Strategic Research Agenda of the NERIS Platform

Implementing Arrangements for Nuclear and Radiological Emergencies in Europe

Draft 30 March 2012

Contents

1. FOREWORD

Implementing of the European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (NERIS Platform) was launched in June 15, 2010. Vision of the Platform was published in 2011 (http://www.eu-neris.net/).

The main objectives of the NERIS Platform are to improve the effectiveness of current European, national and local approaches for preparedness concerning nuclear or radiological emergency response and recovery, promote more coherent approaches in Europe through the establishment of networking activities, maintain and improve know-how and technical expertise among all interested stakeholders in Europe by developing a supranational training programme, and to identify needs for further developments and address new and emerging challenges.

The Platform intends to enhance confidence in the solutions, reduce overlapping work, produce savings in total costs of research and implementation, and make better use of existing competences and research infrastructures in Europe. The NERIS work is driven by 10 organisations (=members of the Management Board) with the common vision that "*by 2015, the self-sustaining association for development of the joint European approach in responding to and recovering from nuclear and radiological emergencies exists, and by 2020, all European countries being members of the association are sharing common views and common approaches and are using compatible technology and methods for consequence management of the emergencies*".

The NERIS Platform has, in March 2012, 42 participating organisations representing stakeholders with a wide range of backgrounds, e.g. authorities, emergency centres, research organisations and the academic community. This Strategic Research Agenda (SRA) provides the basis for priorities regarding R&D (research & development), in particular the Key Topics to be dealt with in order to achieve the Vision. This document therefore communicates the future research needs, but will also be an instrument for creating synergies, co-operation and coordination internally between the NERIS participants and externally with activities taking place within other international forums.

The next steps are to write a statute for the NERIS Platform and register the association as a legal entity in Europe, and to produce a Deployment Plan (DP) detailing how the participants can work together and start actual joint work on some of the Key Topics. This SRA has been produced by the Management Board of the Platform after the R&D Workshop in September 2011 in Brussels. Consultations on a draft version of the SRA have been performed with the NERIS members before and after the the R&D Workshop and the SRA was accepted at the third General Assembly in May 2012.

2. INTRODUCTION

There are hundreds of nuclear reactors and other nuclear facilities in Europe. Being aware that every man-made facility or equipment is always at risk for malfunction or an accident, it is more than likely that bigger or smaller nuclear incidents and accidents will happen also in the future. Risk for nuclear accidents is today very small, but when the risk comes true it will have multidimensional consequences in the society. In addition to nuclear facilities, there are in Europe thousands of smaller installations using radioactive sources and materials. Of course incidents and accidents in connection with them would have more limited radiological consequences compared with big nuclear facilities. However, sources could possibly be stolen or bought by persons with malicious intent, and applied in devices purposely designed to harm people and create anxiety and disruption.

In the past 25 years, major progress has been made at the European, national and regional levels in the management of response to and recovery from nuclear and radiological emergencies. Notwithstanding the broadly adequate provisions now in place in most European countries and internationally, complacency would be misplaced and continuing vigilance remains important. Improvements, of a technical, organisational or political nature, are still needed in emergency management. The multi-national project EURANOS, funded by the European Commission and 23 European countries in 2004 – 2009 (http://www.euranos.fzk.de/index.php), resulted in significant progress in development of pan-European arrangements in emergency management. EURANOS integrated 17 national emergency management organisations and 33 research institutes to bring together best practice, knowledge and technology to enhance the preparedness for Europe's response to and recovery from any radiation emergency and long term contamination, although with focus on accidents at NPP's.

Nuclear and radiological safety and security have common goals and the systems and measures used to achieve these goals need to be complementary. In spite of the fact that remarkable improvements have been achieved in management of nuclear and radiological emergencies, a well-coordinated approach in management of nuclear and radiological accidents and unauthorized acts is essential to assure an equal protection of European citizens in an emergency situation regardless of their place of residence. Involvement of different stakeholders to contribute to the efficiency of the protection and to maintain the public confidence in decision makers and authorities is necessary.

