population only to a lesser extent. People have the rough idea that centers like town halls or elsewhere in the city will be provided for evacuated population.

Interview data about the decontamination of people, animals and equipment (Q2.12) is not available.

Participants answered the question related to food security measures (Q2.13) that – while sheltering and staying inside - they will first consume food that they have stored in their basement and apartment. However, most realize that they have usually not much in stock, and the food and the water will not last long than a couple of days for their family and themselves. Most people buy food from the market or regularly from supermarkets, so this will cause problems. One interview partner focused on tap water, and the question if this is safe to drink. The person plan to fill it in containers in order not to run out in case the order to stay inside will last longer.

People are well aware that in case of a major fallout that is comparable to the Chernobyl accident, huge areas around a nuclear power plant remain inaccessible after an accident and that long-term protective measures like permanent relocation could be applied (Q2.14).

When asking about the emergency zones (Q2.15) strikingly, participants do not have zones of precautionary actions in mind, and when escaping from the affected area, answers like “leaving as far as possible” arose frequently.

### **Information and trust**

On the question of information sources (Q2.16) the participants indicated as first sources the internet, radio and TV to be accessed to get more information. Strikingly, one respondent commented to first consult with neighbours, friends and family, compare with the official opinion from the public sources, and to see how to handle the situation, and the best options to avoid further negative consequences. In general, people will access details from public authorities and printed and online media. Generally, the official sources are seen as reliable.

The question on frequency of information (Q2.17) was only indirectly answered. People tend to check regularly the same internet sources for actual information and updates about the current situation and new recommendation how to react and adjust to the situation. Some access various sources, and compare the details of they are all in line or contradicting.

In case of a black out (Q2.18), radio and mobile phones can be operated with battery for a while, as well as the access to internet. Generally, this was not seen as a huge issue.

Concerning the sources of information, the trust that people have (Q2.19) varied significantly, and no clear picture can be given. One important part of information will be given by public authorities, and some interviewees see them as reliable sources that they can trust most, and that they can follow instruction for countermeasures. One other group fully show distrust to all public authorities, and will fully rely on mass media, opinion of peers (own or from family and friends), or Non-governmental organisations (ATTAC, Greenpeace and BUND as a well-known German environmental group).

Some respondents assume that public authorities will hold back parts of information in the acute case of a nuclear emergency, to avoid chaos, panic, and uncontrollable reactions from the public.

No other languages except German (Q2.20) were mentioned in which the information should be provided.

### Section 3 – Additional questions

Similar to the answers given and summarized above, people very well perceive and remember the two accidents of Chernobyl and Fukushima (Q3.1), and partly other, for example in USA, France and UK.

People got information in case of Fukushima accident (Q3.2) as usual through mass media like television and radio, as well as printed daily and weekly newspapers. Because of the specific event, some interviewees access internet sources like “Spiegel online” and webpages from public authorities to get additional details about the consequences of the nuclear accident and the meltdown, as well as the reasons that cause this catastrophic accident.

According to the interviewees’ opinion, the Federal Government of Germany, the state authorities on the level of regions, as well as the emergency management, police and fire brigades should play major roles on decision making and implementing measures to protect the local population (Q3.3).

## 4.2 Greece

### 4.2.1 Introduction

The goal of the research was the identification of mental models of uncertainty management in emergency situations. In particular, the interviews aimed to:

- understand peoples’ views and perceptions regarding the management of an emergency situation and the related uncertainties.
- understand the level of citizens’ knowledge regarding the prevention and response plans in case of nuclear/radiological accident.

Greece is the only country from the involved that have no nuclear power plant in operation and does not foreseen to construct one. The neighbor with NPPs in operation is Bulgaria; also in Turkey there are plans to operate the NPPs, and currently of one location the construction is under way.

### 4.2.2 The research procedure

The total number of interviews conducted is 20. The interviews were conducted during October and November 2018 in the area of Athens (capital of Greece) and in the area of Thessaloniki, which is the second largest city of Greece.

Interviews were carried out face-to-face in Greek language (the protocol was translated into the Greek language).

Conducting the interview was based on the willingness and the availability of participants within the specified time period. Initially, the interviewers introduced themselves and explained with details the purpose, the procedure and the ethics of the interview.

All the persons that participated were adults (age 18+). Details about the gender, education level and profession of the participants are presented in the table 3.

*Table 3. The demographics of the participants in Greece*

<b>Country</b>	<b>Greece</b>
<b>Period of research</b>	October – November 2018
<b>No of interviews</b>	20
<b>Age</b>	18+
<b>Gender</b>	10 male, 10 female
<b>Education (last achieved education)</b>	Primary education: 1 Secondary education: 10 Tertiary education: 9
<b>Profession</b>	Technical: 5 Student: 3 Social Sciences: 5 Pensioner: 2 Human Sciences: 2 Unemployed: 1 Health Sciences: 2
<b>Place of Residence (city / village)</b>	10 in Athens, 10 in Thessaloniki

### 4.2.3 Findings

#### Section 1 – Warming up

##### Knowledge of a Nuclear Power Plant in the area

The majority of participants felt confident that in their area (municipality or region), as well as in the Greek territory, there is no nuclear power plant (Q1.2).

Individual reports have been made about the nuclear reactor of the research center “Demokritos”, as well as about the Ptolemaida plant (i.e. electricity production unit based on lignite); some confused views about the type of energy produced and the materials used were recorded.

There is absolute certainty about the operation of nuclear power plants in Europe, with particular reference to Bulgaria (Kozloduy), France, Germany, Russia and UK, as well as internationally, namely in America, North Korea, Japan.

Particular concern was expressed about the forthcoming operation of a nuclear power plant in Turkey and the potential consequences for Greece in the event of an accident.

The main source of information is the Internet, with an emphasis on international news sites and, secondarily, television (news or documentary).

### Emergency Preparedness & Response Plans

The lack of knowledge about the preparedness and response plans in Greece in the event of a nuclear/radiological accident (Q1.3) is obvious, without however excluding their existence at local (municipal, regional) and national level.

In general, they expect that provisions for the movement of the population in a safe area (shelters) and special masks distribution are included in the EPR plans, emphasizing the lack of information and education of citizens and the lack of prioritization and interest by the responsible authorities due to the absence of a nuclear plant in Greece.

*"... I suppose some shelters could exist for which no process of informing the public has yet occurred or perhaps they have informed the public but I am personally unaware of ..."*

*"... I think that due to the fact that Greece has no nuclear facilities for production, but experimental, like that of Demokritos, I do not know how far such plans exist. I have never been informed of any such project by anybody ..."*

It is believed that the plans are being developed in accordance with the guidelines of the European Union and of international organizations (e.g. WHO), tailored to the specific circumstances of each country (whether or not a nuclear plant exists, logistics, etc.).

The participants mentioned as main bodies involved in designing and implementing preparation and response plans in the event of a nuclear/radiological accident in Greece: the General Secretariat for Civil Protection, the Ministry of Health, the Ministry of the Environment, the National Emergency Aid Centre (EKAB), the Hospitals, the Security (Police Service, Fire Department, Port Services) and the Army.

An important advisory and supervisory role, in the form of providing guidance to the government agencies, can be carried out by a specialized body (Demokritos)<sup>3</sup> or private bodies (NGOs) because of their knowledge and experience in managing such situations.

*"... I do not know if there are plans from the Greek state. Surely Demokritos will have a plan for dealing with situations, but beyond that I do not know, I am not aware of anything specific, nor did I see any exercise or hear that any specific exercise has been organized on the subject ..."*

### Accident Experience

Most participants reported that they have experienced accidents (Q1.4) that required an immediate response, such as earthquakes (Athens and Thessaloniki), floods (Mandra, Attica) and fire (in the workplace).

The majority of respondents acted individually on the basis of their previous knowledge about natural disasters, while the measures taken by the state bodies (civil protection, municipalities, security

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<sup>3</sup> The responsibility of providing guidance and proposing protection measures during radiological/nuclear emergency situations is assigned to the Greek Atomic Energy Commission (EEAE), which is the regulatory authority in the field of radiological and nuclear safety. However, a confusion of EEAE with the National Center for Scientific Research "Demokritos" in the public's perception is historically observed; this fact allows us to consider that the reference to "Demokritos" role in these interviews implies EEAE.

bodies, health services) concerned the restraint and restoration of the "damage", such as the movement of the population to a safe location, the provision of medical aid, temporary accommodation (tents) and food provision.

*"..The actions were individual. There was no guidance.... "*

*"... They immediately brought us tents, as I recall, and all that time we were in tents, we weren't allowed to enter our houses. That was the briefing. As far as supplementary self-protection, it did not exist ..."*

Coordinated plans to evacuate buildings in case of fire and earthquake were applied in cases of private companies where information and training exercises had been carried out at regular intervals.

*"... The earthquake of 1999 found me working in a company with a very good management of the crisis on the part of the employees and the administration as there was a coordinated program and evacuation plan that was implemented. The building was evacuated, there were special instructions not to use the elevator, there were people trained to check the premises that no one was left in ..."*

*"...Exactly. We do some exercises once a month or once every two months, some who are responsible for our floor to guide the people ..."*

## **Section 2 - Mental models of emergency management and related uncertainties**

### **Basic Elements of EP&R Plan**

With regard to the characteristics and content of the plans (Q2.1), initially priority is given in providing information to citizens, moving away from the accident area in case of high levels of radioactivity, moving to a safe location and in specially designed areas (shelters), in the distribution of masks, tablets (iodine) and other types of personal protection (special uniforms), as well as nutrition information.

Acknowledgment of the difficulty in managing a nuclear/radiological accident due to the large dispersion of radioactivity is identified; consequently, the precise planning and implementation of preparation and response plans is challenging too.

*"..Generally, the nuclear accident is not associated to an earthquake or a fire. I imagine it's a lot harder to handle. Surely there should be zones where you know you are very close to an area, so depending on the zone you are in, you should have a corresponding degree of response and information..."*

The reference center in the event of a nuclear / radiological accident is the municipality and the region, in cooperation with other government agencies, such as the Ministry of Health, HCDPC (KEELPNO), NCSR Demokritos, the General Secretariat for Civil Protection, the Police and Fire Services. Coordination of services should be the responsibility of the state mechanism (Ministry of Health) through the establishment of a special committee of scientists, without excluding the participation of certified private bodies from Greece and abroad.

*"..Well, I believe locally, because I do not think you can work independently. Unless they make a central one for all of Greece ... I do not know that either. But again even if a central one is established, that is developing a service that would deal with it, and again the Municipalities should be aware of it. In order for this service to cooperate with the municipality that will face the problem ..."*

*"..Maybe with the Police, there are some groups that can direct the people to move away from their homes. And then I think there should be some announcements from HCDPC, let's say, which is*

*responsible and/or of Demokritos, to bring out some teams of information and health representatives to help people with some prevention and protection measures ..."*

Particular reference was made of the prevention of nuclear/radiological accidents, focusing on the austerity of safety measures and compliance with international standards on the operation of nuclear plants, intense controls and sanctions that may even lead to the closure of a plant, as well as the introduction of safety zones (in kilometers) from the area of the nuclear plant where the construction of houses and other buildings will be allowed. At community level (municipalities - region), prevention focuses on informing - educating citizens so that there is an organized reaction (evacuation, movement, personal protection measures) and panic prevention.

*"..The basic prevention is the safety measures that the NPPs will have, the safe range of the houses and the far end where the people will safely seek shelter if there is an accident ..."*

The participants' main uncertainties about the programs/plans are identified in 2 sectors.

1. **Citizens:** The degree of readiness to comply with contingency plans due to their lack of information, the possibility of panic-free response in the event of a nuclear /radiological accident and the possible health consequences.
2. **State:** Regarding the co-ordination of services and the possibility of responding directly to the needs of the residents, such as possible high attendance in hospitals, their coordinated movement to other areas and the provision of shelter and food. Also, the lack of experience through simulation exercises makes the country insufficiently prepared. It is worth noting that past experience of other large-scale natural disasters makes impossible or at least doubtful the timely intervention of the state services.

*"... If procedures will be followed, if they will be followed not by the authorities, but us the citizens. If we follow the steps that we need for personal and collective safety or everyone will try to do what he thinks right at that moment to save himself and others around him ..."*

*"..Good planning also includes how the authorities will respond directly to the needs of the people, great or little. Because sometimes they are small and other times they are big. And you always have that fear. If something happens, first of all if you, as a person, can also act / function quickly... "*

Regarding the main controversies that may arise at state level, these initially concern the need for such a plan, as the risk of a nuclear/radiological accident is considered to be low due the absence of a nuclear plant. This disagreement will raise objections regarding to the priority to be given to this field and the funds to be made available at a time of financial crisis. But even if a nuclear / radiological emergency plan is finally developed in a later stage, disagreements will continue to exist with regard to practicality, effectiveness and how quickly it can be implemented. Finally, the fragmentation of the responsibilities of government bodies and the lack of hierarchy and coordination will make more difficult the adoption of common acceptable decisions and more frequent the attribution of responsibility between them.

*"..If coordination does not have clear responsibilities and they get complicated, there may not be the pyramid for who decides at any time. For this reason it is important that there is a pyramid that gathers the opinions and ultimately the person who has to decide on each stage of the project makes the final decision..."*

*".. Who will coordinate, who will direct, whose correct opinion will prevail, and finally who will be responsible? "*

## Radiological and Nuclear Emergencies in Greece

Despite the absence of a nuclear facility in Greece, the release of radioactivity from an accident at a nuclear plant in a neighboring country (Kozloduy-Bulgaria, Turkey) is considered as the most important potential nuclear/radiological emergency (Q2.2) with disastrous consequences for Greece. For this reason, all participants have stressed the need for strict safety measures, according to the guidelines of European and international certified organizations.

*"..From an accident at a factory, let's say due to nuclear tests, using so much radioactivity, and the post-burst effects are enormous and very serious because radioactivity does not just go away, it remains and even later you have an impact..."*

*"..There may be an error with the indicators in the nuclear reactor and an accident may occur, where the radioactivity will begin to spread out of the factory..."*

*"..There have also been accidents at factories in Europe, I think in France and Kozloduy. There should be a pan-European organization that informs directly and perhaps the populations that are at the border of the country should also be informed..."*

The majority of participants were informed about the use of radioactive materials in industry, research and education, and especially in medicine for treatment and diagnostic purposes. In particular, as far as medicine is concerned, it is estimated that the necessary safety measures are applied when examining patients through the control of the amount of radioactivity used.

*"... I know that radioactivity is a very good and efficient source of energy, the percentage of energy produced is very high and therefore it has been chosen as a source of energy, there are too many nuclear materials used in medicine either for examinations or for therapies, there are very small quantities of radioactive materials used in electrical appliances, and it is very important when they are recycled to be done in the right way. "*

*"..As far as the medical field is concerned, I imagine there are appropriate measures. The quantities of radioactive substances used in some tests. I believe this is controlled..."*

However, reservations were raised regarding the management of radioactive waste (transport and storage). Despite the fact that the accidents involving radioactive waste are considered to have no immediate devastating consequences, such as an explosion in a nuclear reactor, there is a suspicion that the necessary safety measures are not applied. In particular, there are many who believe that hospital and industrial waste are not stored in secure places or even worse are being dumped in landfill sites without the planned procedures.

*"Hospitals, that is, their waste, when they are radioactive, should not go to a place that accepts only household waste. They should go to special designated places..."*

*"..For sure. If the appropriate security measures have not been taken, it can certainly be a nuclear accident. Not as widespread as if an accident happened in the factory, but surely it can be done when transporting materials..."*

Safety measures to prevent such accidents point out to the creation of special facilities for the disposal of radioactive materials, the use of appropriate means of transport appropriately designed for the transport of such materials and the existence of specially qualified personnel who can prevent the spread of the radioactivity.

*"The use of appropriate means of transport, designed to carry such materials, where the personnel (drivers, etc.) must be trained so that in the event of an emergency it is capable to manage this material*

*and, in general, not to transport it to residential areas. Do not move such materials near homes. As long as they are remote... "*

*"...There should be a station that measures the radioactivity, as do the hospitals that have such mechanisms and they are evacuated. Also, workers must be informed and take protective measures..."*

Regarding the consequences and risks of a nuclear/radiological accident (Q2.3), it was thought that they would become visible in the long run, affecting both people and the environment. In particular, with regard to people, an increase in mortality rates, in incidence of various types of cancer (e.g., leukemia) and in genetic mutations would occur as has happened in the past in similar accidents.

*"... Too many problems. The country's standard of living. Mortality, we would have had too many deaths. Then, too many illnesses. I remember, that since then, leukemia has been prevailing ..."*

*"What we all know is that you are getting sick. And diseases are usually cancer as a result of all these nuclear, radioactive waste. Various forms of cancer ..."*

As far as the environment is concerned, it was almost unanimous agreement that there would be a great - perhaps irreversible - destruction of the wildlife, which would create not only problems in the quality of life but also in the living standards.

