CALL FOR TENDER N° ENER/D3/2020-228

Title: Review and evaluation of national radon action plans established in EU Member States according to the requirements in Council Directive 2013/59/Euratom –the BSS Directive – focusing on the practical implementation of the actions defined in these action plans

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Part D: Technical offer

Contents

Abbreviations:

ALLIANCE	The European Radioecology Alliance
BSS	Euratom Basic Safety Standards
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organisation
CONCERT	European Joint Programme for the Integration of Radiation Protection Research
CONFIDENCE	Coping with uncertainty for improved modelling and decision making in nuclear emergencies
CRPPH	Committee on Radiological protection and Public Health of the OECD Nuclear Energy Agency
DG	Directorate General
DOREMI	Low Dose Research towards Multidisciplinary Integration
EHS	SCK CEN Institute Environment, Health and Safety
ENA	European NORM Association
ERA	European Radon Association
EU	European Union
EURADOS	European Radiation Dosimetry Group
EURAMED	European Alliance for Medical Radiation Protection Research
GCP Europe	European building services engineering sector
H2020	Horizon 2020
HERCA	Heads of the European Radiological protection Competent. Authorities
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection
InSOTEC	International Socio-technical Challenges for implementing Geological Disposal
IRPA	International Radiation Protection Association
MEENAS	Consortium of European radiation protection research platforms
MELODI	Multidisciplinary European Low Dose Initiative
MetroRADON	Metrology for radon monitoring
MONA	Local community Mols Overleg Nucleair Afval
MS	Member States
NERIS	European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery
NORM	Naturally-Ocurring Radioactive Materials
OECD	Organisation for Economic Co-operation and Development
PLATENSO	Building a platform for enhanced societal research related to nuclear energy in Central and Eastern Europe
PREPARE	Innovative integrated tools and platforms for radiological emergency preparedness and post-accident response in Europe
QA	Quality Assessment
QCA	Qualitative Comparative Analysis
RADPAR	Radon Prevention and Remediation
RAP	Radon Action Plan/s
RICOMET	International conference on Risk perception, communication and ethics related to ionizing radiation
SHARE	Social Sciences and Humanities in ionising radiation research platform
SME	Small and Medium sized Enterprise
SSH	Social sciences and humanities
STORA	Local community Studie- en Overleggroep Radioactief Afval in Dessel
TERRITORIES	To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situation
UK	United Kingdom
UNITAR	United Nations Institute for Training and Research

UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WHO	World Health Organisation

Objectives of the EU-RAP project

The overall objective of the EU-RAP project is to **independently review and assess** in detail the establishment of **national radon action plans** in EU Member States (MS) and the United Kingdom (UK) according to the requirements laid down in Council Directive 2013/59/Euratom – the BSS Directive – with a particular focus on the **practical implementation** of the actions defined in these action plans. The EU-RAP project will review and assess, from a neutral perspective, both exposure and risk assessment by EU MS and the UK on the one hand, and radon risk management of EU MS and the UK, on the other hand. It will also identify **good practices** to address the radon related issues together with experts, regulators, local authorities and other stakeholders from EU MS and the UK.

The EU-RAP project review and assessment will cover radon action plans in all EU MS and the UK and the practical implementation of actions, such as the strategy for conducting surveys of indoor radon concentrations, the delineation of areas, the identification of workplaces and buildings with public access where measurements are required, the establishment of reference levels, the assignment of responsibilities, the strategies for reducing radon exposures, the strategies for communication, remediation, financial support, the establishment of long-term goals, etc. and their application. Firstly, results of the EU-RAP review and evaluation will assist the European Commission in assessing compliance of the practical implementation of national radon action plans with the requirements of the BSS Directive. For this, a detailed overview on the establishment and contents of the national radon action plans will be conducted. Secondly, the project will provide EU MS and the UK with practical solutions to address the challenges related to the implementation of radon action plans. For this, a detailed analysis of the practical implementation of the actions defined in each of these action plans will be undertaken. In general, results of the EU-RAP project will help EU MS and radiation protection authorities to cope with the implementation of the Council Directive 2013/59/Euratom and learn/share pragmatic and effective actions to reduce the health effects from radon. Experiences from EU MS may prove useful to policy-makers in another EU MS.

The EU-RAP consortium is a multidisciplinary consortium which has theoretical, practical and specific knowledge in the establishment of strategies to ensure an appropriate protection of individuals from the dangers arising from exposure to radon. One of the strengths of the EU-RAP consortium is its ability to independently review and analyse Radon Action Plans of EU MS and the UK since none of the members are directly responsible for their development or implementation (as they do not belong to national authorities). The members of the consortium have decades long experience in the field of radiation protection, in particular with regard to exposure to natural radiation sources and radon, and have a European-leading expertise in the development, establishment and implementation of strategies to achieve an appropriate protection of individuals from the dangers arising from ionising radiation in general and exposure to radon in particular. In order to bring different disciplines and radon related expertise together in a comprehensive review and evaluation, experts in stakeholder engagement related to environmental issues and trained facilitators will enable the consortium of EU-RAP to be fully functional and efficient. The technical and professional capacity of the consortium has been proved by numerous scientific articles, successfully conducted radon related projects on national and international levels and active participation of members in different radiation protection and radon related bodies (e.g. European Radon Association (ERA), International Radiation Protection Association (IRPA), Article 31, etc.) as well as practical experiences in the implementation of radon related protective measurements at national levels.

Context of the EU-RAP project

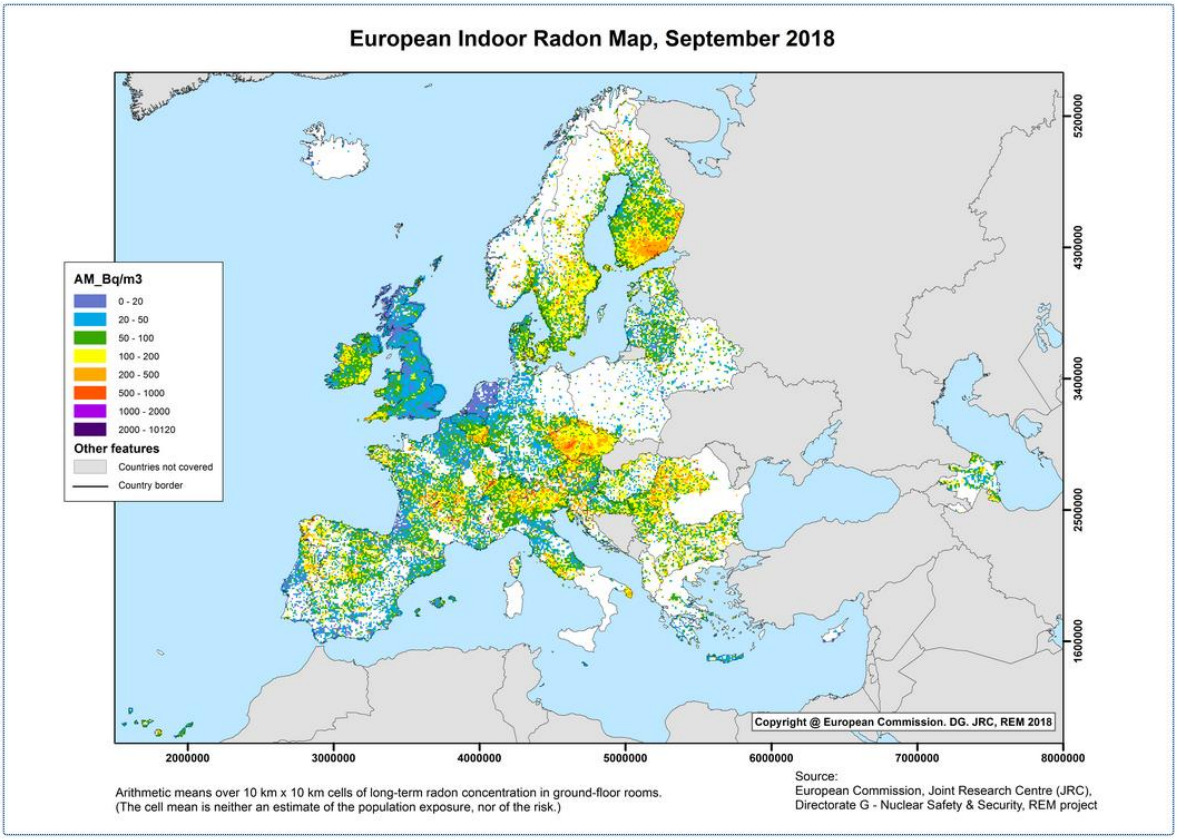
Radon as a health problem

Radon is a proven lung carcinogen for humans (classified in group 1 in the International Agency for Research on Cancer (IARC) classification) [1, 2]. Recent epidemiological findings from residential studies demonstrate a statistically significant increase of lung cancer risk from prolonged exposure to indoor radon at low level of exposure. In addition, studies show that smoking and radon have enhanced joint effects on lung cancer [3, 4]. Radon is responsible for about 9% of deaths from lung cancer and about 2% of all deaths from cancer in Europe

[2]. Several studies demonstrate that there is a substantial problem with radon in houses, public and work spaces, and that there is an urge to protect public health from risks related to radon [2, 5, 6]. Reducing exposure to radon, for instance by remediation of buildings, has subsequently been addressed in several international guidance documents [1]. The World Health Organisation (WHO) recommended in 2005 that comprehensive radon programmes should be developed for radon prone areas [1]. The revised European Basic Safety Standards directive (BSS) (2013/59/EURATOM) also requires from Member States to develop National Action Plans to address long-term risks from radon exposures, given the "statistically significant increase of lung cancer risk from prolonged exposure to indoor radon at levels of the order of 100 Bq/m^3 " [6]. National authorities in many European countries have promoted actions for measuring indoor radon concentration and reducing radon exposure in dwellings, buildings with public access and other workplaces for several years. There has been significant progress in the last years regarding radon mapping, the development of measurement methods and the knowledge of population exposure or radon civil engineering. Figure 1 shows the European Indoor Radon Map developed by the Joint Research Centre as of September 2018.

The Council directive 13/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation (European BSS) introduces the new concept of National Radon Action Plan for addressing long-term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, whether from soil, building materials or water. The implementation of the national action plan has the potential to save lives and should therefore be given an important priority by Member States. The long-term goal is the reduction of lung cancer risk.

Figure 1: European Indoor Radon Map [7]



Legal background in short

The Euratom Treaty empowers the European Atomic Energy Community to establish uniform basic safety standards to protect the health of workers and the general public against dangers arising from ionising radiations. To this end, a comprehensive set of European radiation protection legislation was developed ensuring the highest level of radiation protection for members of the public, workers and patients. In 2013, this legislative framework was modernised and consolidated by adopting Council Directive 2013/59/Euratom which introduced a number

of new and strengthened requirements, the transposition and implementation of which is currently being undertaken by EU MS. In particular, Council Directive 2013/59/Euratom contains concrete requirements to ensure an appropriate protection of individuals from the dangers arising from exposure to radon across Europe. The EU Basic Safety Standards Directive 2013/59/EURATOM widens the application of radiation protection practices to previously not affected fields such as exposures to radon, thoron[1] (including their progeny) and exposures to Naturally-Occurring Radioactive Materials (NORM), and demands that they are regulated in the same way as artificial sources. The exposure of workers and members of the public to indoor radon is explicitly taken up in the scope of Council Directive 2013/59/Euratom (Article 2(2d)). In addition, the Directive provides with Article 100, as a novelty, requirements to establish programmes on existing exposure situations in general and offers in Annex XVII (b) an indicative list of existing exposure situations that refers explicitly to indoor exposure to radon and thoron, in workplaces, dwellings and other buildings. The Directive introduces legally binding requirements on protection from exposure to radon also. According to Article 103 of the BSS Directive, EU MS are required to establish national radon action plans " […] addressing long-term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, whether from soil, building materials or water". Annex XVIII of the BSS Directive provides a list of items to be considered in preparing such a national radon action plan. The requested activities are related both to public and occupational exposure to radon, many of which are common to both types of exposures, while some of them are specific to dwellings and others specific to workplaces. The list of activities described in Annex XVIII covers for example:

- Strategy for conducting surveys of indoor radon concentrations;
- Delineation of areas with potentially high exposure to radon;
- Identification of types of workplaces and buildings with public access, where measurements are required;
- Strategy for reducing radon exposure in dwellings;
- Strategies for facilitating post construction remedial action;
- Strategy for preventing radon ingress in new buildings;
- Strategy for communication to increase public awareness;
- Guidance on methods and tools for measurements and remedial measures;
- Provision of financial support for radon surveys and for remedial measures;
- Long-term goals in terms of reducing lung cancer risk attributable to radon exposure.

Further on Council Directive 2013/59/Euratom specifically asks for stakeholder engagement: „Member States shall provide as appropriate for the involvement of stakeholders in decisions regarding the development and implementation of strategies for managing exposure situations "(Art. 102.).

For exact wording of relevant provisions in Council Directive 2013/59/Euratom that should be reflected in national radon action plans and implemented in MS and the UK, see Annex 1.

Challenges in the implementation of radon action plans recognised in previous projects

The EU-RAP project will identify challenges in the implementation of radon action plans (RAP) through interactions with different stakeholders during the project. Some preliminary lessons learned and challenges have already been identified by different EU radon related projects, authorities and organisations [8, 9]. These challenges may go beyond the definition of the elements in the RAP (as foreseen in the BSS Directive), but they may directly or indirectly influence its implementation, as they may relate to societal awareness, controversies related to radon, economic aspects, etc.

[1] Thoron is very rare and due to its halftime (55 s) it is a problem only in dwellings with building material with high level of thorium (Th232). Therefore, it is regulated through regulations related to the building material. Exposure to thoron could be a problem at workplaces with NORM.

Some of the challenges regarding the implementation of RAP that the project will address, among others, include:

- challenges concerning notably the juridical meaning and use of the **reference level**, the **protection of new buildings** (a regional competence, leading to obligations for architects/builders, with consequences for the measurement protocols) and the implementation of the radon action plan. The use of the reference level concept and its articulation with the dose limitation, in particular at work, may be also challenging. Similarly, the EU BSS Directive imposes to the EU MS a legal regime of **regulatory control**, including **justification** of the protective measures for existing exposure;

- lack of homogenisation of **methodologies for characterising** radon prone areas and **measurement techniques and protocols** leading to evaluation of radon-radon progeny equilibrium and aerosols size distribution, even if the latest are not part of the RAP;

- lack of harmonisation of energy saving technologies and radon control technologies in dwellings and workplaces that requires an application of innovative mitigation systems and methods, following the requirements on **energy performance of buildings** in EU MS stated in the revised European Union Directive 2010/31/EU on the energy performance of buildings which significantly affects the indoor air quality;

- the different potential for radon mitigation (prevention or reduction) in **new buildings** compared to **old houses**, where mitigation may be more technically complex, difficult, expensive and more challenging due to, among others, the values attached to the house (identity, personal, cultural, etc);

- challenges related to health issues, such as the scarce amount of information on **carcinogenicity of radon in other organs** than lungs, whether radon can induce **diseases other than cancer [10]** or the **confusion** regarding symptoms related to high CO_2 levels and radon, including information that household **carbon monoxide** detectors do not detect radon [11];

- challenges linked to risk perception, awareness and behavioural change. While limited research has explored the affected population's **understanding and awareness of radon** and risk perception in Europe, research related to behavior change, e.g. "measure and fix", is limited [12]. Empirical evidence from different countries shows that there is a value-action gap, meaning that there is no or low correlation between knowledge about radon risks (awareness) and willingness to act (behavioural change, remediation). In addition, perception of radiological risks related to the use of NORM for building material and radon spas is rather unexplored and stakeholders' positions are not well known. This has significant implications for communication, socio-political decisions and also adds controversy regarding exposure situations [11, 13];

- there is a need to build scientific and professional **competence** in radiation protection in Europe, for instance, in the building sector. The implementation of BSS is calling for new competences and regulations for radon. For example, socio-technical and political aspects of radon need to be further investigated [14] and additional legislation needs to be put in place in some MS regarding the real state sector [15];

- radiation protection from radon involves **costs** that are perceived by some stakeholders as excessive. The implementation of radon action plans may carry additional costs and encounter **resistance** from politicians, NORM industries, real estate investors, employers and house owners in radon prone areas. The increased awareness of detriment associated with exposure to radon (especially in declared radon prone areas) may be perceived by communities and local residents as a threat for the value of properties, businesses and tourism. This may present challenges related to the willingness to cooperate on implementing the actions of the radon action plan. Furthermore, **subsidies** for measures for reducing radon concentrations in dwellings are not taken up. As an example, in 2004 the Swedish National Board of Housing and Planning assessed that only about half of the radon subsidy budget was taken up by concerned homeowners per year in order to apply measures for reducing radon concentration in their house [16]. Similar experiences are reported by EPA Ireland [17].

- challenges related to the **identification of workplaces** with high radon exposure: e.g. definition of radon risk areas, measurement and declaration protocols and responsibilities of owners and employers have to be cleared out in some MS;

- low level of **stakeholder engagement** on radon risk governance. For instance, radon issues mainly appeared in public discourse through mass media whenever an increased level was found in a public building, e.g. school or kindergarten. The lack of stakeholder engagement in the radon risk governance resulted in sensational mass

media reporting about radon but with small impact on mitigation actions by residents, low level of awareness of risks related to radon among the exposed populations and disregard of application of protective actions [18, 19].

- there is no harmonized method for the development and visualisation of **radon maps** [20-22], despite the efforts to develop a European radon atlas by the Joint Research Centre;

- defining a "**radon prone area**" seems to be a difficult issue for some countries to resolve [20]. The implications of the definition vary between countries, but it can affect the degree of control of building codes for new dwellings and public buildings, and the need for employers in all workplaces to make radon measurements;

- although a considerable amount of **awareness material** has been developed [20], the communication material is often not effective since it is not developed based on scientific input and empirical evidence [23, 24].

Tasks 2, 3 and 4 will evaluate how EU MS and the UK address these challenges. Annex 2 summarises potential approaches to address some of the challenges identified by different projects and organisations.

Preliminary identification of stakeholders related to radon

The EU-RAP project will review and evaluate, in close collaboration with radon stakeholders, national radon action plans established in EU Member States and the UK according to the requirements in Council Directive 2013/59/Euratom –the BSS Directive – with focus on the practical implementation of the actions defined in these action plans. **The radon related stakeholders will be involved in EU-RAP by using innovative and traditional participatory tools at different stages of the project.**

The following stakeholders are preliminarily identified: regulatory authorities (Heads of the European Radiological Protection competent authorities like HERCA), health institutions and other responsible ministries, municipalities and implementing authorities, public building managers and house owners, building professionals, construction engineers and architects, residents, media, relevant scientific communities such as the consortium of European radiation protection research platforms MEENAS which includes the Multidisciplinary European Low Dose Initiative (MELODI), the European Radioecology Alliance (ALLIANCE), the European Radiation Dosimetry Group (EURADOS), the European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (NERIS), the European Alliance for Medical Radiation Protection Research (EURAMED) and the European platform for social sciences and humanities in ionizing radiation (SHARE) and professional associations, such as the European Radon Association (ERA) and the European NORM Association (ENA), among others. These stakeholders will be grouped in networks to be actively involved in the project's activities whenever meaningful. The following ongoing or closed H2020 projects directly or indirectly linked to radon challenges will be consulted: MetroRADON (the Metrology for radon monitoring project addressed the missing links and urgently needed actions to allow for quality assured decisions compliant with the implementation of the BSS; ENGAGE (ENGAGE reviewed why, when and how stakeholder engagement is applied to radiation protection issues related to radon. Case studies on engagement in radon issues from France, Slovenia, Germany and Belgium are presented); TERRITORIES (the project proposed methods to account for uncertainties, and when feasible to reduce them, in long-term situations, including radon, as illustrated by case studies in Belgium, Spain, Norway, and Poland); RADPAR (Radon Prevention and Remediation, aimed to assist in the reduction of the public health burden of lung cancers due to exposure to radon in EU Member States); Norm4building (discusses the depletion of energy resources and raw materials and its huge impact not only on the building market, but also in the development of new synthetic building materials, whereby the reuse of various (waste) residue streams becomes a necessity), among others. Links with the new H2020 RadoNorm project aiming to manage risks from radon and NORM based on improved scientific evidence and social considerations, starting on 1 September 2020, will also be established.

Figure 2 shows the potential interaction of the project consortium with the different stakeholders to be consulted during the EU-RAP study.

Figure 2: EU-RAP stakeholders and interaction with them

Method, overall strategy, work plan and timing

Method

As part of the inception report **D5.1 Inception report** (month 1), the EU-RAP consortium will prepare the detailed methodology to conduct the study, which is summarised in this section. The inception report will include a detailed description of the methodology for independently analysing the national radon action plans, the practical implementation of the actions defined in the action plans and the comparative horizontal analysis of the implementation of the plans in all EU Member States and the UK. The inception report may also include, if deemed necessary by the Commission, the logical framework matrix (the logframe) to summarise what the project intends to do and how, what the key assumptions are and how outputs and outcomes will be monitored and evaluated.

The present work plan describes the scope of the methods to be applied in this study for each task. The Figure below presents which methods will be applied at particular stages of the EU-RAP project. The methods are explained in detail per each subtask in the Section "overall strategy and work plan". The section also includes, for each of the planned sub-tasks, the risk and contingency planning. It is worth mentioning that the EU-RAP consortium has experts with many years' experience in conducting the proposed methods to review and evaluate different ionizing radiation risks management (see section Technical and professional capacity of the EU-RAP consortium).

One of the crucial elements for a sound methodology is that the review and evaluation of radon action plans ensures neutrality and ability to independently assess the work undertaken by different authorities in different countries. In the case of the EU-RAP project, none of the members of the consortium is directly responsible for

the RAP development or implementation (as they do not belong to national authorities). This ensures the independence necessary for this kind of project.

The method will be further detailed and elements/indicators per each radon exposure situation (work, building with public access, and dwelling) will be presented. For instance, for radon at work, the EU-RAP project will focus on how RAP defines and how EU MS and the UK implement RAP from the following elements related to the exposure at work (among others): Radon reference level (art 54 and Annex XVIII, 4); Dose limit for occupational exposure (art 9), including the dose calculation methodology[2]; Radon risk management in NORM activities; Relevancy of radon prone areas for certain workplaces (Annex XVIII, 2); Identification of types of workplaces and buildings with public access (Annex XVIII, 3); Notification procedure (art 25); Arrangements in workplaces for planned exposure situation because of high level of radon (art 35); Assignment of responsibilities (art 31 and Annex XVIII, 5); Strategy/Regulation for reducing radon ingress in workplaces; Strategy/Regulation for reducing radon ingress in building with public access (art 103), taking into account the risk for the public and for employees; Strategy for communication to inform employers and employees of the risks of radon (Annex XVIII, 10).

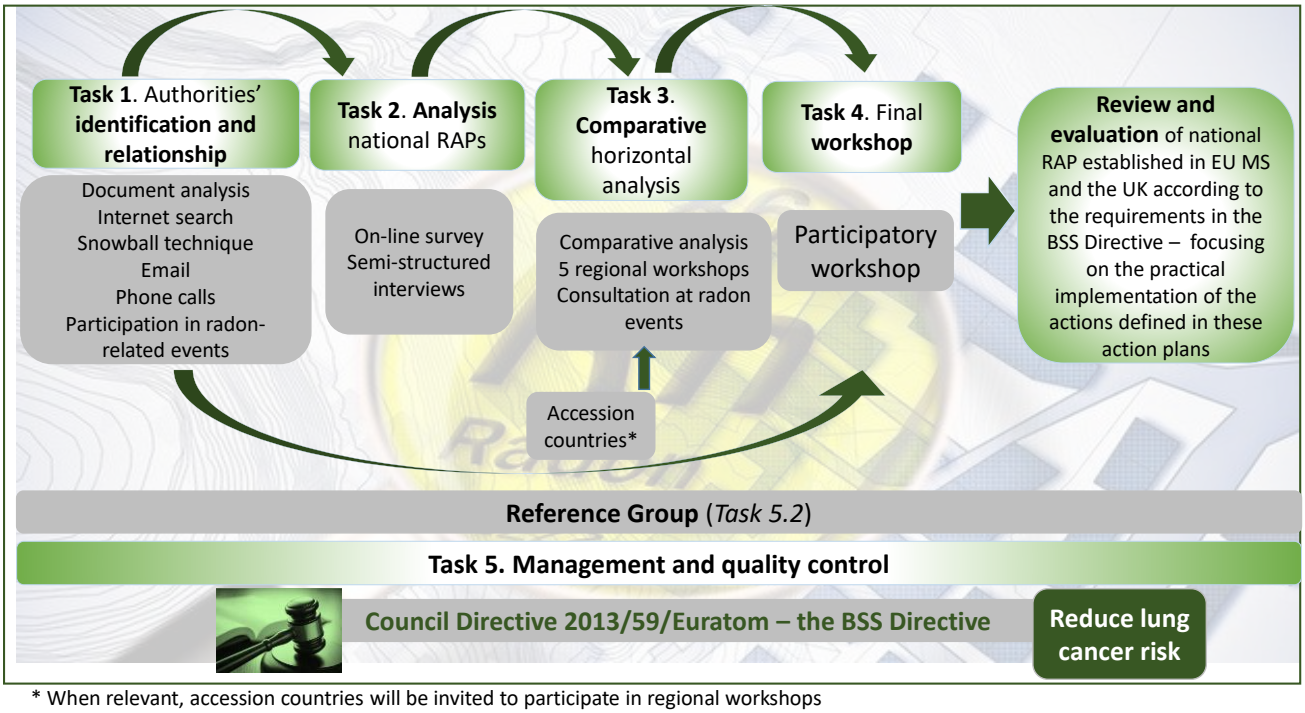
The implementation and realization phases of the RAP, as presented in the flowchart developed by the IAEA and shown in Annex 3, may be used as a **reference point** to review and evaluate the implementation of national radon action plans in EU MS and the UK.