Competent authorities responsible for civil defence and public security in different European countries should have access to consistent technical and cognitive methods and tools, and information should pass without any technical or administrative constraints from country to country. To achieve this, a close co-operation between competent authorities and R&D society is necessary. The development has led to the situation where national arrangements, both technical and organisational ones, are still quite incompatible. The used national systems and methods to monitor radiation, to communicate monitoring results and implemented protective measures to other countries, and the bases for protective measures are not coherent enough in Europe. Joint European arrangements are needed both in safety and security related emergency issues.

The continuing improvements being made in the safety of nuclear installations (with consequential reductions in the risk of an accident) are leading some to claim that less effort may need to be allocated to emergency preparedness in the future. While such arguments are not without substance, a proper balance must be maintained; emergency preparedness remains an essential part of an in-depth approach to nuclear safety and security (i.e., prevention, mitigation, response, and recovery) and is important for improving the efficiency of the protection strategy and building of public confidence. It is also important to acknowledge that the constantly changing society will set new demands also to nuclear and radiological emergency preparedness, and that new ideas and assessments that can substantially improve our knowledge base for tackling the problems constantly emerge and need integration in the European emergency management systems. The accident at the Fukushima 1 nuclear power plant in Japan in March 2011 proved that an event regarded as almost impossible was possible and a very small risk became reality. Fukushima accident also demonstrated that consequence assessments and actions were needed also in Europe although the accident itself happened far away from Europe. In connection of remote accidents European authorities and decision makers have to react to protect their own citizens staying close to the accident site. The more coherent the decisions are in different European countries the more confidence they arouse among the public. Moreover, responding effectively to a radiological emergency situation will always be difficult and subject to much criticism with the benefit of hindsight. This has inevitably given a strong social and political dimension to any nuclear or radiological emergency situation (i.e. public concern, political reaction, etc.). Indeed, the greatest challenge facing emergency and post accident management is how to operate effectively within this broader social and political context. On the technical side, the Fukushima accident for instance also demonstrated through the range of contaminants that were released - and those that were not, compared with, e.g., the Chernobyl accident - that improved consideration of release process-dependent source terms is essential to bring European decision making in line with the state-of-the-art knowledge level.

Organisations that participated in the EURANOS project decided, at the end of the project, to create a unique European Platform on nuclear and radiological emergency response and recovery combining researchers, operational communities and relevant stakeholders. The NERIS Platform (The European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery) was established in June 2010 in Helsinki. The Platform was established to be a forum where joint European arrangements for nuclear and radiological emergencies can be developed and improved in the future. The Platform will address all notable trends, arrangements and capabilities in the area of response to and recovery from nuclear and radiological emergencies.

3. FRAMEWORK OF THE STRATEGIC RESEARCH AGENDA (SRA)

Europe is a heterogeneous array of independent and sovereign countries having different cultural and political background and polity. The countries also have different threats as far as nuclear or radiological emergencies are concerned depending on their geographical location and distance from major nuclear installations. Therefore attempts to implement Europe-wide arrangements, in operational way, in the use of compatible systems and tools in radiation monitoring, decision making, and in communication between different actors is very complex. Interactions with scientific, technologic and social areas and involvement of competent authorities at national and

European levels are necessary. Thus, a full set of competencies is needed to address the challenges of conducting necessary actions in a nuclear or radiological emergency at local, national, regional and European levels. The expertise required and issues addressed extend beyond the realm of pure science and technology. Key issues in emergency management are timing of different protective actions, communication between various actors, mass media and the public and transparency of the decisions taken at different levels. Analysing the development and operation of the different European Technology Platforms (Commission of the European Communities; Communication from the Commission - investing in research: an action plan for Europe; COM(2003) 226, 4.6.2003, Brussels) it becomes clear that there is no standardized procedure for drafting a SRA. However, SRAs by definition must comprise the full range of research topics, and their importance and timing, which play a role in the realization of the specific vision. Therefore, each technology platform has to decide which approach is appropriate for getting a vision-oriented but unbiased SRA, which covers the most essential needs for developing and implementing the required emergency management procedures at different levels. Throughout the development of the SRA of NERIS, consultation has been held with various stakeholders who have provided input in order to make clear what is considered necessary for effective emergency management and also what has already been done.

