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D 2.4 - Annual SRA Statements from MELODI, ALLIANCE, NERIS and EURADOS

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Abstract

D 2.4 - Annual SRA Statements from MELODI, ALLIANCE, NERIS and EURADOS

Annual SRA Statements from MELODI, ALLIANCE, NERIS and EURADOS have been compiled by collecting the SRA Statements from the platforms. This material serves as input for Joint Programming (WP3) and the preparation for the second CONCERT Transnational Call. Each platform considered the same criteria for prioritization and provided a ranked list of priorities as summarized below. As in 2015, the criteria for prioritization were:

- Feasibility (research judged to be achievable in the near future)
- Importance in terms of improved radiation protection system
- Relevance for operational radiation protection (BSS implementation)
- Multidisciplinarity (biology, epidemiology, dosimetry)
- Synergy with other radiation research platforms (ALLIANCE, EURADOS, NERIS, EURAMED, European Medical Associations –ESR, ESTRO, EANM, EFRS, EFOMP)
- Timeliness
- Avoidance of overlap of topics with other calls or topics that have been recently funded and outcome from projects that have recently ended.

In 2016, the ranked list of research priorities by MELODI are:

- To understand the potential impact of individual susceptibility on radiation-induced health effects (Rank 1: high priority)
- To identify, develop and validate biomarkers for exposure, early and late effects for cancer or/and non-cancer diseases (Rank 2: medium priority)
- To understand the health effects of inhomogeneous dose distributions, radiation quality and internal emitters (Rank 2: medium priority)
- To explore and define the role of epigenetic modifications in radiation-induced health effects (Rank 2: medium priority)
- To explore the roles of specific target cells for radiation-induced late developing health effects (Rank 2: medium priority)
- To explore the shape of the dose-response relationship for radiation-induced health effects (Rank 3: low priority)

MELODI encourages, where appropriate, (1) the use of archived biological materials from prior EU funded research, (2) the integration of experienced laboratory networks (such as e.g. RENEB), (3) the integration of expertise from outside the conventional fields of radiation research, in particular expertise from the medical research field where appropriate.

In 2016, the ranked list of research priorities by ALLIANCE are:

- Biomarkers of exposure and effects in living organisms as operational outcomes of a mechanistic understanding of intra- and inter-species variation of radiosensitivity under chronic low dose exposure situations, with a focus on the added value for both human and non-human radiological protection (ranked as priority 1);
- Environmental availability and impact of radionuclides in terrestrial, freshwater and marine ecosystems (including human food chain) and their interactions with atmosphere, incorporating physical, chemical and/or biological processes. Validated

process-based model parameterisation, characterisation of variability and uncertainty, and guidance for fit-for-purpose models (ranked as priority 2);
- Development of models/tools, and datasets for their calibration and validation and guidance to select and evaluate the effectiveness of different remediation strategies in long-lasting exposure situations (e.g. nuclear accidents and/or NORM/TeNORM) (ranked as priority 3);
- Multiple stressors and modulation of radiation effects in living organisms (ranked as priority 4).

The ALLIANCE encourages, where relevant openness to other disciplines to integrate their skills and knowledge into radioecology, and capitalisation of best practices, tools and data in the various fields of research needed. Additionally, research combining "lab-field-modelling" approach and fit-for-purpose applications will be appreciated.

In 2016, the ranked list of priorities by NERIS are:

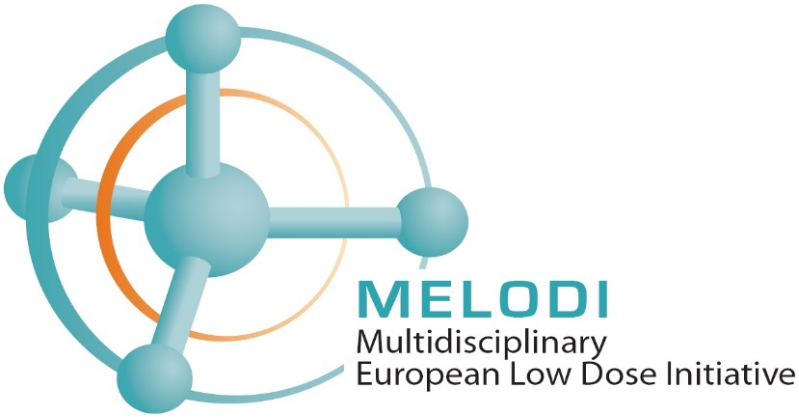
1. **Assessment of and communication of uncertainties.** Investigation of data uncertainties (model or monitoring results) and how they can be communicated, e.g. in model results and in Decision Support Systems (DSS) to help decision-makers to understand the radiological situation. This includes also work on model sensitivity, validity of model results and inter-comparisons of models and measurements.
2. **Robust decision-making.** Structuring the decision processes and the protective strategies at national, regional and local levels with the help of formal decision aid tools, such as multi-criteria analysis and on the basis of feedback from stakeholder processes. Development of guidance on the use of DSS in the various phases of an event based on feedback from stakeholder processes and from Fukushima experience in emergency response and recovery.
3. **Countermeasure strategy preparedness.** Development of sustainable preparedness strategy at Local, National and European levels based on the analysis of countermeasures for relevant accident scenarios. Ensuring that parameters governing the radiological consequences can be identified in time to enable optimized remediation.
4. **Atmospheric dispersion modelling.** To make more reliable forecasts of atmospheric dispersion, including data assimilation and improved inverse modelling (to determine source term and/or source location) in different environments (e.g. urban areas) and/or at different spatial scales (near range to global scale)
5. **Local radio-ecological models.** Development and integration in general DSS of local radio-ecological models interlinked with monitoring information and the more global and food chain dose models. Investigate the capability of such models to be operated by local stakeholders as farmers or local communities. Link with ALLIANCE.
6. **Monitoring strategies.** Optimised use of monitoring resources, including mobile units and trans-border issues. Integration of new monitoring technologies (e.g. drones). Development of processes and tools for integrating the monitoring results from experts and lay people into a common operational picture (monitoring crowdsourcing). Information fusion (radiological and non-radiological). Link with EURADOS but focus on strategy and integration, less on the improvement or development of new measurement methods/techniques.

To further evaluate current research needs, NERIS has reviewed finished and started EU projects in the past year (August 2015-July 2016) in research areas closely related to the NERIS SRA.

In 2016, the ranked list of research priorities by EURADOS remain the same as in 2015. EURADOS identified the following six priorities for the RTD on dosimetry:

- To quantify correlations between track structure and radiation damage
- To improve neutron dosimetry techniques
- To quantify doses after accidental internal contamination
- To develop accurate and on-line personal dosimetry for workers
- To improve the measurement and combination of out-of-field radiotherapy and imaging doses in photon and particle radiotherapy, for input to epidemiological studies
- To improve dosimetry in modern external beam radiotherapy

<End of abstract>



MELODI statement 2016

MELODI (Multidisciplinary European Low Dose Initiative) is a European Platform dedicated to low-dose ionizing radiation risk research. The purpose of the MELODI Association is to integrate national and European activities in low-dose and low-dose rate radiation research, to define priority scientific goals and to facilitate effective implementation of research. The Strategic Research Agenda (SRA) of MELODI identifies these priority goals and the specific resources, infrastructures and training capabilities needed to further develop low-dose risk research.

Prior to EU research funding calls, MELODI develops a short statement indicating its view on current research priorities, which serves as an input to those responsible for defining call topics. The research priorities were identified from the MELODI SRA, which is gradually enriched by the contributions of its members, ongoing and completed research projects and the findings of the MELODI workshops organized annually since 2009. The 7th draft of the MELODI SRA for 2016 has been opened for consultation and can be downloaded from http://www.melodi-online.eu/sra.html. It forms the basis for the definition of the priorities.

The system of radiation protection has been developed and evolved on the basis of an understanding of the magnitude of the health risks associated with radiation exposure and knowledge of the mechanisms of radiogenic disease pathogenesis to inform risk extrapolation. Accurate health risk assessment is fundamental to striking an appropriate and acceptable balance between the benefits of use/exposure to radiation and the associated health risks. Today the main uncertainties in radiation health risk assessment are in the magnitude of cancer risk at low and protracted doses, the magnitude of circulatory diseases, lens opacities and other tissue injuries below 500 mSv, and the variation in disease risk between individuals in the population. More information on these and associated issues is required to ensure adequate protection is afforded to populations and individuals in all situations – occupational, medical, emergency and in the course of normal life.

Criteria for prioritization

- Feasibility (research judged to be achievable in the near future)
- Importance in terms of improved radiation protection system
- Relevance for operational radiation protection (BSS implementation)
- Multidisciplinarity (biology, epidemiology, dosimetry)
- Synergy with other radiation research platforms (ALLIANCE, EURADOS, NERIS, EURAMED, European Medical Associations –ESR, ESTRO, EANM, EFRS, EFOMP)
- Timeliness
- Avoidance of overlap of topics with other calls or topics that have been recently funded and outcome from projects that have recently ended.

Ranked list of priorities (for detailed description see Annex):

- To understand the potential impact of individual susceptibility on radiation-induced health effects (Rank 1: high priority)
- To identify, develop and validate biomarkers for exposure, early and late effects for cancer or/and non-cancer diseases (Rank 2: medium priority)
- To understand the health effects of inhomogeneous dose distributions, radiation quality and internal emitters (Rank 2: medium priority)
- To explore and define the role of epigenetic modifications in radiation-induced health effects (Rank 2: medium priority)
- To explore the roles of specific target cells for radiation-induced late developing health effects (Rank 2: medium priority)
- To explore the shape of the dose-response relationship for radiation-induced health effects (Rank 3: low priority)

MELODI encourages, where appropriate, (1) the use of archived biological materials from prior EU funded research, (2) the integration of experienced laboratory networks (such as e.g. RENEB), (3) the integration of expertise from outside the conventional fields of radiation research, in particular expertise from the medical research field where appropriate.