In particular, the contamination of the environment would make impossible to cultivate land for food production, drastically reduce livestock stockpiles (killing animals), and seafood consumption would also be significantly limited (waste dumping at sea). Finally, if the accident occurred in a neighboring country, the mass movement of the population could not be achieved without all the relative difficulties caused by a large-scale emergency.

*"..Initially, pollution of the aquifer, because it is known that rainfall all ends up in the aquifer. Plants. The atmosphere, everything. Whatever we are breathing and eating..."*

*"... the consequences have to do with the air transporting the radioactivity. Radioactivity stays on everything. You have to eat only packaged and not be exposed to the very radioactivity that exists in the atmosphere ..."*

Interview participants still remember many issues in relation to accident in Chernobyl and Fukushima (Q2.6).

Although many years have passed since the Chernobyl accident, it is still considered to be the most important nuclear accident that has changed the way of thinking and attitude towards nuclear energy. This unprecedented accident, the ignorance and the lack of adequate information on health and environmental consequences, caused fear (even panic) which have been the most important factors that Chernobyl nuclear accident continues to be deeply engraved in the memory of people.

*"..The whole world was worried. Remained a little secret what has happened. I believe that if they warned the people more quickly, quicker action could be taken..."*

*"For Chernobyl, mainly from stories, though theoretically I experienced it, I remember that there was anxiety about how much carcinogen it would be all about and what we would do next ..."*

Concerning the consequences caused by Chernobyl, they focus on mortality increase due to the increase in cancers and other diseases, genetic mutations due to changes in DNA, prohibition of food consumption (mainly in Northern Greece) and also ban of travelling to countries that were near or close to Ukraine.

*"..The consequences were devastating. Many people and generations got sick because it affects DNA and the next generations have issues. We had mutations, the food got infected. The crops were prohibited. There was a big blow to the agricultural sector, and I think even now there is radioactivity on the ground ..."*

*"..We had a lot of fear, I remember, about what to eat. Mostly they told us that we should not eat products that are in the earth, to avoid them. At that time, we paid attention to everything. Also, too many illnesses, which I remember for a decade, have been said to be the result of Chernobyl ..."*

Particular interest presents the different views about if all the above mentioned effects continue to exist or have disappeared after 30 years. Many are those who claim that the consequences exist and will continue to exist over time as they are reflected by the increase of the incidence of various diseases, while others believe that the consequences have been significantly reduced - if not disappeared - after so many years.

*"..No, in no case. I take it for granted that there are still areas of Greece that they were affected more in which we read that the population has a more frequent occurrence of diseases ..."*

Unlike Chernobyl, the nuclear accident at Fukushima, although more recent, it does not seem to have the same impact on the perceptions of the population and therefore on its attitude towards nuclear energy. The previous experience of Chernobyl, the more reliable information, the long distance, the best safety measures in addressing and reducing release of radioactivity, were the reasons why in Greece this accident had a "second place" or even got unnoticed.

*"..For Fukushima, of course, there was much more information, much larger than Chernobyl, although I was young, I felt there was much more detailed information..."*

*"..And I trust the Japanese more than any other people if something similar happened, that they would do the best to face a situation like this..."*

As for the consequences, most participants supported that they had been more limited and related to environmental pollution in the wider region (with more concern about sea pollution), the movement of local population into safer areas and the prohibition of food consumption produced in Japan. Concerning the consequences in Greece, these were only indirect (imported packaged food) or they did not exist at all due to the long distance.

*".. We did not have direct consequences, indirect we may have..."*

*"..Certainly such an accident has global effects. It didn't affect me. It should, but not especially..."*

The main radiation protection measures participant concept in case of radiological and nuclear accident (Q2.7) could be: the temporary mass evacuation of the population from the area of the accident, the stay in specially designed closed spaces (shelters), the oxygen masks, the special uniforms. It was also highlighted the need of restricting the spread of radioactivity to the healthy population through the decontamination of individuals (with iodine tablets and water), the quarantine of people who are contaminated and the consumption of packaged food and bottled water.

*"..I suppose there must be special disinfection chambers, quarantine certainly and I guess there are specific procedures to be followed..."*

*"..What comes first to my mind are oxygen masks. Beyond that, I could imagine some uniforms that protect us from the atmosphere so we don't inhale and come over our clothes, so they will not be transported later. Then, some sterilized spaces to gather the people there. I can't imagine what we can eat. Bottled water, obviously. From then on, the diet will be very difficult..."*

However, some reservations have been expressed about the above-mentioned measures. In particular regarding the possibility of permanent movement for a large part of population (location, diet), the adequacy of closed areas - shelters, living conditions, the availability of large quantities of personal equipment and the existence of organized plans at local and national level.

*"..The issue is this: it is never enough for all. How many can fit in a place like this..."*

*"..Basically, I believe there will be a scenario in which these people will be removed because there may be some people who may not be able to move away by themselves..."*

*"..It is difficult nowadays, it needs too much organization and difficult because nowadays we have too many assets and many people don't want to leave them, as we have seen in other recent emergency situations..."*

### **Understanding of measures**

Participant have their concept of what they would need to do during sheltering (Q2.8).

Most participants reported that the stay indoors should be as short as possible. The reason is that the confinement for a long time in a restricted environment is likely to cause great psychological burden, oppositional behaviors and appearance of mild or severe psychopathology.

*"..It has never happened to me, but by survival instinct, as much as I needed. Depending to the circumstances. It has to do with the conditions. They can't be comfortable, but if the conditions are at a fairly good level, I think I could stay long enough..."*

Basic prerequisite for remaining in a closed area (shelter) is this area to meet basic standards. In particular, the place should be constructed according to the international protection standards that will not allow radioactivity to pass as far as possible. Doors and windows must be well-sealed and there should be a good ventilation system with special filters that will recycle the air.

*"..Certain instructions will surely be given. I believe that these instructions will be to seal everything and wait as long as it needs to calm the whole situation so that they can go out to move or wait the authorities for help..."*

*"..Initially, there must be ventilation but not exposed. Specifically, it must be organized so that we don't inhale contaminated air. The doors and windows of the building should be according to specific standards that I don't know... "*

Food during a stay in a restricted area should only include packaged and long-term food such as canned food, dry food and bottled water. Also, food produced from agricultural crops (such as fruits and vegetables) should be avoided due to possible contamination.

*"..I suppose I would eat canned food and I would drink bottled water..."*

*"From the region affected by this situation I would say nothing. Because everything will have radioactivity and it will be dangerous... "*

For animals, firstly, it should be considered if it's possible to move them to closed spaces, because priority should be given to the people. Many people claimed that the animals should be killed as they will be contaminated, while others have expressed the view that farm animals could be decontaminated in order to be consumed by humans, if there is a need.

*"..For animals, I think that measurements shall be made. In second phase, perhaps an assessment can be made of how infected they are and to take the necessary measures..."*

*"I believe most of them will have to be killed and find a way of how and where to bury them. We are talking about animals that live outside and are affected..."*

*"..Surely the owners of animals will try to take the animals with them. I would support this view. But at a certain point, if things are too tragic, we have to put some priorities and focus more on people's survival..."*

The concepts related decontamination of people, animals and equipment (Q2.12) are identified. The main ways of decontaminating people in order of priority are: relocation from the accident area, their transportation to specific places (hospitals-specialized centers) and their examination by doctors, their "decontamination" by specific methods (iodine tablets, body-wide showers, medicines) and - if the levels of contamination are too high - their isolation (quarantine) to prevent further spreading of radioactivity.

*"...They would certainly isolate them for a while. And then they would try to help them by some means that I don't know exactly how it works, so they won't die because they would be near the accident and live as long as a normal life without side effects..."*

*"..Like a quarantine, where all the people live within. I don't know, of course, if someone is little contaminated with someone whose levels of contamination are too high, and there must be a separation ..."*

Regarding the decontamination of animals, it was argued that a similar process should be followed with the one applied in the case of people. However, there was a strong concern about whether this may be possible, especially in farms that animals are contaminated. Regarding the equipment and contaminated materials, it was reported that they are specialized companies but without any reference about the collection and management process.

*"..The same thing. Direct removal from the place in order to be affected as little as possible. Just like people. Because what exactly happens in humans happens to the animals, the same case ..."*

*"..These are very exposed, it is a very big problem because affects the food chain..."*

*"..Surely we will not give them food from the subsoil. They must be fed with dry food, hay, or whatever else feeds the farm animals, and they should be transported to special facilities ..."*

*"..I have heard that there are some companies that take them but I do not know exactly the process..."*

Food safety was a matter of intense concern (Q2.13) as all food products that were close to the accident had to be avoided. The construction of greenhouses, the import of products and raw materials from other countries, the consumption of packaged food and the existence of food stocks have been mentioned as the main measures for food safety. Concerning the duration of these specific measures, it was claimed that it should be long-term (at least 10 years), until the land is appropriate for food crops.

*"..I suppose you don't eat anything that was exposed to radiation or was near the place of the accident..."*

*"..Anything is in stock. So, we go now to what exist on the super market, to packaged food, to basement, what the factories have. Anything that is long term..."*

*"..Probably for several years. Because I believe that it takes years to stop being radioactive. I do not know whether it is true or not, but I suppose... "*

## Information and trust

The state services are still the main sources of information in case of nuclear or radiological accident (Q2.16), such as the General Secretariat for Civil Protection, the Ministry of Health, the Police, the Fire Service, the Municipalities and the Regions. However, bodies (operations) and organizations with proven experience in the field of atomic energy (Demokritos) or health crisis management (HCDCP - KEELPNO) should play the most important role in coordination.

*"..I would go to "Civil Protection" but I would not just stay there, I would look for anything else I could find. The first thing that comes to mind, from what we have lived through these last few years, is that it is the primary body that deals with emergencies..."*

*"...in some centers. In Demokritos? It is a center that specializes in the particular operation, so you feel sure it is the most reliable..."*

*"Yes, I would definitely visit Internet, it would be the first reaction when we learn that something is happening to obtain relevant information."*

The main channels of communication are Internet, television and radio, with emphasis on scientific articles and informative broadcasts from reliable international and Greek media.

All participants stated that would obey to the instructions of the responsible authorities, despite the possible difficulties that may arise in planning and implementing an emergency plan in the event of a nuclear/radiological accident.

Although the majority of participants stated that the chances of a nuclear/radiological accident are minimal, however, there was a strong need for information to be frequently updated (Q2.17). The main reasons for this are the need for people to understand the danger that exists in case of an accident and the measures to be taken, as well as the development of expertise on how to prevent and manage nuclear accidents.

A very important role in providing information is associated with the way (campaigns in schools and municipalities, establishing a World Day for Nuclear and Radiological Accidents) and the means to be used (interactive tools, TV and radio spots) in order to disseminate information as broadly as possible.

*"... If there is progress on the technical knowledge (expertise) around the subject. After a nuclear accident there is a period where peoples' knowledge is improved based upon experience on the subject. If at the same time, research is taking place on how these accidents are treated, it is important that the research findings are identified and applied to both prevention and planning ..."*

*"... As often as there is new information or studies and something is evolving. At any time, if some innovation, some alternative, and some improvement in the techniques are discovered, people should be updated with this new information making it easier on the overall situation..."*

In the hypothetical scenario that external communication via telephone or electrical power is not available, the first option where the information would be checked (Q2.18) seems to be face-to-face contact with people in the neighborhood for the purpose of exchanging views, and afterwards grouped transportation to a qualified body (police, fire brigade, hospital, municipality) where it is assumed that detailed information and coordination for the safety of citizens shall be found.

*"..Man is panicked very easily, and when things happen that he has not predicted, his behavior is absurd. I would try to find people to approach and be able to communicate with them..."*

*"In general I have thought about it many times. I would be in contact with as many people possible, and we would exchange views ..."*

*"In the municipality. Then to the police and the nearest hospital..."*

The Police and the Fire Service are the two bodies that the participants trust in terms of safety issues (Q2.19). The services – bodies that follow regarding trust are those that specialize in crisis management and have the necessary academic background to reduce the effects, such as Demokritos, HCDPCP (KEELPNO), General Secretariat for Civil Protection and in the wider context the hospitals (Ministry of Health). Secondly, municipalities and regions can contribute additionally in the fields of provision of information and support for people (food, housing, clothing, etc.) who would have been most affected by a nuclear/radiological accident.

*"..I would like to trust the fire brigade, the police, who are supposed to be trained for these cases..."*

*"..Yes, I would follow Demokritos instructions because they are serious scientists. Demokritos consists of scientists and professionals..."*

*"I think, we go to Fire Department, Police, and Mayor and then go to the Region."*

Concerning the basic languages that should be providing the information about the accident (Q2.20) are Greek and English, while it was considered necessary the translation into other languages or dialects spoken by numerous ethnic minorities (Albanian, Polish, Russian) and by immigrants - refugees in Greece (Pakistani, Arabic, Farsi, etc.).

*"..Surely Greek, English and some basic languages of populations that we know exist in Greece, such as Albanian, Arabic..."*

### **Section 3 - Additional questions**

Television and internet were the two main sources of information on the Fukushima nuclear accident in 2011 (Q3.2). Contrary to what happened in Chernobyl (1986), this accident appeared to have a lower impact on the participants' view of the consequences of ionizing radiation to people and the environment. The previous experience of the Chernobyl nuclear accident and the long distance (Japan) were the main reasons why there has been no change in attitude towards such accidents.

However, despite the progress that has been made in the field of nuclear energy, concerns still remain about the risks that exist and the possibility of dealing effectively with such emergencies.

*"..Perhaps because I was just a child living through the Chernobyl accident, it was a first time experience and I saw it more intense then, but I didn't have the opportunity to further look into it. Since the Japanese accident was much further away and it took place in a marine environment I didn't have any particular concern and I didn't deal with looking for something... "*

*"..I went into the process of thinking that this risk still exists. Or that even that it affected us. The thought of the spread an event like this may take frightens me. Because is it not something perceived by the senses, which I find very dangerous..."*

*"All the accidents affect me because I feel that we are still not at the level to be able to have very good control of nuclear power..."*

## 4.3 Slovak Republic

### 4.3.1 Description of the sample

In the Slovak Republic, 17 interviews were carried out in the last two weeks of November 2018. The socio-demographic profile of participants is shown in Table 4.

*Table 4: The demographics of the participants in Slovak Republic*

Socio-demographic variables	Labels	Frequency	Percentage
Age (average: 47 years)	Less than 35 years	4	23.5%
	From 35 to 55	8	47.1%
	More than 55 years	5	29.4%
Gender	Female	9	52.9%
	Male	8	47.1%
Education	Primary school	3	17.6%
	Secondary education	8	47.1%
	Tertiary Education	6	35.3%
Profession	Student	1	5.9%
	Technical	9	52.9%
	Humanistic	7	41.2%
Living in	Town (Trnava)	16	94.1%
	Village (Modranka)	1	5.9%
Living near NPP	Bohunice NPP	17	100.0%

### 4.3.2 Procedure

The interviews took place mainly in the city Trnava and one in the village Modranka (former part of Trnava) located within the emergency planning zone of Bohunice NPP in 17 kilometres south-west from NPP.

The protocol provided by the task leader was reduced to the most important questions in order to promote participation and to facilitate data collection. Interviews were carried out face-to-face in Slovak language and the answers were recorded in written form to the protocol template in Slovak with an average duration of 40 minutes. Conducting of the interview was agreed in advance and was performed in agreement with procedure and the ethics of interview under the agreed CONFIDENCE project methodology.

### 4.3.3 Findings

#### **Familiarity with and knowledge of the emergency plans**

Most of the interviewees once they were asked about what do they know about EP&R plan (Q1.3) explained in details basic elements of the EP&R plan, most of them give very simple descriptions such as “plans in case something happen at NPP” or “what to do, how to act and how to protect themselves in case of an accident”, “to have secured in case something happen so people know what to do”. Some of the interviewees, especially those working at schools or universities in different positions know that there are evacuation plans, coordination among different response organisations and at different levels - national, regional, municipalities/local levels. Many of interviewees do not know many details,

are not very interested in, but they know that plans exist and they are available at internet. Only one answered: "I don't know anything about plans." Information come in most cases from school, from professional duties at school, from media, from KI exchange campaign, from friends and family members, from evacuation exercises and monthly exercises of sirens/alarm.