The EU-RAP proposes five tasks, as indicated in the figure below, which include different methods to meet the project objectives. The methods, which are described in the next subsection, include: document analysis, internet search, snowball techniques, observation and participation at radon-related events, on-line surveys, semi structured interviews, comparative horizontal analysis, five regional workshops, stakeholder consultations and the final project participatory workshop. (All methods are explained in each sub-task in detail – see next section). In case of unforeseen events (e.g. COVID-19), the workshops and meetings will be organised online. The consortium members have large experience in organising on-line interactive events and have available ICT tools to support the organisation of virtual meetings and workshops (see Annex 6 for further information on radon events organised by consortium partners in the last three years).

The mixed methods approach used in EU-RAP, which includes quantitative and qualitative analysis, will be conducted by a multidisciplinary team of trained facilitators and experts in the field of radon. In addition, the EU-RAP Reference Group will advise the consortium and validate the findings throughout the duration of the project (besides quality control).

[2] The dose calculation methodology, specifically the dose conversion factors for radon, is currently under scientific and political discussion.

Figure 3: Scope of methods for each task



* When relevant, accession countries will be invited to participate in regional workshops

Overall strategy and work plan

The EU-RAP project has developed a detailed work plan to meet the primary objectives of the project: to review and assess in detail the establishment of national radon action plans in EU Member States (MS) and the UK according to the requirements laid down in Council Directive 2013/59/Euratom – the BSS Directive – with a particular focus on the practical implementation of the actions defined in these action plans; and to identify good practices to address the challenges related to the implementation of radon action plans together with experts, regulators, local authorities and other stakeholders from EU MS and the UK.

The EU-RAP work plan below clarifies the outline of the core services offered to DG Energy, specifying exactly what will be delivered within the core services throughout the project duration. Tasks and subtasks articulate the specific focus for the service area. Risk management for subtasks allows the consortium to identify the risks that may hamper the execution and/or expected results of the work-plan and the actions to mitigate these risks. The EU-RAP work plan and an effective management and quality control will drive the EU-RAP project, ensuring individual accountability and ensuring the desired results in the 24-month period. The work plan consists of five tasks and nine subtasks, as described below.

Task 1: Identification and establishment of contacts with authorities

Task 1 leader: Meritxell Martell

Subtask 1.1: Identification of those competent authorities in European Union Member States and the United Kingdom responsible for the establishment of the national radon action plan, and those authorities charged with the practical implementation of all elements defined in the action plan

Subtask leader: Meritxell Martell
Partners: Tanja Perko, Ivana Fojtíková

Objectives and description: This task will identify the competent authorities in EU MS and the UK responsible for the establishment of the national radon action plan and those authorities charged with the practical

implementation of all elements defined in the action plan using two different methods described in the method section. In particular, the following authorities will be identified for each MS and the UK:

- Authority responsible for overall coordination of radon related activities shared by different authorities and other stakeholders;
- Authorities responsible for identification of situations with potentially high exposure to radon;
- Authorities responsible for conducting surveys of radon concentration (and/or other relevant parameters (soil and rock types, permeability and radium 226 content of rock or soil) in the country including dwellings, workplaces, buildings with public access;
- Authorities for conducting surveys of soil gas concentrations for the purpose of estimating the distributions of indoor radon concentrations;
- Authority responsible for development of the methods for reference levels established for dwellings, buildings with public access, and workplaces;
- Authorities responsible for development of methods for the delineation of areas with potentially high exposure to radon;
- Authorities responsible for development of strategies for prioritizing actions and practices in areas with potentially high exposure to radon;
- Authorities responsible for identification of types of workplaces and buildings with public access which require measurements;
- Authorities responsible for establishment of protocols for measuring radon in the different contexts (including types of dosimeters, recognition, approval or accreditation of measurement services, etc);
- Authorities responsible for information/communication/public awareness;
- Authorities responsible for stakeholder engagement and for establishment of a general strategy for promoting stakeholder awareness and involvement (e.g. leaflets, web, “radon day”, etc);
- Authorities responsible for development of tools for collecting and sharing information on radon;
- Authorities responsible for development of strategies for reducing exposure to radon (remediation and prevention) and their executing;
- Authorities responsible for strategies of financial motivation for reducing exposure to radon
- Authorities responsible for development of guidance on remedial actions and/or preventive measures
- Authorities responsible for development of criteria for the accreditation of remediation services.;
- List of entities responsible for development and testing of radon preventive measures and/or remedial actions;
- Authorities responsible for establishment and maintenance of a (regional, national or European) database collecting results of remediation;
- Authorities responsible for introduction of specific requirements in national building codes (for new buildings and for remediation);
- Authorities responsible for financial support related to radon activities;
- Authorities responsible for establishment of links with related issues and programmes on energy saving and indoor air quality;
- Authorities responsible for establishment of links with programmes on smoking prevention.
- Authorities responsible for establishment of links with programmes energy saving.
- Authorities responsible for establishment of links with programmes on indoor air quality.

The list of responsible authorities will be fully elaborated for the inception report (D5.1.).

Method: The snowball method using radon national contact points as presented in Annex 4 will be applied. The snowball method consists of identifying potential contacts among the authorities and other radon related stakeholders and ask them to suggest further contacts or to encourage these contacts to take part in the study. The snowball method will be upgraded with literature and document analysis as well as internet based research

to further refine the list of competent authorities in EU MS and the UK. In particular, the existing publications and documents from HERCA, ERA, IAEA and radon related projects will be reviewed in order to identify the competent authorities in EU MS and the UK responsible for the establishment of the national radon action plan and those authorities charged with the practical implementation of all elements defined in the action plan.

Risk and contingency planning: Competent authorities in EU MS and the UK responsible for the establishment of the national radon action plan and those authorities charged with the practical implementation may be greatly dispersed. In many EU MS and also in the UK the responsibilities may be shared between different authorities and other stakeholders. It is also possible that the authorities are not coordinated or have no established collaboration in the field of radon which can jeopardize the identification of all responsible authorities in a country. In order to address this risk, the EU-RAP consortium will apply two complementary methods, i.e. snowball method and document review including internet pages. The consortium already defined the starting contact points (see Annex 4). Consortium institutions (SCK CEN and SURO) already have an extensive network among the authorities; they regularly participate at HERCA activities and are members of ERA management board. The consortium partner MERIENCE has expertise and experience in engagement methods which will be applied in case of missing information.

Deliverables: D1.1: List of competent authorities (month 2)

Subtask 1.2: Establishment of relationship with the identified competent authorities;

Task leader: Tanja Perko
Partners: Ivana Fojtíková, Meritxell Martell, Kateřina Navrátilová Rovenská, Aleš Froňka, Johan Paridaens, Michel Bruggeman

Objectives and description: To establish a relationship and collaborate with the identified competent authorities in Subtask 1.1. in order to engage them in the project from the beginning, ensuring information input, their participation at workshops and to regularly get feedback about the project progress. Once we have established contacts with the competent authorities, the list resulting from subtask 1.1. will be reviewed and completed based on the feedback from the primary data sources (snowball technique). The particular objective is to establish a relationship not only with the authority but also person(s) responsible for particular parts of the national RAP and/or its implementation in all MS and the UK.

Contacts (relationship) will be established with:

- Representative of authority responsible for for overall coordination of radon related activities shared by different authorities and other stakeholders;
- Representative of authority responsible for identification of situations with potentially high exposure to radon;
- Representative of authority responsible for conducting surveys of radon concentration (and/or other relevant parameters (soil and rock types, permeability and radium 226 content of rock or soil) in the country including dwellings, workplaces, buildings with public access;
- Representative of authority responsible for conducting surveys of soil gas concentrations for the purpose of estimating the distributions of indoor radon concentrations
- Representative of authority responsible for development of the methods for reference levels established for dwellings, buildings with public access, and workplaces
- Representative of authority responsible for development of methods for the delineation of areas with potentially high exposure to radon;
- Representative of authority responsible for development of strategies for prioritizing actions and practices in areas with potentially high exposure to radon
- Representative of authority responsible for identification of types of workplaces and buildings with public access which require measurements;

- Representative of authority responsible for establishment of protocols for measuring radon in the different contexts (including types of dosimeters, recognition, approval or accreditation of measurement services…);
- Representative of authority responsible for information/communication/public awareness;
- Representative of authority responsible responsible for stakeholder engagement and for establishment of a general strategy for promoting stakeholder awareness and involvement (e.g. leaflets, web, "radon day", etc);
- Representative of authority responsible for development of tools for collecting and sharing information on radon;
- Representative of authority responsible for development of strategies for reducing exposure to radon (remediation and prevention) and their executing;
- Representative of authority responsible for strategies of financial motivation for reducing exposure to radon
- Representative of authority responsible for development of guidance on remedial actions and/or preventive measures
- Representative of authority responsible for development of criteria for the accreditation of remediation services;
- Selected entities responsible for development and testing of radon preventive measures and/or remedial actions;
- Representative of authority responsible for establishment and maintenance of a (regional, national or European) database collecting results of remediation;
- Representative of authority responsible for introduction of specific requirements in national building codes (for new buildings and for remediation);
- Representative of authority responsible for financial support related to radon activities;
- Representative of authority responsible for establishment of links with related issues and programmes on energy saving and indoor air quality;
- Representative of authority responsible for establishment of links with programmes on smoking prevention.
- Representative of authority responsible for establishment of links with programmes energy saving.
- Representative of authority responsible for establishment of links with programmes on indoor air quality.

This list will be fully elaborated for the inception report (D5.1.).

Method: Personal emails, videoconference and telephone calls, snowball technique (to complement subtask 1.1.), participation in radon-related events including the final workshop. In particular, emails will be sent to all competent authorities to establish contacts with them. Telephone calls will be made in case of no response from specific authorities. In addition, videoconferences might be established, if necessary, to present the consortium and highlight the importance of the authorities' involvement in the project. Additionally, some members of the consortium will participate in radon related events or events where radon-related issues might be presented, such as the IRPA15 conference in January 2021 in Seoul, the radon workshop at the Annual European Conference of the Society for Risk Analysis in June 2021 in Finland, the Annual General Assembly and upcoming events of ERA and the HERCA, for instance 2nd workshop on radon national action plans and other relevant activities and events, as announced at ERA website (http://radoneurope.org/index.php/activities-and-events-2/era-activities-and-events/).

Risk and contingency planning: A long list of competent authorities in the EU MS and the UK responsible for the establishment of the national radon action plan and those authorities charged with the practical implementation of all elements defined in the action plan may be identified in each country. In such a case, it may be difficult to manage and keep the relationship throughout the whole project with all of them. To address this risk, the consortium has identified responsible researcher(s) for particular groups of countries. Each researcher from EU-RAP project will develop a relationship (contact) with a specific group of authorities during the development of

the project. Members of the consortium already have many established relationships in MS. In addition, MERIENCE will apply particular participatory practices and solutions to engagement challenges if problems arise regarding the contacts already identified.

Milestones: Log book of contacts and interactions (M1.1month 3, M1.2 month 9, M1.3 month 12, M1.3 month 16, M1.5 month 20, M1.6 month 24)

Task 2: Review and analysis of national radon action plans and their implementation

Task 2 leader: Ivana Fojtíková

Subtask 2.1: National radon action plan: review and detailed analysis

Task leader: Meritxell Martell

Partners: Tanja Perko, Ivana Fojtíková, Johan Paridaens, Hans Vanmarcke, Michel Bruggeman, Aleš Froňka, Kateřina Navrátilová Rovenská

Objectives and description: Review and detailed analysis of national radon action plans as established by all EU MS and the UK according to the requirements laid down in BSS Directive will be conducted. For this, Article XVIII: "List of items to be considered in preparing the national action plan to address long-term risks from radon exposures" as referred to in Articles 54, 74 and 103 will be discussed with the authorities identified in subtask 1.1 and engaged stakeholders in subtask 1.2., in particular:

(1) Strategy for conducting surveys of indoor radon concentrations or soil gas concentrations for the purpose of estimating the distribution of indoor radon concentrations, for the management of measurement data and for the establishment of other relevant parameters (such as soil and rock types, permeability and radium-226 content of rock or soil).

(2) Approach, data and criteria used for the delineation of areas or for the definition of other parameters that can be used as specific indicators of situations with potentially high exposure to radon.

(3) Identification of types of workplaces and buildings with public access, such as schools, underground workplaces, and those in certain areas, where measurements are required, on the basis of a risk assessment, considering for instance occupancy hours.

(4) The basis for the establishment of reference levels for dwellings and workplaces. If applicable, the basis for the establishment of different reference levels for different uses of buildings (dwellings, buildings with public access, workplaces) as well as for existing and for new buildings.

(5) Assignment of responsibilities (governmental and non-governmental), coordination mechanisms and available resources for implementation of the action plan.

(6) Strategy for reducing radon exposure in dwellings and for giving priority to addressing the situations identified under point 2.

(7) Strategies for facilitating post construction remedial action.

(8) Strategy, including methods and tools, for preventing radon ingress in new buildings, including identification of building materials with significant radon exhalation.

(9) Schedules for reviews of the action plan.

(10) Strategy for communication to increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking.

(11) Guidance on methods and tools for measurements and remedial measures. Criteria for the accreditation of measurement and remediation services shall also be considered.

(12) Where appropriate, provision of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.

(13) Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non- smokers).

(14) Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

In addition to

[…]

Existence of education and training programs for professionals

The review and analysis of RAP will focus on the identification of pitfalls and good practices as put forward by the responsible authorities and engaged radon stakeholders. The challenges identified in previous projects (see project context section) will also be discussed as part of this task. The investigated points of RAP will be specified in detail in the project inception report (D5.1.).

Method: On-line survey upgraded with semi-structured interviews, if needed, will be conducted in order to collect data for all EU MS and the UK. Content analysis of the collected data will be done with NVivo software program (NVivo 12 for Windows). Coding of responses will be done by coders combining broad expertise in the fields of radiation protection research and practice as well as risk management, including radon exposure assessment and dosimetry, radiobiology, radioecology, epidemiology, social sciences and humanities and radon risk management.

Risk and contingency planning: While most of the EU MS may have accepted RAP, some MS may still be in the process of drafting or ratifying it. In addition, the status of RAP in some countries may change during the project duration. There is a risk that representatives of those countries may not feel comfortable with sharing their draft RAPs with the EU-RAP team. In order to address this risk, we will apply proven social science methods and ethical approaches (informed consent, anonymization where needed) The status of RAPs will be additionally checked and updated a month before the final workshop.

Deliverables: D2 (task 2.1 and 2.2): Intermediate report on review and analysis of national radon action plans and their implementation (month 12)

Milestones: Questionnaire formulated M2.1 (month 4), Responses collected M2.2 (month 9), Check of RAP status M2.3 (month 19)

Subtask 2.2: Practical implementation - Review and detailed analysis of the practical implementation of the actions defined in the action plans

Subtask leader: Tanja Perko

Partners: Ivana Fojtíková, Meritxell Martell, Johan Paridaens, Hans Vanmarcke, Michel Bruggeman, Aleš Froňka, Kateřina Navrátilová Rovenská, Ladislav Tomášek

Objectives and description: Review and detailed analysis of the practical implementation of the actions defined in the action plans, such as the strategy for conducting surveys of indoor radon concentrations, the delineation of areas, the identification of workplaces and buildings with public access where measurements are required, the establishment of reference levels, the assignment of responsibilities, the strategies for reducing radon exposures, the strategies for communication, remediation, financial support, the establishment of long-term goals, etc. and their application. This task comprises a review of which elements defined in Annex XVIII of the BSS Directive have been implemented in practice and how. For this, additional interviews will be conducted and regional workshops will be organised. The following elements will be investigated in collaboration with the identified authorities at regional workshops to be organised under subtask 3.2:

(1) Strategy for conducting surveys of indoor radon concentrations or soil gas concentrations for the purpose of estimating the distribution of indoor radon concentrations, for the management of measurement data and for the establishment of other relevant parameters (such as soil and rock types, permeability and radium-226 content of rock or soil).

(2) Approach, data and criteria used for the delineation of areas or for the definition of other parameters that can be used as specific indicators of situations with potentially high exposure to radon.

(3) Identification of types of workplaces and buildings with public access, such as schools, underground workplaces, and those in certain areas, where measurements are required, on the basis of a risk assessment, considering for instance occupancy hours.

(4) The basis for the establishment of reference levels for dwellings and workplaces. If applicable, the basis for the establishment of different reference levels for different uses of buildings (dwellings, buildings with public access, workplaces) as well as for existing and for new buildings.

(5) Assignment of responsibilities (governmental and non-governmental), coordination mechanisms and available resources for implementation of the action plan.

(6) Strategy for reducing radon exposure in dwellings and for giving priority to addressing the situations identified under point 2.

(7) Strategies for facilitating post construction remedial action.

(8) Strategy, including methods and tools, for preventing radon ingress in new buildings, including identification of building materials with significant radon exhalation.

(9) Schedules for reviews of the action plan.

(10) Strategy for communication to increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking.

(11) Guidance on methods and tools for measurements and remedial measures. Criteria for the accreditation of measurement and remediation services shall also be considered.

(12) Where appropriate, provision of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.

(13) Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non- smokers).

(14) Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

The challenges identified in previous projects (see project context section) will be discussed as well as part of this task.

Method: On-line survey upgraded with semi-structured interviews will be conducted in order to collect data in all EU MS and the UK. Content analysis of the collected data will be done with NVivo software program (NVivo 12 for Windows). Coding of responses will be done by coders combining broad expertise in fields of radiation protection research and practice as well as risk management including radon exposure assessment and dosimetry, radiobiology, radioecology, epidemiology, social sciences and humanities and radon risk management.

Risk and contingency planning: It may be expected that not all EU MS or the UK have experience in the practical implementation of RAP since most of the countries only started recently to implement it. Due to this, the EU-RAP members responsible to evaluate RAPs will stimulate respondents to openly communicate about expectations, challenges and proposed solutions related to the RAP implementation. It is expected that more additional semi-structured interviews will need to be conducted to assess the practical implementation of RAP. This consortium has trained facilitators and trained interviewers with knowledge in radon topics to conduct this task.

Deliverable: D2 (task 2.1 and 2.2): Intermediate report on review and analysis of national radon action plans and their implementation (month 12)

Milestones: Questionnaire formulated M2.3 (month 4), Responses collected M2.4 (month 9)

Task 3: Comparative horizontal analysis of the implementation of the national radon action plan by all EU Member States and the United Kingdom;

Task 3 leader: Tanja Perko

Subtask 3.1: Comparative Horizontal Analysis

Subtask leader: Johan Paridaens

Partners: Meritxell Martell, Ivana Fojtíková, Tanja Perko, Hans Vanmarcke, Michel Bruggeman, Robbe Geysmans, Aleš Froňka, Kateřina Navrátilová Rovenská, Ladislav Tomášek

Objectives and description: Objectives of this comparative horizontal analysis are to examine how each action in the national radon action plans is implemented in all EU MS and the UK. Additionally, the consortium will examine both similarities and differences of RAPs and their implementation and they will synthesize distinct practices, challenges and innovative approaches in the implementation of the RAP in EU MS and the UK. Another objective of this subtask is to prepare the grounds for a dialogue between different MS and the UK at the regional and final workshops in order to discuss the preliminary results and reach a certain level of generalization, if possible, beyond the observed cases.

Method: Qualitative Comparative Analysis (QCA) is part of a mixed methods approach to research and evaluation which bridges qualitative and quantitative analysis and provides powerful tools for the analysis of causal complexity. The QCA goes beyond the “method of agreement” or “method of differences” and looks for a single common cause or its absence. The EU-RAP project will look for the systematic matching and contrasting the cases in the implementation of RAPs in EU MS and the UK. For this, the EU-RAP project will apply a systematic approach to all radon action plan contextual elements identified in tasks 1 and 2. We will capture in-depth insight into different cases and their complexity, while still attempting to produce some form of generalization. The QCA method is appropriate to evaluate RAP implementation since it ensures the following common features: formalization, replication, transparency, and different types of uses. In addition, consultation with stakeholders at radon related events will be conducted as shown in figure 2.

Risk and contingency planning: In comparative analysis, there is a risk that results report only differences or single common causes instead of synthesize distinct practices. To address this risk, the QCA method will be applied. This part of the project will be conducted by environmental scientists, experts in this method and with specific knowledge related to radon.

Deliverables: D3 (task 3.1 and 3.2): Intermediate report on comparative horizontal analysis of the implementation of the national radon action plan (month 19)

Milestones: Draft analysis prepared for discussion at regional workshops M3.1 (month 12)

Subtask 3.2: Regional workshops - verification of results of workshops M3.1 (month 12)

Subtask 3.2: Regional workshops - verification of results of the Comparative Horizontal Analysis

Subtask leader: Meritxell Martell

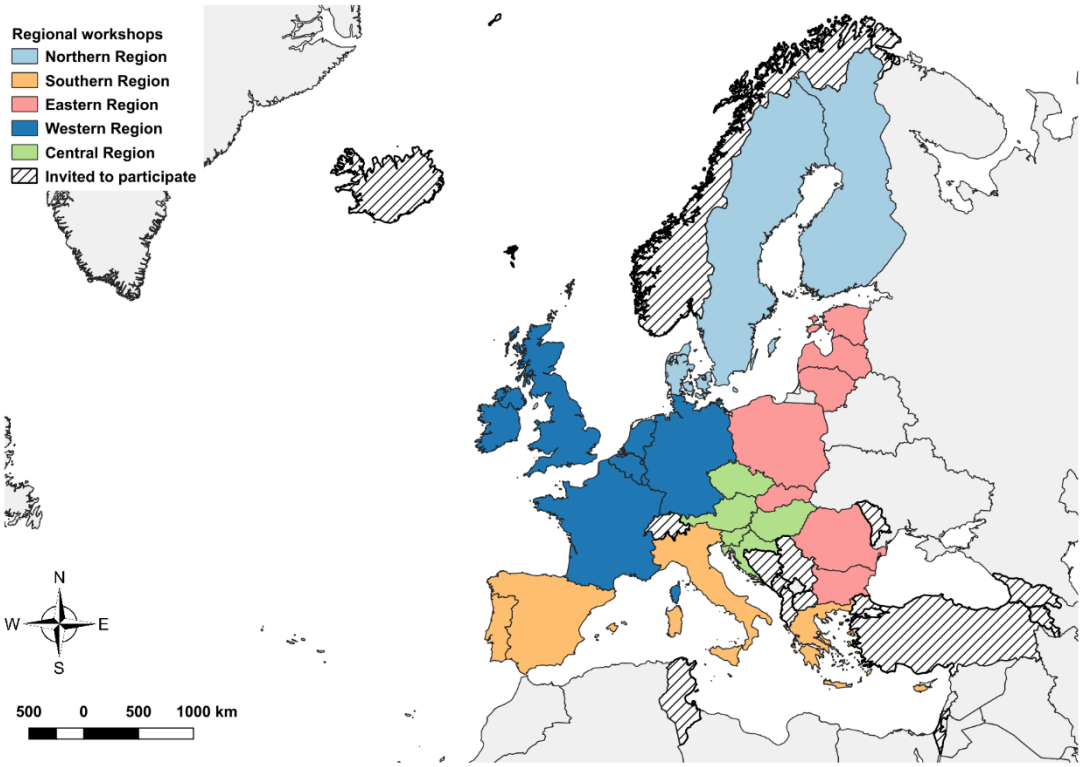
Partners: Tanja Perko, Ivana Fojtíková, Robbe Geysmans

Objectives and description: The objective of the 5 EU-RAP regional workshops is to enable radon experts to make a judgement about the quality of the implementation practices by comparing them, identifying challenges and good practices. MS are grouped according to geographical location and similar institutional radiation protection systems. An additional objective is to obtain consensus on the most reliable opinion of the group of experts as to the best workable solutions to the challenge. The regional workshops will also serve to verify preliminary results achieved in task 3.1. and thus, add an extra quality control to the project output.