ANNEX: Description of MELODI 2016 priorities

Priority title	**To understand the *potential impact of individual susceptibility on radiation-induced health effects*.**
Priority description	Studies of carriers of BRCA1/2 mutations and studies of cancer patients have shown that single nucleotide polymorphisms (SNPs) in a number of genes can modify the radiation responses – either in the long term (risk of cancer) or in the short to medium term (adverse reaction to radiotherapy/interventional radiology procedures). Differences in sensitivity have also been observed in relation to gender, age at exposure, state of health, genetic and epigenetic make-up, lifestyle, and age attained. At present, there is insufficient information on the influence of individual radiation sensitivity on health risk estimates at low-doses/dose-rates. Research is required on the extent of variation of individual sensitivity in the population, on the factors contributing to this variation, as well as integration of mechanistic studies in the quantitative evaluation of health risk.
European relevance	Individual sensitivity is one of the three key policy questions in the **MELODI** SRA and one of the main research priorities in the HLEG. It is also important for **NERIS** in emergency response and surveillance after accidents – children, pregnant women and elderly/ill persons being priority groups for radiation protection in the case of an accident - ; for **ALLIANCE** in protection of non-human biota. Studies of radiation sensitivity obviously need adequate dosimetry, including biological dosimetry, and hence there is an important role for **EURADOS**. Individual sensitivity is extremely relevant for radiation protection of **patients** undergoing both diagnostic and therapeutic exposures, where the possibility of using other medical procedures (MRI for imaging, surgery/chemotherapy/hormone therapy/immune therapy for treatment) exist (EURAMED).
Multidisciplinarity; Reference to the strategic research agendas (SRA)	A multidisciplinary approach is needed to address this topic, including epidemiologists, biologists, clinicians, dosimetrists and modellers, as well as –for aspects related to response to radiation accidents – social scientists, ethicists and psychologists. -MELODI (2015): p.14-16; 3.3 (Individual Radiation Sensitivity) -ALLIANCE (Sept 2013): p.26; Challenge 2, topics 1 & 2 -NERIS (April 2014): p.20; Topic 5.8, Health surveillance -EURADOS (May 2014): p.17; 3.2.2 and p.21; 3.3.1 -EURAMED (Nov 2015): chapter 3.2.1, 3.2.2, 3.2.3
Impact: decreased uncertainty	Individual differences in sensitivity raises ethical and policy question as to whether some individuals or groups are inadequately protected by the present system and regulations. Answers to this question are therefore urgently needed.
Impact: increased radiation protection	Identification of sensitive persons in the population can lead to better RP –in medicine (where approaches not involving IR can be used), in occupational settings as well as in the general population after, for example, accidents.
Impact: increased quality and reliability	Understanding the potential impact of individual susceptibility will contribute to a more realistic assessment of radiation health risks.
Feasibility	Scientific / technological competences needed for this topic are available in Europe. Different approaches can be considered, including (molecular) epidemiological studies of cancer patients or cohorts of genetically predisposed individuals, system modelling, studies of biomarkers, animal models.

Priority title	**To explore and define the role of epigenetic modifications in radiation-induced health effects**
Priority description	In recent years, biological research has identified a range of processes that can modify cellular, tissue and whole organism phenotypes that do not require DNA mutation. Collectively these are termed epigenetic effects and these include modified DNA methylation, microRNA expression and histone acetylation. While there are indications in the literature that radiation can affect epigenetic endpoints, there remains a lack of understanding of dose- and dose-rate responses, and the relationship of the changes to radiogenic disease, although epigenetic phenomena have been linked to cancers and transgenerational effects. Research is required to define radiation dose-/dose-rate responses for individual epigenetic endpoints, determine radiation quality dependence and the relationship of such changes to radiogenic cancers, non-cancer diseases and hereditary/transgenerational effects.
European relevance	The proposed research is relevant to (i) **MELODI** in that it requires consideration of low-dose/dose-rate response and relevance for radiogenic disease and may identify biomarkers of exposure or effect (ii) **ALLIANCE** in that it will explore the relevance to transgenerational effects and population health (iii) **EURADOS** in that it will require a high standard of radiation dosimetry for cell culture systems, model organisms and a range of radiation qualities (iv) **NERIS** in that it may identify biomarkers of exposure or effect (v) **medical** applications in that biomarkers may be identified and through mechanistic understanding of effects, novel radio-protectors may be identified (vi) **BSS** implementation in the future, as evidence taken in to account in ICRP recommendations.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The research topic is of European and wider relevance in that it will help to determine the appropriate risk-benefit assessment for radiation use in all sectors; in this way, by informing the system of protection the research will ensure that the population and non-human biota are neither under nor over protected; and this ensures effective and efficient resource usage. -MELODI (2015): p.10 (and others); 3.1.1, 3.1.2, 3.1.3, 3.3.1 -ALLIANCE (Sept 2013): p.6; Challenge2, topics 1 & 4 -NERIS (April 2014): p.20; Topic 5.8, Health surveillance -EURADOS (May 2014): p.17; 3.2.2 and p.21; 3.3.1 -EURAMED (Nov 2015): chapter 3.2.1, 3.2.2, 3.2.3
Impact: decreased uncertainty	The research will improve the scientific evidence base for judgements in radiation protection. It will address the question whether endpoints in addition to DNA mutation need to be considered in selection of risk extrapolation models for cancer, and if epigenetic effects are important for judgements on risk extrapolation for non-cancer diseases. Detailed dose-/dose-rate response information will be generated.
Impact: increased radiation protection	The proposed research will provide evidence to inform judgements on one of the most fundamental aspects of the system of protection, namely, which is the best model for risk extrapolation for cancer and non-cancer diseases. The research thus informs judgements on dose limits and emergency reference levels.
Impact: increased quality and reliability	The understanding gained from carrying out this research will provide supporting evidence for judgements on the model used for risk extrapolation for all health endpoints and thus increase the quality and reliability of health risk assessment.
Feasibility	The proposed research topic is feasible; many methods that can carry out high-throughput epigenetic analyses have been developed and there is a growing body of technical competence in Europe.

Priority title	**To identify, develop and validate biomarkers for exposure, early and late effects for cancer or/and non-cancer diseases**
Priority description	In recent years, the rapid development of technologies for "omics" research has opened up for a detailed biochemical analysis of cellular responses at each regulatory level in the cell machinery. Understanding interactions at the molecular levels and the use of new software's for pathway analysis have provided new insights in the mechanisms that regulate the cellular responses to different stressors. Identifying biomarkers for radiation-induced stress responses, as well as for early and late stages of diseases induced by radiation will provide a platform for a mechanistic understanding of the cellular responses to ionizing radiation.. If persistent biomarkers for exposure and radiation-induced diseases can be identified, the integration of them in epidemiological studies will have significant implications for risk estimates of low-dose/dose rate exposures. Research is required to define radiation dose/dose-rate responses for biomarkers of exposure, to determine their radiation quality dependence and the relationship of such changes to radiogenic cancers and non-cancer diseases.
European relevance	The proposed research is relevant to (i) **MELODI** in that it requires consideration of low-dose/dose-rate response and relevance for radiogenic diseases and may identify biomarkers of exposure or effect (ii) **ALLIANCE** in that biomarkers of exposure from the human model systems may be of relevance for the studies of other types of species and help to explore the relevance to transgenerational effects and population health (iii) **EURADOS** in that it will require a high standard of radiation dosimetry for cell culture systems, model organisms and a range of radiation qualities (iv) **NERIS** in that it may identify biomarkers of exposure or effect (v) **medical** applications in that biomarkers may be identified that can be used for diagnosis of individual sensitivity to radiotherapy/interventional radiology procedures and early detection of cancer and non-cancer diseases (vi) **BSS** implementation in the future, as evidence taken in to account in ICRP recommendations.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The research topic is of European and wider relevance in that it will help to determine the appropriate risk-benefit assessment for radiation use in all sectors; in this way, by informing the system of protection the research will ensure that the population and non-human biota are neither under nor over protected; and this ensures effective and efficient resource usage. -MELODI (2015): Chapters 3.1, 3.2 and 3.3. -ALLIANCE (Sept 2013): p.6; Challenge2, topics 1 & 4 -NERIS (April 2014): p.20; Topic 5.8, Health surveillance -EURADOS (May 2014): p.17; 3.2.2 and 21; 3.3.1 -EURAMED (Nov 2015): chapter 3.2.1, 3.2.2, 3.2.3
Impact: decreased uncertainty	The research is expected to be of significance for the development of better risk estimates for other types of genotoxic stressors that are challenging the health of humans and other species. Biomarkers of exposure and diseases applied in epidemiology will significantly reduce the uncertainties of the present risk estimates in the low-dose/dose rate range as detailed dose-/dose-rate response information will be generated.
Impact: increased radiation protection	The proposed research will provide evidence to inform judgements on one of the most fundamental aspects of the system of protection, namely, which is the best model for risk extrapolation for cancer and non-cancer diseases. The research thus informs judgements on dose limits and emergency reference levels.
Impact: increased quality and reliability	The understanding gained from carrying out this research will provide supporting evidence for judgements on the model used for risk extrapolation for all health endpoints and thus increase the quality and reliability of health risk assessment
Feasibility	Many methods that can carry out high-throughput "omic" analyses have been developed and the bioinformatics needed for the transfer of these results into a mechanistic understanding is at hand.