Participants mention some basics elements of the EP&R plan (**Q2.1**):

- Sirens / alarm, which are tested monthly.
- Public Address system (PA system) - local radio in the streets. Many of the interviewees inform about the existence of a PA system that would give information to the population in case of a nuclear accident. This system is used in the villages for the local announcements and in the all municipalities within the emergency planning zone is tested together with sirens. During that testing there is announcement to check availability of KI pills at home or at particular bigger institutions/factories.
- Information on how to act. Many of the interviewees mention they expect that the EP&R plan would give instructions on what to do: where to go, where shelters are, what to take with, when to prepare for evacuation. There will be TV and radio transmission with more information and instructions. "Pensioners and unemployed have to be better informed", "
- Sheltering or evacuation: "close the windows, seal the doors, we probably will not have time to go to the shelter", "take the important things and go to shelter", "where to shelter", "where special shelters are", "where are evacuation gathering points", "what to take with", "wait on announcement when evacuation starts and where we will be evacuated", "from which areas to which people will come, also those who are responsible, commander and people and groups he is responsible for".
- Medicine / pills: "take the pills, we have them", "pills are after warranty period", "do not know if they are helpful", ". A couple of the participants do not know if they have them or if they are within the warranty period or where to exchange.

Some of them mentioned also availability of technical, material and personal resources, decontamination resources (clean clothes), availability of accommodation for evacuees, economical resources, monitoring of situation, security of different objects and security forces availability, fair and health brigades

Some **uncertainties** coming from these elements of the emergency plan are highlighted by participants:

1. What to do? Those mentioning uncertainties related to what to do, express mainly doubts about whether to stay at home or go away: "Where is safe to move, how to behave?" or "Do we need the masks, where to take, how we can protect ourselves not to inhale?" or "If it is known in advance to leave the zone if it is possible, if there is suspicion there should be prevention - evacuation, or at least limited groups" or "people will be nervous, will not listed to, or will want to be first
2. Where to go? "Where to go and what to take?" or "Where are shelters now? They have been available before" or "How to gather and where?" or "We do not know the development of weather?"
3. How the population will be informed? "Pensioners and unemployed have to be better informed", "Panic, chaos, would not be informed", "It will not be enough to inform by radio and TV, people from authority offices, army has to be sent to each town part to organize and provide statements and talk to people"
4. What are the risks they will face? "I would afraid of cancer, also of affected children", "at the concert - will be trampled", or "will masks and pills help us?" or "Risk of stress, panic, hysteria,

criminality” or “we will die here, but those far from here have to be prepared, also in Vienna, they have to take pills, it will not help us” or “myself because of panic I will not know what to do.

5. Are available resources sufficient? “Evacuation of the whole city - how it will be protected against plundering?” or “lack of people, when some objects need to be maintained continuously” or “insufficiency of busses for evacuation”.

Regarding previous or possible radiological or nuclear emergencies in the country (**Q2.2**), some of them from elderly generation mentioned the accident occurred in 1977 in Bohunice A1 NPP, and as someone added “there were some patients in the hospital, neighbourhood said”. Some of interviewees have mentioned possible explosion of NPP. Most of them mentioned that release of activity can occur from the NPP. Many of them believe in responsibility of operators and safety of the system saying: “There are responsible people to avoid something happen, believe it” or “it is secured, there is system and that it could not happen” or “development is going on”.

Differences in knowledge seem to exist among those that have relatives or friends working in the NPP.

### **Risk perception**

When participants were asked what they think it could happen during a radiological or nuclear accident (**Q2.3**), following believes come out:

- In case of a major accident, participants share the following believes: “We will die in the short time, the whole area will be contaminated, as after Hiroshima”, “The end, Hiroshima, nuclear explosion”, “Destruction of vicinity by shock wave, but only in case of major accident”. Nonetheless, some participants state that, in that case, it is better to live close to the NPP because you will die faster. Another related idea is that, in the case of a serious accident, all the country will be affected.
- Many of interviewees pointed out some exact risks for health such as “cancer, the daughter - weather her children will be affected”, “later effects related to genetic changes/mutation”, “burns, poisoning, suffocate, even death especially those who will respond first”, “secondary effects, when accident surprise will do not know what to take with for evacuation, it will be flight, transportation crashes, injures less health care, missing medications forgotten at home in a hurry”.
- in case of a minor accident, the risk of radiological contamination is mentioned. “Atmosphere, soil, water, especially water”, “It will be everywhere”.
- One responder answered “Radiation - I do not afraid of it, I cannot see it, I am afraid of what I can see. When I do not see it - it does not exist”.

When we ask what they remember about Fukushima or Chernobyl accident (**Q2.6**) most of them mentioned Chernobyl as the consequences took place also in Slovakia that time. As the main consequence mostly death of many people was mentioned as well as health effects in overall population and especially for children and pregnant women. Equally destruction as the main consequence was mentioned: “Up to now empty town Pripiat, town of ghosts”, “Town die out”. Most of interviewees mentioned lack of information that time. “Information was given too late” or “Information was concealed and hidden”.

One woman remembers: “I was pregnant that time. Information was given that it is not danger, that Chernobyl accident is not influence us. But my neighbour said that I should avoid going outside. I was disoriented. We should know that there is danger. When Fukushima came I get scared if it could also influence us. May be it was because of so much information were in the media. I had fear. I followed all new to have more information”.

When we asked them if they were afraid of related risk, some of them stated that they are not, that “it is better secured now as it was before, improvements done” or they “believe to those responsible for safety, I am optimist” or “they know what to do” or “we cannot have tsunami here”. Some are afraid: “Of course, it could happen anytime”. Some were indifferent: “If something happen - what with that? I am not conscious of that risk now.

### **Foreseen measures for a radiological and nuclear accident**

We ask participants what kinds of measures are foreseen for radiological and nuclear accidents (**Q2.7**). Different measures came out spontaneously:

- Most participants have in mind that population will be warned by sirens and follow up PA system/local radio in the streets, the special transmission will follow in TV and radio.
- Most of interviewees will take iodine tablets which they have at home or expect to receive some in the shelters.
- Most of them will pack important things and go to some shelter, will look for some nearby, but have no information where they are or if older shelters available before are prepared for use also nowadays. Many of them expect to have food and water prepared there. Under knowledge of some of them food supplies are renewed each 5 years. Some will remain at home, but are not sure if it is safe.
- Most of interviewees mentioned evacuation. Some mentioned to go the whole family together. Some interviewees expect to receive instructions how to behave and what to do. Some expect to have provided medical care, instructions from police, fire brigades to prevent panic.
- Some participants declared that it would be necessary to use a mask or special rubber wear as solders have.
- Some interviewees mentioned decontamination to take place and follow up liquidation of waste.

### **Understanding of measures**

#### *1. Sheltering*

The first question of this subset was about sheltering (**Q2.8**). We first ask participants what it means. Most of the respondents relate it with staying indoors: “Stay at home or in cellar/basement” or “Shelters”, “In organized way all go to shelter”. Regarding the shelters some of interviewees know that they have been constructed, but suppose they are neglected now.

When we asked what they would do in case of sheltering in place, some ideas came out: close the windows, do not ventilate, switch off air-conditioning, caulk, listen to the media (TV, radio), look for information in the internet, follow instructions and someone who manage.

We then asked for how long they would stay there. Most of them accepted 2-3 days, as well as one week. Some supposed to come out after a week or in time when it will be announced it is safe. “I will look in information if something changes after a week”, “I will wait at home up to the announcement it is safe”, “They will let us know. I will look for info at internet”. Some answers mentioned rescue brigades: “Maximum 3 days, then rescue brigades will come” or “I will wait until busses will come, in a few days, as soon as busses are available then go to assembly points, evacuate immediately”. Some referred: “I do not think I will stay at home without any problems”, “We have no food reserves for the half a year”.

On the question regarding the food most answers were the food we have at home. “Food from fridge, nothing happen to it”, “Food in cans, packed food, packed water”, “It is important to have a good

pantry, canned food. I have reserve for one and half month". Many of them referred to the limitation in use of tap water: "Tap water will not be good", "I will not drink tap water, it will be contaminated".

Regarding animals opinions differed: some who have pets would like to take them to the shelter but conditioned "if it is possible", some expect there will be some room for them with someone who take care, but many of interviewees (even those who have pets), declared "We have to leave them", "Unfortunately, those who are outside, they will be berserk, could hurt, have to be killed". Regarding livestock the answers were that they have to be sheltered, have veterinary control or slaughtered.

## 2. Iodine prophylaxis

Respondents have very good knowledge about iodine prophylaxis as it is pre-distributed and each 5 years there is new exchange campaign (Q2.9). Most of them on the question why are the tablet used for indicated thyroid protection in their answers: "The level of iodine is growing and then thyroid will not take radioactive one", "So that it will not penetrate to the organism, Iodine protect thyroid,", "Iodine helps so the thyroid remain healthy". Some mentioned in general that it protect against radiation: "So that we will not be ill from radiation", "so that we are protected against radiation".

On the question where to get iodine tablets in case of a nuclear emergency most of interviewees answered that at the municipal office (MNV) and most of them have them at home: "Have them at home, exchange them already", "I have them, each should have them, I think so". Some of them have no tablets at home but know where to get. Some of them have the tablets after expiration, knows were to get new one but did not do it: "Have at home, do not know if expiration date is OK". Some moved to the own housing and did not take tablets from parental house. Some think they will receive them in case of need or will take them at pharmacy.

Most of the respondents will take iodine tablets immediately after sirens or RA system/local radio announcement: "After the accident announcement immediately, all have to take pills". Some of them will wait for exact official instructions in TV or radio: "I suppose I will wait, will follow radio and TV, that they will give instructions". Those who have no tablets at home believe there will be instructions given how many and when to take.

It is generally believed that everybody should take the iodine tablets under the instructions in the package leaflet. Some distinguished explicitly between adults and children dosage: "All, small children... hot to give to them... I will read it in the leaflet".

Those who have pets suppose they give some piece of pills also to them.

## 3. Evacuation

Participants are familiar with the term "evacuation". Most of interviewees responded that evacuation will be organised: "Police, rescue brigades, civil protection, I do not know who else, army, volunteer faire brigades, those who are trained, if there are plans in place", "It is national issue", "Plan, who goes where, I do not know, it must be coordinated, do not panic, listen instructions, women, children first, elderly people, more endangered groups, it should valid". It is believed busses or trains will be used to move as much people as possible far away to the safe places: "Transport should be common - busses, railway". Many of them suppose there will be instructions where to go, where assembly points are: "They will give instructions when and go there. There are new sirens now, they can enter and say and navigate us", "Through the radio they will inform where to go", "We will go to the post near the school, then do not know". Many have mentioned use of private cars for evacuation but underlines problems connected with that: "When announced everybody get into the cars, crashes, it would be chaos, panic, catastrophe", "If everybody evacuate by himself it will never end!". The interviewees supposed to be

transported to far distances: “50-100 km”, “I am not sure if some temporary centres will be available, army should build tent centre”, “to the bunkers, in the halls”.

Regarding what to take during an evacuation, three aspects are highlighted part from the family:

- Money, credit cards and documentation (for instance, ID)
- Food and water, medications
- Clothes and blankets

On the question regarding the evacuation of children most of interviewees answered that it will be organised by the school or responsible from the plan: “Children at school and those at work stay at their places. School staff is taking care about them”, “those who are with them, we are at the different places, different places for evacuation”, “Teachers under the class register, we are exercising that. I know it better what to do in school then at home”, “Each have their own plan, we will find them later on in shelter”, “School will evacuate to the specified place”. Some suppose that “parents will come for those smaller one”, “those who are with them if we could not come”, “those who can take care should do it, may be there be time to come and take children”.

In relation to the tourists most of interviewees’ answers were that responsible for the excursion/travel agencies should take care; it should be issue for the city administration, “will join domestic persons”.

Those participants who have animals split in two groups: one “will take their pets with them”, other “food water and leave at home, I know , it is terrible, they could not go with me, unfortunately, close at home”.

#### 4. Accommodation and care of evacuate population

Very little knowledge exists on shelters and accommodation of the evacuated population (Q2.11). Under interviewees there should be “army tents, where will be beds, something simple for the beginning”, “Tent cities will be built”, “The school gym, some halls, community centres, recreational buildings will be used”. “The important is we will be safe” was mainly their answer.

Participants were asked about how many people would be relocated and most of them referred to thousands: “even 100000”, “60000 is in Trnava, villages in the vicinity, so 120000-150000 thousands, may be 1/5 from it, so 30000? It is also a lot”, “I think 200000”, “All in the vicinity where it happen, nearest to the source”, “a lot, several thousands, depending on what is the range”.

Regarding the question how long the relocation could last most of them referred to the dependence on the “check/control of radiation”. Many of them suppose it will last longer period: “week, two months, when finish I will come home”, “I do not know, while radiation have effect, listen to responsible”, “week, two, under the situation - years”, “while risk will not finish, while radiation endanger people, may be forever”.

All participants believe that state will cover all expenses. Most of them suppose there is some reserve fund created for such a case.

#### 5. Decontamination

All participants know about decontamination (Q2.12) and all of them referred to the “showering, change of clothes”, “I do not know if it is enough to shower or also some special solution will be used”, “big showers, as at the swimming pool”. Only one mentioned internal contamination saying “put antidote”.

Most of them answered that “dirty” or “contaminated” clothes have to be disposed: “burn”, “put into the plastic bags so it is not going to the environment”, “bury”, “put it into barrels”, “give it into a big storage, with concrete walls, enormously big”.

## 6. Food security measures

Participants have very general ideas about food security measures (**Q2.13**). They are aware about the contamination that a nuclear emergency can produce in food. Specifically, vegetable from the open air, from the fields and gardens they will not eat. Also animals that have been outside they will not eat: “people would be afraid, they will not believe it is OK”, “slaughter all without measurements”, “cows in the field, we should not consume their milk”.

Many of them mentioned that food from abroad or from other areas not affected by the accident should be provided. Most of interviewees mentioned state food reserves that should exist in particular one participant exactly stated: “they should be renewed each 3 years; I do not know if it is performed”.

Many of participants mentioned packing and conservation of food as some measure: “eat from our reserves we have”, “canned food, canned meat”, “packed water, not from tap”. Many of them are not sure about how security measures are done: “to cans it (radiation) could not get as much as to preserving jar from glass”. Some of interviewees mentioned feeding of animals with clean feed: “what to give them, something what is preserved, or dry food, or from store”.

Some of interviewees mentioned measurements of the level of radioactivity in the food if it is suitable for consumption.

### Information issues

Interviewees believe they would get information (**Q2.16**) mainly from mass media (TV, radio), the local radio (PA system), local TV, City Council, car with megaphone, responsible persons who will give the instructions, professionals, neighbours, internet. The channels that participants would rely on are:

- Public Address System/local radio.
- Mass media: television and radio: “not so reporter as the interview with professionals, police management, health professionals”.
- Internet, but “not Facebook, there are stupid things there”.
- Phone (mainly mobile phone).
- Family members, friends or someone familiar with NPP.
- Neighbours.

All interviewees will follow governmental instructions: “Sure”, “It is stupid not to follow it”, “Yes, in order to know what to do” “Yes, but first of all local authorities”, “Yes, by chance will change something after announcement and we do not need to do anything!”

A general belief that the information should be updated continuously is transmitted; that is, every time there was a significant change (**Q2.17**). The frequency of information providing was seen differently for the beginning of emergency and follow up days: “often, at the beginning each hour, then once a day, people should know information it depends what will be important”, “As in the airport, people will calm, to avoid panic and making things up”, “Not to repeat Chernobyl”.

Regarding where to check information (**Q2.18**), three main sources are mentioned: the city council and state office (“The City Council, office employees, they have other communication links”, “The President is determinative”), civil protection or police (“Police and responsible persons who are there”, “police, rescue system, fire brigade”), and mass media and local radio (“TV, there will be statements”, “In TV there will be first news, big attention, radio, local radio, there will not be alarming rumours”). Many of respondents will ask neighbours, call friends. Some will use several sources: “Find out at different

sources, if the information is equal”. One answer was: “Do we need to check? If everybody will check we will never evacuate, the organizers will guarantee!”

Participants clearly stated that the information should be provided in Slovak and language of minorities, mainly Hungarian (Q2.20) and as minimum in English and German. Other foreign languages have been mentioned such as Russian, French, and Czech. But there were also doubts: “If there many languages used there could be chaos”, “There are many Serbians now here, they will not understand”, “Tourists, they will have immigration police”.