Method: Five regional workshops with an option to participate on-line. This qualitative method is designed to forecast viable solutions to problems where data is missing or incomplete. As shown in Figure 4, the **Northern European** regional workshop will invite representatives of countries like Denmark, Finland and Sweden, whilst the **Southern European** workshop will invite representatives from Cyprus, Greece, Italy, Malta, Portugal and Spain. The **Eastern European** regional workshop will invite representatives from Bulgaria, Estonia, Latvia,

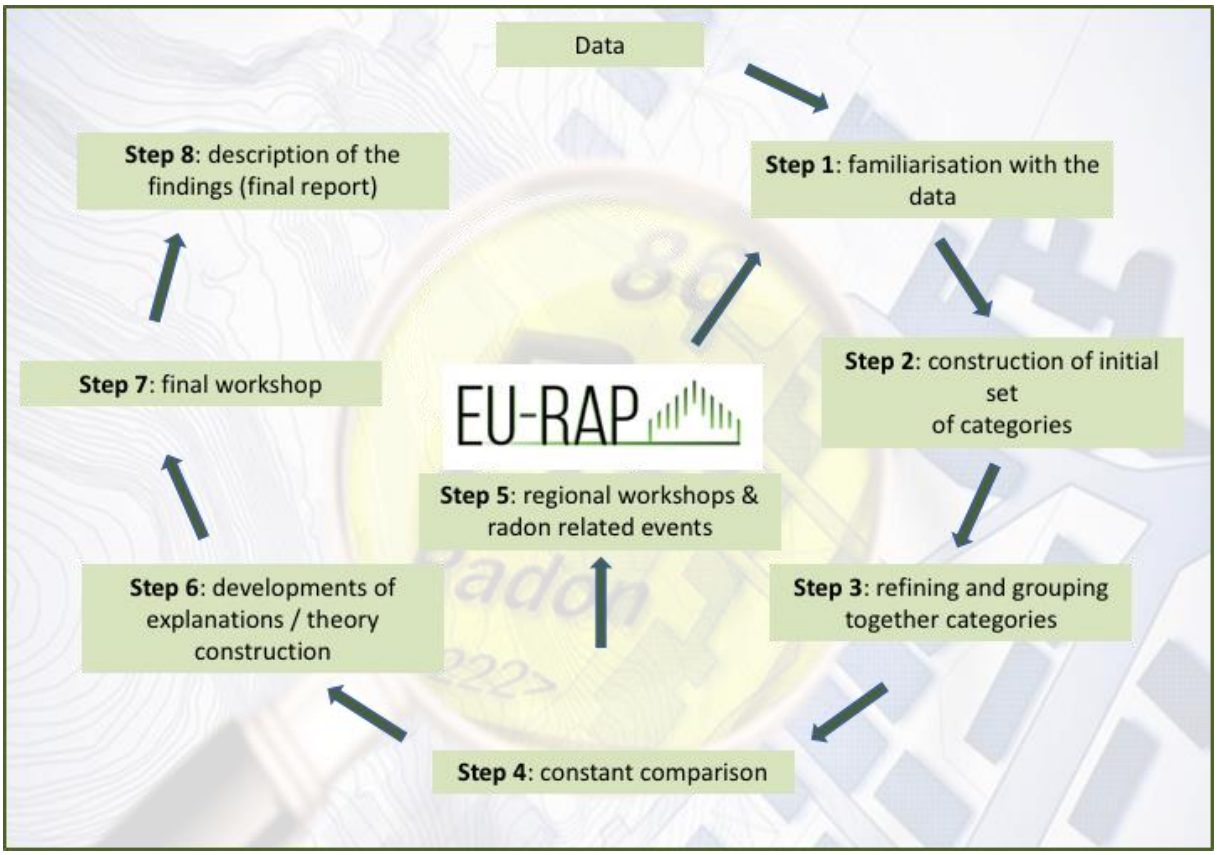
Lithuania, Poland, Slovakia and Romania, whilst the **Western European** regional workshop will cover Belgium, France, Germany, Ireland, Luxembourg, the Netherlands and the United Kingdom. The **Central European** regional workshop will invite representatives from Austria, Croatia, Czech Republic, Hungary and Slovenia. Participants will be experts in the implementation of RAP. When relevant, accession countries will be invited to participate in regional workshops. EU-RAP will cover the costs of the facility, lunch, coffee breaks and if necessary, will provide a per diem for some of the participants who may request it to cover their travel and accommodation expenses. The project foresees a budget of 10 000 euros to support the organisation and participation at these workshops.

Figure 4: Map of EU MS per workshop



As explained above, the comparative horizontal analysis undertaken in subtask 3.1. will be complemented by the findings in the five regional workshops conducted as part of subtask 3.2. The figure below (Figure 5) presents the different stages in the comparative horizontal analysis proposed for the EU-RAP project and the different workshops (regional and final) which will refine the results of the study.

Figure 5: Stages in the comparative horizontal analysis and input from EU-RAP workshops



Risk and contingency planning: Since practical implementation of the radon actions is still ongoing in EU MS and the UK, the QCA method is the most appropriate method to review and analyze the practical implementation of the actions defined in the action plans. In order to motivate experts to participate in the comparative analysis, the workshops will be organised in their region, thus increasing their accessibility. The date of the workshop will be jointly decided between the consortium members and the regional experts. If necessary, their participation will be partly reimbursed. The workshop will start and finish at hours that will enable participants to arrive and depart on the same day. In case of unforeseen events (e.g. COVID-19) the regional workshops will be organised online. The consortium members have large experience in organising on-line interactive events and have available ICT tools to support the organisation of virtual meetings and workshops (see Annex 6 for further information on radon events organised by consortium partners in the last three years).

Deliverables: D3 (task 3.1 and 3.2): Intermediate report on comparative horizontal analysis of the implementation of the national radon action plan (month 19)

Milestones: Regional workshop proceedings M3.2 (month 18)

Task 4: Organisation and implementation of the final workshop

Task leader: Meritxell Martell

Partners: Klaas van der Meer, Tanja Perko, Ivana Fojtíková, Johan Paridaens, Hans Vanmarcke, Michel Bruggeman, Robbe Geysmans, Aleš Froňka, Kateřina Navrátilová Rovenská, Ladislav Tomášek

Objectives and description: The final workshop will be organised to present and discuss the results of the study. The workshop will be organised at the end of the study, at an easily accessible location within the European Union (potentially in Brussels, Belgium). The main objective of this workshop will be to present and discuss the results of the study and to give representatives of the authorities involved in the establishment and practical

implementation of the national radon action plan the possibility to exchange experience. Participation in the workshop will be open to those involved in the establishment and implementation of the national radon action plans in all EU MS and the UK ensuring the broadest possible Member State participation. Participation in the workshop will be free of charge and the consortium will cover the expenses related to its organisation (e.g. rent of meeting room, coffee breaks). In order to ensure participation of representatives from all EU MS and the UK, EU-RAP intends to cover some additional costs (accommodation and transport) for participants from selected countries.

Method: Participatory workshop to present and discuss results and exchange experience will be organised. Around 30 to 40 participants are expected to be present at this workshop. The EU-RAP Reference Group set up as part of Task 5 in the present proposal will be also invited to the final workshop. The workshop will provide an overview of the analysis undertaken as part of this study and will invite experts to present their experiences. A great amount of time will be reserved for discussions and validation of the final results. The workshop agenda will be drafted in collaboration with the EC in the inception report. The consortium proposes to organise 3 topical sessions and devote half a day to discuss radon in workplaces, half a day to discuss radon in dwellings and half a day to discuss radon in public buildings. Within each of these 3 topical sessions, the results summarizing the analysis on radon risk management policies, strategies for measurements and for building and re-construction regulations, (types of preventive measures and remedial actions used), communication plans and awareness building will be presented and discussed.

Travel and accommodation for stakeholders not able to cover their own costs to attend the final workshop will be partially or fully reimbursed, depending on the total number of stakeholders requiring reimbursement. The workshop will be open to anyone interested and will be facilitated by two of the experienced facilitators in the consortium. In addition, it will be well prepared in advance to ensure an efficient time allocation to achieve the workshop objectives.

Risk and contingency planning: The risk of having low attendance will be reduced by engaging the representatives of the authorities involved in the establishment and practical implementation of the national radon action plan from the very start of the project. The financial support foreseen for those stakeholders with difficulties to cover the travel and expenses related to the workshop will facilitate attendance. Within the budget of this project, 25 000 euro is foreseen for the organisation of the final workshop. In case of unforeseen events (e.g. COVID-19) the final workshop will be organised online. The consortium members have large experience in organising on-line interactive events and have license for ICT tools (e.g. Zoom, Microsoft Teams) to support the organisation of interactive virtual conferences, webinars and workshops (see Annex 6 for further information on radon events organised by consortium partners in the last three years).

Deliverables: D 5.3 (task 5): Final study report (month 24) taking into account results of the discussion.

Milestones: Agenda of the workshop M4.1 (month 18); Final workshop proceedings M4.2 (month 22), Draft final report M4.3 (month 22)

Task 5: Project management and quality control

Task leader: Klaas van der Meer

This task includes the administrative, logistic, financial and management activities as well as the establishment and coordination of the EU-RAP Reference Group. Special attention will also be paid to quality control management as part of this task. The activities foreseen in this task cover consortium management and the management of the final deliverable of the project, including the public availability of the findings to the extent possible and agreed by DG Energy. The detailed plan of this project includes a proposal for how the consortium will engage with national authorities and implementers of RAP with a view to allow sharing the information collected in the frame of the study whilst respecting confidentiality issues and at the same time, ensuring that the quality of the study will not be undermined.

Subtask 5.1: Management of the project

Task leader: Klaas van der Meer
Partners: Ivana Fojtíková, Tanja Perko, Meritxell Martell

Objectives: Objectives of task 5.1 are to ensure the successful management of the project; submission of all deliverables in time, coordination of overall activities, administrative and logistic support for all activities including reimbursement of stakeholders for participation in the project; participation at meetings with the European Commission in order to discuss the inception report, interim progress report and final report; taking care of the dissemination of results at different EC publications and conference or meeting presentations, as foreseen in the inception report. The task leader will ensure that EU-RAP does not exceed 24 months.

Risk and contingency planning:

The project is rather ambitious. In principle, the deadlines set out above cannot be extended. The EU-RAP consortium is deemed solely responsible for delays (except for rare cases of force majeure). In order to address the risk of delays, adequate resources (personnel and material) and appropriate organisation of the work including management of potential delays is put in place (see risk and contingency planning for each task and subtasks sections). Consortium partners, SURO and SCK CEN, are large institutes with many experts in radon, therefore, any expert in the EU-RAP team can be immediately replaced by another expert with similar competences and specific knowledge (see description of the consortium and scientific references). In addition, project partners have experience in organising workshops and national, regional and international events including those related to radon (see RICOMET 2019 session on radon, ENGAGE radon workshops, ENGAGE radon round table discussions at ERPW 2018). The consortium has already established contacts with ERA to explore the possibilities of collaboration. Consortium members already published contributions in Radiation Protection series of the European Commission and presented different studies to the Group of Experts referred to in Article 31 of the Euratom Treaty. Moreover, SCK CEN has its Business support unit and financial department which ensures all the support needed for the project. The key experts from SCK CEN have PRINCE2® certificate and they apply PRINCE2® principles to projects: continuous business justification, learn from experience, manage by stages, manage by exception, focus on product and tailor to suit the project environment.

Deliverables:

D5.1 Inception report (month 1) **:** the Inception report will provide an overview of the activities to be undertaken by the EU-RAP consortium: a detailed work programme for the completion of the project; the clearly defined methodology for the study, a description of key tasks and the associated allocation of resources, their duration and intended outcome, and a clear timeline for the execution of the project. The inception report will be delivered at the latest 30 days after signature of the contract along with a draft agenda of the final workshop. The Commission will present its comments within 10 days and may request changes to be made. If requested the EU-RAP consortium will revise the report within 10 days of the receipt of the Commission comments. The inception report may also include, if deemed necessary by the Commission, the logical framework matrix (the logframe) to summarise what the project intends to do and how, what the key assumptions are and how outputs and outcomes will be monitored and evaluated.

D5.2: Progress report (month 11): A progress report will be submitted to the Commission at the latest 11 months after the signature of the contract. This report will provide full information on the status of the project. It will be in English and contain an executive summary.

D5.3: Final Report (month 22): the EU-RAP consortium will prepare a report on the results of the study, summarising the analysis of national radon action plans, as established by all EU MS and the UK, the analysis of the practical implementation of the actions defined in the action plans, and the comparative horizontal analysis of the implementation of the national radon action plan by all EU MS and the UK. The report will be in a format ready for publication in the Radiation Protection series of the European Commission, after approval by the Group of Experts referred to in Article 31 of the Euratom Treaty. A

draft final report will be submitted at the latest 22 months after the signature of the contract. In addition, the report will provide all relevant information on the performance of the contract and the publishable report summarising the study. It will be in English and contain an executive summary in French and English languages.

Milestones:

Kick-off meeting M5.1 (month 1): Within 40 days following the signature of the contract, a kick-off meeting with the Commission will be organised, in order to settle all the details of the work to be undertaken. The meeting will take place in the Commission's premises in Luxembourg.

Minutes of the meeting M5.2 will be sent to the Commission 10 days after the meeting.

Final meeting M5.3 (month 24): A final meeting with the Commission may be organised, if deemed necessary by the Commission, at the latest 40 days after delivery of the draft final report.

Subtask 5.2: Establishment and coordination of the project Reference Group

Task leader: Meritxell Martell

Partners: Tanja Perko, Ivana Fojtíková

Objectives and Description: The EU-RAP Reference Group is the consultative body to provide advice and expertise to the consortium and validate the project results. It will provide input, will be consulted on the work performed and will review the project deliverables and final results (validation). In order to enhance the quality of the analysis, the Reference Group will be regularly informed about the development of the study and will receive both the intermediate and the final outputs and deliverables. The task leader will arrange periodical exchanges with the Reference Group to be held preferably by telephone, skype or videoconference. Additionally, the Reference Group will be invited to the regional workshops and the final workshop.

The Reference Group will be established at the very beginning of the study comprising representatives from all areas involved in the definition, implementation or subject to the RAP and its implementation.
The main tasks of the Reference Group are i) to provide input on RAP and its implementation and ii) to review the work carried out within the project, particularly to comment on the draft final report.
The composition of the Reference Group shall aim at ensuring, as far as possible: i.) a balanced and sufficient representation of relevant know-how and areas of interest, taking into account the specific tasks of the group and the type of knowledge required; ii.) wide European representation to achieve the necessary balance between policy, regulatory and implementation levels of RAP, including technical or administrative roles; and iii) end-users. The selection of members for the Reference Group will start by inviting international and EU organisations (WHO, UNSCEAR, IAEA, JRC); European wide interest groups (HERCA, ERA, European Association of real state professions, GCP Europe (Building sector professionals), Lung Cancer Europe; European research projects (RadoNorm, MetroRADON, MEDIRAD, Life RESPIRE project); former Czech association of companies measuring radon (Asociace radonové riziko); provincial analytical services indoors in Belgium (SAMI) and Environmental Protection Agency in Ireland.

Method: Participatory tools, engagement methods, inclusive risk governance approaches.

Risk and contingency planning: Reference group members may be inclined not to collaborate on the project due to many ongoing activities related to RAP at national levels. EU-RAP will be flexible regarding the organisation of meetings (time, place, mode of communication). Social scientists with knowledge on radon are trained and experienced in engaging different stakeholders in projects and will apply lessons learned from previous radon related activities (e.g. workshops and steering committee members meetings from ENGAGE, radon related scientific sessions from RICOMET, panel discussions from TERRITORIES).

Deliverables: D3.1 List of the Reference Group members M5.4 (month1)
Milestones: Periodical exchanges with the Reference Group members M5.5 (M6), M5.6 (M11), M5.7 (M22)

Subtask 5.3: Quality and scientific control of the project

Quality control officer: Peter Vermaercke, Head of integrated management services
Scientific control officer: Hans Vanmarcke, Head BIO Expert Group "Interdisciplinary Biosciences"
Language control: the SCK CEN in-house language service

Objectives and description: The **scientific control** from the radiation protection point of view and specific radon knowledge will be ensured by a scientific control officer. To ensure the **quality control** system to the service, the quality of the deliverables and continuity of the service in case of absence of the member of the team, a quality control officer from SCK CEN will be appointed. In addition, **language quality check** is ensured by the in-house language service at SCK CEN.

Method: SCK CEN has an operational integrated management system. In the framework of this project, a specific quality plan will be drafted according to the SCK CEN integrated management system requirements, as described in the management system process BPR-296 R&D Management. This process is based upon the relevant items of § 8.3 of ISO 9001:2015 for research projects and PRINCE2® (Projects IN Controlled Environments 2) as a structured project management method.

Description: This specific quality plan will describe:

- The project outline with the project summary, the objectives, the desired planning, the outcomes and deliverables, the project scope and the context;
- The project team with the roles of each member and the relevant deputies for each role;
- The quality assurance requirements as described in the tender as related to document and data control for any raw data during the project and scientific output;
- The quality control requirements in terms of monitoring and control;
- Archiving reports or publications;
- A risk register describing both safety related, but also strategic, operational and financial risks;
- A project plan describing in a Gantt chart the project outline, milestones and deliverables.

In terms of monitoring and quality control in the framework of this tender, the quality plan describes the role of the Quality Assessment (QA) officer for this project (task leader). The QA-officer will

i. review the quality plan, end of project review meeting reports and all project deliverables.
ii. draft on a regular basis (at least twice a year) a milestone trend analysis chart in order to monitor milestones and control expected deliverables

In terms of scientific quality control, the officer for this project will

i. review the plan and deliverables
ii. draft a midterm report (attached to the progress report) and end-term report (attached to the final report).

In addition to high language standards of all partners in the project (they work and publish in English), a language quality check will be made by native speakers and the SCK CEN language service, if needed. A high English language standard of the team is also proven by numerous publications in A1 journals. In case of absence of a member of the team, SCK CEN will appoint a new competent member of the team from a pool of experts from the SCK CEN Institute for Environment, Health and Safety (EHS) which has its main mission in radiation protection.

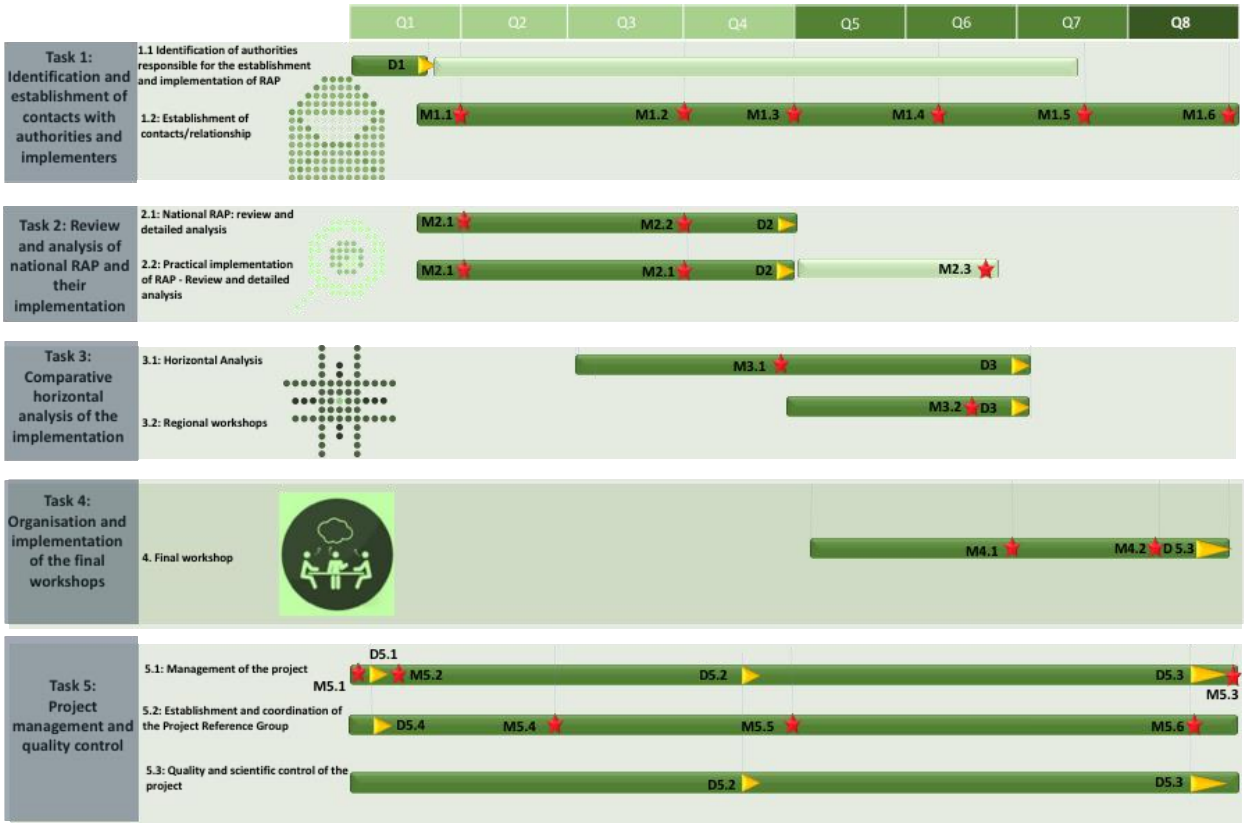
Risk and contingency planning:

SCK CEN has a well-established management system (for instance, based on the principles of ISO 9001:2015 and accredited ISO 17025:2017). This management system will be supplemented by a specific quality control method which has been developed for research and development projects. The leading quality control officers has more than 30 years of experiences in the domain. SCK CEN employs a language service, which will be in this case engaged for a language control. All consortium members publish scientific publications and project reports in English (see references in CVs). All workshops and events organised by the consortium and listed in Annex 6 were conducted in English. All projects coordinated by the project manager and project experts were successfully finalised and results fulfilled the projects' objectives.

Timing: Gantt Chart

The figure below displays the EU-RAP Gantt Chart showing all the activities (tasks and events) over the project time duration (24 months). The tasks and sub-tasks are listed on the vertical axis of the chart and time intervals (quarters) on the horizontal axis. Each sub-task is represented by a bar, showing the start and the end, its duration, if it overlaps with other sub-tasks and for how long.

Figure 6: Gantt Chart of the EU-RAP project



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Technical and professional capacity of the EU-RAP consortium

Consortium as a whole

The EU-RAP consortium comprises a range of professionals with proven specific knowledge in the development and management of this project, ultimately addressed to the establishment of strategies to achieve an appropriate protection of individuals from the dangers arising from exposure to radon. The EU-RAP consortium partners include a large research institute, a Small and Medium Sized Enterprise (SME) and a technical support organisation from the different parts of the EU: SCK CEN from Belgium, SURO from Czech Republic and MERIENCE from Spain. The consortium combines broad expertise in all fields of radiation protection research and practice as well as risk management including radon exposure assessment and dosimetry, radiobiology, radioecology, epidemiology, social sciences and humanities (including legal aspects) and radon risk management. One of the strengths of the EU-RAP consortium is its ability to independently review and analyse radon action plans of EU MS and the UK since none of the members are directly responsible for the RAP development or implementation (as they do not belong to national authorities). The documents attached prove that they have the legal, regulatory, economic, financial, technical and professional capacity to carry out the work subject to the procurement procedure.

Partners of this joint tender led by SCK CEN have sound experience in the field of the tender, as shown in the references to different projects, references to scientific contributions related to radon, and active contribution and collaboration with EU MS national authorities and radon related associations (e.g. European Radon Association, European Norm Association, International radiation protection association, International Commission on Radiological Protection (ICRP), Committee on Radiological protection and Public Health of the OECD Nuclear Energy Agency (CRPPH), etc.). For details see: partner descriptions, project references and CVs here below and statements issued by the clients in accompanied documents to this tender application. In addition, the consortium partners have a demonstrable track record of organising interactive radon related meetings, webinars, workshops and conferences, as shown in Annex 6.

Moreover, members of the consortium already successfully performed similar service contracts with DG Energy (e.g. "Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive", № ENER/D3/2016-409), they published in the Radiation Protection series of the European Commission, and they presented different projects at the Group of Experts referred to in Article 31. SCK CEN is also a member (representative of Belgium) at the Article 31 Group of Experts.

The consortium is gender and geographically balanced. Partners in the EU-RAP consortium speak fluent the following EU languages: Croatian, Czech, Dutch, English, French, German, Italian, Romanian, Slovak, Slovene and Spanish. To ensure the highest English and French standards in documents (e. g. executive project summary) the SCK CEN professional in-house language service will be employed.

The Belgian Nuclear Research Centre, SCK CEN

The Belgian Nuclear Research Centre, SCK CEN is a foundation of public utility under the tutorial of the Belgian Federal Minister in charge of energy. More than 740 employees realize a turnover of about 62M€. Throughout its more than sixty years of experience in the field of nuclear science and technology, radiation protection and radiobiology, the Belgian Nuclear Research Centre, SCK CEN, has earned a reputation as a centre of excellence for research, training and education in the field of peaceful applications of nuclear science and technology and ionizing radiation.