Priority title	**To explore the roles of specific target cells for low-dose/low-dose rate radiation-induced late developing health effects**
Priority description	Currently, radiation risk extrapolation does not specifically include mechanistic considerations, but is more a statistical curve-fitting approach. To improve mechanistic understanding of radiogenic disease processes that can inform mechanistic approaches to cancer risk extrapolation several key pieces of information will be required. Most fundamentally, it is important to identify the cells at risk of conversion into the disease state, and enumerate these. For the case of cancer it is generally assumed that stem and early progenitor cell populations are relevant, but these are not generally well characterised, understood in their responses to low-dose/dose-rate radiation or enumerated. Research is required to clarify these aspects, and similarly to identify, enumerate and define radiation responses of target cell populations for other late-developing diseases such as circulatory diseases and lens opacities.
European relevance	The proposed research is relevant to (i) **MELODI** in that it requires consideration of target cells relevant for radiogenic diseases and low-dose/dose-rate response, providing important input for mechanistic models for risk extrapolation (ii) **EURADOS** in that it will require a high standard of radiation dosimetry for cell culture systems, model organisms and a range of radiation qualities (iii) **NERIS** in that in the longer term it will strengthen and improve risk estimation and thus exposure threshold for emergency action (iv) **BSS** implementation in the future, as evidence can be expected to be taken in to account in ICRP recommendations.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The research topic is of European and wider relevance in that it will help to determine the best approaches to risk extrapolation for all late developing diseases; in this way , by informing the system of protection, the research will ensure that the exposed populations are neither under nor over protected, and this ensures effective and efficient resource usage. -MELODI (2015): p.10 (and others); 3.1.1, 3.2.1, 3.3.3 -ALLIANCE (Sept 2013): p.26; Challenge 2, 3.2.2.1 -NERIS (April 2014): p.18; Topic 5.1 -EURADOS (May 2014): p.17, 3.2.2
Impact: decreased uncertainty	The research will improve the scientific evidence base for judgements in radiation protection. It will address the issue of the improvement of risk extrapolation and strengthening the scientific evidence base for risk extrapolation.
Impact: increased radiation protection	The proposed research will provide evidence to inform judgements on a fundamental aspect of the system of protection, namely, which is the best approach for risk extrapolation for cancer and non-cancer diseases. The research thus in the long term informs judgements on dose limits and emergency reference levels.
Impact: increased quality and reliability	The understanding gained from carrying out this research will provide supporting evidence for judgements on the approach used for risk extrapolation for all health endpoints and thus increase quality and reliability of health risk assessment.
Feasibility	Many methods that can identify stem cells *in vivo* and *in vitro* have been developed, fundamental research in stem cell biology has developed an impressive range of methods for cell manipulation and imaging that can be utilised and there is a growing body of technical competence in Europe.

Priority title	**To understand the effects of inhomogenous dose distributions, radiation quality and internal emitters on health.**
Priority description	Many of the exposures to radiation encountered in the environment, occupationally and in medical settings can be to internal contamination, often to radiations of differing quality or involve other aspects of dose inhomogeneity. The current system of radiation protection makes use of radiation weighting factors to reflect spatial dose distribution differences between radiations of differing quality. The risk associated with all forms of dose inhomogeneity, internal contamination and radiation quality is not well understood. Research is required to determine the extent to which these radiation exposure characteristics modify dose-response relationships for health effects.
European relevance	The assessment of the impact of radiation exposure characteristics on the risk of cancer and non-cancer diseases is a priority of top importance for **MELODI**. Per definition there is clear link to EURADOS with respect to updated fundamental dose concepts and quantities and improved dosimetry for epidemiological studies. The implications of improved risk estimates for emergency management link the priority to **NERIS**. The enhanced risk characterizations may link the priority to **ALLIANCE**. Improved knowledge of health risk will also be of importance for the optimization of ionizing radiation applications in medical diagnostics and therapy (**EURAMED**), and for the **BSS** implementation in the future, as evidence can be expected to be taken in to account in ICRP recommendations.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	A multidisciplinary approach is needed to address this topic, including epidemiologists, biologists and dosimetrists. -MELODI (2015): 4.1.3, 4.2.3 and 4.3.3) -EURADOS (May 2014): Chapter 3.1, 3.2, 3.3.3 -EURAMED (Nov 2015): chapter 3.1
Impact: decreased uncertainty	The research will improve the risk assessment in case of dose inhomogeneity and internal contamination and provide an improved assessment of radiation weighting factors.
Impact: increased radiation protection	The research will improve the scientific evidence base for judgements in radiation protection.
Impact: increased quality and reliability	A better knowledge of the influence of these exposure characteristics on the risk estimation will lead to a higher quality and reliability of health risk assessment.
Feasibility	Research is feasible, because improved biokinetic and dosimetric models are available that can be used in epidemiological studies. Experimental studies in vivo or in vitro with different exposure scenarios where dose modulation plays a role can be conducted.

Priority title	**To explore the shape of the dose-response relationship for radiation-induced health effects**
Priority description	There are major uncertainties concerning the magnitude of cancer risk following (1) Protracted exposures in the order of 100 mSv or less, and (2) organ specific risks following acute or protracted doses of a few hundred millisieviert, particularly for inhomogeneous exposures. Another major uncertainty is related to the magnitude of risk of non-cancer diseases at doses below about 500 mSv. Research is required to quantify the magnitude of cancer and non-cancer risk at low-doses and dose-rates. This can be achieved by mechanistic studies such as for example well-designed experimental animal studies and large (molecular) epidemiological studies with precise dosimetry, information on important confounders and possibly access to biological samples.
European relevance	Per definition, the priority is of top importance for **MELODI**. By the need of improved dosimetry for key epidemiological cohorts the priority is linked to **EURADOS**. The implications of improved risk estimates for emergency management link the priority to **NERIS**. The enhanced risk characterizations may link the priority to **ALLIANCE**. Improved knowledge of health risk will also be of importance for the optimization of ionizing radiation applications in medical diagnostics and therapy (**EURAMED**), and for the **BSS** implementation in the future, as evidence can be expected to be taken in to account in ICRP recommendations.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	This priority needs intensive collaboration of epidemiology, dosimetry, radiation biology, systemsbiology, experts of pathogenesis, mathematical modelling, statistics, radiation protection and emergency measurement. Expertise outside of the traditional fields of radiation research needs to be integrated. -MELODI (2015): p.9-14; chapter 3.1 and 3.2 -ALLIANCE (Sept 2013): p.6; Challenge 3; topic 3 -NERIS (April 2014): p.20, Topic 5.8 Health surveillance -EURADOS (May 2014): p.11-19; 3.2; p.35; 3.5.1 -EURAMED (Nov 2015): chapter 3.2.1, 3.2.2, 3.2.3
Impact: decreased uncertainty	The research will decrease uncertainty with respect to the shape of the dose-response-relationship for cancer and non-cancer diseases in the low dose range.
Impact: increased radiation protection	Improved health risk estimates together with an improved assessment of uncertainties will strengthen the robustness of present radiation protection system. This will especially be the case for i) regulating occupational exposures; ii) optimizing radiation therapy for patients with good prognosis (long time risks of diseases in relatively low exposed tissues); iii) deciding about appropriate diagnostic applications of radiation in medicine (especially for procedures leading to exposures of several tens of mSv in total; and iv) regulating emergency situations (involving reference levels from a few tens to 100 mSv)..
Impact: increased quality and reliability	Experimental animal studies with well validated animal models and key informative large size cohorts, information on important confounders, and precise dosimetry will improve the quality and reliability of currently available risk estimates on the dose-response relationship.
Feasibility	The priority is feasible in terms of scientific and technological competences available in Europe. Key informative cohorts with the potential for access to biological samples and appropriate animal models for many endpoints are available..

ALLIANCE SRA-Statement 2016

The ALLIANCE, the radioecology Strategic Research Agenda and the onset of the Roadmap

The European Radioecology Alliance (ALLIANCE) was founded in 2009 to coordinate and promote European research on radioecology. The ALLIANCE acts as a research platform, defining priorities for research programmes and integrating human and infrastructure resources to advance research in the field of radioecology. It promotes maintenance, updating and mutual use of suitable infrastructures, education and training and communication with stakeholders.
The present statement based on the Strategic Research Agenda[1] (SRA) was produced to serve as an input to those responsible for defining EU research call topics. It provides and justifies research priorities for radioecology at the short- and medium-term consistently with the major outcomes from recent and ongoing projects and with the ALLIANCE SRA, which constitutes the reference document shared by stakeholders and researchers. The strategy underlying the ongoing roadmap development associated to this SRA is driven by the need for improvement of mechanistic understanding across radioecology such that robust fit-for-purpose human and environmental impact/risk assessment can be provided in support of protection of man and the environment, in interaction with society (connecting science, communication, economy) and for the three exposure situations defined by the International Commission on Radiological Protection (*i.e.,* planned, existing and emergency). Several topical working groups[1] each dealing with specific scientific areas and/or complex environmental issues have defined a 5-y topical roadmap: 1) Atmospheric radionuclides in transfer processes, 2) Marine radioecology, 3) Human food chain , 4) Naturally Occurring Radioactive Materials (NORM), 5) Transgenerational effects and species radiosensitivity. Topics 1-3 are mainly linked with NERIS and topic 5 with MELODI. Topics 2-5 are also developed as initial research activities within COMET[2]. The COMET call (2013) supported research in marine radioecology and hot particle environmental behavior. Topics 1 and 3 are also partly covered in the HARMONE task recently granted under the OPERRA 2nd call[3]. Some of the research areas hence provide a powerful catalyst to further increase collaboration between the four European platforms of radiation protection, ALLIANCE, NERIS, MELODI and EURADOS. Since the 2015-SRA statement, there has not been additional trigger to promote major changes in the ALLIANCE priorities. Only two modifications were decided by the ALLIANCE:

(i) to complete the set of ecosystems of interest by adding marine ecosystems to freshwater and terrestrial ones; the objective is mainly to stimulate an integrated and multi-media approach for environmental risk assessment and management, by allowing consideration of processes governing radionuclide fate at interfaces between all ecosystem types and the atmosphere;

1https://wiki.ceh.ac.uk/x/YoFsD

[2]COMET: COordination and iMplementation of a pan-Europe instrumenT for radioecology. www.comet-radioecology.org
[3] http://www.melodi-online.eu/operra.html

(ii) to give the first priority to the topic dedicated to "biomarkers of exposure and effects to living organisms as operational outcome of a mechanistic understanding of radiosensitivity" for two reasons: (1) this topic is not explicitly expressed in any of the two topical areas defining the first CONCERT call in progress at the moment of writing the statement; as a consequence there is no room for proposals linked with effects on non-human species even for mechanistic studies; (2) this is an area of high added value for both human and non-human radiological protection. By regulation, the environment protection needs to be considered and research is needed to unravel the mechanisms behind chronic low-dose, multigenerational effects to enable the derivation of robust environmental protection standards. Human radiation protection may benefit from knowledge acquired on long-term, low dose multigenerational effects.