## **Trust**

We ask participants who they would trust in case of a nuclear emergency (Q2.19). Majority of interviewees will trust those who are responsible for countermeasures implementation: emergency services such as civil protection, police, fire brigade, Red Cross and army: “All who will navigate, evacuate”, “Those who will be responsible, some person”, “Responsible”. Many of respondents declared they will trust all: “All, not to choose, each and every information is good”, “I would trust all, each will contribute”. Many of interviewees will trust Nuclear Regulatory Authority (NRA) and researchers, professors, professionals at Civil Council: “NRA at first”, “The most NRA, they are competent, they are responsible, more precise and more competent info”, “VUJE, researchers from the Academy of Science, professors, engineers”, “Professionals at Civil Council”. Some trust to NPPs: “Directly those who are responsible - NPP, are near the source”, “The Company who own and operate, I will trust them”. Some trust in media, independent and public television. Some trust in state institutions: “To rely what they will tell us is true, it is the state interest to calm people to avoid panic”, “President, is responsible for people, will calm people”.

## 4.4 Slovenia

### 4.4.1 Description of the sample

In Slovenia, 15 interviews were carried out from mid-November 2018 to mid-January 2019. The socio-demographic profile of participants is shown in Table 5.

*Table 5: The demographics of the participants in Slovenia*

Socio-demographic variables	Labels	Frequency	Percentage
Age (average: 47 years old)	Less than 35 years old	3	20.0 %
	From 35 to 55 years old	8	53.3 %
	More than 55 years old	4	26.7 %
Gender	Female	8	53.3 %
	Male	7	46.7 %
Education	Primary education	1	6.6 %
	Secondary education	10	66.7 %
	Bachelor's degree and Higher	4	26.7 %
Employment status	Retired	3	20.0 %
	Employed	9	60.0 %
	Not employed	3	20.0 %
Distance to NPP	Less than 50 km	6	40.0 %

	From 50 km to 100 km	8	53.3 %
	More than 100 km	1	6.7 %
Place of living	City	7	46.7 %
	Village	8	53.3 %

#### 4.4.2 Procedure

A member of the research group carried out the interviews across Slovenia with citizens in the areas of less than 50 km from NPP Krško, from 50 km to 100 km and more than 100 km. According to Slovenian National Emergency Response Plan for Nuclear and Radiological Accidents (2010) and Risk Assessment for Nuclear and Radiological Accidents (2018) the whole territory of Slovenia is endangered, distinguish several different zones: up to 25 km – medium risk, and whole Slovenia – small risk on 5 level scale. The geographical distribution of risk in NPP is given in Figure 2.

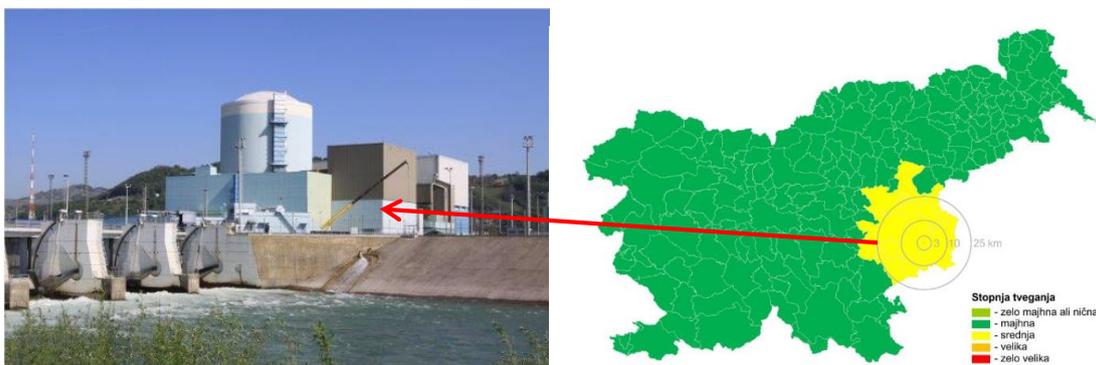


Figure 2: Geographical distribution of risk for nuclear accident in NPP Krško

It has to be mentioned that is NPP Krško located near the border with Croatia and has 3 different local zones and general area:

- **Precautionary action zone (PAZ)** in which protective measures are planned and implemented lies at a distance of 3 km from the Krško NPP where, due to the proximity, immediate preventive protective measures are implemented. The PAZ includes entire settlements, even if they extend outside the 3 km zone.
- **Urgent protective action planning zone (UPZ)** in which immediate protective measures are planned and implemented lies at a distance of 10 km from the Krško NPP. To facilitate the planning and implementation of protective measures, the entire UPZ is divided into settlement areas covered by a grid of 16 sectors.
- **Long-term protective action planning zone (LPZ)** in which long-term protective measures are planned and implemented lies at a distance of 25 km from the Krško NPP. To facilitate the planning and implementation of protective measures, the entire LPZ is divided into settlement areas covered by a grid of 16 sectors.
- **Area of General Preparedness** includes territory of entire Slovenia where protective measures are implemented on the basis of model and radioactivity measurement results. Protective measures in the entire territory of Slovenia are long-term, food security measures and immediate.

In Croatia the zones are defined differently, with remark that capital Zagreb is 30 km from NPP:

- UPZ (Urgent protective action Planning Zone) in the area of 20 km;
- EPD (Extended Planning Distance) in the area of 100 km; and

- ICPD (Ingestion and Commodities Planning Distance) for the entire territory of Croatia.

The protocol for interviews was provided in advance and was mainly followed. In some interviews was modified to adopt to particular situation and available time. The most important questions were followed in order to promote participation and to facilitate data collection. Interviews were carried out face-to-face, mainly in the inside spaces or by using internet-based communication tools, with an average duration of 45 minutes. Interviews were audiotaped and transcript in English. Conducting of the interview was agreed in advance and was performed in agreement with procedure and the ethics of interview under the agreed CONFIDENCE project methodology.

### Data analysis

MS Excel was used to organize the discourse of the interviews, to enable overview of the responds and made the comparisons and derive the outcomes. Codes were derived from the interview protocol but also from the discourse of the participants. Next section presents a narrative thematic analysis of the discourses.

Cmap Tools (<https://cmap.ihmc.us/>) has been used to draw the mental model map. Cmap software empowers users to construct, navigate, share and criticize knowledge models represented as concept maps.

#### 4.4.3 Findings

##### Familiarity with and knowledge of the emergency plans

Most of the interviewees declare to have heard about the concept of “Emergency Preparedness and Response plan” (Q1.1). Some also admit that they never have seen such document and that they more imagine that such document should be developed. However, very little knowledge exists among participants. Already at first respond they admit that they “do not know what the content would be” (Interview 4, 12 and 14). In Slovenia all of the interviewees were able to identify the NPP and also its location in Krško (Q1.2). Once participants were asked about what do they know about EP&R plan (Q1.3), most of them give some descriptions of what the plans should cover: such as “plans in case there was a nuclear or radiological accident” (Interview 3 and 4) or should be developed for people “prepared to inform people and what to do” (interview 13), they also mentioned facilities/activities for which plans should be developed “should be developed for nuclear plant, for transport of radioactive material, for evaluation of impacts on environment” (interview 10). The responds identified actors which should be included, like fire fighters, army, ministry for internal affair, civil protection. The interviewees also have some ideas how the plans should be prepared: at the national level, local level and also EU level. They recognize that responsible institutions would be involved, like civil protection, nuclear regulatory authority, NPP, and some services (police, fire fighters, army, ...). Several also believe that “local population should also be involved” in development of plans (interview 5, 12, 13,) and that they “should be public and not too long” (interview 11), “approximately 5 pages long” (interview 8).

The participants have some experiences from accidents which would call for immediate reaction (Q1.4) and they mentioned cases like fire, flooding, from previous regular exercises performed in previous state of Yugoslavia (called “Nič Nas ne sme Presenetiti” – Noting should surprise us) and also Chernobyl accident. They say that they received the knowledge of EPR plans mostly from media, from military service, and based on their logic.

Participants mention some basic elements of the EP&R plan (Q2.1):

- evacuation plan for near and far surrounding, actions for mitigation of accident, remediation and evaluation of impact, notification and warning.
- how to protect yourself, what to do first and what follows, who to contact, what to do in case you cannot evacuate,
- notification and warning for people, which services and institutions are involved, what they do, the measures for protection of people,
- basically, it is a system how people would react in case of accident, who would be involved, what to do,
- what to do, where to hide, where to go, for each building should be known where the people should move,
- the accidents should be announced by sirens and loud speakers,
- also, information about what are possible accidents, at start they always says it is nothing, only later you get the whole information.

Some **uncertainties and disagreements** coming from the emergency plan are highlighted by participants:

1. What information should be available? There is not sufficient information available now, ministries and responsible institutions should find the ways how to inform population: should be responsible to include the topic in schools and other channels (like mobile applications) that all would be informed, measures to protect should be clear to all (interview 3, 7). There would be multi sources of information and should be known what reliable sources are. In addition, there should be exercises performed and practice at all levels: local and national (interview 2, 3, 7, 8).
2. What to do? Some people would not follow the instructions as they do not trust the government and institutions: “they do not trust governmental institution” (interview 1), “the government do not reveal the information promptly, they try to hide information, then when all other are informed, they open some. This are the experiences from accidents.” (interview 5). There would be panic (“panic could be very big, data are not understandable”- interview 3) and as they are not really informed, they would use their own imagination what to do.
3. Are plans harmonised with behaviour of population? There is question between participants if plans foresee the real behaviour of citizens - “Each would first collect the family members. People would take food and other things from shops, people could run to the summer houses.” (interview 10), “people would pick their kids and then go away, for example in Italy” (interview 2).
4. What are the risks they will face? The associated risk is assessed as very high “Public is not aware of what could happen. It might be much worse than in Chernobyl.” (interview 4), and some elements of fatalism are present “if something severe happen there would be not sufficient time to do anything” (interview 6).

Regarding what kind of radiological or nuclear emergencies can happen in the country (**Q2.2**), most of participants think that very severe accident in NPP can happen, like explosion of reactor, melting of the core with release of radioactivity to environment, similar to accident in Chernobyl. Besides, they also recognise some other accidents in NPP: like fire, error with fuel and accidents during transport of fuel. Even fresh fuel accident could have impacts on environment according to their opinion. They also listed some other accidents with the impact to environment: mistake at the radioactive waste storage facility, accident in TRIGA research reactor, accident during transport, in medical use, mis manipulation of radioactive isotopes, terrorism and dirty bombs. Differences in knowledge seem to exist among those that have worked for the NPP, although most of participants have not been worked for NPP but still could identify the potential accidents.

## **Risk perception**

When participants were asked what they think it could happen during a radiological or nuclear accident (**Q2.3**), three main believes come out:

- In case of a major accident in NPP, participants share the belief that if something very serious occurs, we will die, and it will be impossible to do anything. Some of the images that appear are: “in few hours there will be genetic consequences” (interview 1), “the radiation would be fatal, cancer can be a consequence and dead” (interview 4), “if something severe happen there would be not sufficient time to do anything” (interview 6),
- In case of a minor accident in NPP, participants share the perception that the consequences would be long lasting with impacts on current and future generation and not much can be done like “impact on population for a long time, pregnant women and impact on babies, if someone is irradiated radioactivity stays in the body” (interview 3), “Impact is slow during longer period, it can destroy bone marrow, bones are weaker and break, leukaemia and other cancer can occur” (interview 7), “the impact on human is slow and after radiation one does not die immediately” (interview 8). It can be seen that some people believe that irradiation means that the irradiated body become radioactive itself (even if there is no internal contamination): “everything would absorb the radioactivity, which irradiate, and can last for very long time” (interview 7).
- In case of accident in other facilities or during activities, the risk of radiological contamination is mentioned, but it is regarded as not so important. Exact risks for health seem to be unknown.

However, independent of accident (in NPP or other facilities) participants mostly agree that the plans should be developed for all potential accidents in NPP, other facilities and also for activities, and should be known to employees, population and institutions (**Q2.4**). Interviewees have recognised some organisations which would be responsible for reaction in case of accident (**Q2.5**) like nuclear administration, police, fire fighter, civil protection, army, services which communicate with public on national and local level. They also believe that NPP and other licensees should be involved in reactions to accident.

When we ask what they remember about Fukushima or Chernobyl accidents (**Q2.6**) most of them mentioned destruction as the main consequence and bad governance, but also impacts imposed in Slovenia: “I heard for accident in Chernobyl. I remember that mushrooms cannot be picked, or vegetables. Chernobyl is more in the memory then Fukushima. It is now a ghost city. People were afraid, it was horrible, as the impact is so big.” (interview 3) or “in Fukushima: older were cleaning to protect younger, this is also an ethical question, cooling water was leaked, 200.000 people were evacuated” (interview 10) or “Both accidents were very severe, people were afraid, there was many dead, evacuation of big zones and closed areas. There was no clear how many people were affected, dead, illness and with other consequences.” (interview 15).

When we asked them if they were afraid of related risk similar to accidents in Chernobyl and Fukushima, the participants who confirmed explained:

- Yes, I believe that impacts are very harmful for people.
- I was afraid because they did not tell about the real impacts.
- People saw for the first time how dangerous is nuclear.
- It was the ignorance of governments in both cases and the proof that they are not able to control nuclear.
- Not able to really control the nuclear obviously.

In general, the level of risk perception is different among interviewees, basically depending on their knowledge and background information and experiences with NPP and other nuclear activities:

- Participants living more far away from NPP are more worried about potential accident and the associated risk, they believe the serious accident could have fatal and immediate impacts, and have less trust in the management of NPP,
- Participants living nearer to NPP have positive cohabitation experiences and are not worried about associated risk, they also know the management and trust them, although they share also the fatalistic views “if something real happens, we would all die” (interview 14).

### **Foreseen measures for radiological and nuclear accident**

We ask participants what kind of measures are foreseen for radiological and nuclear accidents (**Q2.7**). Different measures came out spontaneously:

- Most people mentioned evacuation, food protection and decontamination (cleaning of people),
- Some also added sheltering, notification and warning, pointing out the need to inform not just Slovenian but also neighbours, with use of TV, radio and social media,
- One participant mentioned distribution and ingestion of iodine tablets and one the use of protective equipment and masks,
- Also, it was mentioned that first help and medical support would need to be organised.

It can be seen that participants have imagination from other experiences or based on logic what measures could be foreseen for radiological or nuclear accident.

### **Understanding of measures**

#### *1. Shelter in place*

The first question of this subset, was about shelter in place (**Q2.8**). We first ask participants what it means. Most of the respondents relate it with staying indoors: “Shelter is a place where people would hide” (Interview 4). But further discussion pointed out that almost all involved in interviews have in mind underground structures like bunkers with thick wall: “you shelter in bunker until it is safe, use of skafanders (spacesuits) and clothes, 1 week inside or even 14 days, the radiation is absorbed into soil” (interview 3) or “Shelters are bunkers with thick concrete walls to resist radiation.” (interview 6) or even organised for citizens “Shelters are bunkers organised for citizens to hide underground” (interview 14). It is perhaps also part of our national heritage as in previous state Yugoslavia indeed all cities and communities had to have shelters for population to hide in case of need (like nuclear attack or some other danger): “Before such shelters were available with all equipment, protection clothes and masks” (interview 6). One description is very dramatic and connects to the military background of the knowledge: “You put yourself as low as possible, you jump into the shelter, you wait until the shock wave is over, you breathe thru sleeve, then you move to shelter and stay there until you have reserves. The problem is how to communicate with other words.” (interview 2).

Several participants were not supporting sheltering: “there is no point to shelter, the consequences would be too bad, the best is to go away” (interview 13) or “shelters would need to be established forever, so the only solution is to evacuate from territory” (interview 9).

When we asked for some more descriptions of shelters, the participants mentioned:

- Food and water supplies,

- Thick concrete walls and also with layer of lead,
- Ventilation of air and use of filters,
- Use of protective clothes and masks,
- What to do with animals – most would be afterwards slaughtered,
- Communication abilities to follow what is going on.

We then asked for how long they would stay there. The idea of many days is widely shared, and participants mention from several days (1 or 2 days), to even 1 month or until radiation would be reduced. When we asked how they would know it, the respond was “some people are more sensitive and can feel radiation” (interview 1). Participants also mentioned the issue with food and water supply as it is now not normal to store a lot of food at home. They also expressed concern about the animals: “The animals would need to be place in stalls, so they are not in the open and are not grazing. Something more cannot be done.” (interview 10).

## 2. Iodine prophylaxis

Respondents have very little knowledge about iodine prophylaxis (**Q2.9**). They have a general idea that iodine tablets would protect them from radiation in broader sense and give different descriptions when we asked why the tablets are used for:

- Tablets are used to block radioactive iodine uploading, and some for reducing the consequences.
- In thyroid the Iodine is uploaded, by taking tablet you upload the non radioactive iodine,
- I did not know that they protect against radiation.
- To take iodine tablets - I do not have any idea, what they would be used for, or how to take them.
- I have hard for this, it is about neutralisation of impact of radiation, like base and acid, all people should have them at home, free of charge.
- I knew about tablets before, they should be available for all with clear instructions how to use them.
- Tablet are used to stop radioactivity absorption in body. It should be available at homes for all, also across Slovenia.
- Tablet are prescribed for all, and we would need to have them at homes, even now. But we do not have them, and this is wrong.
- Yes, I have heart from films and games. There are iodine tablets which should be used to protect from absorption of radioactive iodine.
- I do not know much - doctors to prescribe and should be in advance distributed, should be part of plan, especially for local population.