The SCK CEN Institute Environment, Health and Safety (EHS) studies the behaviour of radioactive substances in air, water and soil and evaluates the effects of radiation on man and environment. It has an expertise in all fields of radiation protection research and practice as well as risk management including radon exposure assessment

and dosimetry, radiobiology, radioecology, epidemiology, social sciences and humanities and radon risk management. Based on this knowledge, EHS makes practical recommendations on radiation protection and safety to the government, the industrial and the medical world. SCK CEN measures, analysis and controls the doses that both workers and the environment incur. We have accreditated laboratories for low-radioactivity measurements and radiation protection dosimetry. EHS evaluates the potential risks of ionising radiation on man and its environment. Specific attention is paid to the effects of low doses of ionising radiation on man, radiosensitivity of the developing organism, to individual susceptibility, cancer and non-cancer effects of ionising radiation. We thereby provide the scientific background for occupational, accidental, medical or cosmic exposure to radiation and we make practical advice to the government, the industry and other stakeholders including local communities. The institute also examines the possibilities for surface and deep disposal of radioactive waste and the decommissioning of nuclear installations. Moreover, EHS pays attention to societal and ethical aspects of nuclear technologies such as sustainable development, safety and legal issues. The competences of EHS in radon related field are recognised at national and international levels. The institute conducts, on a regular basis, different assignments related to radon for authorities, industry, local communities and other research organisations. For instance, SCK CEN formulated the EC stakeholder engagement recommendations for the implementation of the BSS directive in the context of the H2020 project ENGAGE. Also, the scientific contribution of EHS to studies related to radon and its management is significant (See scientific references in Annex 5). SCK CEN has also an in-house language service, which will take care for language quality of the project reports.

Radon related projects (national and international) conducted by SCK CEN in last years

Ref #1	**Project title**		**Radiological surveillance of the Belgian territory**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
SCK CEN	Belgium	800 000/annual	50	22	Federal Agency for Nuclear Control (FANC)	FANC	1990 - ongoing	-
Detailed description of project						**Type and scope of services provided**		
On behalf of the Belgian Federal Agency for Nuclear Control (FANC), the Belgian Nuclear research Centre (SCK CEN) and IRE/IRE EliT are in charge of the radiological surveillance of the whole Belgian territory. This task consists in the collection of atmospheric, terrestrial and aquatic samples, food chain samples as well as of effluents from nuclear facilities on a daily, weekly or monthly basis. All these samples are chemically prepared for measurements: gamma spectrometry, alpha spectrometry, gross alpha and beta, H-3, C-14, Sr-90 … The results are quarterly reported to the FANC. Radon is one of the surveyed radionuclides.						- Collection of samples in environment and food chain - Radiochemical preparation of samples - Radioactivity measurements (level and isotopes) - Data reporting - Quality Management		

Ref #2	**Project title**		**TERRITORIES "To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
SCK CEN	Belgium	4,238,644	10.5	10	EC	H2020	Jan 2017 – Jan 2020	See TERRITORIES partners at https://territories.eu/partners
Detailed description of project						**Type and scope of research provided**		

The TERRITORIES project targeted an integrated and graded management of contaminated territories characterised by long-lasting environmental radioactivity, filling in the needs emerged after the recent post-Fukushima experience, legacy sites (NORM) and the publication of European Basic Safety Standards defining long term exposure situations including to Radon. A graded approach, for assessing doses to humans and wildlife and managing long-lasting situations (where radiation protection is mainly managed as existing situations), was achieved through reducing uncertainties to a level that can be considered fit-for-purpose. The integration was attained by: Bridging dose and risk assessments and management of exposure situations involving artificial radionuclides (post-accident) and natural radionuclides (NORM), with the NORM work focussing on the uranium decay series of which radon and its daughters are members; Bridging between environmental, humans and wildlife populations monitoring and modelling, Bridging between radiological protection for the members of the public and for wildlife, Bridging between experts, decision makers, and the public, while fostering a decision-making process involving all stakeholders and communication aspects.	This project interlinked research in sciences supporting radiation protection (such as radioecology modelling and field measurements, including radon in outdoor environments, human or ecological dose and risk assessments, social sciences and humanities), providing methodological guidance, supported by relevant case studies as well as recommendation for management of long-term exposure situations. The overall outcome was an umbrella framework, constituting the basis to produce novel guidance documents for dose assessment, risk management, and remediation of NORM and radioactively contaminated sites as the consequence of an accident, with due consideration of uncertainties and stakeholder involvement in the decision making process. The results were widely disseminated to the different stakeholders and accompanied by an education and training programme.

Ref #3	**Project title**		**ENGAGE: ENhancinG stAkeholder participation in the GovernancE of radiological risks for improved radiation protection and informed decision-making**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
SCK CEN	Belgium	777,442.00	24%	7	EC	H2020-CONCERT	20/11/2017-31/12/2019	See ENGAGE partners at https://www.engage-concert.eu/en/Partners

Detailed description of project	**Type and scope of research provided**
The ENGAGE project, funded under the H2020 CONCERT, aimed at "ENhancinG stAkeholder participation in the GovernancE of radiological risks for improved radiation protection and informed decision-making". It focused on identifying and addressing key challenges and opportunities for stakeholder engagement in relation to exposure to indoor radon; medical use of ionising radiation; post-accident exposures. In all these situations, stakeholder engagement is a key issue for improving the governance of radiological risks and the radiation protection of the exposed individuals. The project analysed the international and national legislation and guidelines; ii) highlighted through case studies the forms stakeholder engagement that can be observed in practice, iii) investigated processes to build and transmit radiation protection culture, adapted to the specificities of different exposure situations. Based on this, it formulated recommendations for a more robust stakeholder engagement in radiological protection.	SCK CEN coordinated the project, co-led the work package on the analysis of legal frameworks, co-led the task on case studies pertaining to indoor radon exposures. It also led the preparation of the final report with recommendations from the project (e.g. related to enhancing the effectiveness of radon action plans), which are principally aimed at regulatory authorities and co-organised the final project workshop bringing together several radon stakeholders, among other participants. Additionally, SCK CEN performed a cross national analysis of radon websites of national and local authorities in eight European Member States, from a stakeholder engagement perspective.

Ref #4	Project title		Services for geothermal energy projects in Flanders, Belgium					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
SCK CEN	Belgium	12.675,96 EUR (VITO)/25.935,39 EUR (Janssen Pharmaceutics)	100	3	EC	H2020	2017 - present	None
Detailed description of project						**Type and scope of research provided**		
Services for owners/operators of geothermal power plants in the Flanders region, Belgium, related to NORM handling and monitoring. Radon (^{222}Rn) is one of the isotopes of interest given the high ^{226}Ra concentrations found in the geothermal brines (~100 Bq/L).						SCK CEN provided education & training activities, monitoring plans and monitoring devices to the operators of these plants. Also a joint PhD is carried out with VITO on prediction of NORM scaling accumulation in these geothermal plants.		

Selected SCK CEN scientific references related to radon

For the radon related scientific references, including references to the implementation of national radon action plans see Annex 4

SCK CEN team delivering the service

All EHS experts in the field of radon and radiation protection may contribute to the project. The key experts, with dedicated time for the EU-RAP projects are:

Klaas van der Meer – expert in radiation protection and a manager of many successfully closed EC projects – will be the EU-RAP project manager and he will represent the EU-RAP consortium. (see CV in chapter Key personnel involved in the EU-RAP project)

Prof. Dr. Hans Vanmarcke has an expertise in radon exposure assessment and dosimetry (he developed dose conversion factor for exposure to radon used as a basis by UNSCEAR), radiobiology, radioecology and epidemiology. He will be the scientific control officer in the EU-RAP project. (see CV in chapter Key personnel involved in the EU-RAP project)

Dr. Tanja Perko has an expertise in socio-political and economic expects of radon management. She was involved in implementation of radon awareness campaigns in different EU MS. She will coordinate and engage experts in tasks 1, 2, 3 and 4. (see CV in chapter Key personnel involved in the EU-RAP project)

Dr. Johan Paridaens has an expertise in dosimetry and radon surveillance programs. He measures radon in the living environment and performs NORM measurements for the Belgian government on yearly basis. He will be a team member and will be involved in Tasks 3 and 4. He is also a backup of K. van der Meer. (see CV in chapter Key personnel involved in the EU-RAP project)

Dr. Robbe Geysmans has an expertise in science & technology studies and conducted radon stakeholder workshops in the context of the ENGAGE project. He will help with horizontal comparative analysis (task 3) and organisation of the project workshops (Task 3 and 4). He is also a backup of T. Perko. (see CV in chapter Key personnel involved in the EU-RAP project)

Dr. Michel Bruggeman is an expert in spectrometry and responsible for running different laboratories for sampling and nuclear measurements including measurements of radon in water and other environmental

monitoring. He will be involved in overall contribution to the project in particular Tasks 2 and 3. He is also a backup of scientific quality officer. (see CV in chapter Key personnel involved in the EU-RAP project)

Ing. Peter Vermaercke, is head of integrated management services with many years of experiences in the nuclear field. Among others he was also a quality control officer of the DG Energy founded project "Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive". He will be a quality control officer.

SURO

SURO – The National Radiation Protection Institute (NRPI) - is a public research institution and technical support organisation in radiation protection for the State Office for Nuclear Safety (SONS). SURO continues in its long-lasting tradition of the Institute of Radiation Hygiene in Prague established in 1966. SURO main role is R&D in radiation protection (emergency exposure, radon and natural exposure, medical exposure) and R&D in methods of measurements. SURO coordinates activities in the Czech Radon Action Plan, performs epidemiological studies of health effect of radiation, and is also involved in analysis and control of medical exposures. SURO provides SONS with measurements and expertise. SURO also play the main role in Czech radiation monitoring network (data acquisition and processing), elaboration of methodologies, guidance and recommendations, provides education, public information and basis for legislation. In addition, SURO has a group of experts engaged in relevant research areas, inter alia, radon field measurements, radon detectors development, and performance of epidemiological studies on lung cancer induced by radon etc. The SURO R&D projects are supported by the Technology agency of the Czech Republic, Ministry of the Interior, State Office for Nuclear Safety, SURO participated in EU projects for environmental modelling, prognosis and data evaluation, security research (CATO), radon project (RADPAR), low radiation doses and epidemiology (DOREMI). SURO participates in IAEA projects for environmental modelling VAMP, EMRASS I and EMRASS II, MODARIA. The experts of SURO are working in United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), in EU Group of Experts (Article 31 Euratom), Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) and in IAEA radon programme missions in the world.

Radon related projects (national and international) conducted by SURO in last years

Ref #5	**Project title**		**Radon Program of the Czech Republic - Action Plan**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany (SURO)	Czech Republic	10 400 000 CZK (approx. 400 000 €)	100%	10 people	State Office for Nuclear Safety	Czech Republic	2011 - 2019	-
Detailed description of project						**Type and scope of services provided**		
The comprehensive project of radiation protection from radon in dwellings, ensures the implementation of the Czech Radon Program designed for control of public exposure to radon. Surveillance programme of the Czech Territory, ongoing analyses of preventive measures, independent monitoring of mitigation effectiveness, education of public and experts.						- Surveillance programme of the Czech Territory - The ongoing analyses of preventive measures - Independent monitoring of mitigation effectiveness - Education of members of public and experts - Radon awareness testing - Communication strategies development		

Ref #6	Project title		The research on exposure of Czech population to radon and other sources of natural ionizing radiation. The impact of the existing regulation system.					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany (SURO)	Czech Republic	13 222 000 CZK (approx 497 800 €)	83,73%	7	Technology Agency of the Czech Republic	Czech Republic	2012 - 2014	Czech Technical University in Prague
Detailed description of project						**Type and scope of services provided**		
The project was split into 5 parts investigating different aspects of radon program running in the Czech Republic: 1. Evaluation of the impact (and weakness) of the existing system of radon prevention (in new buildings) on radiation exposure of the public focused on using of new materials, the structural systems of buildings (wooden houses, passive and low-energy houses, insulation, etc.), the technical building systems (heating and ventilation systems). 2. Evaluation of the impact of selected construction technologies used within buildings reconstruction on radiation exposure focused on reduction of energy consumption technologies, building insulation, changes in technical systems (heating and ventilation) and identification of weakness of the existing regulation system. 3. Analysis of EU approaches in measurement, radon diagnosis of buildings, radon remediation and EU radon regulation systems and analysis of their applicability in the Czech Republic. 4. Proposal of changes in existing regulatory system (radon exposure in houses) including the possible impact of implementation of optimization principle. 5. Proposal of changes in CZ technical building code and technical standards						- Radon diagnostic measurements in dwellings chosen, repeated measurements in the above mentioned dwellings - SWOT analysis performing - Analysis of strategic documents of EU member states with respect to radon - Effect of radon remedial actions evaluation - Analysis of strategic documents of atomic law valid in the CR with respect to radon and collected results of measurements and analysis and proposal of updates and changes of the system. - Development of list of updates to be included into the CZ building code and technical standards dealing with protection against radon from soil and from building material		

Ref #7	Project title		Optimalization of Exposure of Public and Workers to Natural Sources of Ionizing Radiation in the Czech Republic					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany (SURO)	Czech Republic	2 791 000 CZK (approx. 133 370 €)	100%	6	Technology Agency of the Czech Republic	Czech Republic	2014 - 2016	-
Detailed description of project						**Type and scope of services provided**		

The project was split into 2 interconnected parts. First part of the project was focused on the research of possible irradiation pathways of persons from workplaces where increased irradiation from natural sources of ionizing radiation may occur (except workplaces with radon, hereinafter referred to as NORM workplaces). The second part was research of possible ways of waste management from these workplaces with regard to the radiation exposure of the public and proposals for criteria and optimal methods of disposal. The following aspects were studied in detail: the possible ways of handling of waste containing natural radionuclides produced in these workplaces with regard to the requirements of radiation protection of the public, identification of the optimal ways of disposal for different types of NORM waste in relation to the size of exposure and determination of criteria for selection of appropriate method for NORM waste disposal. Existing methodology for dose for workers assessment was reviewed and updates were proposed.	- Assessment of the possible ways of handling of waste containing natural radionuclides produced in NORM workplaces. - Identification of the optimal ways of disposal for different types of NORM waste, incl. models for evaluation of exposure arising from the applied disposal scenario. - Determination of criteria for selection of appropriate method for NORM waste disposal. - Analysis of exposure pathways for workers and public, summarization of necessary updates of the national methodology for dose for workers calculation.

Ref #8	**Project title**		**Creating of new strategic documents to regulate radiation from natural sources in the housing stock in the Czech Republic**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany, (SURO)	Czech Republic	9 949 000 CZK (approx. 374 580 €)	100%	9	Technology Agency of the Czech Republic	Czech Republic	2015 - 2016	-
Detailed description of project						**Type and scope of services provided**		
The project was aimed at preparation of the representative radon survey determining the population exposure from natural sources of ionizing radiation in housing fund for further conceptual work of State Office for Nuclear Safety by performing representative survey with regard to the new European legislation - new Council Directive no. 2013/59/Euratom. It was primarily focused on the assessment of exposure from radon Rn-222 and thoron Rn-220 and its decay products. Another goal was to carry out a detailed analysis of the factors influencing the exposure to natural sources in indoor air of a building, especially the assessment of the impact of ventilation based on the direct determination of the air exchange rate.						- Long and short term measurements of radon activity concentration - Testing of available types of radon and thoron detectors - Statistical analysis of obtained data - Ventilation rate measurement - Formulation of methodology for executing the representative survey of irradiation from natural radiation sources in the Czech building stock. - Formulation of methodology for assessment of mean indoor thoron concentration and methodology for assessment of air-exchange rate indoor using passive detection system.		

Ref #9	**Project title**		**Research on the best practices to identify workplaces with a potentially increased exposure to radon for the purpose of the implementation of EU Council Directive 2013/59 / Euratom**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**

Statni ustav radiacni ochrany (SURO)	Czech Republic	1 001 000 CZK (approx. 37 690 €)	100%	3	Technology Agency of the Czech Republic	Czech Republic	2016 - 2016	-
Detailed description of project						**Type and scope of services provided**		
Research aimed at formulation of conditions, rules and practices for an optimal implementation of the new obligations imposed by the EU Council Directive 2013/59 / EURATOM in the field of the radiation protection of the workers in workplaces with a possible increased exposure to radon. The results were used in the process of implementation of EU Council Directive 2013/59 / EURATOM to Czech atomic law.						- The analysis of data measured in workplaces with higher radon activity concentration - The design of methodology for calculation of the radon index of the municipalities - Radon-prone areas for workplaces delineation - Sociological qualitative survey among employers concerning their attitudes to regulations		

Ref #10	**Project title**		**Radon probes of a new generation**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany (SURO)	Czech Republic	11 960 000 CZK (approx. 450 300 €)	33,18%	5	Ministry of Industry and Trade of the Czech Republic	Czech Republic	2018 - 2020	TESLA Hloubetin a.s.
Detailed description of project						**Type and scope of services provided**		
The project aimed at innovating the radon and thoron sensors and the measurement systems for buildings intended for continuous measurement and regulation of indoor radon and thoron concentration and other microclimate parameters used in smart homes and workplaces. New sensors should be able to reach higher sensitivity of measurements and rapid response thanks to optimization of radionuclide nanoparticles collection (Po-218, Pb-214, Bi-214) on the electronic sensor.						- Sensors testing in the artificial atmosphere of the radon chamber in SURO - Testing of the influence of important parameters (humidity, aerosol spectra and concentration, equilibrium factor) on the sensor response - Sensors testing in indoors and outdoors - Sensors testing in the underground atmosphere		

Ref #11	Project title		Mapping and Determination of Radiation Risks of Contaminated Territories					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
Statni ustav radiacni ochrany (SURO)	Czech Republic	13 500 000 CZK (approx. 508 280 €)	33,61%	10	Ministry of Industry and Trade of the Czech Republic	Czech Republic	2019 - 2021	National Institute for Nuclear, Chemical and Biological Protection; Masaryk University
Detailed description of project						**Type and scope of services provided**		
The project aimed at mapping of the state and following setting of conditions, rules and processes for optimal rehabilitation and further use of territories contaminated with natural radionuclides. An increased content of natural radionuclides in mine waters discharged into surface streams and subsequent contamination of sediments was found in the past. The possible remediation of these areas after the end of mining after the removal of mining plants must therefore be assessed in terms of possible radiation risks. For this reason, it is necessary to perform a systematic and detailed mapping of both current and no longer operated mine water discharges in the region of interest and areas that are, or may have been, contaminated with natural radionuclides during the operation of individual mining plants. Based on the results of field measurements and sampling of contaminated waters and sediments, subsequently determine any radiation risks associated with further discharge of mine waters or with remediation and further use of the contaminated area.						- Environmental study providing - Laboratory gamma-spectrometric analysis of samples of sediments - Contaminated areas monitoring - Soil radon measurement incl. depth profiles - Radionuclide analysis of water samples - In situ dose-rate measurements and mapping		

Selected SURO scientific references related to radon

For the radon related scientific references see Annex 4.

SURO team delivering the service

All SURO experts in the field of radiation protection against radon and natural radionuclides may contribute to the project. The key experts, with dedicated time for the EU-RAP projects are:

Aleš Froňka– internationally recognized expert in radon and radon progeny measurements in dwellings, radon diagnostics of buildings and mitigation effectiveness evaluation. He will be an radon measurement, expert for strategies of optimization of radiation protection. (see CV in chapter Key personnel involved in the EU-RAP project)

Kateřina Navrátilová Rovenská - expert involved in environmental radioactivity measurement campaigns and monitoring programs, including soil gas radon measurement and measurements in radon workplaces and NORM facilities. She will be an expert for radon measurement in dwellings, workplaces and public buildings. (see CV in chapter Key personnel involved in the EU-RAP project)

Ivana Fojtíková - expert involved in radon and radon progeny measurements in dwellings, schools and workplaces, performing radon diagnostics in buildings, and effectiveness of preventive measures/remedial actions evaluation. She will be an expert for implementation of national radon program – Action Plan and radon mapping. (see CV in chapter Key personnel involved in the EU-RAP project)

Ladislav Tomášek - internationally recognized expert in radon and radon progeny epidemiology. He will be an expert for epidemiology. (see CV in chapter Key personnel involved in the EU-RAP project)

MERIENCE

MERIENCE SCP is a small/medium sized enterprise based in Barcelona. It was established in 2010 as a strategic environmental consultancy to provide valuable insights on communication, stakeholder involvement and dissemination in the field of complex socio-technical processes, such as nuclear energy, radioactive waste management or radon exposure. The work is conducted following a network based business model, engaging qualified specialists from specific areas on a project by project basis depending on the specific needs.

Merience is involved in H2020 projects related to radiation protection research (RadoNorm) and has been involved in several European projects under the 7th Framework Programme related to governance and societal aspects in nuclear technology (i.e. PLATENSO); radioactive waste management (i.e. InSOTEC); carbon capture and storage (i.e. TRUST) or in outreach related activities (i.e. Abyss ITN). As part of these projects, Merience was responsible for undertaking research and coordination tasks related to stakeholder involvement, risk communication and dissemination. Additionally, Merience has long standing experience of co-ordinating and organising training courses and workshops for different target groups at the European level and international levels.

Stakeholder engagement projects (national and international) related to radiological risks conducted by MERIENCE in last years

Ref #12	**Project title**		**Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive**					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
MERIENCE	Spain	90 000 EUR	20	1	EC	DG Energy	2017 - 2018	SCK CEN / MERIENCE
Detailed description of project						**Type and scope of research provided**		
Review existing procedures amongst EU Member States and identify good practices for the purpose of promoting the effective implementation of the public information and transparency provisions of the Euratom legislation. Its scope included both arrangements to deal with national emergencies as well as those with cross-border impacts. Declared arrangements of the various governments and local authorities, responsible for informing the general public prior to and in the event of a radiological or nuclear emergency, were reviewed. Activities for this study included a legal analysis, comprehensive survey, case studies, review of experience from significant nuclear and radiological accidents worldwide, comparative analysis with requirements and practices in the European non-nuclear hazard industries, round table discussion, consultation with a representative stakeholder group and a final workshop.						MERIENCE coordinated the establishment of and the interaction with the representative stakeholder group consisting of twenty members, co-organised the final workshop, contributed to developing and reviewing all the activities and deliverables undertaken as part of this study.		

Ref #13	Project title		Learning from experiences of local involvement in radioactive waste management					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
MERIENCE	Spain	40 000 EUR	100	1	IAEA	IAEA	2018 - 2019	
Detailed description of project						**Type and scope of research provided**		
Provide technical support to the scientific secretary to prepare, co-ordinate, arrange and facilitate the discussion during four consultancy meetings and two technical meetings with national representatives on learning from experiences of local involvement in radioactive waste management. The project included also the drafting and reviewing of the IAEA technical document.						MERIENCE supported the scientific secretary in organising and facilitating two technical meetings and leading the discussion. The draft document was also developed by MERIENCE as well as the revisions from the consultancy meetings, technical meetings and scientific secretary.		

Ref #14	Project title		Learning from experiences of local involvement in radioactive waste management					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by legal entity (%)**	**No of staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
MERIENCE	Spain	6 545 EUR	100	1	United Nations Institute for Training and Research (UNITAR)	United Nations	2019 - 2020	
Detailed description of project						**Type and scope of research provided**		
Provide support to UNITAR's Multilateral Diplomacy Programme Unit in the delivery of three workshops on stakeholder engagement and coordination for diplomats at major United Nations locations. One workshop was delivered on-line, another one in Geneva and another one at the United Nations in Vienna.						MERIENCE provided training material, liaised with the specialist of the multilateral diplomacy programme unit, delivered the workshop and provided lessons learned.		

Selected MERIENCE scientific references related to stakeholder engagement in radiological risks

- Perko, T., Martell, M. and Turcanu, C. (2020) Transparency and stakeholder engagement in nuclear or radiological emergency management. Radioprotection. https://doi.org/10.1051/radiopro/2020040
- Martell. M. (2019) Effective dialogue and broad societal support. Stakeholder dialogues on radioactive waste management in the Czech Republic and Spain: A review. Chapter of the book "Conflicts, Participation and Acceptability in Nuclear Waste Governance. An International Comparison. Volume III". BrunnengrV§ber, A. and Di Nucci, R.M. (eds.)
- Perko, T. and Martell, M. (2019) Study on good practices in implementing the requirements on public

information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive. EU publications. Directorate General for Energy (European Commission)

Key personnel involved in the EU-RAP project

Ir. Klaas van der Meer, Expertise in management of EC projects related to radiation protection

Proposed role in the project: Project Manager

Family name: van der Meer
First name: Klaas
Date of birth: 02-03-1962
Nationality: Dutch

Education:

Institution (Date from - Date to)	Degree(s) or Diploma(s) obtained:
University of Amsterdam (Sep 1980-Jan 1986)	Master in Experimental Physics (nominal 5 years, spec. Solid State Physics)
Technical University of Delft (Sep 1991-Aug-1993)	Engineer in Technical Physics (nominal 4 year, spec. Nuclear Reactor Physics)
ECN, Petten, The Netherlands	Radiation expert level 3

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch (mother tongue)	1	1	1
English (working language in SCK CEN and numerous publications in English language)	1	1	1
French	1	2	3
German	2	4	5
Spanish	3	5	5

Membership of professional bodies:

- Belgian Society for Radiation Protection BVS/ABR;
- President of ESARDA (European SAfegaurds Research and Development Association) 2013-2014;
- Member of Steering Committee of ESARDA;
- Member of Executive Committee of ESARDA;
- Member of ESARDA Working Groups of Training and Knowledge Management, Verification Technologies and Methodologies.