ALLIANCE priorities and ranking

On the basis of (i) our 2015-SRA statement, (ii) discussions/decisions within the ALLIANCE SRA WG and the topical roadmap leaders and their associated WGs, (iii) the timing to release our 2016-statement with no lessons learnt from the first CONCERT call, currently in progress, our priorities are ranked as follows:

- Biomarkers of exposure and effects in living organisms as operational outcomes of a mechanistic understanding of intra- and inter-species variation of radiosensitivity under chronic low dose exposure situations, with a focus on the added value for both human and non-human radiological protection **(ranked as priority 1);**
- Environmental availability and impact of radionuclides in terrestrial, freshwater and marine ecosystems (including human food chain) and their interactions with atmosphere, incorporating physical, chemical and/or biological processes. Validated process-based model parameterisation, characterisation of variability and uncertainty, and guidance for fit-for-purpose models **(ranked as priority 2) ;**
- Development of models/tools, and datasets for their calibration and validation and guidance to select and evaluate the effectiveness of different remediation strategies in long-lasting exposure situations (*e.g.* nuclear accidents and/or NORM/TeNORM) **(ranked as priority 3);**
- Multiple stressors and modulation of radiation effects in living organisms **(ranked as priority 4)**.

The ALLIANCE encourages, where relevant openness to other disciplines to integrate their skills and knowledge into radioecology, and capitalisation of best practices, tools and data in the various fields of research needed. Additionally, research combining "lab-field-modelling" approach and fit-for-purpose applications will be appreciated.

ANNEX: Description of ALLIANCE 2016 priorities

Priority title	**Biomarkers of exposure and effects in living organisms, as operational outcomes of a mechanistic understanding of intra- and inter-species variation of radiosensitivity under chronic low dose exposure situations, with a focus on the added value for both human and non-human radiological protection (ranked as priority 1)**
Priority description	The issue of biological effects of low doses of ionising radiation is still of major concern for both human and environmental radiation protection, as highlighted after the Fukushima accident, especially with the aim of quantifying (and reducing if needed) the magnitude of risk to individuals (human and endangered species) and populations (human and biota) health at low doses/dose rates. We need urgently to complement the system of radiation protection to be able to face the wide biodiversity and biological responses to radiation (from molecules to ecosystems) in a credible and robust way. A key for success is to explore intra- and inter-species causes of radiosensitivity variation. This requires reliable quantification of radiosensitivity *in vitro* and ideally also *in vivo*. This will help to screen out candidates for biomarkers to be used as early warning tools after *ad hoc* validation. Research is required to contribute to the identification of the primary mechanisms of radiation induced effects at the molecular level and their propagation up to the individual level, including consequences for physiological functions (*e.g.* reproduction). This will be evidenced by evaluating suitable biomarkers of exposure and biomarkers of effects. A comparative and "lab-field-modelling"-combined approach for a number of exposure conditions and/or a number of species will enhance the understanding of the toxicity profiles as a response to exposure conditions. Dose-response relationships will be established making the best use of "omics" analytical methods, possibly combined with the use of a system biology approach, to provide evidence of linkage between metabolic pathways and associated biomarkers of effects. Research could expand to the use of genetic and epigenetic changes as biomarkers by implementing innovative approaches to test changes in the genome (*e.g.* mutation rates and types) and the epigenome (*e.g.* epigenetic tags) through generations.
European relevance	This topic, synergistic with MELODI, was highly scored in the OPERRA e-survey. It presents a high potential for multidisciplinarity beyond the radiological protection community since it highlights similarities that radioecology has with ecotoxicology, stress ecology and human radiation biology. The topic is indirectly relevant to NERIS in that biomarkers potentially also useful in health surveillance, are looked for. The research is also relevant to EURADOS as accurate dosimetry is a prerequisite for any robust dose-response relationships. Impact on risk communication is expected by providing answers to burning questions emerging from public perception of the consequences of the Fukushima and the Chernobyl accidents. Outcomes will support emerging policy in the field of radioprotection of the environment, explicitly mentioned in the EURATOM Basic Safety Standards.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	This topic will complement human and environmental radiation protection frameworks in a consistent way and will contribute to an improved and efficient integration of both protection frameworks. -MELODI (Aug 2015): p.12-17: chapter 4.2, 4.3. -ALLIANCE (Sept 2013): p.23-30: challenge 2 – research lines 3.2.2.1, 3.2.2.2; 3.2.2.4; p.33: challenge 3-research line 3.3.2.2. -NERIS (Apr 2014): p.18: key topic 5.1; p.20: key topic 5.8; p.23: cross cutting issues. -EURADOS (May 2014): p.7-13: vision 1 topics 1, 2, 3; p.22-25: vision 3 topic 1
Impact: decreased uncertainty	This research should provide the basis for the development of biologically-based extrapolation models which are the key to tackle the wide species diversity and would be useful for risk assessors by helping reducing uncertainty in predictions of effects (and ultimately risk).

Impact: increased radiation protection	Identification of such biomarkers will be relevant to humans or non-human species radiation protection. Acquired knowledge will highlight and feed the various extrapolations needed when assessing radiological risk to humans or non-human species, and will provide robustness in effects predictions and decision making.
Impact: increased quality and reliability	By encouraging openness to other disciplines and innovative hypothesis-driven approach to understand underlying mechanisms, this research topic will contribute to increasing acceptability of the radiation protection system and aid in risk prediction, management and communication.
Feasibility	A wide range of methods and approaches exists to make this research highly feasible, along with effect database (*e.g.* FREDERICA).

Priority title	**Environmental availability and impact of radionuclides in terrestrial, freshwater and marine ecosystems (including human food chain) and their interactions with atmosphere, incorporating physical, chemical and/or biological processes. Validated process-based model parameterisation, characterisation of variability and uncertainty, and guidance for fit-for-purpose models (ranked as priority 2).**
Priority description	A key goal of radioecology is to understand and predict the transfers of radionuclides and consequent exposure of humans and wildlife. More specifically, this is needed for a wide range of sources and release scenarios, exposure situations and assessment contexts in continental environments, including interactions with atmosphere. Although considerable advances have been made since the Chernobyl accident in predictive modelling, the Fukushima accident in Japan has highlighted the need of improved transfer and exposure models. The new models should represent the behaviour of the radionuclides in a more realistic way, ideally considering the different levels of organisation present in the environment. The key physical, chemical and biological processes that govern radionuclide transfers, and how transfers and exposure of humans and wildlife vary spatially, temporally and with the source term, should also be taken into account. Research should contribute to an improved process-based understanding of radionuclide transport and transfers in various radioactively contaminated areas and eventually into the human food chain. Major physical and biogeochemical processes should be identified, conceptualised and mathematically translated into models (from empirical to mechanistic, depending on the requirement) taking into account spatial heterogeneity and temporal variability of the environment under study. One of the expected outcomes is to provide guidance for selecting the level of refinement for models according to the targeted uncertainty. Another is to obtain calibrated and validated models which are fit for purpose.
European relevance	This topic is highly relevant for European radioecology in view of substantial advances in improving process-based understanding of radioecology in Europe, which needs to be supported by adequate funding, allowing European scientists to be leaders in the field. This topic has synergies with MELODI, NERIS and EURADOS, since dose assessment is a key step in the radiological impact/risk characterisation. This synergistic topic was highly scored by the OPERRA e-Survey. The radioecology research lines related with this topic (Challenge 1) also received a high score in the OPERRA e-Survey.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	This topic is multidisciplinary because it connects radioecology, radiation protection, dosimetry, ecotoxicology, physics and biogeochemistry. The topic has links with European research platforms: -ALLIANCE (Sep 2013): p.14-22; Challenge 1; research lines: 3.1.2.1; 3.1.2.2.; 3.1.2.3; and 3.1.2.4; p.32, Challenge 3, research line 3.3.2.1. - NERIS (April 2014): p. 12: key topic 1.6; p. 13: key topic 2.1; p. 16: key topic 3.4; p. 18: key topic 5.1; p.23: cross cutting issues. -EURADOS (May 2014): p.6: vision 3 and 5.

Impact: decreased uncertainty	A deeper scientific understanding of the environmental processes involved in the transport and transfer of radionuclides will reduce uncertainties and hence robustly support decision making in various exposure situations. The knowledge gained will allow providing guidance for selecting the level of refinement for models according to the targeted uncertainty.
Impact: increased radiation protection	The topic will contribute to improve the radiation protection system, since it will allow to accurately predict exposure to humans and wildlife in planned, existing and emergency exposure situations, within continental and marine ecosystems that may interact between each other and with atmosphere.
Impact: increased quality and reliability	Uncertainties and lack of predictive power in risk assessments are major contributors to the public's reduced credibility of radiological sciences. Therefore, the acquisition of new scientific knowledge to reduce the uncertainties of the dose assessments, allowing more robust predictions and improved human and wildlife impact/risk assessments, will improve credibility with stakeholders.
Feasibility	There is a strong European radioecology research base with access to modelling, international databases, long-term collaborations with international organisations and first-class facilities.