Great confusion is also found regarding where to get iodine tablets in case of a nuclear emergency. There are two general ideas: those that would expect someone is going to distribute them through the houses after the accident (for instance, the police or the civil protection, available in shelters) and those who think they would have to get them outside (in pharmacies or in the health centre). The images are: “I do not know where to get them. The instructions would be issued at the accident” (interview 1) or “The medical staff would need to distribute them to people, all population would need to take them, also in neighbouring countries.” (interview 3) or “they should be available at shelters” (interview 7). Some participants expressed scepticism: “we received the prescriptions for iodine tablets - but I do not believe that they would be effective. I do not have them. There was once leaflet given, but I do not have it any longer.” (interview 14). Some also believe that the tablets would be used for animals.

Most of the respondents do not know when they should take iodine tablets. They believe that the instructing would be at the accident and the distribution after the accident. Most of them respond that they do not know but they expect someone would explain it in case of an emergency.

It is generally believed that everybody should take the iodine tablets with some exceptions: some participants think that tablets should be different depending on the group and that some restriction could be for pregnant women and children. One participant mentioned that those above 65 years do not need to take the tablets, without specification why.

### 3. Evacuation

Participants were asked about their knowledge and understanding of evacuation (**Q2.10**). The responds show that they are familiar with the term “evacuation – is removal of people from certain territory”. Different discourses about where and how far to go in case of evacuation came out. These discourses can be divided in two cases:

- If the evacuation is leaded by authorities.
  - o Instructions will be given: “the civil protection and nuclear regulatory authority would lead the evacuation .... by buses” (Interview 2) or “army and civil protection would need to organise and coordinate evacuation of people ... with sufficient number of vehicles” (interview 3),
  - o It will depend on the plume and the direction of the wind: “I would listen to weather information and drive as far as possible, most probably to Italy.” (Interview 8).
  - o Some participants explain there would be meeting points where people would organize further, and people would be taken in accommodation centres in the distance of 100 km from NPP.
  - o Participants also recognize some ambiguity about who will take care of children: “The buses would perform the transports for citizens. .... Parents would take the children. There could be a lot of traffic jams and chaos.” (interview 10).
- If the evacuation is spontaneous:
  - o Organise by themselves: “Local population would need to evacuate by themselves. They would pick their children and older relative.” (interview 1) or “people would use their own cars and then they could be stopped in traffic jams” (interview 5)
  - o As far as possible: “People would go as far as possible from accident” (Interview 3) or “people would be taken in neighbouring countries, as far as possible, maybe in Italy” (interview 14).
  - o To known place: “We would go to our second house in south of Croatia” (Interview 15).

Regarding what to take during an evacuation, three aspects are highlighted apart from the family members:

- Money, credit cards and documentation (for instance, ID),
- Clothes and blankets,
- Only vital things (medicine).

Many concerns exist regarding the fact that children would be evacuated from the school by others. Clearly opposition come out and those participants that have children or grandchildren at school or kinder gardens express they will not follow the instructions and will go themselves to pick up the children: “I would go and first pick up my kids.” (Interview 2) or “Definitely, I would first gather all family members to go.” (Interview 7).

Those who say they would use their cars in case of evacuation also express awareness that this would lead to traffic problems and chaos. All participants express opinions that there would be panic and that

there is lack of exercises and preparedness among people: “Evacuation was in previous times practices, every company, school has a plan what to do. Also, exercises were regular ... Now we do not know what to do.” (interview 6).

Also, some awareness of zoning exists among some participants: “the evacuation would be performed ... in the first zone 1,5 km app 2300 persons, in 10-15 km app 20.000 persons.” (Interview 2).

Those participants who have animals state they will take their pets with them but would leave big animals in stalls for which they expect governmental surveillance.

#### 4. Accommodation and care of evacuate population

Some knowledge exists on reception centres and accommodation for the evacuated population (Q2.11) but very little where that would be. The ideas of accommodations include public buildings, big halls (like sport or festival halls), warehouses, military barracks and some even mentioned mobile homes to be built for the purpose. The participants foresee that such facilities would need to be prepared and equipped, but that also social and medical support would need to be available: “there should be food, medicine, protection clothes, safety equipment” (interview 4) or “There should be accommodation centres which should be established with all what is necessary - to leave and stay, with social and medical support.” (interview 10).

Participants were asked about how many people would be relocated, and all agree that it should be all the population in the larger area. In the territory of Posavje region there are approximately 75.000 people living, and most would need to be evacuated according to opinions of participants. Some mentioned also much larger population which should be relocated: “It would be a lot of people, like 200.000 in the area of 50 km.” (interview 12). Participants also recognise that there would be obligation to take care also about the tourist (a big touristic complex in the area of 12 km distance from NPP).

Participants give a diversity of responses regarding how long the relocation could last: from only 1 week to much longer times of 6 months or one year and more. Some also mentioned that the relocation could be forever as “until the danger is over. But danger could stay forever.” (interview 5). Some also pointed out that the evacuation and relocation would need to be performed very quickly after the accident “Accommodations should be prepared in advance, but it is very costly. Now we do not have anything, the only thing is to shelter. We would have 1 hour to react, but there would be chaos.” (interview 6).

#### 5. Decontamination

Most of the participants have some imagination about decontamination (Q2.12). The idea is that people, animals and things would be cleaned from radiation by using water and also some chemicals to remove the contamination: “Decontamination is cleaning of radioactivity from people, things and animals. You use water or liquids to clean the skin.” (interview 2) or “people would be decontaminated with chemical means, should be washed with chemicals.” (interview 13). Similar procedures would be used for animals and things.

In case of internal radiation some would aspect that there would be medical treatment applied: “In case of inner contamination drugs would be used - you drink something and then radioactivity exits.” (interview 6) or “In case of inner contamination some medicaments would be used” (interview 11). Some participants suppose that iodine tablets could be used to clean contamination “... in case of internal radiation, people would take iodine tablets.” (interview 5). There are also some images about the properties of zeolite which will remove the radioactivity from body: “We would need to take zeolite to protect and absorb the poisons substances.” (interview 8). Several participants have no knowledge

what to do in case of internal contamination and think that not much can be done: “In case of internal contamination, there is no much to do.” (interview 2).

In general participants understand that in case of decontamination, all waste (clothes and also water) should be collected and properly managed, even solidified in concrete.

#### 6. Food security measures

In general, participants have some ideas about food security measures (**Q2.13**). They are aware about the contamination that a nuclear accident can produce in food and feed. Specifically, milk, vegetables and water are mentioned. Most of the interviewees declare that they would not eat food from the contaminated area and that such food would be restricted. Some also mentioned that there would be measurement established about the food and there should be clear limits what is eatable and what not. Also, for animals the feed should be controlled. They would prefer that measurements are performed by independent foreign institution: “All food in the evacuated zones would be controlled: fruits, vegetables, animals, animals’ products, also feed for animals, the measurement would need to be performed by independent foreign institution every day.” (interview 8).

Here also ideas about the intake of radiation if irradiated can be seen: “Food which was irradiated cannot be used, it is poisoned. ... Also, fruit is poisoned.” (interview 5). In addition, there is impression that some classical chemical process could clean the radiation: “Food would need to be cooked to be eatable.” (interview 11).

Participants believe that control could last for a long time periods, up to 1 years, or until it would be radioactive.

#### 7. Emergency zones

Participant have different opinion about the emergency zones which would be related to accidents (**Q2.15**). They understand that the zones would depend on the accident it would happen: “The zones are defined in advance but are not the same for all accidents.” (interview 1). But when they are asked what would be the biggest zone of accident impact, they provide various areas from “20-30 km” to “100 km, with impact up to 400-500 km” and even the whole Slovenia “if the accident is big, all territory of Slovenia would be endangered – 200 km”.

Participants also most probably based on experience and location of NPP suggest that major accident would have transboundary impacts to Croatia, Austria, and also Italy. Some also mentioned Bosnia and Hercegovina and all Europe.

#### **Follow up of governmental instructions**

Beliefs about official instructions and intention to follow them up were recognised during the interviews (**Q2.16**). In general, we find out clear awareness of three aspects:

1. It is not the same what we think we would do in the case of a hypothetical accident (intended behaviour) and what we are really going to do in a real accident (real behaviour): “In fact, we do not know how we would react in reality” (Interview 10).
2. It will be better for all to follow instructions although not blindly: “yes, not blindly, but yes.” (interview 1) or “I would judge myself, the governmental information are not completely trusted, they do not tell all” (interview 6) or “people should follow the orders although this is questionable” (interview 12).
3. That if they have previous information it would be easier: “informing people is most important - some would follow, other not, third would be panic. This would lead to chaos.

The way of communication should be defined and known in advance and then you can better decide.” (interview 6).

Participants can be divided in three groups:

- Those who would take their own actions based on their understandings,
- Those who would follow governmental instructions and
- group of participants’ who would follow instructions under some conditions:
  - o If their family is with them,
  - o If instructions seem logic,
  - o If they trust the information sources.

### Information issues

There is a general belief of lack of information available regarding what to do in case of a nuclear emergency. Participants claim for more information in order to be better prepared. Some of the interviewees state that some information has been provided at least in the vicinity of NPP, but long time ago and without organised meeting and discussion: “We received some leaflets what to do in case of emergency, but not further discussions were organised. We live so near to NPP, and there would need to be many meetings organised according to local expectation, but there is almost nothing. Only thing we hear is that we are safe.” (interview 14). Most of the interviewees who live further from NPP reveal that they do not have information: “We do not have information what to do in case of nuclear and radiological emergency. In previous state we were much more informed and therefore also prepared.” (interview 6).

Interviewees believe they would get information (**Q2.16**) mainly from national media, like radio and television, and also internet. The channels that participants would rely on are:

- National Public Media: TV and radio – this would be the most followed source of information.
- Other mass media: other station of television and radio, to check if there are some other information or data.
- Internet: to follow also social media and reporting in other countries: “I always check more sources – to see how reliable they are.”
- Telephone (mainly mobile phone): to discuss the information with others (friends, people they would have more knowledge and could advise, also NPP): “This part is most difficult whom to trust. Doctors would be trusted but they do not have the knowledge, other are questionable.”
- Family members or acquaintances working in the NPP: to get more information and advice what to do: “I would ask those who are more familiar with possible situation.”
- Neighbours: to see what are plans of others: “I would also follow what others do.”

A general there is belief that the information should be updated continuously and transmitted; that is, when the accident happens and every time there was a significant change (**Q2.17**), but at least 2 times a day. Participants also state that bad experiences from e.g. Chernobyl accident and delay in provision of information is still remembered. On participant also add that provision of information would need to be performed carefully not to make panic.

Regarding where to check information (**Q2.18**), three main sources are mentioned: people I believe and trust, state, national information, and other sources like internet and social media.

In case there would be no electricity participants believe that responsible would need to go door by door or perhaps develop a mobile application which would automatically provide harmonised

information for affected population. They also mentioned that it is possible that mobile service would not function. A feeling of defencelessness and no control was expressed when participants imagine a situation without electricity and telephone.

Participants clearly state that the information should be provided at least in three languages (**Q2.20**): Slovenian and both minority languages Italian and Hungarian. In addition, many mentioned that English and German information should be given for foreigners and tourists, and also Serbo- Croatian for inhabitants from former Yugoslavia.

### **Trust**

We ask participants who they would trust in case of a nuclear emergency (**Q2.19**). Some of the interviewees declare they would not trust neither NPP managers nor authorities: “I would be sceptical about governmental information or information from NPP.” (interview 9). The main reason is that both organisations would like to minimise impacts. The other participants would rely on public information coordinated by government: “Depending who would lead the respond, but mainly civil protection, NPP and regulatory authority.” (interview 1). The other trustful sources of information mentioned by participants were: medical workers, expert organisation with scientific and technical knowledge, friends, mayor, IAEA.

## 4.5 Spain

### 4.5.1 Description of the sample

In Spain, 15 interviews were carried out from mid-September to mid-November 2018. The socio-demographic profile of participants is shown in Table 6.

*Table 6: The demographics of the participants in Spain*

Socio-demographic variables	Labels	Frequency	Percentage
Age (average: 60 years old)	Less than 35 years old	1	6.6%
	From 35 to 55 years old	7	46.6%
	More than 55 years old	7	46.6%
Gender	Female	6	40.0%
	Male	9	60.0%
Education	Primary education	5	33.3%
	Secondary education	6	40.0%
	Vocational Education and Training	3	20.0%
	Bachelor's degree	1	6.6%
Employment status	Retired	7	46.6%
	Employee	5	33.3%
	Self-employed	3	20.0%
Years in the town (average: 26 years)	Less than 10 years	3	20.0%
	From 10 to 30	6	40.0%
	More than 30 years	6	40.0%
Worked in the NPP	No	12	80.0%
	Yes	3	20.0%

## 4.5.2 Procedure

Two members of the research group carried out the interviews in L’Hospitalet de l’Infant, a town located in the northeast of Spain, in the area of 0 to 3 kilometres from Vandellós 2 NPP. The location is presented on figure 3.

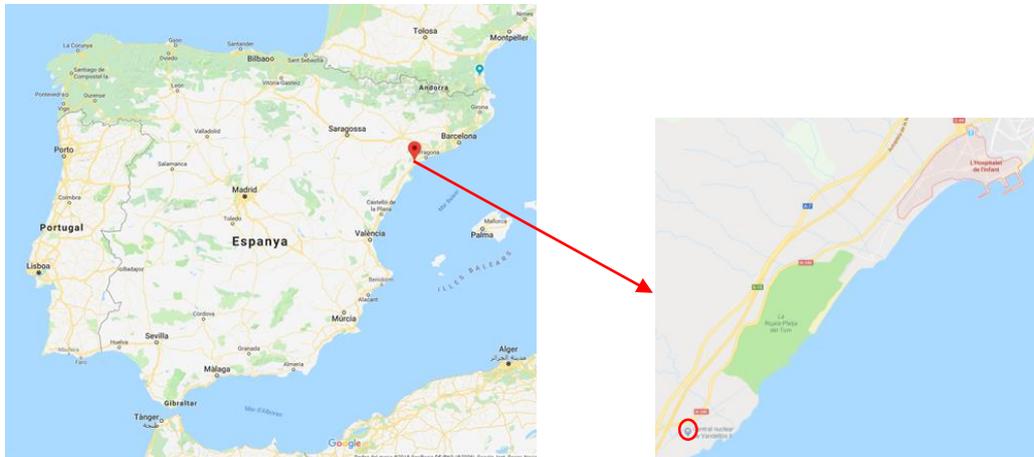


Figure 3: The location of NPP Vandellós 2 in Spain

The protocol provided by the task leader was reduced to the most important questions in order to promote participation and to facilitate data collection. Interviews were carried out face-to-face, mainly in the street or inside shops, with an average duration of 30 minutes. Interviews were audiotaped and transcript in their original language (Catalan or Spanish).

## Data analysis

MS Excel was used to organize the discourse of the interviews in codes. Codes were derived from the interview protocol but also from the discourse of the participants (for instance, codes related to risk perception and follow up of governmental instructions were added to the topics considered in the protocol). Next section presents a narrative thematic analysis of the discourses. Cmap Tools has been used to draw the mental model map.

## 4.5.3 Findings

### Familiarity with and knowledge of the emergency plans

Most of the interviewees declare to have heard about the concept of “Emergency Preparedness and Response plan” (**Q1.1**). Nonetheless, very little knowledge exists among participants. Once they were asked about what do they know about EP&R plan (**Q1.3**), most of them give very simple descriptions such as “plans in case there was a nuclear emergency” (Interview 3) or “how to act in case of an emergency” (Interview 13). Some of the interviewees recognize they hardly know something: “I don’t know. The truth is I do not know” (Interview 1). No references to how it is developed or at what level have been obtained.

Participants mention some basic elements of the EP&R plan (**Q2.1**):

- Sirens / alarm. Most of the interviewees are aware of an alarm system installed in the village to warn the population in case of a nuclear accident.

- Public Address system (PA system). Many of the interviewees inform about the existence of a PA system that would give information to the population in case of a nuclear accident. They mention that this system is often tested but some complaints appear because it does not sound good in all areas of the municipality.
- Information on how to act. Many of the interviewees mention they expect that the EP&R plan would give instructions on what to do: “the steps to follow in case of emergency” (Interview 8)
- Sheltering or evacuation: “if we have to run away or stay at home” (Interview 9).
- Medicine / pills. A couple of the participants mention the existence of some medicine to be taken in the case of an accident but they are not sure for whom is it.
- To assemble or congregate people is another measure mentioned by some participants: “Find the concentration point and wait for instructions” (Interview 15).