Present position: Head of Expertise Group Society and Policy Support at Institute for environment, health and safety

Years within the organisation:29

Key qualifications (relevant for the project):

- Manager of a research group of 25 scientists (9 different nationalities);
- Working in multi-cultural environment;

- Working in a multidisciplinary environment (research group consists of physicists, biologist, engineers, mathematician, philosopher, social scientists)
- Course development and lecturer of safeguards course in FP6 GENTLE project
- Development safeguards workshop in FP6 GENTLE project
- Course and workshop development for safeguards in ANNETTE project
- Developed and provided radiation protection courses for SCK CEN Academy
- Coordinator of the Belgian Support Programme for safeguards to the IAEA
- Member of the International Platform for Nuclear Disarmament Verification

Managerial experiences:

- Project leader of CBRN Centres of Excellence project 9 (improvement CBRN national response plan in Lebanon);
- Project leader of CBRN Centres of Excellence project 16 (improvement RN security in North Africa);
- Project leader of CBRN Centres of Excellence project 44 (Strengthening CBRN first response capabilities and regional cooperation in South East Europe, Southern Caucasus, Moldova and Ukraine);
- Project leader of CBRN Centres of Excellence project 57 (Strengthening CBRN forensics capabilities and regional cooperation in South East Europe, Southern Caucasus, Moldova and Ukraine);
- Project leader of CBRN Centres of Excellence project 73 (Protection of Critical Infrastructures against CBRN threats in Middel East);
- Organisation and execution of many tabletop and fiels exercises in the framework of project 44 (24 exercises for CBRN first response) and 57 (6 exercises for CBRN forensics);
- Coordinator SCK CEN for INSC project TZ 3.01/14A to support Regulatory Authority in Tanzania;
- Project leader of INSC Project CH3.02/11A “Enhancing the capabilities in China in the field of nuclear safety in the areas of emergency management and the management of severe accidents” ;
- Main responsabilities for these projects include among others contacts with the representatives of the beneficiary countries, contacts with the Consortium partners, follow-up of the progress of the different work packages, solving issues that arise during the project like adapting the work packages to the real needs as expressed by the beneficiaries. Active participation in several work packages.
- Coordinator of SCK CEN response activities during 131I release in 2008, including performing in-field measurements, sample taking and organising thyroid measurement campaign on 1000 local inhabitants;
- Participation in SCK CEN measurement campaign for Belgian citizens during Fukushima accident;
- Participation in FP6 project TMT Handbook (development of scenarios for malevolent use of radioactivity, development practical exercise of malevolent use for emergency response training);
- Lecturer European course on emergency management (other emergencies, malevolent radiological emergencies).
- Radiological expert for the Belgian government in the framework of Belgian nuclear emergency plan.

Selected publications:

Baeten, P., Paepen, J., van der Meer, K., & Aït Abderrahim, H. (2000). Absolute Measurement of b-eff and l on Weapon-grade MOX Fuel at the VENUS Critical Facility by means of the RAPJA Technique. Annals of nuclear energy.

Borella, A., Rossa, R., & van der Meer, K. (2013). Modeling of a highly enriched 235U fission chamber for spent fuel assay. Annals of nuclear energy, 62, 224-230. https://doi.org/10.1016/j.anucene.2013.06.015

Borella, A., Mihailescu, C., & van der Meer, K. (2014). Validation of a Monte Carlo Model of the Fork Detector. International Journal of Modern Physics: Conference Series, 27, 1-8. https://doi.org/10.1142/S2010194514601513

Braekers, D., Turcanu, C., Olyslaegers, G., Camps, J., & van der Meer, K. (2013). Comparison of the Belgian interventions levels and the new ICRP recommendations for emergency exposures. Radioprotection, 48(5), 111-116. https://doi.org/10.1051/radiopro/20139917

Braet, J., Carchon, R., & van der Meer, K. (1998). Plutonium stockpiles: searching for solutions. NEI - Nuclear Engeneering International.

Camps, J., Olyslaegers, G., Braekers, D., & van der Meer, K. (2013). Case study on the improved use of collective dose for nuclear and/or radiological emergencies. Radioprotection, 48(5), 65-72. https://doi.org/10.1051/radiopro/20139910

Genicot, J. L., Koukouliou, V., Carinou, E., & van der Meer, K. (2007). Monte Carlo Calculations Applied to the Parametrical Studies in a Whole Body Counter. Radiation protection dosimetry, 128(1), 49-61. https://doi.org/10.1093/rpd/ncm242

Hardeman, F., Rojas Palma, C., Sohier, A., van der Meer, K., & Bendam, K. (2007). Monitoring in case of emergency situations related to orphan sources. International Journal of Emergency Management, 4(3), 376-393. https://doi.org/10.1504/IJEM.2007.014292

Hardeman, F., Vermeersch, F., & van der Meer, K. (2010). Safety, dose optimisation and security : the quadrature of the circle. European ALARA Newsletter, 2010(Special Issue 1), 13-18.

Lauritzen, B., Astrup, P., Drews, M., Jorgensen, H., Mikkelsen, T., Thykier-Nielsen, S., ... van der Meer, K. (2005). Atmospheric dispersion of argon-41 from a nuclear research reactor: measurement and modelling of plume geometry and gamma radiation field. International Journal of Environment and Pollution, 20(1-6), 47-54. https://doi.org/10.1504/IJEP.2003.004244

Pommé, S., Camps, J., Sibbens, G., Vidmar, T., Spasova, Y., & van der Meer, K. (2009). Some modifications to Sima's model for total efficiency calculation of well-type detectors. Journal of Radioanalytical and Nuclear Chemistry, 281(1), 143-147. https://doi.org/10.1007/s10967-009-0066-y

Rossa, R., Borella, A., Labeau, P-E., Pauly, N., & van der Meer, K. (2015). Influence of fuel composition on the spent fuel verification by Self-Interrogation Neutron Resonance Densitometry. Esarda Bulletin, (52), 17-24.

Rossa, R., Borella, A., & van der Meer, K. (2015). Investigation of the Self-Interrogation Neutron Resonance Densitometry applied to spent fuel using Monte Carlo simulations. Annals of nuclear energy, 75, 176-183. https://doi.org/10.1016/j.anucene.2014.08.012

Rossa, R., Borella, A., & van der Meer, K. (2013). Development of a reference spent fuel library of 17x17 PWR fuel assemblies. Esarda Bulletin, (49), 27-39.

Rossa, R., Borella, A., Labeau, P-E., Pauly, N., & van der Meer, K. (2015). Neutron absorbers and detector types for spent fuel verification using the self-interrogation neutron resonance densitometry. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 791(08), 93-100. https://doi.org/10.1016/j.nima.2015.04.032

Rossa, R., Borella, A., Labeau, P-E., Pauly, N., & van der Meer, K. (2017). Detection of fuel pins diversion with the self-indication neutron resonance densitometry technique. Esarda Bulletin, 54-61.

Schillebeeckx, P., Borella, A., Emiliani, F., Gorini, G., Kockelmann, W., Kopecky, S., ... van der Meer, K. (2012). Neutron resonance spectroscopy for the characterization of materials and objects. Journal of Instrumentation, 7(March), 1-18. https://doi.org/10.1088/1748-0221/7/03/C03009

Schillebeeckx, P., Abousahl, S., Becker, B., Borella, A., Emiliani, F., Harada, H., ... van der Meer, K. (2013). Development of Neutron Resonance Densitometry at the GELINA TOF Facility. Esarda Bullettin, (50), 9-17.

Professional expériences:

Date from - Date to	Location	Employer	Position	Description
Feb 1986-Nov 1990	Petten, The Netherlands	Energieonderzoek Centrum Nederland (now NRG)	scientific collaborator	safeguards research, reactor physics calculations
Dec 1990-1998	Mol, Belgium	StudieCentrum voor Kernenergie SCK CEN	Head section fuel measurements	safeguards research, reactor physics experiments, reactor fuel research
1998-2002	Mol, Belgium	StudieCentrum voor Kernenergie SCK CEN	Head section reactor dosimetry	reactor dosimetry, reactor physics experiments, safeguards
2002-2006	Mol, Belgium	StudieCentrum voor Kernenergie SCK CEN	Head Department Safeguards & Physical Measurements	Safeguards, gamma-spectrometry, personal dosimetry
2007-present	Mol, Belgium	StudieCentrum voor Kernenergie SCK CEN	Head Expertise Group Society & Policy Support	safeguards, emergency planning, societal aspects nuclear technology

Prof. Dr. Hans Vanmarcke: Expertise in dose conversion factor for exposure to radon

Proposed role in the project: scientific quality control officer
Family name: Vanmarcke
First names: Hans
Date of birth: 11-02-1958
Nationality: Belgian

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Ghent University, PhD, Ghent, Belgium, 1987	PhD in Science Thesis title: Behaviour of radon and decay products in the indoor environment (in Dutch: De bijdrage van het woonmilieu tot de blootstelling aan straling afkomstig van nucluden uit de natuurlijke ^{238}U reeks)
Ghent University, Licentiaat in Computer Science, Ghent, Belgium, 1982	Master (licentiaat) in Computer Science
Ghent University, Licentiaat in Physics, Ghent, Belgium, 1980	Master (licentiaat) in Physics

Language skills

Language	Reading	Speaking	Writing
Dutch	Mother tongue	Mother tongue	Mother tongue
English	C1	C1	C1
French	C1	B2	B2

German	A2	-	-

Membership of professional bodies:

- Member of the Belgian UNSCEAR delegation (United Nations Scientific Committee on the Effects of Atomic Radiation) since 1996, Representative for Belgium since 2008, Vice-Chair of UNSCEAR for 2015-2016, Chair of UNSCEAR for 2017-2018, Member UNSCEAR Bureau as immediate past Chair for 2019-2020
- Member of the Scientific Council of the FANC (Federal Agency for Nuclear Control) since 2009
- Member of the Belgian Superior Health Council as an expert in the area of ionizing radiation since 2008
- Member of the Bureau of the BVS-ABR (Belgian Society for Radiation Protection), president of the BVS-ABR in 1999-2000, honorary member since 2012
- Member of the BNS (Belgian Nuclear Society)
- Member of the Board of Governors of the local partnership MONA (Mols Overleg Nucleair Afval) on the future surface disposal facility of short lived radioactive waste since 2013
- Member of the General Assembly of the local partnership STORA (Studie- en Overleggroep Radioactief Afval in Dessel) on the future surface disposal facility of short lived radioactive waste since 2013

Present position: Head of the BIO expert group "Interdisciplinary Biosciences" consisting of 43 SCK CEN staff and 16 PhD students divided into 3 units

- Biosphere Impact Studies (BIS): radioecology, both effect studies and modelling
- Radiobiology (RDB): health effects of low dose radiation, medical applications and space research
- Microbiology (MIC): bacterial adaptation to extreme environments (radiation, space, geomicrobiology)

Years within the organisation: 30

Key qualifications (relevant for the project): When I joined SCK CEN in 1989 as head of the Section on Nuclear Spectrometry and Absolute Measurements, I had the opportunity to continue my PhD research on radon and radon decay products in the context of several international research projects. Fairly quickly, I expanded my research into the assessment of the radiological impact of exposure to Naturally Occurring Radioactive Material (NORM) in the non-nuclear industry.

Through my whole career, I have been involved in policy support at both the national and international level in the fields of radiation protection and life sciences. This commitment is expressed in my professional life since 1993 when I became head of the Radiation Protection Research at SCK CEN and in my current position as head of the BIO Expert Group. In 2015, I was asked by RIVM to chair an international audit committee for the RIVM measurement campaign for radon and thoron in Dutch homes since 1930.

There is no consensus within the scientific community on the value of the dose conversion factor for exposure to radon. UNSCEAR and ICRP do not agree on this issue and my doctoral research is still mentioned in this discussion. As Chairman of UNSCEAR, I was closely involved in the scientific report "Lung cancer from exposure to radon" adopted by UNSCEAR last year and contributed to a joint UNSCEAR-ICRP paper clarifying the differences in dose conversion factors between the two leading international organisations.

Selected publications:

Vanmarcke H., de With G., Dehandschutter B., Hoffmann B., Kovacs T., McLaughlin J., Tschiersch J. "Report of the audit on VERA II, the 4th radon and thoron survey in Dutch dwellings", National Institute for Public Health and the Environment (RIVM), The Netherlands, March 2015.

H. Vanmarcke "Radon: a special case in radiation protection", In: Radiation Protection Dosimetry, 130 (1): 76-80, 2008.

H. Vanmarcke, "Lack of consistency in the ICRP approach on protection against ^{222}Rn at home and at work" In: Health Physics, 67: 668, 1995.

Vanmarcke H. "Importance of engaging in dialogue with the population after a nuclear accident", In: Radiation Protection Dosimetry, 173 (1-3): 63-68, 2017.- doi: https://doi.org/10.1093/rpd/ncw320

Professional experience:

Date from - Date to	Location	Employer	Position	Description
2017-present	Mol, Belgium	SCK CEN	Head BIO Expert Group "Interdisciplinary Biosciences"	Life sciences and radiation protection
1998-present	Leuven, Belgium	KU Leuven	Visiting professor in the Faculty of Medicine (5% appointment)	Course on "Radiation Protection: Organisation, Legislation and Risk Communication"
2006-2017	Mol, Belgium	SCK CEN	Head Expert Groups "Radiological Impact and Performance Assessments" and "Molecular and Cellular Biology"	Life sciences and radiation protection
2000-2006	Mol, Belgium	SCK CEN	Head Radiation Protection Research Department	Life sciences and radiation protection
1995-2000	Mol, Belgium	SCK CEN	Head Section on Radon Research	Radon and NORM
1993-1995	Mol, Belgium	SCK CEN	Head Radiation Protection Research	Life sciences and radiation protection
1989-1993	Mol, Belgium	SCK CEN	Head Section on Nuclear Spectrometry and Absolute Measurements	Gamma spectrometry, radon and calibration sources
1980-1989	Ghent, Belgium	Ghent University	Research assistant	Radon research

Dr. Tanja Perko, Expertise in socio-political and economic aspects of radon management

Proposed role in the project: Project Expert
Family name: Perko
First names: Tanja
Date of birth: 15-01-1974
Nationality: Slovenian/Belgian

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
University of Antwerp (UA), Faculty of Social Sciences, Antwerp, Belgium (2008 – 2012)	PhD in Social Sciences Thesis title: Modelling Risk Perception and Risk Communication in Nuclear Emergency Management: An Interdisciplinary Approach

Faculty of Social Sciences, University of Ljubljana, Slovenia (2001-2004)	Master of Science Journalism, Communications, Political studies, international security and defence Thesis title: Mass media as a bridge between civil society and armed forces
Faculty of Social Sciences, University of Ljubljana, Slovenia (1992 – 1998)	Bachelor of Science Faculty of Social Sciences, University of Ljubljana, Slovenia Major: Journalism, Communications, Political studies

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Slovenian (mother tongue)	1	1	1
English (working language in SCK CEN and numerous publications in English language)	1	1	1
Dutch	1	2	3
German	2	3	5
Serbian and Croatian	2	2	3

Membership of professional bodies:

Belgian Association for Radiation Protection, BVS- ABR (board member)
European Radon Association, ERA (board member)
European Norm Association, ENA (member)
International Radiation Protection Association, IRPA (task group member)
European platform for Social Sciences and Humanities in ionizing radiation research, SHARE (vice-president)
Society for Risk Analysis (member)
Media, Movements and Politics (m²p) - University of Antwerp (member)

Present position: Senior researcher
Years within the organisation: 8 (+ 4 as PhD researcher)
Key qualifications (relevant for the project): Tanja Perko holds a PhD in Social sciences; "Risk Perception and Risk Communication in Nuclear Emergency Management" (University of Antwerp, Belgium), MSc in political studies; and bachelor in journalism (University of Ljubljana, Slovenia). Her areas of expertise are Risk communication, Risk perception, Health communication, Mass Media, Stakeholder involvement, Participation, Societal aspects of emergency management and Public opinion. She works in inter-, multi- and trans- disciplinary teams. She applies the following research methods: Quantitative (public opinion surveys, media content analysis, structural equation modeling); Qualitative: (interviews, observational studies, focus groups, consensus workshops, media framing analysis) and mixed methods.
T. Perko works as senior researcher at Belgian Research Center, SCK CEN, she is a scientific collaborator of UA since 2012 and is member of Media, Movements and Politics (m2p) research group at UA. She is a vice-president of SHARE (European platform for social sciences and humanities in ionizing radiation). She aligns social science and humanities (SSH) research with R&D of IR technologies and makes the societal aspects more visible to the technical and policy stakeholders related to IR technologies in Europe by boosting European SSH research, stimulating multidisciplinary approach and supporting the integration of links between research, innovation and society in the field of IR by e.g. leading development of Strategic Research Agenda for Social Sciences and Humanities in radiation protection under the H2020 project CONCERT (Perko et. all, 2019).
In 2018-2019, she was a key researcher for DG Energy research project: Public information and Transparency in nuclear or radiological emergencies according to new BSS directive and amended Nuclear safety directive

(Project Ref. Ares(2016)7037963). She has been a coordinator of the European FP7 project EAGLE (Enhancing education, training and communication processes for informed behaviors and decision-making related to ionizing radiation risks) and has been or is a task leader of H2020 projects related to crisis management, decision making, participation and communication in a field of ionizing radiation, e.g. PREPARE (Evaluation and improvement of global communication for nuclear/radiological emergency), OPERRA (Open Project for the European Radiation Research Area), CONFIDENCE (Coping with uncertainties for improved modelling and decision making in nuclear emergencies), ENGAGE (ENhancinG stAkeholder participation in the GovernancE of radiological risks for improved radiation protection and informed decision-making), TERRITOIRIES (To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations) and others. She is a work package leader of new H2020 project RadoNorm where she coordinates research related to societal aspect in radon and NORM exposure situations. She is author and co-author of 47 scientific articles since 2011 and has h-index 8 (Scopus). (see bibliography section). She is a founder and main organiser of the RICOMET conferences and educational events e.g. SRA Benelux (Society for Risk Analysis). She acts as consultant and lecturer in different universities and international organisations e.g. IAEA and EC projects on stakeholder involvement and communication for radon, environmental remediation and communication in nuclear/radiological emergencies and risk communication about ionizing radiation in general. She participated in writing of IAEA guidelines “Communication with the public in a nuclear or radiological emergency”; “Communication and stakeholder involvement in environmental remediation processes”; and chapter in related to “Societal constraints related to decommissioning and environmental remediation”. She is/was promotor or mentor of PhD and Master students at University of Antwerp, Belgium; University Hasselt, Belgium; University Leuven, Belgium and University of Life Sciences, Norway.

Selected radon related publications:

Perko, Tanja ; Turcanu, Catrinel. / **Is internet a missed opportunity? Evaluating radon websites from a stakeholder engagement perspective**. In: Journal of environmental radioactivity. 2020 ; Vol. 212.

Perko, Tanja ; Tomkiv, Y. ; Oughton, D.H. ; Cantone, M.C. ; Gallego, E. ; Prezelj, I. ; Byrkina, E. / **Units related to radiation exposure and radioactivity in mass media: the Fukushima case study in Europe and Russia**. In: Radiation protection dosimetry. 2015 ; Vol. 165, No. 1-2. pp. 154-159.

Perko, Tanja. / **Radiation risk perception: a discrepancy between the experts and the general population**. In: Journal of environmental radioactivity. 2014 ; Vol. 133. pp. 86-91.

Bouder, Frederic ; Perko, Tanja ; Lofstedt, Ragnar ; Renn, Ortwin ; Rossmann, Constanze ; Hevey, David ; Siegrist, Michael ; Ringer, Wolfgang ; Pölzl-Viol, Christiane ; Dowdall, Alison ; Fojtikova, Ivana ; Barazza, Fabio. / **The Potsdam radon communication manifesto**. In: Journal of Risk Research. 2019 ; pp. 1-4.

Turcanu, Catrinel ; Schieber, Caroline ; Schneider, Thierry ; Fallon, Catherine ; Geysmans, Robbe ; Perko, Tanja ; Cantone, Marie Claire ; Economides, Sotiris ; Barazza, Fabio ; Sylvie, Charron ; Gschwind, Regine ; Zeleznik, Nadja ; Pölzl-Viol, Christiane. / **Stakeholder engagement in the management of indoor radon exposures**. In: Radioprotection. 2020 ; pp. 1-7.

Hoti, Ferdiana ; Perko, Tanja ; Thijssen, Peter ; Renn, Ortwin. / **Radiation risks and uncertainties: a scoping review to support communication and informed decision-making**. In: Journal of Radiological protection. 2020; Vol. 40, No. 2. pp. 612-631.

Professional Experiences:

2012 - present	Senior Researcher at Institute Environment, Health and Safety, Lecturer University Antwerp, Belgium

	Belgian Nuclear Research Centre SCK CEN, Mol, Belgium Senior Researcher, lecturer and consultant in risk communication, risk perception, media analysis, stakeholder involvement and public opinion. Member of the PISA Programme for Integration of Social Aspects into nuclear research. Coordinator or task leader in several European projects deealing with societal aspects of nuclear technologies and exposure to ionisng radiation.
2006-2012	Researcher at University of Antwerp and Institute Environment, Health and Safety Belgian Nuclear Research Centre SCK CEN, Mol, Belgium and University of Antwerp (Belgium), Media, Movements and Politics (m2p) international research group
2003 - 2006	Senior advisor Public Relations Slovenian Ministery of Defence Ministry of Defence, Republic of Slovenia, Ljubljana, Slovenia Internal and external communication activities; coordination of crisis and risk communication.
2000 - 2003	Head of Public Relations Office and spokesperson of the Slovenian Armed Forces Ministry of Defence, Republic of Slovenia, Ljubljana, Slovenia Public relation advisor; crisis communication; research on public opinion, views and expectations; two way communication; organisation and coordination of external communication.
1998 – 2000	Journalist at Slovenian National Radio and TV Broadcast Company RTV Slovenia, Ljubljana, Slovenia Field journalist covering ecological, health, social and political issues. Editor of University Views TV series, Studio journalist for TV news

Dr. Johan Paridaens, Expertise in radon in the living environment and NORM measurements

Proposed role in the project: Project team member
Family name: Paridaens
First names: Johan
Date of birth: 23/04/1965
Nationality: Belgian

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Ghent University (1988 - 1992)	PhD Nuclear Physics
Ghent University (1983 - 1987)	Master in Sciences, Nuclear Physics

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch (mother tongue)	1	1	1
English	1	1	1
French	1	1	2
Italian	1	1	2
German	2	5	4

Present position: Senior Researcher

Years within the organisation: 25

Key qualifications (relevant for the project): Johan holds a PhD and master in Nuclear Physics. His areas of expertise are Radon and Radiation Protection , with a particular focus on radon in the living environment (passive and active radon measurements in dwellings and industrial environments, outdoor radon measurements, domestic radon remediation, radon related aerosol studies, retrospective radon measurement techniques, radon calibration measurements) and NORM (mostly related to NORM industry, such as phophate industry, environmental radioactive contamination mapping and remediation). He also has expertise in emergency planning, focusing on aerial gamma surveys (helicopter surveys of large areas, experimental development of rotary wing drone base measurement equipment) and measuring and collecting meteodata.
He has worked as a scientific researcher on these topics at the Belgian nuclear research center SCK CEN since 1995, and has published numerous articles and book chapters on the above topics.

Selected publications:
J Uyttenhove and J.Paridaens **Automation of a Readout System for Passive Radon Dosemeters**, In: Radiation Protection Dosimetry. 1988. Vol. 24

J.Paridaens, H.Vanmarcke. **The Usability of Wood as a Volume Trap for the Purpose of Retrospective Radon Exposure Assessment** In: Health Physics. 1999. Vol. 76

J.Paridaens, H.Vanmarcke, K.Jacobs, Z.Zunic .**Retrospective Radon Assessment by means of 210Po Activity Measurements**, In: Applied Radiation and Isotopes. 2000. Vol. 53

J.Paridaens, H.Vanmarcke. **Radium Contamination of the Laak River Banks as a Consequence of Phosphate Industry in Belgium**. In: Journal of Environmental Radioactivity. 2001. Vol.54/1.

J.Paridaens, H.Vanmarcke, Z.Zunic, J.P.McLaughlin . **Field Experience with Volume traps for Assessing Retrospective Radon Exposures**. In: The Science of the Total Environment. 2001. Vol. 272.

H.Vanmarcke, J.Paridaens **Radon exposure versus exposure to other sources of ionising radiation** In: The Science of the Total Environment. 2001. Vol. 272

Z.S.Zunic, J.P.McLauglin, C.Walsh, A.Birovljev, S.E.Simopoulos, B.Jakupi, V.Gordanic, M.Demajo, F.Trotti, R.Falk, H.Vanmarcke, J.Paridaens, K.Fujimoto **Integrated natural radiation exposure studies in stable Yugloslav rural communities**. In: The Science of the Total Environment. 2001.