Priority title	**Development of models/tools and datasets for their calibration and validation, and guidance to select and evaluate the effectiveness of different remediation strategies in long-lasting exposure situations (*e.g.* nuclear accidents and/or NORM/TeNORM) (ranked as priority 3).**
Priority description	Management approaches in emergency and existing exposure situations can range widely in complexity. Although a significant knowledge exists for a wide range of exposure situations, it tends to be fragmentary rather than forming an integrated strategy capable of dealing with complex, dynamically changing conditions. The need for integrated and graded management approaches and the appropriate tools to implement them over the entire spectrum of possible exposure scenarios, and thus ensuring that socio-economic facets are taken into account in the rehabilitation of the impacted areas, are primary drivers for radioecological research in the coming decades. The events at Fukushima after the NPP accident exemplify these problems and the existing deficiencies. There is a need for sound, fundamental and progressive science to yield maximum benefits from these efforts. Research is needed to guide the development/selection of models and assessment tools for medium to long-term predictions. There is a parallel need to generate and make available field data for their validation. Appropriate models (from empirical to process-based) should be developed to help compare radiological effects from various remediation measures, including those reducing radionuclide transfers into the food chain and/or those improving ecosystem services. For relevant radionuclides, models need to be applied to design remediation strategies to the major components of the ecosystems. Regarding more specifically post-accident exposure situations, the research to be done ought to complement the OPERRA-2014 HARMONE project activities, mainly dealing with the early phase of an emergency situation. Regarding NORM/TeNORM sites research is needed to give answers to the specific requirements of the EURATOM Basic Safety Standards (BSS).
European relevance	This topic has synergies with NERIS and EURADOS, in the establishment of priorities for pre-accident recovery preparedness, which was highly scored by OPERRA e-Survey. The topic defined by ALLIANCE will complement the expected outcomes from OPERA-2014 HARMONE, by dealing with medium- to long-term transfer processes and by tackling remediation issues. The topic is relevant to implement the requirements from the EURATOM BSS in relation to NORM/TeNORM. The priority is designed up-front to address specific BSS requirements for long-lasting exposure situations / remediation strategies.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	Multidisciplinarity is assured through topical links between radioecology, radiation protection/dosimetry, ecotoxicology, physics and biogeochemistry. -ALLIANCE (Sept 2013): p. 30-37- challenge 3- research lines 3.3.2.1 to 3.3.2.6; p.14-22: challenge 1- research lines 3.1.2.1 to 3.1.2.4.

	-NERIS (Apr 2014): p. 12: key topic 1.6; p. 16: key topic 3.4; p. 19: key topic 5.7; p.23: cross cutting issues -EURADOS (May 2014): p.6: vision 3 and 5.
Impact: decreased uncertainty	Scarcity of data is one of the major sources of uncertainty. The databases developed will contribute to the reduction of uncertainties in the impact/risk characterization in long-term radiological assessments, making remediation strategies more credible and robust, and offering the possibilities of comparing a range of strategies. The use of calibrated and validated models will also contribute to reduce uncertainties.
Impact: increased radiation protection	The predictions obtained in the assessment models are often key constituents in decisions made about emergency response, waste management, environmental remediation, and mitigation. The availability of more accurate validated models will increase the confidence in the radiological impact/risk assessment process, and therefore will contribute to the improvement of the radiation protection system through robust evaluation of the best remediation strategies to minimise exposures to the public and the environment.
Impact: increased quality and reliability	The use of validated models will improve the predictive accuracy and precision of the radiological impact assessments, with a greater confidence in the results. Moreover, justification of nuclear industry activities is increased if robust remediation approaches exist and are well evaluated before things go wrong.
Feasibility	The expertise and technological resources needed exist and are well consolidated at the European level to make this research highly feasible.

Priority title	**Multiple stressors and modulation of radiation effects in living organisms** (**ranked as priority 4**)
Priority description	Exposure to multiple stressors may directly or indirectly modulate radiation effects in living organisms. Even though studying a contaminant in isolation is necessary to understand the underlying mechanisms resulting in the observed effects, this does not allow to predict potential interactions among the many stressors to which organisms are actually exposed and the resulting effects. Interactions can reduce overall damage or augment single stressor effects. Hence, the presence of co-stressors may alter the level at which organisms are likely to show radiation effects. From a risk point of view, knowing how co-contaminants/stressors might influence the radiosensitivity of organisms is therefore a pressing need. Research is required to contribute to the mechanistic understanding of how radiation effects in living organisms are modulated in the context of multiple stressors. Emphasis is on environmentally relevant combinations of stressors that interact such that synergistic effects are likely to occur with exposure to radiation or radionuclides. The occurrence of synergisms will have to be investigated at realistic radiation levels and realistic concentrations/conditions of other stressors. Given the multitude of potential stressors and combinations that exists in real exposure conditions, the approach to prioritise hypotheses, select stressor combinations and conditions is quintessential. Projects should be directed to the mechanistic understanding of the site where interactions occur: at the level of exposure, where interactions can take place in various processes (*e.g.* uptake, internal distribution of the radionuclides), or at the level of effect (where interactions could be observed at the primary site(s) of disturbance or in regulation and signal transduction of the response of the organism following exposure). Dynamic and biology-based methods and approaches (*e.g.* DEBtox, gene expression pathways) could contribute to mechanistic understanding. Multiple stressor research will benefit from field based studies and the evaluation of the results in a risk assessment context. The question of the robustness of screening values in a multiple stressor context should be considered.

European relevance	This multidisciplinary complex topic can build on the achievements of the STAR Network of Excellence and was selected as a high importance synergistic topic by ALLIANCE, MELODI and EURADOS. The research on this topic will help reduce uncertainties by taking into account environmentally relevant exposure conditions. The research is relevant to EURADOS as accurate dosimetry is a prerequisite for any robust dose-response relationships. Impact in communication to the public is expected by improving the capability of demonstrating the impact of ionising radiation in comparison to other environmental stressors.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	This topic will support chemical and radiological environmental protection frameworks in a consistent way and will improve consistency for any environmental impact assessment. This research is highly multidisciplinary in nature and will benefit from interacting with ecotoxicology and biochemistry. -MELODI (Aug 2015): p.17: synergistic topic 1. -ALLIANCE (Sept 2013): p.27: challenge 2 – research line 3.2.2.3; p.34: challenge 3-research line 3.3.2.3. -NERIS (Apr 2014): p. 16: key topic 3.6; p.23: cross cutting issues.-EURADOS (May 2014):): p.7-13: vision 1 topics 1, 2, 3; p.22-25: vision 3 topic 1
Impact: decreased uncertainty	This research will complete the scientific foundation for fully integrating environmental and human protection frameworks under one generalised system (*i.e*. consistent between radiation and chemicals on one hand and human and environment on the other hand), which would be of much interest to regulators, industry and the public.
Impact: increased radiation protection	This research will demonstrate if radiation protection standards are robust and protective enough. Will provide robustness to any risk assessment, associated decisions and communication.
Impact: increased quality and reliability	Gaining knowledge on low dose effects under realistic exposure conditions and explaining clearly important and relevant results obtained to the public are needed to give people the power of informed choice and of making decisions knowing the level of risks associated to their living conditions for them and the future generations. Being able to clearly demonstrate the role of ionising radiation in comparison to any other environmental stressor is a must for being successful.
Feasibility	This research needs to implement an innovative approach and as such, is risky.

European Platform on Preparedness for Nuclear and

Radiological Emergency Response and Recovery

NERIS statement – July 2016

NERIS is a European platform on preparedness for nuclear and radiological emergency response and recovery, founded in June 2010. The mission of the NERIS Platform is to establish a forum for dialogue and methodological development between all European organisations and associations taking part in decision making of protective actions in nuclear and radiological emergencies and recovery in Europe. 59 institutions are currently members of the NERIS platform from which 28 are supporting organisations.

An integral part of the mission of NERIS is to identify gaps and needs for further research and developments and addressing new and emerging challenges in the field of preparedness for nuclear or radiological emergency response and recovery. The Strategic Research Agenda (SRA) of NERIS, coordinated by the NERIS R&D Committee, identifies these research needs.

In its statement of August 2015, NERIS has identified research priorities which can serve as input for defining call topics. The identified research priorities defined in the NERIS SRA statement of August 2015 are still considered to be current needs and are repeated in this statement.

Research and development in the field of emergency management and recovery at the European level calls for co-operation between authorities, emergency centres, research organisations and the academic community in different countries, as well as interactions with key concerned stakeholders with the goal to enhance adequate and coherent response throughout Europe in case of a nuclear and or a radiological event. To reach this goal, apart from advances in the development of models, research improving the decision-making processes is crucial (NERIS SRA key topic 5). Four out of the six priority subjects proposed here fall within this key topic and include uncertainty handling in emergency response and recovery, robust decision making, countermeasure preparedness strategy and monitoring strategies. This research requires a highly multidisciplinary approach and should include societal and ethical aspects. The identified priority research needs related to advances in modelling are in the domain of atmospheric dispersion modelling and local radio-ecological modelling. Based on the exchange of ideas with other radiation protection platforms (MELODI, ALLIANCE, EURADOS) a link with potential common research priorities was identified.

Short descriptions of the current ranked research priorities identified by NERIS are given below. A more detailed description can be found in annex 1. In annex 2 also a short summary is given of the main European research projects finished and started in the past year in areas closely related to the NERIS SRA.

1. **Assessment of and communication of uncertainties**. Investigation of data uncertainties (model or monitoring results) and how they can be communicated, e.g. in model results and in Decision Support Systems (DSS) to help decision-makers to understand the radiological situation. This includes also work on model sensitivity, validity of model results and inter-comparisons of models and measurements.
2. **Robust decision-making.** Structuring the decision processes and the protective strategies at national, regional and local levels with the help of formal decision aid tools, such as multi-criteria analysis and on the basis of feedback from stakeholder processes. Development of guidance on the use of DSS in the various phases of an event based on feedback from stakeholder processes and from Fukushima experience in emergency response and recovery.
3. **Countermeasure strategy preparedness.** Development of sustainable preparedness strategy at Local, National and European levels based on the analysis of countermeasures for relevant accident scenarios. Ensuring that parameters governing the radiological consequences can be identified in time to enable optimized remediation.
4. **Atmospheric dispersion modelling.** To make more reliable forecasts of atmospheric dispersion, including data assimilation and improved inverse modelling (to determine source term and/or source location) in different environments (e.g. urban areas) and/or at different spatial scales (near range to global scale)
5. **Local radio-ecological models.** Development and integration in general DSS of local radio-ecological models interlinked with monitoring information and the more global and food chain dose models. Investigate the capability of such models to be operated by local stakeholders as farmers or local communities. Link with ALLIANCE.
6. **Monitoring strategies.** Optimised use of monitoring resources, including mobile units and trans-border issues. Integration of new monitoring technologies (e.g. drones). Development of processes and tools for integrating the monitoring results from experts and lay people into a common operational picture (monitoring crowdsourcing). Information fusion (radiological and non-radiological). Link with EURADOS but focus on strategy and integration, less on the improvement or development of new measurement methods/techniques.