Some **uncertainties** coming from these elements of the emergency plan are highlighted by participants:

6. What to do? Those mentioning uncertainties related to what to do, express mainly doubts about whether to stay at home or go away: “I think the main question for the population would be if they leave or if they stay” (Interview 3) or “What do you have to do? Do you have to leave home or stay indoors? These are the first questions that will come to mind. What will happen if you leave home, if you have to stay indoors... these are the first uncertainties” (Interview 7). Some of the interviewees think that people will panic and will go away with the car, so there will be traffic problems in the roads. Uncertainties about the effectiveness of shelter in place and evacuation come out.
7. Where to go? “Where to go and what to take, of course” (Interview 12).
8. How the population will be informed? Those mentioning the issue of who is going to inform, also mentioned the lack of available information and the consequent lack of trust in information sources: “what is missing is written information that says: if this happens you have to follow this instructions” (Interview 10).
9. What are the risks they will face? “If the contamination has arrived ...” (Interview 3) or “are we in danger?” (Interview 6).

Regarding previous radiological or nuclear emergencies in the country (**Q2.2**), some of them mention the accident occurred in 1989 in the Vandellós Unit 1 (INES 3), especially those living in the town for more than 30 years. Those who lived the accident declared that there was not any risk for the population: “I hardly remember the accident of Unit 1, many years ago. I do not remember exactly but we did not have any fear here in town. No, because everything was very controlled, and everything was very well” (Interview 2) or “the emergency plan for the population was not activated” (Interview 3). They remember it was something related with a fire. Other participants stated: “there have been incidents and we have not even heard about them” (Interview 9) or “we feel better informed by television, the NPP managers do not say anything” (Interview 13).

Differences in knowledge seem to exist among those that have worked in the NPP.

### **Risk perception**

When participants were asked what they think it could happen during a radiological or nuclear accident (**Q2.3**), two main believes come out:

- In case of a major accident, participants share the following belief: If something very serious occurs, we will die and it will be not necessary to do anything. Some of the images that appear are: “I think it's an explosion and that everything disappears” (Interview 9) or “If it explodes, it

is no necessary to go anywhere” (Interview 14). Nonetheless, some participants state that, in that case, it is better to live close to the NPP because you will die faster. Another related idea is that, in the case of a serious accident, all the country will be affected.

- In case of a minor accident, the risk of radiological contamination is mentioned. Exact risks for health seem to be unknown.

When we ask what they remember about Fukushima or Chernobyl accidents (**Q2.6**) most of them mentioned destruction as the main consequence: “Yes, of course. Chernobyl and Fukushima. These were real emergencies. From Chernobyl I remember the reactors burning and the destruction of the area. The tsunami in Japan was also the same. Firefighters extinguishing the fire, carrying water from the sea... What TV shows you” (Interview 3) or “I remember the destruction” (Interview 11) or “Everything disappeared in a moment. Everything was devastated” (Interview 13).

When we asked them if they were afraid that a similar accident occurred in their town, most of them state that they are not. Three main reason were given:

- They were less prepared than we are: “In Chernobyl, they were not as prepared as here. It was a very precarious plant” (Interview 2).
- After the accidents, great improvements in safety systems have been done: “After these accidents new criteria, new techniques and an improvement of all systems have been applied” (Interview 15).
- “It is not the same because here we do not have tsunamis” (Interview 6).

In general, low level of risk perception exists among the interviewees. Participants state that they are not really worried about this and that it do not affect their daily lives. Indirectly, many issues came out about the reasons why it is not necessary to be worried about the NPP:

- It is clean: “...the beach around the nuclear is the cleanest one of all the town” (Interview 1) and “For me, it is worst when I pass near the petrochemical plant of Tarragona, because you see all those fumes... that must be worse than it is living next to the NPP” (Interview 1) or “The worst thing would be if something happened, but the day-to-day we are not contaminated” (Interview 2).
- It is safe: “It is very controlled. The power plants have a very large safety system. Nowadays CSN [the regulatory body] is standing over them continuously. A nuclear power plant is more secure than any construction site or any other company. The nuclear power stations have had their failures, but failures that have not been very important” (Interview 4).
- The probability of accident is low: “You have the same probabilities or less than having a car accident” (Interview 11).
- Managers are worried about safety issues: “I am calm because I know they care about it” (Interview 3).
- In case of accident the effects will be wider: “If the NPP explodes, Barcelona inhabitants will be fucked up. We will not notice anything. I would prefer to be here” (Interview 10) or “If something happens everybody must be prepared. Because when the Chernobyl accident happened, all my canaries died” (Interview 2) or “If it explodes, the population that is next to the NPP is not going to notice it. The problem is the radiation that exists when you are at 200km. Those from here are not going to suffer” (Interview 11).
- We don’t think about it: “I do not think about it. You know you have the nuclear power station next door but do not think it. If not, I could not live here” (Interview 7) or “In general, it is as if the NPP does not exist” (Interview 2).

### **Foreseen measures for a radiological and nuclear accident**

We ask participants what kind of measures are foreseen for radiological and nuclear accidents (**Q2.7**). Different measures came out spontaneously:

- Most participants have in mind that population will be warned by the PA system and sirens, others expected to be warned by the radio or by phone.
- Some interviewees expect to receive instructions for sheltering (staying indoors) or evacuating. One participant declare that in case of evacuation, school-children would be evacuated first.
- One participant mention iodine tablets. He thought that the distribution of iodine tablets would be one of the first measures in case of an accident.
- One participant declared that it would be necessary to use a mask and that it would be forbidden to consume tap water.

### Understanding of measures

#### 1. *Shelter in place*

The first question of this subset, was about shelter in place (**Q2.8**). We first ask participants what it means. Most of the respondents relate it with staying indoors: “They leave you in a closed place” (Interview 10) or “When there is a radiation leak you have to be in your house and be informed until you can leave” (Interview 12). We also find out some allusions to underground sites, bunkers or similar places: “Get into a bunker. It would be to get a lot of people into a bunker for a while until the radiation is checked” (Interview 11). The descriptions that came out were short and not so detailed.

When we asked what they would do in case of shelter in place, some ideas came out:

- Close the windows
- Lower the blinds
- Isolate air conditioners
- Isolate doors with wet towels.

Seek for information (in the radio, TV) and follow instructions.

We then asked for how long they would stay there. The idea of many days is widely shared but participants are divided into those declaring that they cannot stay more than one day and those declaring they could stay for a week or more. Those that state they could not be sheltered for more than one day is mainly because of shortage of food and drink or because they will not tolerate it: “I would not bear it, I would have claustrophobia” (Interview 1). In general, participants did not feel prepared to stay indoors for a long time in terms of food and drink: “Scarcely. Nowadays there are supermarkets just around the corner. We do not store food at home” (Interview 12).

Regarding animals, those who have it, declared very firmly they would shelter the animals with them.

Finally, we asked if they would follow this instruction in case it was given by authorities during a real nuclear accident. We find out that most of them do not feel prepared to follow it. Some of them argued that in case of a real accident they will take the car and leave. Another barrier seems to be the need to go to school to pick up children. The following quote clearly illustrates the feeling of one of the interviewees: “I would try to do it but, as I am a father, it would be impossible for me. I would go to school to pick up my children. If both my children and my wife are with me, then I could stay at home. Anyway... I think it would not be the solution. I believe that the solution would be to evacuate the whole village” (Interview 6). Other participants affirm that they are not sure about what would really do in a real situation. A general perception of low fulfilment is transmitted: “I believe that 100% of the population would not do it, because of fear or ignorance” (Interview 7). Some awareness also exists about the consequences of spontaneous evacuation: “if we all went out at the same time, will not be good...” (Interview 14).

## 2. Iodine prophylaxis

Respondents have very little knowledge about iodine prophylaxis (**Q2.9**). They have a general idea that iodine tablets would protect them from radiation and give very broad descriptions when we asked why the tablets are used for: "I think they would be specific for internal radiation" (Interview 3). Only one participant talk about specific health protection effects and wonder if they are used to protect the nervous system: "It seems to me that iodine... can it be to help the nervous system? I do not know specifically" (Interview 6).

Great confusion is also found regarding where to get iodine tablets in case of a nuclear emergency. There are two general ideas: those that would expect someone is going to distribute them through the houses (for instance, the police or the emergency services, with protective clothes) and those who think they would have to get them outside (in pharmacies, in the health centre, or in the City Council). One participant (retired but having worked in the NPP) declared that these iodine tablets are only for NPP workers: "we had it inside the nuclear power plant. There are not for outside, not for the population" (Interview 4).

Most of the respondents do not know when they should take iodine tablets. Most of them respond that they do not know but they expect someone would explain it in case of an emergency: "They would give us instructions" (Interview 7). A general feeling of "as soon as possible" also come out: "I suppose when you have the news, at that moment, if not it won't be useful" (Interview 10).

It is generally believed that everybody should take the iodine tablets: "I think that everyone who is affected by radiation must take it" (Interview 6). Another participant thinks only NPP workers should take it: "This is for the workers inside" (Interview 4). Two participants declare that only health professionals have the knowledge to advise this: "I cannot answer that. These are very technical things... I suppose it would be the doctors who should say who had to take it and who does not". (Interview 5).

## 3. Evacuation

Participants are familiar with the term "evacuation". Different discourses about where to go in case of evacuation came out. These discourses can be divided in two cases:

- If the evacuation is leaded by authorities.
  - o Instructions will be given: "I suppose they would say it through the PA system... at least the direction we should take..." (Interview 5)
  - o It will depend on the plume and the direction of the wind: "I imagine that in the opposite direction where the danger is..." (Interview 7).
  - o Some participants explain there would be an assembly point in the town to bring together the population and start the evacuation. This assembly point is thought to be in the City Council or in the way out of the town. One of the interviewees give this complete explanation: "There would be some buses by the public administration. We would all be informed through the mobile phone, television or radio about the steps that we should follow. The assembly points would be at the entrance of the village. There would be the army there indicating if you should go to Mora d'Ebre or to Barcelona. These would be the two ways of escaping" (Interview 7).
- If the evacuation is spontaneous:
  - o As far as possible: "Of course, I know where I have to go. At least 200km away from where the nuclear power plant is located" (Interview 4).
  - o Somewhere I have a second house: "We would leave somewhere, but I do not know exactly where. I suppose where we had a house to live" (Interview 2).

Regarding what to take during an evacuation, three aspects are highlighted apart from the family:

- Money, credit cards and documentation (for instance, ID)
- Food and water
- Clothes and blankets

Some awareness exist regarding the fact that children will be evacuated from the school. Clearly opposition come out and those participants that have children or grandchildren at school express they will not follow this instructions and will go themselves to pick up the children: “It would be myself who would go for my granddaughters at school” (Interview 4) or “No, honestly not. I could not leave my children in the hands of anyone” (Interview 6).

Most interviewees say they would use they car in case of evacuation. Nonetheless, some of them are aware that this can lead to traffic problems and believe that it would probably be done with buses in order to avoid this, mainly if evacuation is done by authorities.

Also some awareness of zoning exists among some participants: “I suppose they would evacuate first the people who live in the most affected area. From the most affected by radiation to the least” (Interview 11).

Those participants who have animals state they will take they pets with them.

#### *4. Accommodation and care of evacuate population*

Very little knowledge exist on shelters and accommodation of the evacuated population (**Q2.11**). The idea of shelters refers to some of the participants to movies about technological or natural disasters. One participant state: “I cannot imagine it in a different way because I have neither information nor I have lived it. Then the only way I can imagine it is like the movies” (Interview 9). Some participants explain that bunkers or sport halls will be prepared to accommodate people. Only one participant seems to be aware of the existence of a shelter: “Well, I think there was one in an area near Lleida” (Interview 15).

Participants were asked about how many people would be relocated and all agree that it should be all the population in the village. Most of them specify that the tourists should be taken into account: “It's very complicated because here it is not the same in winter than in summer. There is a lot of difference. In winter we are around 4.000 but in summer we can be the double” (Interview 3).

Only three participants give a response regarding how long the relocation could last. These participants think that the duration of the relocation would depend on the contamination but could not give specific time periods.

#### *5. Decontamination*

Most of the participants know very little about decontamination (**Q2.12**). Once again, a couple of them in fact state that the word refers them to science fiction films: “What you see in the movies... They go through these tunnels and they are poured with liquids to decontaminate them, but... no idea...” (Interview 11).

Only a couple of participants seem to have better knowledge on what decontamination is done. Both differentiate between external and internal contamination. The following quote illustrates this knowledge: “If it is external contamination, first it is necessary to shower it with hot water, with soap and to rub well the areas where there is the contamination. When the contamination is inside, medical services should act” (Interview 6).

#### *6. Food security measures*

In general, participants have very vague ideas about food security measures (**Q2.13**). They are aware about the contamination that a nuclear emergency can produce in food. Specifically, milk, vegetables and water are mentioned. Most of the interviewees declare that they would not eat food from the contaminated area. Only one participant state that there will be no effects on food: “Well I think that in principle it would be eating as usual” (Interview 15).

### **Follow up of governmental instructions**

Beliefs about follow up of official instructions come out during the interviews. In general, we find out clear awareness of three aspects:

4. That it is not the same what we think we would do in the case of a hypothetical accident (intended behaviour) that what we are really going to do in a real accident (real behaviour): “You do not know how you'll end up reacting” (Interview 1).
5. That it will be better for all to follow instructions: “In the end, instructions are set to follow them. If people do not follow, for instance, an evacuation; then the evacuation will not help. I think it would be more risky not complying with instructions” (Interview 7).
6. That if they have previous information it would be easier: “If you have information I suppose it would be easier. Previous information, such as brochures. Because you can read it. If you tell me: stay home, you don't know anything... But if you know what the protocol is and what you have to follow and how it works ... maybe you're quieter” (Interview 13).

Participants can be divided in three groups:

- Some participants state that in a nuclear emergency they will go as far as possible with their car, and they will not follow any instruction: “If there was an emergency, I would run away and I would forget the assembly points and everything else...” (Interview 15).
- Other participants admit they would follow instructions without any doubt. One participant clearly admit that the main reason is because “we do not know what do in that case” (Interview 2).
- A third group of participants' state that they will follow instructions under some conditions:
  - o If their family is with them
  - o If they can keep calm and do not panic
  - o If instructions seem logic
  - o If they trust the information sources

### **Information issues**

There is a general belief of lack of information available regarding what to do in case of a nuclear emergency. Participants claim for more information in order to be better prepared. Some of the interviewees state that some information meetings have been organized at the City Council: “They do not stop informing the people. But if the people do not attend to these meetings, it is not the fault of neither the NPP managers nor the City Council. It's people's fault, our fault” (Interview 1). But most of the interviewees do not agree with this: “Well, I think there is very little information. Maybe they do not say anything not to worry people, but I think there should be a bit more information” (Interview 3) or “There have been drills but none about outside evacuation, never. At least during the period that I have been living here” (Interview 10, 28 years living there) or “That is what it is lacking, to have written information that says if this happens you have to follow this protocol” (Interview 11).

Interviewees believe they would get information (**Q2.16**) mainly from the City Council, the Regional Government, the NPP, and the emergency services (especially firefighters). The channels that participants would rely on are:

- Public Address System. It is the most cited channel. It seems that the population is really aware of this channel. Only one participant complain about this system: “But I have never heard the PA system saying that something has happened at the NPP. I mean... probably because so far nothing important has happened for that. But I’m not sure if it would be effective to use it... It sounds very bad” (Interview 8). Interestingly, there is no apparent association between this channel and the City Council or any other public authority.
- Mass media: television and radio.
- Internet.
- Telephone (mainly mobile phone).
- Family members or acquaintances working in the NPP.
- Neighbours.

A general belief that the information should be updated continuously is transmitted; that is, every time there was a significant change (**Q2.17**). One participant state that too much information could be counter-productive: “It should be constant information, but not harping on the same because it will make the situation even more difficult” (Interview 7).

Regarding where to check information (**Q2.18**), three main sources are mentioned: the City Council (“I suppose the City Council. Yes, I would call them”, Interview 2), Civil Protection or Police (“Well, it is very difficult to say it... I’m not sure whether if Civil Protection, the City Council or the Municipal Police... would we have access to them at that time? Because everything could be collapsed... It is very difficult. But, yes, I think I would call the Municipal Police”, Interview 3), and mass media (“I suppose the press and television, I suppose they would tell us what’s going on, right?”, Interview 5).