A.Birovljev, R.Falk, C.Walsh, F.Bissolo, F.Trotti, J.P.McLaughlin, J.Paridaens, H.Vanmarcke. **Retrospective assessment of historic radon concentrations in Norwegian dwellings by measuring glass implanted 210Po an international field intercomparison**. In: The Science of the Total Environment. 2001. Vol. 272

J. Paridaens, L. de Saint-Georges, H. Vanmarcke **. Mitigation of a radon-rich Belgian dwelling using active subslab depressurization**. In: Journal of Environmental Radioactivity. 2005. Vol.79.

J. Paridaens . **GPS-based handheld device for measuring environmental gamma radiation and mapping contaminated areas**. In: International Congress Series, High Levels of Natural Radiation and Radon Areas: Radiation Dose and Health Effects. 2005. Vol.1276.

J. Paridaens. **Radiological Health Risk Evalution of Radium Contaminated Land : a Real Life Implementation**. In: Radiation Protection Dosimetry. 2005. Vol. 113

J. Paridaens. **Development of a low cost, GPS-based upgrade to a standard handheld gamma detector for mapping environmental radioactive contamination** In: Applied Radiation and Isotopes. 2006. Vol 64.

Zora Žunić, Ilia Yarmoshenko, Kevin Kelleher, Johan Paridaens, James Mc Laughlin, Igor Čeliković, Predrag Ujić, Alexandra Onischenko, S Jovanović, A Demajo, Alexandr Birovljev, Francesco Bochicchio. **Comparison of retrospective and contemporary indoor radon measurements in a high radon area of Serbia** In: Science of the Total Environment. 2007. Vol 387

J. Paridaens. **Mapping large areas of radioactively contaminated land with a self adapted, handheld, GPS coupled, scintillation detector** In: Journal of Environmental Radioactivity. 2008. Vol.99.

J. Paridaens and H.Vanmarcke . **Radiological impact of almost a century of phosphate industry in Flanders, Belgium** In: Health Physics. 2008. Vol. 95.

Žunić Zora S., Kelleher Kevin, Čeliković Igor, Ujić Predrag, Paridaens Johan, Mclaughlin James P., Čuknić Olivera, Milić Gordana, NikoliĆ Jugoslav, Simović Rodoljub. **Identification and assessment of elevated exposure to natural radiation in the Balkan region (Serbia)**. In: Nuclear Technology and Radiation Protection. 2009. Volume 24.

Z.S. Žunic, I.V. Yarmoshenko, N. Veselinovic, M.V. Zhukovsky, P. Ujic,I. Celikovic, J.P. Mc Laughlin, S.E. Simopoulos, A. Birovljev, K. Fujimoto, J. Paridaens, F. Trotti, S. Tokonami, P. Olko, K. Kozak, F. Bochicchio, R. Ramola, J.W. Mietelski, B. Jakupi, G. Milic, G. Ciotoli, K. Kelleher, M. Budzanowski, S.K. Sahoo, H. Vanmarcke and M.P.R. Waligorski . **A comparison of retrospective radon gas measurement techniques carried out in the Serbian spa of Niška Banja**. In: Radioprotection. 2009. Vol. 44.

J.Paridaens. **Anomalous results with the widely used NRPB/SSI type passive radon dosemeter**. In:Radiation Protection Dosimetry. 2010. Vol. 142.

Professional Experiences:

2005-present	Scientific Researcher, Emergency planning, Belgian Nuclear Research Centre SCK CEN, Mol, Belgium
1995 – 2005	Scientific Researcher, Radon and radiation protection, Belgian Nuclear Research Centre SCK CEN, Mol, Belgium
1992 – 1995	Human Capital & Mobility Post Doc (Universtità degli Studi di Trento, Italia)

Dr. Robbe Geysmans, Expertise in science & technology studies, radon stakeholder participation

Proposed role in the project: Project team member
Family name: Geysmans
First names: Robbe
Date of birth: 05-01-1989
Nationality: Belgian

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Ghent University (2012-2017)	PhD in Sociology

Ghent University (2011-2012)	Master in Conflict and Development Studies
Ghent University (2007-2011)	Master in Sociology

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch (mother tongue)	1	1	1
English	1	1	1
French	2	3	3
Spanish	2	3	3
German	3	5	5

Membership of professional bodies:

OECD Working Party on Information, Data, and Knowledge Management (member)

Present position: Researcher
Years within the organisation: 1

Key qualifications (relevant for the project): Robbe holds a PhD in Sociology, MSc in Conflict & Development Studies, and MSc in sociology (Ghent University, Belgium). His areas of expertise are science and technology studies, stakeholder engagement, and socio-technical approaches to radioactive waste management. In his research, Robbe applies insights from economic and political sociology, science and technology studies, actor-network theory and practice theory, and uses a range of qualitative methods (interviews, focus groups, document nalysis, participant observation).
Robbe works as a researcher at the Belgian Nuclear Research Center SCK CEN since 2019, where he is part of a multidisciplinary team working on nuclear science and technology studies. At SCK CEN, he has worked on stakeholder engagement in different exposure situations (e.g. the H2020 ENGAGE project), socio-technical aspects of radioactive waste management, and the interplay of nuclear safety and security (as a PhD mentor). Robbe's work has been published in various international peer-reviewed journals, and presented at numerous international conferences and workshops. He has experience in mentoring master- and PhD-students, and is a member of the OECD Working party on IDKM.

Selected publications:

Geysmans, R., Zeleznik, N., Abelshausen, B., Duranova, T., Schieber, C., Schneider, T., ... Cantone, M. C. / **Broadening and strengthening stakeholder engagement in emergency preparedness, response and recovery**. In: Radioprotection. 2020

Turcanu, C., Schieber, C., Schneider, T., Fallon, C., Geysmans, R., Perko, T., ... Pölzl-Viol, C. / **Stakeholder engagement in the management of indoor radon exposures**. In: Radioprotection. 2020

Professional Experiences:

2019-present	Researcher at Institute Environment, Health and Safety, Belgian Nuclear Research Centre SCK CEN, Mol, Belgium
2017 - 2019	HR Specialist, local government Mol, Belgium

2012 - 2017	PhD Researcher, Department of Sociology, Ghent University

Dr. Meritxell Martell Lamolla, Expertise in stakeholder engagement and risk communication related to radon

Proposed role in the project: Project team member
Family name: Martell Lamolla
First names: Meritxell
Date of birth: 23-01-1975
Nationality: Spanish

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
University Autonoma de Barcelona, Barcelona, Spain (1993-1998)	Degree in Environmental Sciences
University of East Anglia, Norwich, United Kingdom (1998 – 2002)	PhD in Environmental Sciences

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Catalan and Spanish (mother tongue)	1	1	1
English	1	1	1
French	1	2	2

Membership of professional bodies:
- European platform for Social Sciences and Humanities in ionizing radiation research, SHARE (secretary)
- Environmental Professionals Association in Catalonia, member of the Board (2010-2014);
- Catalan Association of Environmental Sciences (1996-2011);
- Marie Curie Fellowship Association;
- Small and medium Sized Enterprise in Catalonia (PIMEC) 2010-2014.

Present position: Managing Director Merience SCP
Years within the organisation: 10
Key qualifications (relevant for the project):
- More than 20 years' professional experience in the field of environmental protection and risk communication;
- Working in European and international projects involving multidisciplinary consortiums (physicists, biologists, engineers, philosophers, social scientists, psychologists);
- Secretary of SHARE (European platform for social sciences and humanities in ionizing radiation) since its establishment in July 2019;
- Key researcher for DG Energy study "Public information and Transparency in nuclear or radiological emergencies according to new BSS directive and amended Nuclear safety directive" (Project Ref. Ares(2016)7037963);

- Member of the management board of RICOMET conference since 2016;
- Project coordinator of FP6 OBRA (Observatory for Long-term Governance on Radioactive Waste Management) 2006-2008;
- National coordinator of Cowam In Practice FP6 European project 2010-2013;
- Project leader of local capacity building project in nuclear territories led by Group of European Municipalities with Nuclear Facilities and funded by DG Energy, 2007 -2008;
- Advisor and expert to IAEA in consultancy meetings and technical missions on nuclear activities, communication and stakeholder involvement in different countries (Belarus, Japan, Malaysia, Mexico, Kirgizstan, Turkey, Ukraine) and supporting scientific secretary in different technical documents;
- Advisor and consultant to OECD/Nuclear Energy Agency on different projects, including crisis communication of nuclear regulatory authorities, stakeholder confidence and safety culture;
- Co-ordinator of the Group of European Municipalities with Nuclear Facilities (GMF) since 2019, former advisor and consultant to GMF;
- Coordinator of the Spanish Energy Mix Forum (SEMF) 2012-2013;
- Participation in several European FP6 and FP7 projects on risk governance (InSOTEC, PLATENSO, TRUST, SAPIERR-2, FUNMIG);
- Manager of the Virtual Information Centre as part of the PLATENSO FP7 European project on establishing a platform for societal research related to nuclear energy in Central and Eastern European countries;
- Main responsibilities for these projects include establishing contacts and working with the representatives of different stakeholder groups (e.g. academia, nuclear industry, regulatory authorities, regional and local authorities, civil society, international organisations, etc), organising workshops in different countries, drafting reports and recommendations in English and adapting the work to the real needs of the beneficiaries.
- Lecturer on crisis communication and risk communication at the Masters programme on Scientific, Environmental and Medical Communication at Universitat Pompeu Fabra since 2012;
- Participation in conferences and scientific missions in many different countries in all continents.

Selected publications

- Perko, T., Martell, M. and Turcanu, C. (2020) Transparency and stakeholder engagement in nuclear or radiological emergency management. Radioprotection. https://doi.org/10.1051/radiopro/2020040

- Perko, T. and Martell, M. (2019) Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive. EU publications. Directorate General for Energy (European Commission)

- Martell. M. (2019) Effective dialogue and broad societal support. Stakeholder dialogues on radioactive waste management in the Czech Republic and Spain: A review. Chapter of the book “Conflicts, Participation and Acceptability in Nuclear Waste Governance. An International Comparison. Volume III”. Brunnengräber, A. and Di Nucci, R.M. (eds.)

- Perko, T.; Van Oudheusden, M.; Turcanu, C.; Pölzl-Viol, C.; Oughton, D.; Schieber, C.; Schneider, T.; Zölzer, F.; Mays, C.; Martell, M.; Baudé, S.; Choffel de Witte, I.; Prlic, I.; Cantone, M.C.; Salomaa, S.; Duranova, T.; Economides, S. and Molyneux-Hodgson, S. (2019) Towards a strategic research agenda for social sciences and humanities in radiological protection. Journal of Radiological Protection. Vol. 39, No 3, p. 766-782.

- Perko, T.; Monken-Fernandes, H.; Martell, M.; Zeleznik, N.; O’Sullivan, P. (2016) Societal constraints related to environmental remediation and decommissioning programmes. Journal of Environmental Radioactivity, June 2017. DOI 10.1016/j.jenvrad.2017.06.014.

- Martell, M. and Van Berendoncks, K. (2015) Integrating societal concerns into research and development (R&D) on geological disposal at the national level. Mineralogical Magazine, November 2015; Vol. 79 (6), p. 1563-1571.

- Ferraro, G. and Martell, M. (2015) Radioactive waste management and public participation in the EU. Lessons learnt from the EURATOM Research Framework Programmes. Energy Policy, Economy and Law. atw Vol. 60 (2015) Issue 12. December 2015.
- Ferraro, G. and Martell, M. (2015) EURATOM projects, radioactive waste management and public participation: What have we learnt so far? A synthesis of principles. JRC Science and Policy Report. Joint Research Centre Institute for Energy and Transport.
- Martell, M. and Ferraro, G. (2014) Radioactive Waste Management Stakeholder Map in the European Union. JRC Science and Policy Reports. Joint Research Centre.
- Martell, M. & Bergmans, A. (2013) 'Potential scenarios for broadening stakeholder involvement in the Implementing Geological Disposal Technology Platform' ICEM 2013-96151. Proceedings 15th ICEM, September 8-12, Brussels. ISBN: 9789057284205.
- OECD/NEA (2013). Crisis Communication: Facing the Challenges. Workshop Proceedings. Madrid, Spain. 9-10 May 2012. Consultant to the OECD/NEA to develop the proceedings.
- OECD/NEA (2012) Road Map for Crisis Communication on Nuclear Regulatory Organisations – National Aspects. Nuclear Energy Agency. NEA / CNRA / (2011)11. June 2011. Consultant to the OECD/NEA to develop this report.

Professional experience:

Date from - Date to	Location	Employer	Position	Description
April 2010-Present	Barcelona, Spain	Merience SCP	Managing director	Management, coordination and development of projects focusing on environmental protection and risk communication. Consultant to international organisations on risk communication.
March 2003-March 2010	Barcelona, Spain	Amphos XXI Consulting SL (previously, Enviros Spain, 2003-2007)	Group Manager	Responsible for a team of 4 consultants coordinating and developing projects in the field of sustainability and environmental strategies. Environmental scientific and strategic consultant.
March 2003 – March 2010	Barcelona, Spain	Amphos-Enresa Chair on Sustainability and Waste Management at the Technical University of Catalonia (UPC)	Support to research	Organisation of seminars and conferences. Participation in research projects and international training courses in Mexico, Bolivia and Congo.
January 2002-January 2003	Barcelona, Spain	Department of the Environment, Barcelona Provincial Council	Environmental Advisor	Develop guides and manuals on public participation for sustainability for local authorities.

Dr. Michel Bruggeman, Expertise in gamma-ray spectrometry and radon measurements

Proposed role in the project: Project team member
Family name: Bruggeman
First names: Michel
Date of birth: 03-06-1962
Nationality: Belgian

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Catholic University Leuven (KU Leuven) (1984 - 1990)	PhD Nuclear Physics
Catholic University Leuven (KU Leuven) (1984 - 1990)	Geaggregeerde HSO Physics (a teaching degree)
Catholic University Leuven (KU Leuven) (1980 - 1984)	MSc Physics (Licentiaat in de Natuurkunde)

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch (mother tongue)	1	1	1
English	1	1	1
French	1	2	3
Spanish	3	3	4

Membership of professional bodies:

- ALMERA (IAEA)
- Belgian Radiation Protection Association (BVS-ABR) (Member)
- Société Française de Radioprotection (Member)
- ICRM (member of scientific committee)

Present position: Head Expert Group
Years within the organisation: 28

Key qualifications (relevant for the project): Dr. Bruggeman holds a PhD in nuclear physics and MSc in physics, (Catholic University Leuven, Belgium). Over the past 28 years, he has served as a scientific collaborator, section head and task manager at the Belgian nuclear research center SCK CEN, we he currently holds the position of head of the expert group on Low-Level Radioactivity Measurements (LRM). In this function, he heads a group of 22 people running different laboratories for sampling and nuclear measurements. He is responsible for the strategic planning, personnel policy, financial management, and evaluation of techniques and methods within this group.
Dr. Bruggeman has a strong expertise in low-level radioactivity measurements, nuclear metrology (gross counting, alpha spectrometry, gamma-ray spectrometry, liquid scintillation counting), and radon in drinking water. He has strong communication and presentation skills gained through various positions at SCK CEN, through speaking at various conferences, and through being an experienced lecturer for the BNEN course on

Advanced Radiation Protection, and in different courses on gamma-ray spectrometry and nuclear measurements. He has also extensively published his work through internal and external reports, and scientific publications for various scientific journals. He has also co-edited and reviewed numerous publications for various scientific journals. Furthermore, he is skilled as technical auditor ISO17025 for nuclear measurement technology (BELAC, RVA, OLAS), and in developing various software (such as analysis programs, LIMS).

Selected publications:

Bruggeman M., Verheyen L., Vidmar T.- **A dedicated LIMS for routine gamma-ray spectrometry: 19th ICRM Conference 2013, Antwerp, Belgium, 17-21 June 2013**.- In: Applied Radiation and Isotopes. 2014. Volume 87:5.

Bruggeman M., Vidmar T., Verheyen L.- **Efficiency calibration of BEGe and extended range detectors.**- In: Applied Radiation and Isotopes. 2014. Volume 87:5.

Stals M., Verhoeven S., Bruggeman M., Pellens V., Schroeyers W., Schreurs S.- **The use of portable equipment for the activity concentration index determination of building materials: method validation and survey of building materials on the Belgian market.**- In: Journal of Environmental Radioactivity. 2014. Volume 127.

Lebacq A., Bruggeman M., Vanhavere F.- **Efficiency calibration of a whole-body-counting measurement setup using a modular physical phantom: European Conference on individual monitoring of ionising radiation, Athens, Greece, 8-12 March 2010**.- In: Radiation Protection Dosimetry. 2011. Volume 144.

Vermaercke P., Farina Arbocco F., Sneyers L., Leal A., Bruggeman M.- **Environmental Monitoring for Safeguards Using k0-standardized Neutron Activation Analysis**.- In: IEEE Transactions on Nuclear Science. 2010. Volume 57:5.

Sneyers L., Verheyen L., Vermaercke P., Bruggeman M.- **Trace element determination in beauty products by k0-instrumental neutron activation analysis.**- In: Journal of Radioanalytical and Nuclear Chemistry. 2009. Volume 281:2.

Vermaercke P., Farina F., Sneyers L., Bruggeman M., Bouças J.- **Validation of the determination of tin by k0-instrumental neutron activation analysis in foodstuff**.- In: Journal of Radioanalytical and Nuclear Chemistry. 2009. Volume 281:1

Vermaercke P., Sneyers L., Bruggeman M., De Wispelaere A., De Corte F.- **Neutron spectrum calibration using the Cd-ratio for multi-monitor method with a synthetic multi-element standard**.- In: Journal of Radioanalytical and Nuclear Chemistry. 2009. Volume 278:3.

Professional Experiences:

2012-present	Head Expert Group: Low-Level Radioactivity Measurements (LRM), SCK CEN, Belgium
2010 - 2012	Task Manager Physico-Nuclear Analysis within LRM laboratories, SCK CEN, Belgium
2007 - 2010	Head Expert Group Reactor & Nuclear Measurements, SCK CEN, Belgium
2000 - 2007	Section Head Safeguards and Nuclear Physics Measurements, SCK CEN, Belgium
1992 - 2000	Scientific collaborator, SCK CEN, Belgium

MSc Ivana Fojtíková, Expertise for implementation of national radon program – Action Plan and radon mapping

Proposed role in the project: Project Expert
Family name: Fojtíková
First names: Ivana
Date of birth: 03-06-1963
Nationality: Czech

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Faculty of Nuclear Sciences and Application of Ionizing Radiation, Czech Technical University in Prague, Czech Republic (1981 – 1986)	Master of Science Nuclear Chemistry Thesis title: Study of U(VI) sorption on weakly acidic ion exchangers

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Czech (mother tongue)	1	1	1
English	1	1	1
German	1	2	2

Present position: Senior researcher, head of Natural Radiation Sources Section
Years within the organisation: 22
Key qualifications (relevant for the project):
Ivana Fojtikova holds master degree in nuclear chemistry. She works as senior researcher and head of Natural Radiation Sources Section. Ivana is involved in radon and radon progeny measurements in dwellings and workplaces, performing radon diagnostics in buildings, and effectiveness of preventive measures or remedial actions evaluation. She is an expert in risk perception and psychosocial aspects in radiation protection; as the manager of national qualitative and quantitative sociological surveys. Since 1994 is Ivana responsible for execution of the Czech Radon Program and radon mapping.
During her 30-year career Ivana Fojtikova becomes an internationally recognized expert in radon and radon progeny measurements in dwellings, workplaces, communication of radon issues towards stakeholders and organisation of measurement and communication campaigns.
Ivana worked as expert and lecturer with the IAEA, Regional Workshop to Enhance the Competence of National Authorities in Implementing Radon Communication Strategy through Practical Exercise, Beograd, June, 2019; Regional Workshop on Communication Strategies in the Control of Public Exposure to Radon, Tallin, 2015; Regional training workshop on developing and implementing national programs for control of public exposure to radon, Sofia, October 2014; Expert meeting to review and further develop training material on communication in relation to national radon programs, September 2014, Vienna.
Ivana Fojtikova is author and co-author of 26 scientific articles and has h-index 7. Ivana participated as key researcher and researcher in several national and international projects.

Selected publications:

Ivana Fojtíková, Jan Helebrant, Petr Kuča. Ramesis project: collaboration with schools and institutions on the building of a citizen monitoring network. Radiation Protection Dosimetry, Volume 186, Issue 2-3, December 2019, Pages 288–290

Fojtíikova, I.; Ženatá I.; Timkova J.: Radon in workplaces - Czech Approach to EU BSS Implementation, Radiat Prot Dosimetry (2017) 177 (1-2): 104-111

Timková, J., Fojtíková I., Pacherová, P.: Bagged neural network model for prediction of the mean indoor radon concentration in the municipalities in Czech Republic, Journal of Environmental Radioactivity (2016) 166 (Pt 2)

Fojtikova, I.; Rovenska, K. Navratilova: Methodology for measurement in schools and kindergartens: Experiences, Radiat Prot Dosimetry (2015) 164 (4)

Fojtikova, I.; Rovenska, K. Navratilova: Influence of energy-saving measures on the radon concentration in some kindergartens in the Czech Republic, Radiat Prot Dosimetry, (2014) 160 (1-3): 149-153,

Fojtíková I.: SWOT Analysis of the Czech Radon Programme, Radiat Prot Dosimetry (2014) 160 (1-3): 35-37

Fojtíkova I., Rovenska K.: Radon programmes and health marketing, Radiat Prot Dosimetry (2011) 145 (2-3): 92-95

Bochicchio et al: National Radon Programmes and Policies, Radiation Protection Dosimetry (2014) 160 (1–3): 14–17

Thomas, J.; Tomasek, L.; Fojtikova, I.; Bernovsky, P.: Cost-effectiveness of countermeasures against radon in the Czech Republic: Preliminary report Radiat Prot Dosimetry (2008) 130 (1)

Fojtikova I., Barnet I., Marusiakova M.: Radon index of a local administrative unit, Radiat Prot Dosimetry (2011) 145 (2-3): 107-109

Barnet I., Fojtikova, I.: Soil gas radon, indoor radon and gamma dose rate in CZ: Contribution to geostatistical methods for European atlas of natural radiations, Radiat Prot Dosimetry (2008) 130 (1), 81-84

Professional Experiences:

2018 - present	Head of Natural Radiation Sources Section, National Radiation Protection Institute
1998 - present	Researcher at National Radiation Protection Institute Head of Department of radon survey
1994 - 1998	State office for Nuclear Safety, inspector Development and implementation of Radon Programme of the Czech Republic Development of national radon database
1990 – 1994	Hygienic station of the capital city of Prague, Department of Radiation Hygiene: specialist in radiation protection, responsible for establishment of Radiation Monitoring Network of the Czech Republic in the capital city of Prague; responsible for development of radon program in Prague.
1986 - 1990	Psychiatric Research Center, Department of Biological Psychiatry, junior researcher in the biochemical lab, working in the team performing mutagenicity studies

Dr. Aleš Froňka, Expertise in dosimetry, strategies of optimization of radiation protection

Proposed role in the project: Project Expert
Family name: Froňka
First names: Aleš

Date of birth: 11-06-1976
Nationality: Czech

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Faculty of Nuclear Sciences and Application of Ionizing Radiation, Czech Technical University in Prague, Czech Republic (2008 – 2015)	PhD in Nuclear Engineering Thesis title: Advanced methods of radon diagnostics of buildings
Faculty of Science, Charles University, Czech Republic (1994 – 1999)	Master of Science Quantum chemistry Thesis title: ”I. Theoretical Study of Penning´s Ionization Dynamic in He*-H2 System” “II. Nuclear Quadruple Coupling Constant in Molecule CN+”

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Czech (mother tongue)	1	1	1
English	1	1	1
Spanish	3	2	3

Membership of professional bodies:

Czech Association for Radiation Protection, CSOZ (member)

Present position: Senior researcher, deputy director for radiation protection
Years within the organisation: 22
Key qualifications (relevant for the project):
Aleš Froňka holds a PhD in Nuclear Engineering. Aleš Froňka is internationally recognized expert in radon and radon progeny measurements in dwellings, workplaces and NORM facilities, radon diagnostics of buildings. He was involved in environmental radioactivity measurement campaigns and monitoring programs, including soil gas radon measurement and field ground based and airborne radiation survey using low resolution gamma spectrometry. He was also involved in research and development projects focused on new measuring methods and techniques used in radon diagnosis of buildings, co-author of several utility models and patents granted for radiation detection devices. He is author and co-author of 18 scientific articles and has h-index 5 (Scopus).
Aleš Froňka worked for the IAEA as lecturer and organiser of Regional Training Course on Inter-Comparison of Active Radon Monitors 20 – 21 September, 2018, as expert and lecturer for Regional Training Course (RTC): Measurement Protocols for National Radon Strategies, Bangkok, Thailand, 9-13 September 2013.
Collaboration with Comprehensive Nuclear-Test-Ban Treaty Organisation – member of the On-site inspection team as a surrogate inspector for field radiation survey participating in large scale Integrated Field Exercises IFE08 in Kazakhstan 2008 and IFE14 Jordan 2014 and other CTBTO training activities.
Dr. Aleš Froňka is official member of the Czech delegation to the CTBTO WGB (Working Group B) focused on technical aspects of the OSI Operational Manual.
Form the year 2011 he was key researcher of several research projects focused on radon and natural radioactivity, radiological aspects of emergency situation. He is a work package leader focused on mitigation of new H2020 project RadoNorm.