Annex 1. Detailed description of the NERIS research priorities.

Priority 1	**Assessment of and communication on uncertainties**
Priority description	Important advances have been made in the last decades in the development of models and monitoring methods for evaluating the impact of nuclear/radiological events or to assist in the recovery phase after such an accident. Examples are the validation of food chain and hydrological models, validation of the RODOS model for the Hanford scenario, use of models & monitoring methods in the aftermath of the Fukushima accident. However, uncertainty in these assessments has never been addressed in detail. Both, uncertainty arising from limited information, especially in the early phase of an accident, as well as inherent model or monitoring uncertainties have to be addressed. The research needs identified are: - The investigation of data uncertainties on model or monitoring results and how to propagate uncertainty through simulation models; - How to communicate uncertainty to decision-makers. Key research questions are: - Identify the need of decision makers: how to include uncertain information from simulation and modelling in their decision making process; - Define the level of uncertainty for the key simulation areas of a DSS; - How to include/visualise uncertainty in the results of simulations & measurements and how to propagate them between simulations (e.g. source term – dispersion – dose assessment)? - Is there a methodology for uncertainty handling and sensitivity analysis applicable for all? - How to communicate uncertainty – legal, social and ethical aspects.
European relevance	The topic is part of the NERIS Strategic Research Agenda (Key Topic 5, sub-topic 5.1). Especially in European context, in which accidents have a high probability to have cross border consequences, having better insight in the uncertainty of evaluations based on models or monitoring and how to communicate and visualize these uncertainties is of key importance to come to common European decisions on protective actions and for the harmonization of intervention levels across Europe.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	Uncertainty handling is crucial in all aspects of radiation protection and of importance in several disciplines: apart from assessments in nuclear emergency response and recovery it is of importance e.g. in radio-ecological modelling (ALLIANCE), dosimetry (EURADOS) and studying dose-effect relationships (MELODI).
Impact: decreased uncertainty	Better understanding and quantification of the sources of uncertainty will result in efforts to reduce the main sources of uncertainty
Impact: increased radiation protection	Taking into account the uncertainty of model calculations and monitoring results makes it possible to take better scientifically sound decisions.
Impact: increased quality and reliability	One of the main challenges of communication of uncertainties is to improve the decision making processes (DMP).
Feasibility	The propagation of the uncertainty between simulations is a scientific challenge. However, model developers are the key scientists to address this topic. It is expected that the necessary research could be carried out within 3 years.
Other justifications	The topic has a high scientific relevance because by identification of the uncertainties new research priorities will be identified. In addition, it has a very societal relevance by addressing uncertainties to improve DMP and favour the communication with the public.

Priority 2	**Robust decision-making**
Priority description	Further developments in decision-making are currently required to clearly address i) the structure of the different levels of decision making and the needs of different tools and ii) how to make best use of existing Decision Support Systems (DSS). The work proposed entails: • Structuring the decision processes and the protective strategies at national, regional and local levels with the help of formal decision aiding tools, such as multi-criteria analysis and on the basis of feedback from stakeholder processes. • Development of guidance on the use of DSS in the various phases of an event based on feedback from stakeholder processes and from Fukushima experience in emergency response and recovery. The work proposed will investigate: how are DSS used today and if this complies with their existing structure and robustness; the potential added value of using formal decision aiding tools in the decision making process; the adequacy of decision support tools at different levels of decision making, including all possible stakeholder groups; stakeholder involvement in the preparedness phase: the use of predefined strategies in emergency and recovery management and inclusion of social resources (crowd sourcing, stakeholder participation,…) in the Decision Making Processes (DMP).
European relevance	The topic is part of the NERIS Strategic Research Agenda (Key Topic 5, sub-topic 5.3). Moreover, the work proposed will help in evaluating whether pre-defined protective strategies are sufficient to manage the early phase of an emergency and if yes, how to define and use them in an emergency. It is thus relevant to the implementation of the BSS, namely recommendations regarding emergency planning and recovery strategies. Finally, the work is grounded on strong stakeholder involvement and will entail establishing legal, social and ethical guidelines; it will thus require input from social sciences and humanities and contribution from stakeholder engagement processes in Europe.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The topic is highly relevant at European level, since it will lead to the identification of criteria for the “optimal” use of European DSS and the development of additional guidance material to support their usage. The topic is related to the priorities described in the SRA of European platforms: - NERIS: Key Topic 5, sub-topic 5.3 -ALLIANCE: Challenge 3
Impact: decreased uncertainty	By helping to develop appropriate tools to support the decision making process at the various levels, the topic will contribute to decreased uncertainty concerning the efficiency of the protection and thus to the health effects for people in emergency and recovery situations.
Impact: increased radiation protection	By contributing to an improved decision making process on protective actions in case of a nuclear or radiological accident, it will contribute to better protection of workers, people living in affected area and the general public in emergency and recovery situations.
Impact: increased quality and reliability	A better structured and more efficient decision-making process will bring increased transparency and grounds for justification of protective actions in case of an emergency and recovery situations. It will thus also contribute to increased social participation in the DMP and thus improve efficiency of protection and favour reassurance.
Feasibility	The scientific/technological competences needed for this topic are available in Europe. It is estimated that the necessary research could be carried out within 3 years
Other justifications	The topic has a high societal relevance since it aims at a better protection of the population in case of a nuclear or radiological situation.

Priority 3	**Countermeasure strategy preparedness**
Priority description	Several European projects in past Framework Programmes have addressed the multiple dimensions (radiological effectiveness, technical feasibility, stakeholder involvement, economic impact, legal issues, etc.) of management options for agricultural and urban areas in the aftermath of a nuclear accident (FARMING, SAGE, EURANOS, NERIS TP, PREPARE. The accident in Fukushima highlighted however, the need for further work in the area of emergency and recovery preparedness and response as regards the development of countermeasure and recovery strategies, by: ▪ Drawing the lessons on the applicability, efficiency and sustainability of countermeasures strategies from the emergency and recovery responses following the Fukushima accident ▪ Improving the adequacy of existing decision making processes and tools at national/regional/local levels to favour the preparedness of efficient countermeasure strategies ▪ Achieving sustainable engagement of local stakeholders in emergency and recovery preparedness and response The work proposed under this topic entails: • The development of sustainable preparedness strategy at Local, National and European levels, based on the analysis of countermeasures for relevant accident scenarios and recovery strategies. • Ensuring that parameters governing the radiological consequences can be identified in time to enable optimized remediation. • Ensuring that countermeasures preserve territorial resilience
European relevance	The topic is part of the NERIS Strategic Research Agenda (Key Topic 5, sub-topic 5.7). Inputs from social sciences and humanities are required concerning the social and ethical dimensions of countermeasure strategies.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The accidents in Chernobyl and Fukushima demonstrated that consequences of nuclear accidents exceed by far national boundaries and could last over several decades. The topic proposed will contribute to improved preparedness and response to nuclear and radiological emergency and recovery situations. It is highly relevant at European level, since it entails the development of sustainable preparedness strategies at both local and European level. It is also essential to draw the lessons from the long term management of the consequences of the Fukushima accident. The topic is related to the priorities described in the SRA of European platforms: NERIS: Key Topic 5, sub-topic 5.7 & ALLIANCE: Challenge 1
Impact: decreased uncertainty	Optimized remediation contributes to decreasing uncertainty concerning the effects on people and the environment in emergency and recovery situations and to improve the stakeholder engagement in the strategies.
Impact: increased radiation protection	By developing sustainable countermeasure and recovery strategies and that ensuring that parameters governing the radiological consequences are identified in time to enable optimized remediation, the topic contributes to increased protection of the population in emergency and recovery situations.
Impact: increased quality and reliability	Stakeholder involvement at different levels of preparedness and response will reinforce the efficiency of decisions taken in case of an emergency and recovery situations and will lead to increased acceptability of countermeasures strategies. It will also increase the capability of resilience in case of an accident.
Feasibility	The scientific / technological competences needed for this topic are available in Europe. It is estimated that the necessary research could be carried out within 3 years.
Other justifications	The topic has a high societal relevance since it aims at a better protection of the population in case of a nuclear or radiological situation. It will also allow drawing on the lessons from the management of the consequences of the Fukushima accident.

Priority 4	**Atmospheric dispersion modelling**
Priority description	Atmospheric dispersion models are the key tools to study the impact of atmospheric releases of radioactive material to humans and the environment. Although a long history exists in the development of atmospheric dispersion models and recent improvements such as worldwide applicability of the JRODOS system (FP7 project NERIS-TP), the use of higher spatial and temporal resolution meteorological data (FP7 project PREPARE) and source term estimation based on monitoring has been achieved, several improvements are still required. Important steps can still be made to improve reliable forecasts of atmospheric dispersion, including data assimilation and inverse modelling to determine source term and/or source location. Especially in specific environments e.g. urban areas and specific ranges (e.g. the near-range) room for improvement is possible. Specifically highly interesting research questions are: • Model improvements responding to the needs of decision makers in specific areas: e.g., near-range, urban areas, confined spaces • Inverse modelling and data assimilation techniques related to dispersion modelling from near-range to global scales • Multi-scale modelling: how to integrate model calculations from local to global scale to allow coordinated use of ADM • Better understanding of the complex interplay between time-varying release characteristics and meteorological conditions (E.g. use of ensembles, impact of precipitation, …) • Statistical analysis and graphical representation of multiple model simulations (using different source terms and meteorological analyses), including use of below-threshold data (null measurements) • Model validation, robust uncertainty handling and visualization in ADM
European relevance	The topic is part of the NERIS Strategic Research Agenda (Key Topic 1). Improved and validated modelling tools will help harmonization of emergency countermeasures across Europe.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	Atmospheric dispersion modelling is of particular interest, apart from assessing the impact of emergency exposures, in the impact analysis of routine emissions in planned exposures (planned exposure situations …).
Impact: decreased uncertainty	Improved and validated models will reduce the uncertainty in the output generated by the models and in all further assessments of the radiological evaluation and improve advice to the decision makers.
Impact: increased radiation protection	Improved and validated models for different ranges and environments will contribute to better protection strategies and increase in this way radiation protection.
Impact: increased quality and reliability	More confidence in model calculations will result in more confidence in protection strategies and increase the acceptability of advised countermeasures.
Feasibility	Atmospheric dispersion modelling is a key research theme within the emergency and NERIS community for many years. Improvements are linked to the access to better meteorological data, increasing computer power and the continuous development of dispersion and transport methodologies (e.g. Computational Fluid Dynamics) It is estimated that the necessary research can be carried out within 3 years
Other justifications	The continuous improvements in meteorological forecasts and calculation methods allow the improvement of dispersion models for specific ranges and environments. Also very specific situations require new , more advanced modelling techniques.