A special mention was made in case of lack of electricity: some participants would use a battery-operated radio while others would try to inform through the neighbours: “It’s complicated because without a telephone and without electricity ... with a battery-operated radio, little else. We would have to go back to the time of the blackout and use word of mouth” (Interview 6) or “I would try to contrast information with someone, with neighbours, with the well-known people” (Interview 10). A feeling of defencelessness is expressed when participants imagine a situation without electricity and telephone: “If there is no electricity, I would be waiting. Only waiting. There is no other option” (Interview 11).

Participants clearly state that the information should be provided at least in three languages (**Q2.20**): Catalan, Spanish and English. It is a municipality that receives a lot of tourism, especially in summer. Some participants declare there are a lot of people from France and Germany, so it would probably be needed to provide the information also in French and German: “Catalan, Spanish, English and French. This is a tourist area, so mainly Catalan and Spanish but also in English, French and probably German” (Interview 6).

## Trust

We ask participants who they would trust in case of a nuclear emergency (**Q2.19**). Some of the interviewees declare they would not trust neither NPP managers nor authorities. The main reason they give is that there is an important lack of information from the NPP managers to the population. One of the interviewees illustrate this believe in the following quote: “There is a lot of secrecy. You do not know anything. You find out that something has happened once the time has passed or through the

environmentalist groups. They are the only ones who take things out, but of course not the NPP managers. Only if it is very serious” (Interview 13) or “If we have to rely on politicians, badly” (Interview 15) or “When the accident happened in unit 1 they showed that they were prepared, because there was no risk for the population” (Interview 2).

Others state they trust NPP managers. The main reasons they give are: there is a lot of safety, they are ready to manage a nuclear emergency and they care people’s health: “There is a lot of safety” (Interview 9), “Yes, I trust because I have realized that when there is a small leak or any other risk the NPP is stopped” (Interview 3).

A third group of participants declare they would trust other institutions or organizations:

- Emergency services, for instance Civil Protection, Police or Firefighters. “I trust local police, firemen ... any emergency service” (Interview 7).
- Mass media (TV or Internet).

## 5. Summary, Observations and Suggestions

### 5.1 Summary of findings

Figure 4 summarizes how lay people understand measures to manage nuclear or radiological emergency situations. To sum up, we can affirm that participants have a general idea of the basic elements of EP&R plan, but only vague knowledge of each specific protective measure.

Interestingly, interviewees differentiate in general two possible situations in case of accident in a nuclear power plant: major accident or minor nuclear accident. In case of major accident, we find out a belief that nothing would help. They imagine a scenario of death and devastation and they do not see the real usefulness of EP&R plan in that situation. This model is linked with the misconceptions of effects of ionizing radiation to human, as many believe that nothing can be done and that the effects of ionizing radiation would be fatal. In case of minor accident, they believe there would be radiation contamination, also impacts on human and the emergency plan would be useful.

The memory of major nuclear accidents in Fukushima and Chernobyl is still present and defines the models people have in relation to a nuclear accident. They perceive that similar accidents would have big impacts with dangerous consequences, bringing fear and dread across the borders of the accident, even to all continents. The consequences would stay for very long periods and could impact the whole lifetime of several generations. Also, the number of dead is believed to be high and the trust in reporting by governments is low.

People believe that there are no sufficient and relevant available information for population and that the responsible poorly communicate with public. In addition, there are also evidences of distrust in competent and responsible authorities which make the communication even more difficult. On the other hand, interviewees state that too much and too intensive communication could increase the concerns and could lead to panic and chaos.

Some uncertainties and disagreements coming from the emergency plan are highlighted by participants:

- What information should be available? Currently it is not clear what information are available and what should be known by all. The new ways of communication should be implemented, also based on the social media and other alternatives (like citizens science and measurements). In addition, there should be exercises performed and practice at all levels: local and national.
- What to do? Some people would not follow the instructions as they do not trust the government and institutions. There would be panic and as they are not really informed, they would use their own imagination what to do.
- Are plans harmonised with behaviour of population? There is question if plans foresee the real behaviour of citizens. Some areas of disagreement were pointed out (children in schools and kindergartens, self-evacuation).
- What are the risks they will face? The associated risk is assessed as very high and some elements of fatalism are present that nothing can be done.

Participants' refer spontaneously some of the protective measures considered in the interview protocol but also other elements come which are implemented in different local environments (like the Public Address System in Spain, which seems to be well-known by the population, or the Assembly Points).

Regarding sheltering, interviewees think they would be confined inside (for instance, at home or at work) and they would have to be there for many days. Some protective measures such as to close doors and windows or to isolate air conditioners were mentioned. Some images exist that such shelters

should be underground bunkers with thick concrete walls. The main uncertainty is whether they would have enough food and drink.

If we take evacuation into account, a clear difference between evacuation led by authorities and spontaneous or private evacuation is done. We find the belief that in case of governmental evacuation probably buses will be used to avoid traffic problems. Assembly points will be used to gather people. If the evacuation is spontaneous, private car will be used. Participants think evacuation would affect the whole region or even more. They would take with them mainly money, credit cards and documentation, food and water, and clothes; and, of course, their family and pets. The evacuation of school children is mentioned as an important uncertainty.

Accommodation and relocation would also be different in case of spontaneous versus advised evacuation. In case of advised evacuation, participants imagine they would be confined in bunkers or in sport halls. In case of spontaneous evacuation, they would go as far as possible, to a second residence if possible or even abroad.

In general, participants have very little knowledge about iodine prophylaxis, and they do not know what the tablets are used for. An important uncertainty is where to get iodine tablets in case of a nuclear emergency. In the same sense, interviewees have very limited knowledge of decontamination. Only some participants relate it with having a shower if the contamination is external or with the need of medical care if the contamination is internal.

Participants believe that milk, vegetables and water would be affected in case of accident, but they do not have any idea of what food security measures will be taken.

Nevertheless, there is a clear awareness that in case of an accident it would be better to comply with governmental instructions, follow up of instructions is not clear for all the interviewees. This is linked with lack of trust to the responsible authorities. Main uncertainties mentioned will be what to do, where to go, and how would they be informed. Nevertheless, also some of the participants would prefer to trust others, like non-governmental organisations, medical doctors, expert and scientists.

Some actors are mentioned as reliable sources of information during an emergency: NPP managers, authorities (both local and regional) and the emergency services (Police, Firemen, Civil Protection). Also, some channels are mentioned: sirens and PA system, mass media, Internet, telephone, neighbours, and family and friends working in the NPP.

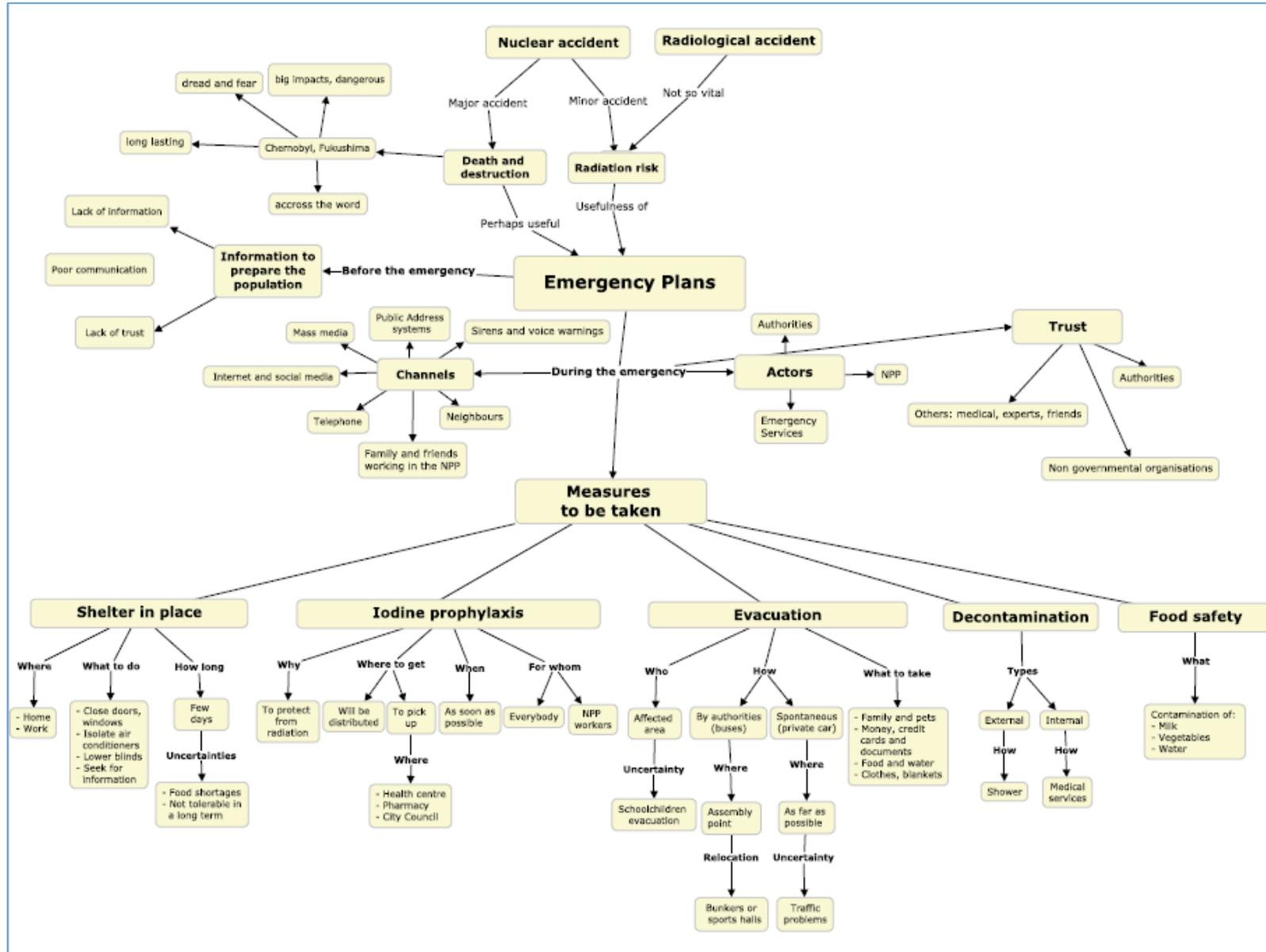


Figure 4: Mental model of lay public in relation to emergency management

## 5.2 Main observation and suggestions

Observations and related suggestions which can be revealed from the analyses of interviews are distributed in six topics:

- Familiarity with and knowledge of emergency plans
- Risk perception
- Understanding of measures
- Follow up of governmental instructions
- Information sources
- Trust

### Familiarity with and knowledge of emergency plans

- There is lack of knowledge about preparation and response plans in the event of a nuclear/radiological accident.
- The existing experience of accidents that required an immediate response is related with earthquakes, floods and fires.
- The respondents identified the following content for the EPR plans: information to citizens, moving away from the accident area in case of high levels of radioactivity, moving to a safe location and in specially designed areas (shelters), distribution of masks, tablets (iodine) and other types of personal protection (special uniforms), as well as nutrition information.
- ➔ **The provision of information regarding the EP&R plans shall be intensified; a public information campaign could include the development of information material (like leaflets, Q&A, ....) and outreach activities. The involvement of local authorities shall be considered in order to increase the impact of this campaign at local level, where is needed. Tailored info and education campaigns with the local community would be, if possible, linked to other emergency preparedness measures like fire and evacuation drills in companies, districts and schools.**

### Risk perception

- The respondents consider as the most important potential nuclear/radiological emergency the release of radioactivity from a nuclear plant in the country or abroad. The other radiological accidents are perceived as less important and more controlled. In general, the level of risk perception is different among interviewees, basically depending on their knowledge and background information and experiences with NPP:
  - ❖ Participants living more far away from NPP are more worried about potential accident and the associated risk, they believe the serious accident could have fatal and immediate impacts, and have less trust in the management of NPP,
  - ❖ Participants living nearer to NPP have positive cohabitation experiences and are not worried about associated risk, they also know the management and trust them, although they share also the fatalistic views of dangerousness of severe accident.
- Chernobyl is considered to be the most important nuclear accident of the history. The unprecedented nature of the accident, the ignorance and the lack of adequate information on health and environmental consequences caused fear (even panic). The respondents identified as consequences the increase in mortality rate due to the increase of cancers and other diseases, the genetic mutations due to changes in DNA, the prohibition of food consumption and the prohibition

of travelling to countries close to Ukraine. The respondents said that there are still consequences nowadays.

- Fukushima is considered as an accident that did not have the same impact on the perceptions and attitude of the population towards nuclear energy. The consequences were more limited and related to the environmental pollution in the wider region, the relocation of local population into safer areas and the prohibition of food consumption produced in Japan.
- Despite the progress in the field of nuclear energy, there are still doubts about the risks and the possibility of dealing effectively with a nuclear / radiological accident.
- ➔ **Risk communication activities shall take into account the national (radiological) threat assessment. To this purpose, basic elements that could be included in the information given to the public are related to the radiation facilities and activities in the country, as well as to the risks involved.**
- ➔ **Fears shall be addressed with provision of knowledge.**
- ➔ **The memories about the restrictions people faced for a while after the big accidents could serve as a basis for a collective thinking, and the development of a story “What might happen when a similar nuclear accident happens here at the nuclear power plant...?” The awareness of the current risk of a nuclear accident might be increased among the population, and discussions could be intensified.**

#### Understanding of measures

- As main protection measures in the case of an emergency were mentioned the following: temporary mass evacuation of the population from the area of the accident, the stay in closed spaces (shelters), the oxygen masks, the special uniforms, the decontamination (with iodine tablets and water), the existence of special camps (quarantines) for people who are contaminated, the consumption of packaged food and bottled water.
- The respondents expressed reservations on how a large part of population can be relocated, about the adequacy of shelters, etc.
- Regarding the protection measures:
  - Sheltering: it must be as short as possible, big uncertainty if food.
  - Iodine prophylaxis: uncertainties are where to get tablet, how they are used, are there any restrictions, for what they are used.
  - Evacuation: the related uncertainties are how to evacuate, where to evacuate, evacuation of family members (children in schools, other vulnerable people), how far to go, trust in instructions.
  - Decontamination: this is not entirely known to people, but no major uncertainties were revealed.
  - Food - water restrictions: avoidance of food produced from agricultural crops (fruits and vegetables) due to possible contamination.
  - Animals: if possible, move them to enclosed spaces. Different opinions regarding decontamination. Strong concern for farm animals due the contamination by radioactivity

- ➔ **The need for better understanding of the protection measures that are usually taken in case of a radiological/nuclear emergency is clear. Modern approaches to public information could include audio-visual material (e.g. video), social media or different mobile applications explaining what are the main protection measures and their implications.**
- ➔ **During emergency response exercises emphasis shall be given in the aspect related with the implementation of protection measures. Actions needed shall be discussed among the bodies involved in the implementation of EP&R plans.**

### Information sources

- Regarding the sources of information, the respondents stated that they will choose the public authorities, such as the Civil Protection, the Police, the Fire Service, the Municipalities and other authorities. Some were reluctant and would prefer to rely on other sources, like NGOs, medical doctors and scientists.
- Affected persons will use a variety of sources to develop a picture of what happened at the nuclear power plant nearby, and this includes personal opinion of peers.
- The respondents highlighted the strong need for frequent update of information. As main channels of communication were identified the Internet, the television and the radio. They believe that the information shall be communicated in national language and in English.
- ➔ **Clarification regarding the roles of different emergency response players in the field of public information can be pursued through the organization of stakeholders' panels and emergency response exercises.**
- ➔ **Authorities in charge of public information during emergencies shall become more visible within the public opinion i.e. by means of information campaigns, media interviews etc.**
- ➔ **Resources shall be available in order to support the increased needs of information during emergencies.**
- ➔ **The access to information about countermeasures for public should be improved through using all channels, like social media, specialized warn-apps for catastrophes, and internet sources.**

### Trust

- Trust varies significantly and can be lost quite easily when something goes wrong in normal period and in particular in an emergency.
- Specific expert bodies, as well as first responders, such as Police and Fire brigade, who are considered trained to deal with emergency situations are trusted by the respondents.
- ➔ **Trustworthy organizations shall be used effectively in order to convey the crucial information to the public.**
- ➔ **Chances to increase trust are limited, but could focus on the consistent and transparent flow of information provided by as many sources from public authorities as possible.**

## 6. Conclusions

A mental models approach was employed to investigate and compare experts' and lay people's sense-making of uncertainties related to emergency preparedness and response. The research was conducted in five countries: Germany, Greece, Slovakia, Slovenia and Spain and focused on how plans are developed including what is associated risk, what are the typical elements and what protective measures are foreseen. In addition, also issues of information, notification and trust was analysed.