Aleš Froňka is former head of Natural Radiation Sources Section, currently his position is senior researcher and deputy director for radiation protection.

Selected publications:

Froňka, O., Froňka, A., Moučka, L., & Knapp, K. (2004). Device for measurement fast changes of the radon volume activity based on an ionization chamber detector. Czech Republic: Prague Industrial Property Office of the Czech Republic.

Froňka, A., & Moučka, L. (2005). Blower door method and measurement technology in radon diagnosis. *International Congress Series, HLNRRA: Radiation Dose and Health Effects, 6-10 September 2004, Elsevier, B.V.*, *1276*, 377–378.

Cechák T., Moucka L., Jiránek M., Fronka A., Thinová L. (2008*)* Investigation and remediation of houses affected by radon phenomena connected with earlier exploration of silver and uranium ore, *Radiation Protection Dosimetry,* Vol.130: 64-67

Moucka L., Fronka A., Jiránek M. (2008) Radon diagnosis procedures focused on dwellings with ineffective measures against radon, *Radiation Protection Dosimetry* Vol.130: 60-63

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Jiránek, M., & Froňka, A. (2008). New technique for the determination of radon diffusion coefficient in radon-proof membranes. *Radiation Protection Dosimetry*, *130*(1), 22–25.

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L Thinova, R Bican, A Fronka, K Johnova, J Solc, J. Vosahlik. RADON CONCENTRATION IN THE AREA OF WASTE ROCK DUMPS, BROD, CR—CASE STUDY. Radiation Protection Dosimetry, Volume 177, Issue 1-2, November 2017, Pages 149–154, https://doi.org/10.1093/rpd/ncx142

K Jílek, M Slezáková, A Fronka, T Prokop, L Neubauer. THE NRPI MULTI-PURPOSE ON-LINE MONITORING STATION FOR MEASUREMENT OF NATURAL RADIOACTIVITY IN THE AMBIENT ATMOSPHERE AND IN THE SOIL. Radiation Protection Dosimetry, Volume 177, Issue 1-2, November 2017, Pages 57–62, https://doi.org/10.1093/rpd/ncx138

L. Thinová, A. Froňka, K. Rovenská. The overview of the radon and environmental characteristics measurements in the Czech show caves. Radiation Protection Dosimetry, Volume 164, Issue 4, June 2015, Pages 502–509, https://doi.org/10.1093/rpd/ncv337

Professional Experiences:

2018 – present	Deputy director for radiation protection, National Ration Protection Institute

2010 - 2018	Head of Natural Radiation Sources Section
2005 – present	Inspector, CTBTO
1999 – present	Researcher, National Radiation Protection Institute

Dr. Kateřina Navrátilová Rovenská, Expertise in radon measurement and implementation of radon action plan

Proposed role in the project: Project Expert
Family name: Navrátilová Rovenská
First names: Kateřina
Date of birth: 21-07-1983
Nationality: Czech

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Faculty of Nuclear Sciences and Application of Ionizing Radiation, Czech Technical University in Prague, Czech Republic (2007 – 2015)	PhD in Nuclear Engineering Thesis title: Degradation of polymeric waterproof membranes by alpha particles
Faculty of Nuclear Sciences and Application of Ionizing Radiation, Czech Technical University in Prague, Czech Republic (2002 – 2007)	Master of Science Dosimetry and application of ionizing radiation Thesis title: Calculation of dose from radon

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Czech (mother tongue)	1	1	1
English	2	2	2
German	5	5	5

Membership of professional bodies:

Czech Association for Radiation Protection, CSOZ (member)

Present position: Senior researcher
Years within the organisation: 14
Key qualifications (relevant for the project):
Kateřina Navrátilová Rovenská holds a PhD in Nuclear Engineering. She was involved in environmental radioactivity measurement campaigns and monitoring programs, including soil gas radon measurement and related to radon workplaces and NORM facilities. Kateřina Navrátilová Rovenská is co-organiser of International Conference on Protection against Radon at Home and at Work, 2007, 2010, 2013, 2016, 2019, organiser of 1st

International comparison measurement of diffusion coefficient of radon in waterproof membranes. Organiser of the EU-NORMII conference in 2014. She works as consultant for radon issues at the IAEA in the years 2013-2015. She organised the RER-9.128-004 - Regional Training Course on Occupational Radiation Protection in NORM Industries, Prague Czech Republic, 7 - 11 September 2015.

She is author and co-author of 17 scientific articles and has h-index 4 (Scopus). Kateřina Navrátilová Rovenská participated as researcher in several national and international projects.

Selected publications:

I. Fojtíková, K. Navrátilová Rovenská. Methodology for measurement in schools and kindergartens: experiences. Radiation Protection Dosimetry, Volume 164, Issue 4, June 2015, Pages 612–617, https://doi.org/10.1093/rpd/ncv340

L. Thinová, A. Froňka, K. Rovenská. The overview of the radon and environmental characteristics measurements in the Czech show caves. Radiation Protection Dosimetry, Volume 164, Issue 4, June 2015, Pages 502–509, https://doi.org/10.1093/rpd/ncv337

Rovenska, Katerina Navratilova. The effect on the radon diffusion coefficient of long-term exposure of waterproof membranes to various degradation agents. RADIATION PROTECTION DOSIMETRY Volume: 160 Issue: 1-3 Pages: 92-95 Published: JUL 2014

Rovenska, Katerina; Jiranek, Martin. 1st international comparison measurement on assessing the diffusion coefficient of radon. RADIATION PROTECTION DOSIMETRY Volume: 145 Issue: 2-3 Pages: 127-132 Published: MAY 2011

Jiranek, Martin; Rovenska, Katerina. Basic principles for the development of a common standardised method for determining the radon diffusion coefficient in waterproofing materials. APPLIED RADIATION AND ISOTOPES Volume: 70 Issue: 4 Pages: 752-757 Published: APR 2012

Fojtikova, I.; Rovenska, K. Navratilova. Influence of energy-saving measures on the radon concentration in some kindergartens in the Czech Republic. RADIATION PROTECTION DOSIMETRY Volume: 160 Issue: 1-3 Pages: 149-153 Published: JUL 2014

Bochicchio, F.; Hulka, J.; Ringer, W.; et al. National radon programmes and policies: the RADPAR recommendations. RADIATION PROTECTION DOSIMETRY Volume: 160 Issue: 1-3 Pages: 14-17 Published: JUL 2014

Slezakova, M.; Navratilova Rovenska, K.; Tomasek, L.; et al. Short- and long-term variability of radon progeny concentration in dwellings in the Czech Republic. RADIATION PROTECTION DOSIMETRY Volume: 153 Issue: 3 Pages: 334-341 Published: MAR 2013

Fojtikova, Ivana; Rovenska, Katerina. Radon programmes and health marketing. RADIATION PROTECTION DOSIMETRY Volume: 145 Issue: 2-3 Pages: 92-95 Published: MAY 2011

Jiranek, Martin; Rovenska, Katerina. Limited applicability of cost-effectiveness and cost-benefit analyses for the optimization of radon remedial measures. JOURNAL OF HAZARDOUS MATERIALS Volume: 182 Issue: 1-3 Pages: 439-446 Published: OCT 15 2010

Rovenska, K.; Thinova, L.; Zdimal, V. Assessment of the dose from radon and its decay products in the Bozkov dolomite cave. RADIATION PROTECTION DOSIMETRY Volume: 130 Issue: 1 Pages: 34-37 Published: JUN 2008

Professional Experiences:

2013-2015	Consultant, IAEA

2006 – present	Researcher, National Radiation Protection Institute

Dr. Ladislav Tomášek - Expertise in radon and radon progeny epidemiology

Proposed role in the project: Project Expert
Family name: Tomasek
First names: Ladislav
Date of birth: 1947
Nationality: Czech

Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Faculty of Mathematics and Physics, Charles University, Czech Republic (1983 – 1988)	PhD. in Statistics Thesis title: Asymptotic simultaneous confidence bands for autoregressive spectral densities
Faculty of Mathematics and Physics, Charles University, Czech Republic (1966 – 1971)	Master of Science Mathematical statistics and probability Thesis title: On superregular functions in Markov chains and related inequalities

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Czech (mother tongue)	1	1	1
English	1	1	1

Membership of professional bodies:

Dr Tomášek is a member of the Editorial Board of the Health Physics Journal.

Present position: Senior researcher
Years within the organisation: 25
Key qualifications (relevant for the project):
Ladislav Tomasek received his PhD. in statistics in 1988. Ladislav Tomasek attended research fellowship at the London School of Hygiene and Tropical Medicine and the Imperial Cancer Research Fund in Oxford during 1991-92, and in the Institut de Radioprotection et Sûreté Nucléaire in Fontenay-aux-Roses (France) during 1994-95. In 1996 he had short term attachment at the National Cancer Institute, Bethesda (USA).
He is involved in epidemiology of radon and risk assessment of ionizing radiation for more than 40 years. For both topics he became internationally recognized expert. The results of epidemiological studies he worked on are cited repeatedly by the United Nations Scientific Committee of the United Nations on the effects of atomic radiation (UNCSEAR). Between the years 1995 and 2017 he held the position of head of the Department of radiological risk assessment at the National Radiation Protection Institute in Prague.
Dr Tomasek is a member of UNSCEAR since 2006.
He lectures on statistics at the 3rd Medical faculty of Charles University and at the Faculty of Nuclear Science and Application of Ionizing Radiation of the Czech Technical University in Prague.

Ladislav Tomasek is author and co-author of 87 scientific articles and has h-index 23 (Scopus). Ladislav participated as key researcher and researcher in several national and international projects.

Selected publications:

Tomasek L. Lung cancer risk from occupational and environmental radon and role of smoking in two Czech nested case-control studies. Int. J. Environ. Res. Public Health 10: 963-979; 2013.

Tomasek L. Lung cancer in a Czech cohort exposed to radon in dwellings – 50 years of follow-up. Neoplasma 59:559-565, 2012.

Tomasek L. Lung cancer mortality among Czech uranium miners - 60 years since exposure. J. Radiol. Prot. 32:301-314, 2012.

Tomášek L. Interaction of radon and smoking among Czech uranium miners. Radiat. Prot. Dosim. 145:238-242, 2011.

Tomasek L. Dose conversion of radon exposure according to new epidemiological findings. Radiat. Prot. Dosim. 130:98-100, 2008

Tomasek L, Rogel A, Tirmarche M, Mitton N, Laurier D. Lung cancer in French and Czech uranium miners: radon-associated risk at low exposure rates and modifying effects of time since exposure and age at exposure. Radiat. Research 169:125-137, 2008.

Thomas, J.; Tomasek, L.; Fojtikova, I.; Bernovsky, P.: Cost-effectiveness of countermeasures against radon in the Czech Republic: Preliminary report Radiat Prot Dosimetry (2008) 130 (1)

Professional Experiences:

1995 - present	Senior researcher, National Radiation Protection Institute
1995 - 2017	National Radiation Protection Institute Head of the Department of radiological risk assessment
1975 – 1995	Institute of Hygiene and Epidemiology in Prague, Department of mathematical statistics and programming. The main content of the work make up since 1978 are epidemiological studies of people exposed to radon and generally risk assessment of ionizing radiation.

Ir. Peter Vermaercke, EU-RAP Quality control manager

Proposed role in the project: Quality control Project Manager.
Family name: Vermaercke
First names: Peter
Date of birth: 06-01-1962
Nationality: Belgian

Education:

Institution (Date from - Date to)	Degree(s) or Diploma(s) obtained:
University Gent, Belgium (1980-1985)	Master in Civil Engineering in Physics and Electronics
University of Diepenbeek, Belgium (1997-2000)	Postgraduate Level - Master in Total Quality Management

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch (mother tongue)	1	1	1
English	1	1	1
French	1	2	3
German	2	3	5
Spanish/Italian	3	5	5

Membership of professional bodies:

- BELAC – Belgian Accreditation Body;
- Expert for NBN - Belgian Standardization Body TC 85 related to nuclear standards
- Member of k0-NAA International Scientific Committee Nuclear Data

Other skills: standard PC software
Present position: Unit Head of IMS (Integrated Management Systems) Group – IMS manager
Years within the organisation: 26.
Key qualifications (relevant for the project):

- Head of a group of 4 process engineers/architects
- As IMS is part of the Safety Department involved in all regulatory inspections by FANC and Bel V
- Involved in the design and follow up of EU stress tests analysis for our nuclear installations
- Involved in the development of the IAEA General Safety Standard Part 2 on Safety Management and Leadership, as based upon relevant WENRA requirements
- Working in multi-cultural scientific environment with different positions at quality, scientific and lately nuclear safety related issues;
- Main responsibilities for these projects include reviewing all nuclear safety related processed related to free release, nuclear transport, nuclear waste, emergency planning, radiological monitoring, Safety Analysis Report, modification of nuclear installations, ALARA, management of nuclear sources, management of nuclear incidents, return of experience, radioactive measurements, ….

Other qualifications:

- Auditing and training:
  - BELAC (Belgian Accreditation Body for inspection bodies, testing and calibration laboratories and certification bodies): lead auditor (generalist ISO/IEC 17025, ISO/IEC 15189, ISO/IEC 17020, ISO/IEC 17065, ISO/IEC 17021, ISO/IEC 17024) and technical auditor in nuclear analysis (ISO/IEC 17025) – over 500 assessments
  - BELAC: Trainer of the accreditation auditors – yearly several training related to ISO/IEC 17025, ISO/IEC 15189, ISO/IEC 17020, ISO/IEC 17065, ISO/IEC 17021, ISO/IEC 17024
  - Independent trainer: validation, measurement uncertainty, auditing, interpretation of standards
  - RVA, OLAS, Renar, Turkak (foreign accreditation bodies): several audits as technical auditor in nuclear analytical techniques such as k0-NAA, γ-spectrometry, α/β-measurements, LSC, α-spectrometry, TLD/OSL/-dosimetry, nuclear irradiations, ….
- IAEA (International Atomic Energy Agency - United Nations, Vienna) – Expert missions
  - Expert for IAEA for Integrated Management Systems (IAEA GS-R-3 or GSR part 2)
  - Expert for the evaluation of QA/QC and training in the field of ISO 17025 in nuclear analytical techniques in several countries in Eastern-Europe, South-America, Asia and Africa.
  - Expert for NAA and k0-NAA in several countries

Professional experiences:

Date from - Date to	Location	Employer	Position	Description

1991-present	Mol, Belgium	SCK CEN, Belgian Nuclear Research Center	– SHEQ (Safety & Health, Environment and Quality) IMS Manager since 2012 – Low Radioactivity Measurements: 2001 to 2012: Laboratory Head – involved techniques: k0-Neutron Activation Analyses, Gamma spectrometry, Alpha spectrometry, Liquid scintillation counting, Gross alpha/beta measurements, internal dosimetry (whole body counting) – Low Radioactivity Measurements: project leader for the radiological surveillance programme for the Belgian territory – Corporate Quality Assurance manager from 1991 till 2002 – Internal Auditor since 1992 – Research Engineer Personnel Monitoring and External Dosimetry (TLD and OSL)	Responsible for Safety & Health, Environment and Quality related core, supporting and management business processes based upon IAEA GSR part 2, ISO 9001, 14001 and 45001
1987-1991	Olen, Belgium	CANBERRA SEMICONDUCTOR, Production plant of nuclear detectors	Research Engineer and Quality Assurance Manager	
1998	Ispra, Italy	JRC, EU	Advisor to the director on quality management issues	
1985-1996	Gent, Belgium	University Gent	Research Engineer	

Annex 1: Relevant provisions in Council Directive 2013/59/Euratom

The Council Directive 2013/59/Euratom is laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation. Although the whole directive relates to radiation protection, the following articles of Council Directive 2013/59/Euratom are directly linked to radon:
Article 2(2)d, Article 4(35, 82, 83, 84, 97), Article 7, Article 5 Article 9, Article 25(2), Article 31, Article 35(2), Article 43, Article 54, Article 100, Article 101, Article 103, Annex XVII and Annex *XVIII.* Further to this, recitals (9), (10), (11), (17), (22), (23), (24) and (25) address radon in workplaces. Recital (25) sets out the reasoning behind the decision to introduce requirements on exposure to indoor radon in workplaces. Further on Council Directive 2013/59/Euratom specifically asks for stakeholder engagement: „Member States shall provide as appropriate for the involvement of stakeholders in decisions regarding the development and implementation of strategies for managing exposure situations "(Art. 102.).

These requirements will be evaluated and their implementation will be reviewed in ER-RAP project in details.

Article 2 Scope

…

2. This Directive applies in particular to:

…

(d) the exposure of workers or members of the public to indoor radon,

….

Article 4 Definitions

…

(35) "existing exposure situation" means an exposure situation that already exists when a decision on its control has to be taken and which does not call or no longer calls for urgent measures to be taken;

…

(82) "radon" means the radionuclide Rn-222 and its progeny, as appropriate;

(83)"exposure to radon" means exposure to radon progeny;

(84) "reference level" means in an emergency exposure situation or in an existing exposure situation, the level of effective dose or equivalent dose or activity concentration above which it is judged inappropriate to allow exposures to occur as a result of that exposure situation, even though it is not a limit that may not be exceeded

…

(97) "thoron" means the radionuclide Rn-220 and its progeny, as appropriate;

…

Article 5 General principles of radiation protection

….

b) Optimisation: Radiation protection of individuals subject to public or occupational exposure shall be optimised with the aim of keeping the magnitude of individual doses, the likelihood of exposure and the number of individuals exposed as low as reasonably achievable taking into account the current state of technical knowledge and economic and societal factors.

…

Article 7 Reference levels

1. Member States shall ensure that reference levels are established for emergency and existing exposure situations. Optimisation of protection shall give priority to exposures above the reference level and shall continue to be implemented below the reference level.
2. The values chosen for reference levels shall depend upon the type of exposure situation. The choices of reference levels shall take into account both radiological protection requirements and societal criteria. For public exposure the establishment of reference levels shall take into account the range of reference levels set out in Annex I.
3. For existing exposure situations involving exposure to radon, the reference levels shall be set in terms of radon activity concentration in air as specified in Article 74 for members of the public and Article 54 for workers.

Article 9 Dose limits for occupational exposure

1. Member States shall ensure that dose limits for occupational exposure apply to the sum of annual occupational exposures of a worker from all authorised practices, occupational exposure to radon in workplaces requiring notification in accordance with Article 54(3), and other occupational exposure from existing exposure situations in accordance with Article 100(3). For emergency occupational exposure Article 53 shall apply.
2. The limit on the effective dose for occupational exposure shall be 20 mSv in any single year. However, in special circumstances or for certain exposure situations specified in national legislation, a higher effective dose of up to 50 mSv may be authorised by the competent authority in a single year, provided that the average annual dose over any five consecutive years, including the years for which the limit has been exceeded, does not exceed 20 mSv.
3. In addition to the limits on effective dose laid down in paragraph 2, the following limits on equivalent dose shall apply:

(a) the limit on the equivalent dose for the lens of the eye shall be 20 mSv in a single year or 100 mSv in any five consecutive years subject to a maximum dose of 50 mSv in a single year, as specified in national legislation.
(b) the limit on the equivalent dose for the skin shall be 500 mSv in a year, this limit shall apply to the dose averaged over any area of 1 cm 2 , regardless of the area exposed;
(c) the limit on the equivalent dose for the extremities shall be 500 mSv in a year.

Article 25 Notification

….

2. Member States shall ensure that notification is required for workplaces specified in Article 54(3), and for existing exposure situations that are managed as a planned exposure situation, as specified in Article 100(3).

….

Article 31 Responsibilities

1. Member States shall ensure that the undertaking is responsible for assessing and implementing arrangements for the radiation protection of exposed workers.
2. In the case of outside workers, the responsibilities of the undertaking and the employer of outside workers are stiputated in Article 51.
3. Without prejudice to paragraphs 1 and 2, Member States shall arrange for a clear allocation of responsibilities for the protection of workers in any exposure situation, to an undertaking, an employer or any other organisation, in particular for the protection of:

   …

   (c) workers who are exposed to radon at work, in the situation specified in Article 54(3).
   This shall also apply to the protection of self-employed individuals and individuals who work on a voluntary basis.
4. Member States shall ensure that employers have access to information on the possible exposure of their employees under the responsibility of another employer or undertaking.

Article 35 Arrangements in workplaces

[…]

2. For workplaces specified in Article 54(3), and where the exposure of workers is liable to exceed an effective dose of 6 mSv per year or a corresponding time-integrated radon exposure value determined by the Member State, these shall be managed as a planned exposure situation and the Member States shall determine which requirements set out in this Chapter are appropriate. For workplaces specified in Article 54(3), and where the effective dose to workers is less than or equal to 6 mSv per year or the exposure less than the corresponding time-integrated radon exposure value, the competent authority shall require that exposures are kept under review.

[…]

Article 43 Recording and reporting of results

1. Member States shall ensure that a record containing the results of individual monitoring is made for each category A worker and for each category B worker where such monitoring is required by the Member State.
2. For the purposes of paragraph 1, the following information on exposed workers shall be retained:
   (a) a record of the exposures measured or estimated, as the case may be, of individual doses pursuant to Articles 41, 42, 51, 52, 53 and, if decided by the Member State pursuant to Article 35(2), 54(3);
   (b) in the case of exposures as referred to in Articles 42, 52 and 53, the reports relating to the circumstances and the action taken;
   (c) the results of workplace monitoring used to assess individual doses where necessary.
3. The information referred to in paragraph 1 shall be retained during the period of their working life involving exposure to ionising radiation and afterwards until they have or would have attained the age of 75 years, but in any case not less than 30 years after termination of the work involving exposure.

4. Exposures as referred to in Articles 42, 52 53 and, if decided by the Member State pursuant to Article 35(2), 54(3) shall be recorded separately in the dose record referred to in paragraph 1.
5. The dose record referred to in paragraph 1 shall be submitted to the data system for individual radiological monitoring established by the Member State in accordance with the provisions of Annex X.

Article 54 Radon in workplaces

1. Member States shall establish national reference levels for indoor radon concentrations in workplaces. The reference level for the annual average activity concentration in air shall not be higher than 300 Bq m –3, unless it is warranted by national prevailing circumstances.
2. Member States shall require that radon measurements are carried out:
   (a) in workplaces within the areas identified in accordance with Article 103(3), that are located on the ground floor or basement level, taking into account parameters contained in the national action plan as under point 2 of Annex XVIII, as well as
   (b) in specific types of workplaces identified in the national action plan taking into account point 3 of Annex XVIII.
3. In areas within workplaces, where the radon concentration (as an annual average), continues to exceed the national reference level, despite the action taken in accordance with the principle of optimisation as set out in Chapter III, Member States shall require this situation to be notified in accordance with Article 25(2) and Article 35(2) shall apply.

Article 100 Programmes on existing exposure situations

1. Member States shall ensure that measures are taken upon indication or evidence of exposures that cannot be disregarded from a radiation protection point of view, to identify and evaluate existing exposure situations taking into account the types of existing exposure situations listed in Annex XVII, and to determine the corresponding occupational and public exposures.
2. Member States may decide, having regard to the general principle of justification, that an existing exposure situation warrants no consideration of protective or remedial measures.
3. Existing exposure situations which are of concern from a radiation protection point of view and for which legal responsibility can be assigned shall be subject to the relevant requirements for planned exposure situations and accordingly such exposure situations shall be required to be notified as specified in Article 25(2).

Article 101 Establishment of strategies

1. … Each strategy shall contain the objectives pursued; appropriate reference levels, taking into account the reference levels laid down in Annex I.

Article 102 Implementation of strategies

1. … Member States shall provide as appropriate for the involvement of stakeholders in decisions regarding the development and implementation of strategies for managing exposure situations …
4. …b) provide information to exposed populations on the potential health risks and on the available means for reducing their exposure; c) provide guidance for the management of exposures at individual of local level; d) with regard to activities that involve naturally occurring radioactive material and are not managed as planned exposure situations, provide information on appropriate means for monitoring concentrations and exposures and for taking protective measures.

Article 103 Radon action plan

1. In application of Article 100(1), Member States shall establish a national action plan addressing long-term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, whether from soil, building materials or water. The action plan shall take into account the issues set out in Annex XVIII and be updated on a regular basis.
2. Member States shall ensure that appropriate measures are in place to prevent radon ingress into

new buildings. These measures may include specific requirements in national building codes.

3. Member States shall identify areas where the radon concentration (as an annual average) in a significant number of buildings is expected to exceed the relevant national reference levels.