Priority 5	**Local radio-ecological models**
Priority description	Past and on-going European projects (FUTURAE, EURANOS, NERIS TP, COMET, PREPARE) have contributed to the development and integration in Decision Support Systems (DSS) of models for the estimation of the radiological spatial-temporal situation in different environments (terrestrial and aquatic) and the impact on the population. Such models have been applied for remediation purposes in both emergency and recovery situations. Furthermore, generic regionalisation has been done for different European climatic regions of the radiological parameters and other socio-economic factors. However, there is a need to: ▪ Develop / adapt the radioecological models used in DSS for the preparedness and management of the emergency and recovery to the complex local specificity. ▪ Apply the radioecological models to establish feasible and efficient site-specific remediation and monitoring strategies. ▪ Improve the operability and the understanding of the dose assessment and countermeasures models by potential users, including non-expert stakeholders The work proposed under this topic entails: • Development and integration in general DSS of local radio-ecological models interlinked with monitoring information and more global and food chain dose models. • Estimation of the efficiency and spatial-temporal evolution of the protective /remediation actions in relation to site-specific characteristics • Investigation of the capability of locally customised models to be operated by local stakeholders such as farmers or local communities especially for the recovery situation. • Identification/classification of vulnerable areas in European environments with the implication on stakeholders
European relevance	The topic is highly relevant at European level since it involves further developments of European DSS, such that they can be used at local level in order to allow enhanced preparedness and optimised response. The topic is part of the NERIS Strategic Research Agenda (Key Topic 5, sub-topic 5.6). Inputs from social sciences and humanities are required concerning stakeholder involvement at the local level.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	The topic proposed will contribute to improved preparedness and response to nuclear and radiological emergency and recovery situations. The topic is related to the priorities described in the SRA of European platforms: NERIS: Key Topic 5, sub-topic 5.6 & ALLIANCE: Challenge 1 and Challenge 3.
Impact: decreased uncertainty	Adaptation of generic models to the specificity of the local areas affected by a nuclear or radiological accident will lead to an improvement in the estimation of radiological transfer and impact on the population. This in turns leads to decreased uncertainty in the estimation concerning the effects on people and the environment in emergency and recovery situations.
Impact: increased radiation protection	The topic will contribute to optimised decision-support and thus to increased protection of the population in emergency and recovery situations.
Impact: increased Quality and reliability	Empowering local stakeholder and communities with tools adapted to the specificity of the local context will contribute to increased preparedness and higher efficiency and acceptability of countermeasures strategies.
Feasibility	The scientific / technological competences needed for this topic are available in Europe. It is estimated that the necessary research could be carried out within 3 years.
Other justifications	The topic has a high societal relevance since it aims at a better protection of the population and the environment in case of a nuclear or radiological situation.

Priority 6	**Monitoring Strategies**
Priority description	Decisions in the aftermath of or recovery from a nuclear or radiological accident are largely based on monitoring efforts. Although most countries have installed monitoring capacity for nuclear and radiological accidents, important challenges still exist, such as: - The optimization of the monitoring strategy in function of the decision support; - The integration of different monitoring techniques in one strategy, including new technologies (drones, measurement by the public …). Research questions are: • How to optimize the measurement strategy taking into account radiological, societal and ethical factors in case of a nuclear accident, especially addressing accidents with cross border impact; • Evaluation of new technologies and how they can be integrated in nuclear emergency and long term monitoring: e.g., drones, smartphone apps, …; • How to integrate and support monitoring by the public; • How can monitoring be linked with nuclear emergency and recovery reference levels (e.g. related to contaminated goods); • How can monitoring (strategies) be linked with advanced modelling (source term calculations); • How to combine monitoring data, including non-radiological data (data fusion); • How does monitoring uncertainty impact decision support and how to visualize monitoring uncertainty; • How to use monitoring efficiently in optimization of recovery countermeasures; • What are the specific differences needed in monitoring in the different phases of an accident.
European relevance	The topic is part of the NERIS Strategic Research Agenda (Key Topic 5, subtopic 5.9). Currently all European countries have developed their own monitoring capacity. A sound scientific basis, taking into account local differences, for developing a robust monitoring methodology, considering technical as well as societal factors is missing.
Multidisciplinarity; Reference to the strategic research agendas (SRA)	Apart from NERIS, monitoring is strongly linked to research related to the European platform for dosimetry (EURADOS). However, it should be noted that this topic doesn't focus on the development or optimization of new measurement techniques, but addresses the integration of existing and new technologies in a robust monitoring strategy to support decision making. The set-up of monitoring strategies should also include stakeholder involvement.
Impact: decreased uncertainty	A robust monitoring strategy will allow a much faster assessment of the situation. It will also improve the efficiency of countermeasures.
Impact: increased radiation protection	This topic aims at optimizing monitoring strategies, which should result in acquiring a clear picture of the radiological situation in a limited timeframe. In this way better and faster protective actions can be taken.
Impact: increased quality and reliability	A clear, stable picture of the radiological situation will enhance trust in decisions related to protective actions and consequently increase acceptability of countermeasures. In addition capabilities will be developed for stakeholders.
Feasibility	The main challenge is to connect monitoring experts with radiological emergency and recovery experts (advisors to the decision makers) and integrate societal/ethical aspects. It is estimated that the necessary research could be carried out within 3 years.
Other justifications	The Fukushima accident demonstrated that the involvement of the public in measurements is essential. Research in this context should be the basis for any preparedness actions in this respect.

Annex 2. Finished and started EU projects in the past year (August 2015-July 2016) in research areas closely related to the NERIS SRA.

FP7-project Prepare (Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe)

The European research project PREPARE ended in January 2016 and brought together 46 partners from Europe and Japan. The objective was to close gaps identified after the Fukushima accident. With respect to the NERIS SRA work was conducted in the following areas of Key topics of the SRA, however, it cannot be stated that the work reported in the following bullet points is completed. It is more an indication that work has been performed and it has to be analysed to which extent further research is needed.

- Atmospheric modelling (key topic 1)
    - First prototype of inverse source term estimation modules (released quantities, isotopic composition, height) through data assimilation of near or far field measurements
    - Improvements in the speed of calculation allowing to use them for long lasting releases
    - Improved deposition modelling of particles with spectrum of different sizes and densities
- Aquatic modelling (key topic 2)
    - Improved models for coastal areas
    - Improved run-off modelling, however still very limited
- Data mining, information gathering and providing information to stakeholders and mass media (key topic 4)
    - Analytical Platform for data exchange
    - Knowledge data base – so far limited to the early phase, but work in HARMONE will deal with the later phase
    - Trustworthiness of information
- Stakeholder engagement and dialogue (key topic 6)
    - Contaminated goods
- Social media/networking technology (key topic 7)
    - Public behaviour
    - How the public obtains information
    - Factors important for trust

PREPARE has not addressed the key topics 3 and 5, even if results from topics 1 and 2 were integrated in the DSSs ARGOS and JRODOS, however, the individual objectives of these two topics were not addressed. For topic 7 the work provides an initial view and cannot be regarded as completed.

OPERRA-project CATHyMara (Child and Adult Thyroid Monitoring after Reactor Accident)

The Cathymara project aims at setting-up guidance for monitoring the internal contamination in the case of a large scale nuclear accident, with a focus on the measurement of I-131 content in the thyroid, especially for children and includes:

- Evaluation of existing response capabilities for thyroid monitoring in Europe in case of a large scale accident;
- Harmonization of measurement practices and establishment of a robust protocol in case of the need to monitor children;
- Setting-up the basis for a sustainable network of responders, including trained but non-specialized operators;
- Studying to what extent the total committed effective dose (internal dose) can be evaluated from I-131 measurements and the development of emergency oriented dose assessments methods;
- Developing the optimal monitoring strategy, including guidelines and recommendations.

In this respect, the CATHyMara project mainly touches upon the following topics and areas in the NERIS SRA:

- Improving the decision-making processes (key topic 5), more specifically Health surveillance (subtopic 5.8), Monitoring (subtopic 5.9) and Assessment and communication of uncertainties (subtopic 5.1)

but only with a well-defined and limited focus. In addition also elements of the following NERIS SRA topics are partly addressed:

- Stakeholder engagement and dialogue (key topic 6), more specifically Defining stakeholders and framing problems (subtopic 6.1)

OPERRA-project HARMONE (Harmonising Modelling Strategies of European Decision Support Systems for Nuclear Emergencies)

The HARMONE project started December 1, 2015 and aims to reduce scientific, methodological and operational gaps identified in the strategic research agendas of the four European Platforms in the area of radiation protection and issued as TOPIC 2 of the OPERRA-2014 Call: “Spatial and temporal environmental modelling and human dose assessment after a nuclear accident”. This includes the following work activities

- Development of a knowledge data base and guidance that allows, according to the first event description, to propose a first management strategy to reduce doses and highlights potential issues for the dose assessment.
- Refinement of simulation models for all exposure pathways to obtain a better assessment of the total dose. This would include also a methodology for the regionalisation of the model to have assessments on all relevant scales.
- Development of guidelines for dose monitoring to back-up the first two steps and facilitate the refinement of the simulations.