Discussions with experts from different countries revealed that the basic elements emergency and response plans are very similar, including general information about accidents, roles and responsibilities in an emergency situation, classification of alert levels, emergency planning zones, notification and warning, activation of forces and resources, governance, monitoring of radioactivity, emergency measures, food safety measures and long-term measures. Country specific adaptations translate in the focus on accidents within or outside of the national territory, depending on the presence or absence of nuclear power plants in operation; the specification of EP&R elements such as the radius of planning zones or the values of the reference levels; and the governance structures. According to experts, uncertainties that need to be addressed related to low knowledge about ionizing radiation among emergency management actors; the inherent uncertainties in the accident development; the potential impact on areas requiring relocation; behaviour of people in an emergency situation; the lack of exercises and drills at local level with broad stakeholder involvement (e.g. schools, nursing homes, etc.); the limited number of field exercises; the lack of formal arrangements concerning some services (e.g. use of a mobile unit in case of a radiological accident); dealing with several sources of information with potentially conflicting or inaccurate information.

Interviews with lay people generally showed low awareness of emergency plans, though basic elements were better known in some of the countries, and no active search for information. A nuclear accident is perceived in a fatalistic way, as a very disruptive and uncontrollable event, causing huge dispersion of radioactivity, devastation, damage to the whole region and infrastructure, and severe health consequences such as death, increase in cancers or genetic mutations.

While experts assume that the EP&R plan is a tool for risk management and mitigation in any situation, in most countries lay respondents expressed doubts on the effectiveness of an EP&R plan. In some countries the plan was deemed as a useful instrument despite fatalistic views on the potential consequences, while in another (Slovenia) a differentiation was made between major and minor accidents. In this situation, the EP&R plan assumed useful only in the latter case. The accidents in Fukushima and Chernobyl are well remembered, but respondents in some countries argued that in the case of Fukushima there was more information available (Spain) and the impact was lower (Greece). In Germany, respondents recalled the impact of the Chernobyl accident on their daily life, e.g. not consuming mushrooms, milk, fresh fruits. While they expressed trust in safe management of radioactive sources in medicine (e.g. Greece), main risks for accidents were seen to be accidents in nuclear power plants.

Knowledge about protective measures differs among publics in the countries investigated but is revealed particularly low as regards iodine tablets. Respondents were uncertain about their use, the location or means of distribution in case of an accident.

A differentiation was generally made between organised and spontaneous evacuation. For the former evacuation, it is assumed that authorities will take the lead, and potential evacuation centres mentioned were town halls, bunkers, sport halls or tents. As for spontaneous evacuation, respondents mostly mentioned they would go "as far as possible", possibly after consultation of meteorological

conditions, although in some cases in Germany respondents indicated they would drive in the direction of the nuclear power plant in order to avoid traffic jam.

In some countries, respondents assume that evacuation of school children will be taken care of by responsible authorities (e.g. Slovakia), while other express their intention to gather children and other family members before an evacuation (e.g. Germany).

Related to sheltering, some respondents thought it could take many days, while others argued that it should be as short as possible and not longer than a couple of days, since food and water in stock would not last for a longer time. In Slovakia some believe that clean food will be provided from unaffected areas of abroad.

In general, there was uncertainty about what to do in case of a nuclear accident, and opinions were divided between following instructions or simply leaving the affected area.

There was also uncertainty about how the public would be informed about the accident and the necessary protective measures. The sources that the publics in different countries would consult are mostly information provided by public authorities and printed and online media, but – in some cases- also informal sources such as neighbors and friends. In Germany it was mentioned they would consult different information sources to check for potential discrepancies. Some respondents expressed trust in public authorities, others in NGO's, mass media or opinion of peers (own or from family and friends). In several countries respondents expressed their belief that authorities will try to hold back parts of information, for instance to avoid chaos, panic, and uncontrollable reactions from the public (Germany). In other cases, this belief was founded on previous cases of lack of info and transparency. The interviews with members of the public revealed that from their point of view key elements in the emergency plans are instructions for the population what to do in case of an accident, guidance to pick up children, channels for reliable information, precautionary recommendations, information about moving away from the area or to a safe location, distribution of masks, tablets and protective equipment, dietary advice. In turn, lack of knowledge about these elements are sources of lay public uncertainties.

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## 8. Annex 1: Protocol for the interviews



### WP5

#### T5.2 ii.) Identification of mental models of uncertainty management in emergency situations

##### Protocol for the Interviews

Nadja Železnik

To be implemented in Germany, Greece, Slovakia, Slovenia, Spain

#### Notes for investigator:

1. The interview on mental models of uncertainty management in emergency situation is intended to be very open, therefore the **questions are indicative and flexible**. You may formulate the question as you consider appropriate for the respondent and also for the evolution of the interview. At the same time, you can add more questions to clarify aspects and also to deeply investigate interesting issues that appear during interview and are useful for the scope of project.

2. You may use the following as general reaction on the answers:

- Anything else?
- Can you tell me more?
- Don't worry about whether it's right - just tell what is on your mind.
- Can you explain why?

3. There are several sections in the protocol. Section 1 (Warming up) is devoted to start the discussion on the Emergency Preparedness and Response (EP&R) in case of radiological or nuclear accident. Section 2 is the kernel of the investigation and it is expected to give detailed information for mental model investigation. In this section you should insist on details the interviewee can reveal in order to recognise their understanding of main uncertainties of emergency management and associated elements (protective measures, their characteristics, risks and related uncertainties). Section 3 includes supplementary questions in case you have enough time to discuss and the questions aimed to obtain broader prospective. Section 4 is compulsory and consists of socio-demographics data.

4. Generally, you have a main question and (*in italics*) one or more additional questions aim to help you to reformulate (if needed) or to extract more details. Questions marked in yellow are those which can be omitted and marked in green are not relevant for Greece (as non-nuclear country).

5. For the investigation you would need to perform approximately 15- 20 interviews with lay people, preferably living near nuclear facility (nuclear power plant, research reactor, and other nuclear or radiological facility for which Emergency preparedness and response plan is developed). The sample participants for mental model interviews of uncertainty management in emergency situation should be from target audience: in this case they should be representative members (related to gender, age, education) living in the areas for which the EP&R plans are developed and where in general they would be more informed (the areas with radius of 25 km around the nuclear facility). In case of no nuclear country, the sample participants should be from areas which are also involved in planning, based on the IAEA category V (areas within emergency planning zones and distances in a country for a facility in category I or II located in another country).

## Preamble

Good morning/.../....

*My name is ..... and I am performing a research in the CONFIDENCE project (“COping with uNcertainties For Improved modelling and DEcision making in Nuclear emergenCiEs”) financed by the European Commission. The CONFIDENCE Project aims to close existing gaps in several areas of emergency management and long-term rehabilitation in case of nuclear or radiation accident. Work Package 5 deals with identification of social and ethical issues related to uncertainty management in emergency and post-accident situations and clarify how stakeholders at the various levels deal with uncertainty in their decision-making processes.*

*As part of the project we are investigating also how people think about the uncertainties related to emergency management, it is called the mental model research. With mental models we explain how we believe that something works in the real world. Results of this investigation should help to create better information and communication to explain about this topic in Europe. With this interview we’ll try to understand public perception on emergency management and related uncertainties. Of course, there are various opinions and perceptions on the issue, but today we’ll focus on your experiences and your understanding that are extremely important for our research. Please feel free to express your opinions, there are no wrong or right answers. Also, don’t worry about repeating yourself. The interview is divided in several topics and I will take notes on your answers. The information from our discussion will be collected, but your name will not be mentioned in the reports.*

Interview no \_\_\_\_\_

**Do you agree to have audio recording? Yes/No**

### **Terms to be used if needed:**

**1. IAEA Safety Glossary, 2007, Emergency preparedness**

*The capability to take actions that will effectively mitigate the consequences of radiation or nuclear emergency for human health and safety, quality of life, property and the environment.*

**2. IAEA Safety Glossary, 2007, Emergency response**

*The performance of actions to mitigate the consequences of radiation or nuclear emergency for human health and safety, quality of life, property and the environment. It may also provide a basis for the resumption of normal social and economic activity.*

**3. IAEA Safety Glossary, 2007, Emergency plan**

*A description of the objectives, policy and concept of operations for the response to a nuclear or radiological emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response. The emergency plan serves as the basis for the development of other plans, procedures and checklists. Emergency plans are prepared at several different levels: national, local and facility. They may include all activities planned to be carried out by all relevant organizations and authorities, or may be primarily concerned with the actions to be carried out by a particular organization.*

**Legend:**

- Q\_.\_ - can be omitted,
- Q\_.\_ - not relevant for Greece (as non-nuclear country).

No.	Question	Observations and records
<b>Section 1 – Warming up</b>		
Q1.1	Have you heard about the concept of “Emergency preparedness and response” (EP&R) in case of radiological or nuclear accident in your country?	<b>If yes – discuss about it: where and what</b> <b>If no – present the IAEA definition 1 and 2</b>
Q.1.2	Do you know if there is a nuclear power plant nearby?	<b>Discuss what information is available</b>
Q.1.3	What do you know about EP&R plan, how it is developed, at what level and for what purpose? <i>From where you have such knowledge?</i>	<b>Discuss and use IAEA definition 3 in case there is no respond</b>
Q.1.4	Did you experience any other accident which would call for immediate reaction, like fire, flooding, earthquake, or similar? <i>Do you remember the steps taken?</i>	<b>Discuss the experience and what is remembered about it.</b>
<b>Section 2 – Mental models of emergency management and related uncertainties</b>		
<b>EP&amp;R plan and risks</b>		
Q2.1	Please tell me what are the basic elements of EP&R plan? <i>What should be the content of EP&amp;R plan according to your understanding?</i> <i>What would you imagine such plan should include?</i> <i>What are the main uncertainties which can come from the plan?</i> <i>Where the main disagreements would come from?</i>	<b>Discuss the understanding</b>
Q2.2	Can you tell me what are the radiological or nuclear emergencies which can happened in your country? <i>Could you think about possible accidents?</i> <i>Where do you think radioactive material is used?</i> <i>What can happen in Nuclear Power Plants (NPPs), in medicine, research and industry, during transportation and elsewhere?</i>	<b>Discuss the understanding</b>
Q2.3	What you think it could happen during radiological or nuclear accident? What kind of risk one can be faced? <i>In NPPs,</i> <i>During uses of radioactive material in medicine, research or industry,</i> <i>In radioactive waste facility,</i> <i>During transport.</i>	<b>Discuss the understanding</b>

Q2.4	<p>For which radiological and nuclear accidents the EP&amp;R plans are developed?</p> <p>Do you know the difference between EP&amp;R plans for:</p> <p style="padding-left: 40px;"><i>Radiological accident and Nuclear accident</i></p>	Discuss the understanding
Q2.5	<p>Do you know who is responsible for reaction in case of accident?</p> <p style="padding-left: 40px;"><i>Which institutions are involved?</i></p> <p style="padding-left: 40px;"><i>What are their roles, what do they do?</i></p> <p style="padding-left: 40px;"><i>Who is involved for notification and warning?</i></p>	Discuss the understanding
Q2.6	<p>Do you remember anything about Fukushima (or Chernobyl) accident? Could you tell something about it?</p> <p style="padding-left: 40px;"><i>What were the consequences?</i></p> <p style="padding-left: 40px;"><i>Are you afraid of related risk?</i></p> <p style="padding-left: 40px;"><i>Do you remember any other similar accident?</i></p>	Discuss the understanding
Q2.7	<p>What kind of measures are foreseen for radiological and nuclear accident?</p> <p><i>You already mentioned some</i></p> <p><b>Immediate protective measures</b></p> <p style="padding-left: 40px;"><i>Sheltering</i></p> <p style="padding-left: 40px;"><i>Iodine prophylaxis (ingestion of potassium iodine tablets)</i></p> <p style="padding-left: 40px;"><i>Evacuation</i></p> <p style="padding-left: 40px;"><i>Accommodation and care of evacuated population</i></p> <p style="padding-left: 40px;"><i>Decontamination of people, animals and equipment</i></p> <p><b>Food security measures</b></p> <p><b>Long-term measures</b></p> <p style="padding-left: 40px;"><i>Temporary transfer of population</i></p> <p style="padding-left: 40px;"><i>Permanent transfer of population</i></p> <p style="padding-left: 40px;"><i>Environmental decontamination</i></p>	Discuss the understanding
<b>Understanding of measures</b>		
Q2.8	<p>What do you think you have to do during sheltering:</p> <p style="padding-left: 40px;"><i>Explain what means sheltering</i></p> <p style="padding-left: 40px;"><i>What would you do in case of sheltering (with doors, windows, ventilation)</i></p> <p style="padding-left: 40px;"><i>For how long time you would stay there</i></p> <p style="padding-left: 40px;"><i>What would you eat and drink (any limitation for water and food)</i></p> <p style="padding-left: 40px;"><i>What to do with animals (also in case of farms)</i></p>	Discuss the understanding

Q2.9	<p>What do you think you have to do for Iodine prophylaxis (ingestion of potassium iodine tablets)</p> <p><i>Why are the tablet used for?</i></p> <p><i>Do you have them or do you know where to get them</i></p> <p><i>How you would use the medicine?</i></p> <p><i>When you would take them?</i></p> <p><i>Who need to take them (all, also children, pregnant, older)?</i></p> <p><i>What about animals?</i></p>	Discuss the understanding
Q2.10	<p>What do you know about evacuation?</p> <p><i>When and where to go</i></p> <p><i>What to take</i></p> <p><i>Who will take kids (in case they are in school/kinder garden) and disabled</i></p> <p><i>What will you use for transport</i></p> <p><i>Who will evacuate tourists</i></p> <p><i>What to do with animals</i></p>	Discuss the understanding
Q2.11	<p>Accommodation and care of evacuated population</p> <p><i>Where the shelters are</i></p> <p><i>What it is included in accommodation</i></p> <p><i>How many people would be relocated</i></p> <p><i>What will happen with properties and animals</i></p> <p><i>Who will cover the costs</i></p> <p><i>How long the relocation could last</i></p>	Discuss the understanding
Q2.12	<p>Decontamination of people, animals and equipment</p> <p><i>What does it mean</i></p> <p><i>How it is done</i></p> <p><i>How to treat irradiated persons</i></p> <p><i>What happens to the wastes (contaminated material)</i></p>	Discuss the understanding
Q2.13	<p>Food security measures</p> <p><i>What does it mean</i></p> <p><i>How it is done</i></p> <p><i>What is controlled – examples</i></p> <p><i>What about the animals</i></p> <p><i>How long it is performed</i></p>	Discuss the understanding
Q2.14	<p>Long-term measures</p> <p><i>What does it mean- what is included</i></p> <p><i>How it is done</i></p> <p><i>What is environmental decontamination and remediation</i></p> <p><i>For how long measures can stay</i></p>	Discuss the understanding

Q2.15	<p><b>Emergency zones</b></p> <p><i>What are the distances for precautionary action zone (PAZ) or for urgent protective action planning zones (UPZ)</i></p> <p><i>What is the biggest zone of accident impact, any guess</i></p> <p><i>In your case, how many countries would be involved</i></p>	<b>Discuss the understanding</b>
<b>Information and trust</b>		
Q2.16	<p>Who would you get the information from</p> <p><i>Give some most reliable sources of information in case of accident</i></p> <p><i>Give the channels from where the information you would rely</i></p> <p><i>Would you follow the governmental instructions</i></p>	<b>Discuss</b>
Q2.17	How often the information should be updated	<b>Discuss</b>
Q2.18	<p>Where you would check the information</p> <p><i>What would you do if there would be no electricity and no telephone option</i></p>	<b>Discuss</b>
Q2.19	<p>Who would you trust</p> <p><i>Give the information about the institutions or organisations you would trust</i></p> <p><i>Order them</i></p>	<b>Discuss</b>
Q2.20	What languages the information should be provided	<b>Discuss</b>
<b>Section 3 – Additional questions</b>		
Q3.1	<p>What was your main information source in case of Fukushima accident?</p> <p><i>How much this accident influences your knowledge and your perceptions on Ionizing Radiation?</i></p>	<b>Discuss</b>
Q3.2	<p><b>In your opinion, who should be the main decision-makers to introduce measures to protect population and the environment in case of a nuclear accident?</b></p> <p><i>What role should play mass-media?</i></p> <p><i>What role for the common public?</i></p>	<b>Discuss</b>
<b>Section 4 – Socio-demographic data</b>		
Q4.1	<p>Your age</p> <p>Gender</p> <p>Education (last achieved education)</p> <p>Profession (area of education: humanistic, social, natural, technical)</p> <p>Living in village/city</p> <p><b>Living near nuclear installation or not, which one</b></p> <p>Country</p>	

**Attachment: any drawings, schemes, graphs, ....**