3.1. Process of development of the Strategic Research Agenda (SRA)

Vision of the NERIS Platform is that by 2015, the self-sustaining association for development of the joint European approach in responding to and recovering from nuclear and radiological emergencies exists, and by 2020, all European organizations being members of the association are sharing common views and common approaches and are developing and using compatible technology and methods for consequence management of the emergencies. This vision includes an idea that the NERIS Platform will be a legal entity under legislation of some member country of the Platform. The goal is that this legal association is, by 2015, self-sustaining in financial terms meaning that there will be some participation fee for the member organisations. The member organizations identify the future research and development needs in this area and the Platform itself is also able to send project proposals to the financing societies, e.g. to the European Commission in its future Framework Programmes. The longer term vision means that the SRA shall include topics producing such outputs, which can be taken into operational use as broadly as possible in Europe. The longer term vision also includes an idea that the future R&D projects will produce compatible methods and tools so that data and information exchange between the European organizations and countries in emergency management would not encounter unnecessary barriers and constraints.

For the development of this SRA, consideration has been given to the results and achievements made so far. A good basis for this is the output of the broad EURANOS project (http://www.euranos.fzk.de/index.php), in which several of the NERIS partners participated in 2004 – 2009. The SRA shall also tackle the development of international recommendations in radiation protection and how they could be implemented in the best possible way in national emergency management procedures and how the existing Decision Support Systems could be adapted to the new approach for management of emergency response and recovery.

Formal development of the NERIS SRA was started in September 2011 by organising a brainstorm workshop in Brussels. Already before the workshop, some members of the Platform prepared a list of topics having relevance in the future R&D. The first draft of the SRA was prepared after this workshop and circulated for consultations with the NERIS members and other stakeholders. Another workshop was arranged in Bratislava in February 2012 focusing on implementation of the new ICRP recommendations in practical emergency response and recovery. After these two workshops, the second draft of the SRA was written. The second draft was an input for discussion at the Third General Assembly of NERIS in May 2012 in Glasgow. Process of the SRA development is schematically described in Figure 1.

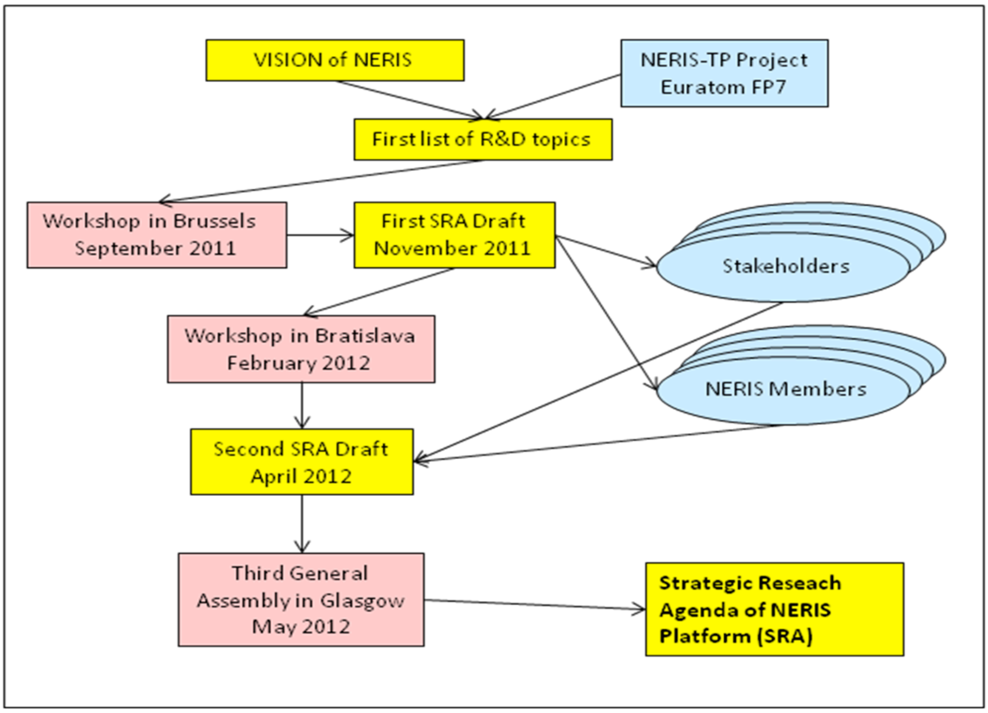

Figure 1. Development of the Strategic Research Agenda (SRA) for the NERIS Platform.