Annex XVII Indicative list of types of existing exposure situations as referred to in Article 100

(a) Exposure due to contamination of areas by residual radioactive material from
(i) past activities that were never subject to regulatory control or were not regulated in accordance with the requirements laid down by this Directive;
(ii) an emergency, after the emergency exposure situation has been declared ended, as provided for in the emergency management system;
(iii) residues from past activities for which the undertaking is no longer legally accountable
(b) Exposure to natural radiation sources, including:
(i) indoor exposure to radon and thoron, in workplaces, dwellings and other buildings;
(ii) indoor external exposure from building materials;
(c) Exposure to commodities excluding food, animal feeding stuffs and drinking water incorporating:
(i) radionuclides from contaminated areas specified in point (a), or
(ii) naturally-occurring radionuclides.

Article XVIII List of items to be considered in preparing the national action plan to address long-term risks from radon exposures as referred to in Articles 54, 74 and 103

(1) Strategy for conducting surveys of indoor radon concentrations or soil gas concentrations for the purpose of estimating the distribution of indoor radon concentrations, for the management of measurement data and for the establishment of other relevant parameters (such as soil and rock types, permeability and radium-226 content of rock or soil).

(2) Approach, data and criteria used for the delineation of areas or for the definition of other parameters that can be used as specific indicators of situations with potentially high exposure to radon.

(3) Identification of types of workplaces and buildings with public access, such as schools, underground workplaces, and those in certain areas, where measurements are required, on the basis of a risk assessment, considering for instance occupancy hours.

(4) The basis for the establishment of reference levels for dwellings and workplaces. If applicable, the basis for the establishment of different reference levels for different uses of buildings (dwellings, buildings with public access, workplaces) as well as for existing and for new buildings.

(5) Assignment of responsibilities (governmental and non-governmental), coordination mechanisms and available resources for implementation of the action plan.

(6) Strategy for reducing radon exposure in dwellings and for giving priority to addressing the situations identified under point 2.

(7) Strategies for facilitating post construction remedial action.

(8) Strategy, including methods and tools, for preventing radon ingress in new buildings, including identification of building materials with significant radon exhalation.

(9) Schedules for reviews of the action plan.

(10) Strategy for communication to increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking.

(11) Guidance on methods and tools for measurements and remedial measures. Criteria for the accreditation of measurement and remediation services shall also be considered.

(12) Where appropriate, provision of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.

(13) Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non- smokers).

(14) Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

Recitals

(9) Calculation of doses from measurable quantities should rely on scientifically established values and relationships. Recommendations for such dose coefficients have been published and updated by ICRP, taking scientific progress into account. A collection of dose coefficients based on its earlier recommendations in ICRP Publication 60 (3), is available as ICRP Publication 119 (4). However, in ICRP Publication 103, a new methodology was introduced by ICRP to calculate doses based on the latest knowledge on radiation risks, and this should, where possible, be taken into account in this Directive.

(10) For external exposure, values and relationships have been published following the new methodology in ICRP Publication 116 (5). These data, as well as the well-established operational quantities, should be used for the purpose of this Directive.

(11) For internal exposure, while ICRP has consolidated in ICRP Publication 119 all earlier publications (on the basis of ICRP Publication 60) on dose coefficients, updates of this publication will be provided and the coefficients that are tabulated in it will be superseded by values based on the radiation and tissue weighting factors and phantoms laid down in ICRP Publication 103. The Commission will invite the group of experts referred to in Article 31 of the Euratom Treaty to continue to monitor scientific developments and the Commission will make recommendations on any updated values, relationships and coefficients, including those for exposure to radon, taking relevant opinions of the group of experts into account.

(17) It is appropriate for this Directive to establish reference levels for indoor radon concentrations and for indoor gamma radiation emitted from building materials, and to introduce requirements on the recycling of residues from industries processing naturally-occurring radioactive materials into building materials.

(22) Recent epidemiological findings from residential studies demonstrate a statistically significant increase of lung cancer risk from prolonged exposure to indoor radon at levels of the order of 100 Bq m–3. The new concept of exposure situations allows the provisions of Commission Recommendation 90/143/Euratom (1) to be incorporated into the binding requirements of the Basic Safety Standards while leaving enough flexibility for implementation.

(23) National action plans are needed for addressing long- term risks from radon exposure. It is recognized that the combination of smoking and high radon exposure presents a substantially higher individual lung cancer risk than either factor individually and that smoking amplifies the risk from radon exposure at the population level. It is important that Member States address both of these health hazards.

(24) Where, due to national prevailing circumstances, a Member State establishes a reference level for indoor radon concentrations in workplaces that is higher than 300 Bq m–3, the Member State should submit the information to the Commission.

(25) Where radon enters from the ground into indoor workplaces, this should be considered to be an existing exposure situation since the presence of radon is largely independent of the human activities carried out within the workplace. Such exposures may be significant in certain areas or specific types of workplaces to be identified by Member States, and appropriate radon and exposure reduction measures should be taken if the national reference level is exceeded. Where levels continue to remain above the national reference level, these human activities carried out within the workplace should not be regarded as practices. However, Member States should ensure that these workplaces are notified and that, in cases where the exposure of workers is liable to exceed an effective dose of 6 mSv per year or a corresponding time-integrated radon exposure value, they are managed as a planned exposure situation and that dose limits apply, and determine which operational protection requirements need be applied.

Annex 2: Recommendations to address challenges in RAP implementation based on existing literature.

EU-RAP will focus on the practical implementation of the actions defined in radon action plans and it will also identify best practices to address the issues related to radon together with experts, regulators, local authorities and other stakeholders from EU MS and the UK. HERCA and some EU supported projects have already developed recommendations that authorities and implementers can use for better practical implementation of RAP as defined by Council Directive 2013/59/Euratom in Annex XVIII. EU-RAP project will evaluate the institutional uptake of these recommendations as well.

HERCA Recommendations: National Action plan, justification and responsibilities and risk communication

- Radon exposure, including exposures of workers during all their professional and domestic life, is a public and occupational health issue. The implementation of the national action plan has the potential to save lives and should therefore be given an important priority by Member States. The long-term goal is a reduction of lung cancer risk.

- The national action plan for radon should aim to: a) reduce the individual lung cancer risk by reducing high radon exposures; b) reduce the overall lung cancer risk by reducing the average radon concentrations to well below the reference level.

- The national action plan should include preventive and educative actions developed for all employees, involving stakeholders such as Labour Unions and Employers Associations. To allow the effective performance of radon measurements and remedial actions as well as better overall supervision and monitoring, a clear responsibility assignment for radon control in workplaces should be addressed.

- While in general radon mitigation strategies in the national action plan may include both voluntary and mandatory approaches, HERCA supports the regulatory approach for radon measurement and mitigation in workplaces, including those in buildings with public access.

- Radon risk communication is a key aspect of any radon action plan. As a part of the action plan, customized information should be prepared for employers, employees and their representatives, and other stakeholders. Appropriate communication channels should be used, with particular attention given to small and medium-sized enterprises.

- Mechanisms for worker participation in managing radon risk should be encouraged.

- HERCA draws national authorities' attention to the radon risk management in workplaces with public access, particularly on the issue of risk communication. In a situation where the radon concentration remains above the reference level, even after optimization, risk communication should cover both the public and workers' exposures. The communication should allow for the difference between the regulatory frameworks (existing exposure situation without dose limitation on the one hand and an existing exposure situation deliberately managed as a planned exposure situation under certain circumstances, with dose calculation, on the other hand). The elements for risk communication toward the workers and the public should be generally prepared in advance, particularly in schools and kindergartens.

HERCA Recommendations: Identification of workplaces, radon measurements and control

- Since the radon measurement results are meant to be representative of the annual average activity concentration in air, HERCA recommends to carry out measurements of radon activity concentrations according to national protocols, taking into account international standards, considering for example the relevant ISO standards (EN ISO 11665-1 to EN ISO 11665-8 and EN ISO 13164-1 to EN ISO 13164-3).

- HERCA strongly recommends that radon measurement in workplaces, in the case where these measurements are mandatory, should have to be carried out by bodies recognized by national authorities. The qualification and training of bodies in charge of remedial actions should also be considered. For these radon measurements, HERCA recommends to collect and use the results as a tool to assess the impact of the regulations and/or the national strategy put in place and to evaluate the national action plan. HERCA suggests to explore opportunities to collect this results in a database.

- The regulatory procedure should define appropriate time schedules for the implementation of the requirements related to measurement, notification and optimisation.

- HERCA considers that a regular assessment of the implementation of the regulation related to radon in workplaces and buildings with public access has to be carried out. This assessment should be integrated into other issues related to health and safety at the workplace. Relevant inspectors' training with regard to the concerns about radon has to be ensured.

HERCA Recommendations: Graded approach for radon exposure in workplaces

- HERCA recommends the use of international guidelines, and associated tools, to calculate annual effective doses from the time integrated radon concentration, for different situations such as mines, caves, spas as well as ordinary workplaces and NORM activities. HERCA should ask the European Commission, with reference to the procedure described in the BSS (recitals (9) and (11)), to put this issue on the agenda of article 31 Experts Group as soon as possible.

- In order to verify whether the dose limit is complied with, since the duration of exposure should be taken into account in the evaluation of the effective dose or of the corresponding time-integrated radon exposure, HERCA recommends to define, at national level, in which situations a recording of the individual exposure times is necessary.

- In case of doses exceeding 6 mSv per year or a corresponding time-integrated radon exposure, requirements set out for occupational exposure need to be laid down; HERCA recommends to apply the occupational exposure requirements related to optimisation, to the radiological surveillance of workplaces (adapted to radon exposure), to workers' information and, in some cases, to individual monitoring.

- Information should be given to occupational health services in order to allow them to inform workers of the specific radon risk, in particular in combination with smoking . To facilitate the workers' information, employers should ensure that there is sufficient internal expertise on radon, or that external expertise can be called upon.

- To facilitate the implementation of the BSS requirements on radon in workplaces, HERCA should ask the European Commission to prepare European Guidance (to be published in the Radiation Protection Series) based on good practices. Taking into account the different types of concerned workplaces, this guidance should focus on the identification of workplace types, on measurements protocols and on adequate approaches to optimisation.

ENGAGE recommendations: stakeholder engagement

- Broaden the motivation for stakeholder engagement in indoor radon management, in both prescriptions and practice.

- Include in radon action plans a structured approach to stakeholder engagement in the design, implementation and evaluation of actions.

- Integrate radon risk management into a comprehensive environmental and public health protection approach, with engagement. of all stakeholders connected to these issues.

- Support the development of context specific, local / regional approaches for stakeholder engagement in radon management.

- Develop multidisciplinary, multi-level and multi-stakeholder, participatory approaches to build, enhance and transmit radon radiological protection culture.

National Radon Control Strategy – Phase 1 and 2, 2014 to 2018, Final Report (Ireland)

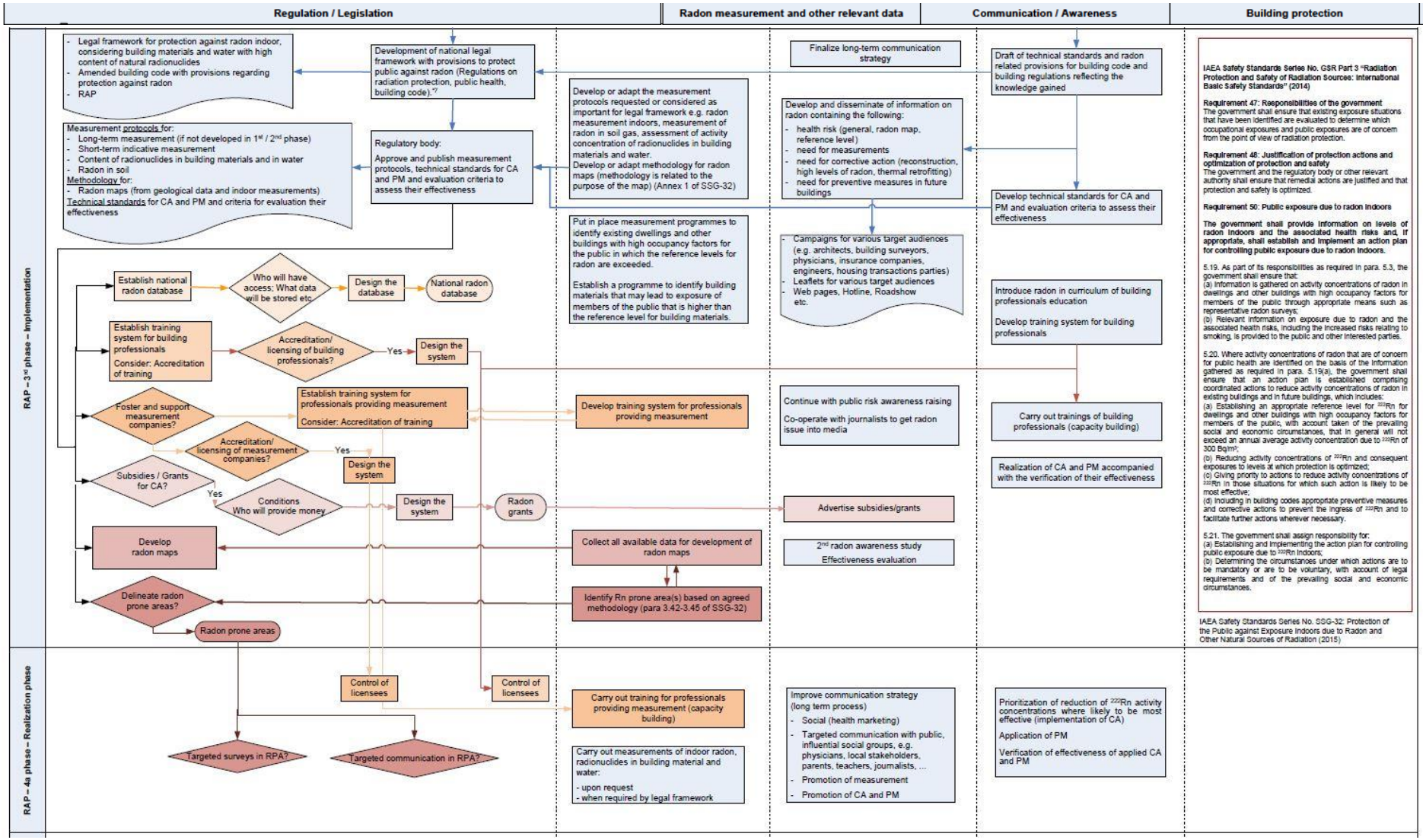
- Research in Ireland has shown that information campaigns alone will not result in a further increase in the number of homes that test for radon. It is advised that regulatory or other policy approaches, supported by financial incentives and combined with high quality information programmes, are more effective.

- The first steps have been taken to establish the cost of a national scheme to provide financial support to homeowners for radon testing and remediation. The establishment of this financial support is considered critical

for the long-term effectiveness of the National Radon Control Strategy in reducing the number of radon-related lung cancers.

Annex 3: A Flowchart for the development of a national Radon Action Plan

The flowchart for the development of a RAP proposed by the IAEA may be used as a reference point to review and evaluate the implementation of national radon action plans in EU MS and the UK. Below there is an illustration related to the part corresponding to the implementation and realisation of the national radon action plan. (Source: https://www.iaea.org/sites/default/files/18/03/final-radon.pdf)


Regulation / Legislation
Radon measurement and other relevant data
Communication / Awareness
Building protection
RAP – 3rd phase – Implementation
RAP – 4a phase – Realization phase
- Legal framework for protection against radon indoor, considering building materials and water with high content of natural radionuclides
- Amended building code with provisions regarding protection against radon
- RAP
Development of national legal framework with provisions to protect public against radon (Regulations on radiation protection, public health, building code).*7
Measurement protocols for:
- Long-term measurement (if not developed in 1st / 2nd phase)
- Short-term indicative measurement
- Content of radionuclides in building materials and in water
- Radon in soil
Methodology for:
- Radon maps (from geological data and indoor measurements)
Technical standards for CA and PM and criteria for evaluation their effectiveness
Regulatory body:
Approve and publish measurement protocols, technical standards for CA and PM and evaluation criteria to assess their effectiveness
Develop or adapt the measurement protocols requested or considered as important for legal framework e.g. radon measurement indoors, measurement of radon in soil gas, assessment of activity concentration of radionuclides in building materials and water.
Develop or adapt methodology for radon maps (methodology is related to the purpose of the map) (Annex 1 of SSG-32)
Put in place measurement programmes to identify existing dwellings and other buildings with high occupancy factors for the public in which the reference levels for radon are exceeded.
Establish a programme to identify building materials that may lead to exposure of members of the public that is higher than the reference level for building materials.
Finalize long-term communication strategy
Develop and disseminate of information on radon containing the following:
- health risk (general, radon map, reference level)
- need for measurements
- need for corrective action (reconstruction, high levels of radon, thermal retrofitting)
- need for preventive measures in future buildings
- Campaigns for various target audiences (e.g. architects, building surveyors, physicians, insurance companies, engineers, housing transactions parties)
- Leaflets for various target audiences
- Web pages, Hotline, Roadshow etc.
Draft of technical standards and radon related provisions for building code and building regulations reflecting the knowledge gained
Develop technical standards for CA and PM and evaluation criteria to assess their effectiveness
Introduce radon in curriculum of building professionals education
Develop training system for building professionals
Carry out trainings of building professionals (capacity building)
Realization of CA and PM accompanied with the verification of their effectiveness
IAEA Safety Standards Series No. GSR Part 3 "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" (2014)
Requirement 47: Responsibilities of the government
The government shall ensure that existing exposure situations that have been identified are evaluated to determine which occupational exposures and public exposures are of concern from the point of view of radiation protection.
Requirement 48: Justification of protection actions and optimization of protection and safety
The government and the regulatory body or other relevant authority shall ensure that remedial actions are justified and that protection and safety is optimized.
Requirement 50: Public exposure due to radon indoors
The government shall provide information on levels of radon indoors and the associated health risks and, if appropriate, shall establish and implement an action plan for controlling public exposure due to radon indoors.
5.19. As part of its responsibilities as required in para. 5.3, the government shall ensure that:
(a) Information is gathered on activity concentrations of radon in dwellings and other buildings with high occupancy factors for members of the public through appropriate means such as representative radon surveys;
(b) Relevant information on exposure due to radon and the associated health risks, including the increased risks relating to smoking, is provided to the public and other interested parties.
5.20. Where activity concentrations of radon that are of concern for public health are identified on the basis of the information gathered as required in para. 5.19(a), the government shall ensure that an action plan is established comprising coordinated actions to reduce activity concentrations of radon in existing buildings and in future buildings, which includes:
(a) Establishing an appropriate reference level for 222Rn for dwellings and other buildings with high occupancy factors for members of the public, with account taken of the prevailing social and economic circumstances, that in general will not exceed an annual average activity concentration due to 222Rn of 300 Bq/m3;
(b) Reducing activity concentrations of 222Rn and consequent exposures to levels at which protection is optimized;
(c) Giving priority to actions to reduce activity concentrations of 222Rn in those situations for which such action is likely to be most effective;
(d) Including in building codes appropriate preventive measures and corrective actions to prevent the ingress of 222Rn and to facilitate further actions wherever necessary.
5.21. The government shall assign responsibility for:
(a) Establishing and implementing the action plan for controlling public exposure due to 222Rn indoors;
(b) Determining the circumstances under which actions are to be mandatory or are to be voluntary, with account of legal requirements and of the prevailing social and economic circumstances.
IAEA Safety Standards Series No. SSG-32: Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation (2015)
Establish national radon database
Who will have access; What data will be stored etc.
Design the database
National radon database
Establish training system for building professionals
Consider: Accreditation of training
Accreditation/ licensing of building professionals?
Yes
Design the system
Foster and support measurement companies?
Establish training system for professionals providing measurement
Consider: Accreditation of training
Develop training system for professionals providing measurement
Continue with public risk awareness raising
Co-operate with journalists to get radon issue into media
Accreditation/ licensing of measurement companies?
Yes
Design the system
Subsidies / Grants for CA?
Yes
Conditions Who will provide money
Design the system
Radon grants
Advertise subsidies/grants
Develop radon maps
Collect all available data for development of radon maps
2nd radon awareness study
Effectiveness evaluation
Delineate radon prone areas?
Identify Rn prone area(s) based on agreed methodology (para 3.42-3.45 of SSG-32)
Radon prone areas
Control of licensees
Control of licensees
Carry out training for professionals providing measurement (capacity building)
Improve communication strategy (long term process)
- Social (health marketing)
- Targeted communication with public, influential social groups, e.g. physicians, local stakeholders, parents, teachers, journalists, ...
- Promotion of measurement
- Promotion of CA and PM
Prioritization of reduction of 222Rn activity concentrations where likely to be most effective (implementation of CA)
Application of PM
Verification of effectiveness of applied CA and PM
Targeted surveys in RPA?
Targeted communication in RPA?
Carry out measurements of indoor radon, radionuclides in building material and water:
- upon request
- when required by legal framework

Annex 4: List of National Contact Points (HERCA)

This list of radon contacts per county will serve as a starting point for the identification of those competent authorities in European Union Member States and the United Kingdom responsible for the establishment of the national radon action plan, and those authorities charged with the practical implementation of all elements defined in the action plan (Subtask 1.1). (Source of information: HERCA)

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Annex 5: Radon related scientific references of consortium partners

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Annex 6: Radon events organised by consortium partners in the last three years

The consortium partners have a demonstrable track record of organising interactive radon related meetings, webinars, workshops and conferences. The experiences range from small brainstorming meetings related to legal aspects of radon action plans to workshops related to practical implementation of RAP and big conferences related to multiple aspects, such as the transposition of the BSS Directive, and the development and implementation of RAP. This non-exhaustive list of events demonstrates the organisational and logistic capacities of the EU-RAP consortium. The consortium members have organised or will organize in the next months the following events face-to-face as well as on-line events:

Workshop: ***Regional Workshop on Communication Strategies in the Control of Public Exposure to Radon***
Time and place: Tallinn, Estonia; 16th to 18th March 2018
No. of participants: 31
Role of the consortium partner: co-organiser of the workshop and lecturer, facilitator of working sessions
More information: IAEA, Trevor John BOAL

Round table: ***stakeholder engagement in relation to radon exposures, ENGAGE project***
Time and place: Rovinj, Croatia; 2nd October 2018 (3rd European Radiation Protection Week)
No. of participants: 14
Role of the consortium partner: Co-organiser and moderator
More information: https://www.engage-concert.eu/en/Events/ERPW2018

Workshop: ***Regional Workshop to Enhance the Competence of National Authorities in Implementing a Radon Communication Strategy through Practical Exercise***
Time and place: Beograd, Serbia; 4th to 6th June 2019
No. of participants: 40
Role of the consortium partner: co-organiser of the workshop and lecturer, facilitator of working sessions
More information: IAEA, German Olga

Conference session: ***Communication about indoor radon and stakeholder engagement in a radon national plan, RICOMET***
Time and place: Barcelona, Spain; 1st of July 2019
No. of participants: 100
Role of the consortium partner: president of the organising committee, discussants, the conference host, management board members
More information: https://ricomet2019.sckcen.be/

Workshop: ***ENGAGE Final Project Workshop***
Time and place: Bratislava, Slovakia; 11th to 13th September 2019
No. of participants: 46
Role of the consortium partner: co-organiser of the workshop, presenter, facilitator of working sessions
More information: https://www.engage-concert.eu/en/Events/ENGAGE-final-project-workshop

Webinar: ***Societal aspects and marketing challenges of naturally occurring radioactive materials in building products***
Time and place: on-line, 2nd of September 2020, 12.30 - 14.00, 2020
No. of participants: expected 500
Role of the consortium partner: organiser, facilitator of the discussion, chat area moderator, ICT support
More information: www.ricomet.eu

Webinar: ***Radon air pollution: Communication and protective behaviour***
Time and place: on-line, 2nd of September 2020 at 10.00 - 11.30
No. of participants: expected 200

Role of the consortium partner: organiser, facilitator of the discussion, chat area moderator, ICT support
More information: www.ricomet.eu

On-line public consultation: ***Investigating the potential of citizen science for effective radon measurements and mitigation***
Time and place: on-line, 2nd of September, 2020 at 15.00 - 16.30
No. of participants: expected 300
Role of the consortium partner: organiser, facilitator of the discussion, chat area moderator, ICT support
More information: www.ricomet.eu

CALL FOR TENDER N° ENER/D3/2020-228

Title:

Review and evaluation of national radon action plans established in EU Member States according to the requirements in Council Directive 2013/59/Euratom –the BSS Directive – focusing on the practical implementation of the actions defined in these action plans

Ref. Ares(2020)2496502 - 12/05/2020

Part E: Financial offer

Total price: 234.000,00 EUR (free of all duties, taxes and other charges, including VAT)

The total price is composed as follows:

Labor costs: 184.600, 00 EUR

Travel costs: 14.400, 00 EUR

Other costs related to the Final workshop and Regional workshops (e.g. for venues, workshops, reimbursement of stakeholder participation if needed, etc.): 35.000,00 EUR (five Regional workshops x 2000 euro per workshop and 25 000 euro for the Final workshop)