In this respect, the HARMONE project addresses the following areas and topics of the NERIS SRA

- Aquatic modelling (key topic 2)
  - Test of runoff models and identify gaps therein
- Improvement of existing Decision Support Systems (key topic 3)
  - Support the customisation of the foodchain and dose models to European conditions
  - Refinement of simulation models, e.g. introduce snow in the ADM, snow melting in ERMIN
- Data mining, information gathering and providing information to stakeholders and mass media (key topic 4)
  - Knowledge data base for the later phase scenarios
- Improving the decision making process (key topic 5)
  - Development of generic guidance on countermeasure strategies
  - Some ideas on monitoring strategies for model support

HARMONE is limited in resources and therefore will not result in new developments but more in the refinement of existing ones.

OPERRA-project SHAMISEN (Nuclear energy situations – Improvement of medical health surveillance)

The aim of the project is to build upon the experience and feedback from Chernobyl, Fukushima and other emergency situations to develop recommendations for health surveillance and medical follow-up of affected populations for:

1. Dose assessment in support of emergency response, clinical decision-making in the aftermath of a radiation accident, and long-term follow-up of exposed populations;
2. Improvement of living conditions of affected populations, responding to their needs, and engaging them in surveillance programmes without generating unnecessary anxiety; and
3. Improvement of population estimates of radiation-induced risk both for radiation protection and for communication with affected populations, if and where feasible.

Work is organised in five complementary subtasks (ST): ST1 focuses on learning from radiation accidents; ST2 looks at the needs of populations by way of case-studies; ST3 will develop recommendations for health surveillance aimed at improving living conditions of affected populations and knowledge on health effects; ST4 focuses on cross-cutting issues (stakeholder engagement, ethics, and economics of health surveillance); and ST5 is dedicated to efficient project management.

In this respect, the SHAMISEN project mainly touches the following topics and areas in the NERIS SRA:

- Improving the decision-making processes (key topic 5), essentially Health surveillance (subtopic 5.8), but also partly Monitoring (subtopic 5.9).

Due to the duration of the project, the guidance to be produced will partly cover the topic. In addition also elements of the following NERIS SRA topics are partly adressed:

- Stakeholder engagement and dialogue (key topic 6), including ethical considerations.

Second EURADOS SRA Statement – July 2, 2016

W. Rühm, E. Fantuzzi, R. Harrison, H. Schuhmacher, F. Vanhavere, J. Alves, J.F. Bottollier Depois, P. Fattibene, Ž. Knežević, M.A. Lopez, S. Mayer, S. Miljanić, P. Olko, H. Stadtmann, R. Tanner, A. Vargas, C. Woda

History of SRA development

In 2012, the EURADOS Council recognized the need to actively contribute to the identification of future research needs in radiation dosimetry in Europe and encouraged all eight EURADOS working groups (WGs) to collect the required information, depending on their field of expertise. In February 2013, the Council established a dedicated Task Group (TG) to collate this information and produce a draft first version of a EURADOS Strategic Research Agenda (SRA) for dosimetry. An advanced version of the SRA was distributed in January 2014 among the EURADOS Voting Members and Working Group Chairs, for discussion. This version was produced with major input from all EURADOS WGs and the Voting Members. It included what – according to the EURADOS community – should be done to improve dosimetry during the next decades and be funded in future calls issued by the European Commission. The SRA was published as EURADOS Report 2014/01, which can be downloaded from the EURADOS website (www.eurados.org). In early 2016, a condensed version of the EURADOS SRA appeared in the printed version of *Radiation Protection Dosimetry* (Radiat. Prot. Dosim. 168, 223-234, 2016).

Brief summary of SRA content

The published EURADOS SRA version includes five visions for dosimetry. For each vision, key challenges in dosimetry research were identified that were considered important for the next decades. These visions will also be used to steer the EURADOS research programs and the working group activities.

The first vision describes scientific developments required towards updated fundamental dose concepts and quantities. The second vision includes scientific developments needed towards improved radiation risk estimates deduced from epidemiological cohorts. The third vision deals with efficient dose assessment for radiological emergencies. The fourth vision identifies work towards integrated personalized dosimetry in medical applications. Finally, the fifth vision identifies efforts needed towards improved radiation protection of workers and the public.

Actions related to SRA development

Organisation of the EURADOS Winterschool on "Dosimetry for Epidemiological Cohorts"

At its meeting in July 2015 in Braunschweig, Germany, the EURADOS Council decided to organize a one-day Winterschool during the EURADOS Annual Meeting in Milano, Italy, in February 2016. The topic of the Winterschool, "Dosimetry for Epidemiological Cohorts" was chosen in relation to Vision 2 of the EURADOS SRA (see above), to highlight the current status and future needs in dosimetry to support risk estimates deduced from human cohorts exposed to ionizing radiation. First, the cohorts most important for radio-epidemiology were selected. Then internationally renowned experts were invited whose focus is on the dosimetry of the various cohorts. The programme of the Winterschool is shown in Annex A: the presentations given at the Workshop can be downloaded for free from the EURADOS website at "http://www.eurados.org/en/Events/Winter_schools".

Stakeholder involvement

It was acknowledged from the beginning that the EURADOS SRA was a moving target and that continuous efforts are needed to improve and update the SRA. At its meeting in July 2015 in Braunschweig, Germany, the EURADOS Council decided to organize a one-day workshop where relevant stakeholders should be invited and asked to provide their view on the current version of the EURADOS SRA. The date proposed for the workshop as June 30th, 2016. It was further decided that for this effort, emphasis should be placed on international organisations expected to be interested in an improved dosimetry of ionizing radiation. A list of potential stakeholders was then developed, the workshop program was drafted, and invitations were distributed. By end of the reporting period (beginning of June 2016), more than 20 organisations had accepted the invitation.

Annex B gives the list of identified stakeholders, Annex C shows the planned workshop agenda.

Annex A: Program of the 9th EURADOS Winter School, February 2016

09:00	Welcome on behalf of the Scientific Committee	
Session 1:		
09:05	D. Laurier, France	Basics in epidemiology
09:35	H. Cullings, Japan	Dosimetry for the atomic bomb survivors
10:05	M Degteva, Russia	Dosimetry for the Techa River population
10:35	Coffee Break	
Session 2:		
11:00	P. Renaud, France	Dosimetry for the Fukushima population
11:30	V Chumak, Ukraine	Dosimetry for Chernobyl workers
12:00	R. Haylock, UK	Dosimetry for Mayak and Sellafield workers
12:30	Thierry-Chef, France	Dosimetry for nuclear workers
13:00	Lunch break	
Session 3:		
14:00	A Giussani, Germany	Dosimetry for uranium miners
14:30	J Dabin, Belgium	Dosimetry for medical cohorts (CT diagnostics)
15:00	L Struelens, Belgium	Dosimetry for medical cohorts (eye lens)
15:30	W. Newhauser, US	Dosimetry for medical cohorts (radiotherapy)
16:00	End of the Winter School	

Annex B: International organisations invited to participate in the "First EURADOS Stakeholder Workshop"

ALARA	European ALARA Network
ALLIANCE	European Radioecology Alliance
COCIR	European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry
EANM	European Association of Nuclear Medicine
EC	European Commission
EFOMP	European Federation of Organisations for Medical Physics
EFRS	European Federation of Radiographer Societies
ENISS	European Nuclear Installations Safety Standards Initiative
ENS	European Nuclear Society
ESR	European Society of Radiology
ESTRO	European Society for Radiotherapy and Oncology
EURAMET	European Association of National Metrology Institutes
EUTERP	European Training and Education in Radiation Protection
HERCA	Heads of the European Radiological Protection Competent Authorities
IAEA	International Atomic Energy Agency
IARC / WHO	International Agency for Research on Cancer
ICRP / C2	International Commission on Radiological Protection / Committee 2 on Dosimetry
ICRP / C3	International Commission on Radiological Protection / Committee 3 on Radiation Protection in Medicine
ICRU	International Commission on Radiation Units & Measurements
IEC TC45	International Electrotechnical Commission
ILO	International Labor Organization
IRPA	International Radiation Protection Association
ISO	International Organization for Standardization
ISSDO	International Solid State Dosimetry Organization
MELODI	Multidisciplinary European Low Dose Initiative
NEA	Nuclear Energy Agency
NERIS	European platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery

NRC	US Nuclear Regulatory Commission
NUGENIA	Nuclear Generation II and II Association
PTCOG	Article Therapy Co-Operative Group
RENEB	Realizing the European Network of Biodosimetry
SSH	Social Sciences and Humanities
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation

Annex C: Draft Agenda of the "First EURADOS Stakeholder Workshop"

1st EURADOS Stakeholder Meeting for European Research in Dosimetry

30 June 2016, 09:00 to 17:30
HMGU, Munich, Germany

AGENDA (preliminary)

Welcome and organizational issues (W Rühm, HMGU) (9:00 – 9:15)

The HMGU Department of Radiation Sciences (N.N., HMGU) (9:15 – 9:30)

EURADOS – Strategic Research Agenda (N.N.) (9:30 – 10:00)

CONCERT – European Joint Programming in Radiation Protection Research
(N Impens, SCK-CEN) (10:00 – 10:30)

Coffee Break (10:30 – 11:00)

Participants – Research Needs in Dosimetry (~ 12' each) (11:00 – 12:30)

Lunch (12:30 – 13:30)

Participants – Research Needs in Dosimetry (cont'd) (~ 12' each) (13:30 – 15:00)

Coffee Break (15:00 – 15:30)

Participants – Research Needs in Dosimetry (cont'd) (~ 12' each) (15:30 – 17:00)

Final remarks, action list (W. Rühm, HMGU) (17:00 – 17:30)

Closure (17:30)