3.2. Identifying, characterizing and prioritizing of topics of SRA

Before the brainstorm Workshop in September 2011 in Brussels, a list of research topics was produced without any advance discussion and prioritizing to stimulate the workshop participants for inspirational discussion and debate about their experiences in existing practices of emergency management situation in Europe. The list contained 24 identified topics and they formed the basis for the discussions. Unauthorized acts with nuclear and radioactive materials have created a new concern and they have brought a security related aspects also into the emergency management discussion, in addition to the traditional safety related issues. Also experiences from the accident at Fukushima 1 power plant in Japan in March 2011 influenced the list of topics. 35 Participants from 25 organizations in 13 countries and the European Commission attended the Workshop. The discussions were arranged in three break-out sessions focusing on the following areas:

1. New challenges in atmospheric & aquatic modelling – Needs for improvement.

2. New challenges for better dose assessments and decision support based on improved knowledge: source term, scenarios, etc.
3. New challenges in stakeholder involvement and local preparedness and communication strategies.

The Area 1 deals with dispersion of radioactive materials (in solid or gas form) in the atmosphere or in water systems. Most of the challenges in atmospheric dispersion are related, on one hand, to dispersion in urban and confined environments, and on the other hand on very short- or very long-duration releases (explosions and Fukushima type releases). Malicious explosion with radioactive materials in an urban environment is an extremely difficult and current topic. The existing dispersion models are developed mainly for traditional accident scenarios of nuclear power plants. New programming techniques and more efficient algorithms enable today modelling of different urban environments and very short-duration releases. Development of rapid data assimilation techniques and inverse modelling are associated with all kind of dispersion modelling and need to be included in the future R&D. The same applies very much to source term estimation because today the greatest uncertainties are associated with source terms. The Fukushima accident proved the importance of dispersion of radionuclides in coastal environment. The current models are not sufficient powerful to predict dispersion in aquatic systems and there is a real need to develop site-specific models to major nuclear facilities in Europe. Contamination of drinking water with radionuclides in intentional or accidental releases is also an area where we have today big caps in our knowledge.

The Area 2 deals with development of existing Decision Support Systems (DSS). These systems are in central role when consequences of intentional or accidental releases of radioactivity into the environment are estimated. The systems include several environmental models like dispersion and dose assessment models, so they are closely related to topics in the Area 1 and in more general radioecology studies. Source term estimations are of primary importance. Particularly, an identification of release-process specific parameters for physicochemical characterization of the source term from different types of nuclear releases is decisive for the radiological consequences of dispersed contaminants (deposition, solubility, migration, forced removal of contaminants). This needs to be integrated throughout the European decision support systems. Coupling of DSS with Command and Control (C2) systems is something we are lacking today. So far decisions are taken on a strategic level requesting e.g. sheltering or evacuation without any glue if these actions can be carried out. Developing computational models to simulate the recommendations on the operational/tactical level can close this gap and link the crisis centre better to the commander in chief locally. The use of knowledge data bases developed in the previous European Framework Programmes, e.g. handbooks for inhabited areas, foodstuffs, drinking water, and TMT (http://www.euranos.fzk.de/index.php , http://www.tmthandbook.org/), needs more efficient training to provide better support for decision making. The handbooks themselves also need revision for consideration of malicious dispersion scenarios. The Fukushima accident proved that Decision Support Systems have to be applicable world wide, even if there is no effect in your own country, since every country need to protect their own citizens in the accident country. Also politicians, media and the public need reliable information. The Fukushima accident also demonstrated the need for a European platform where data and information of governmental and non-governmental organizations in one country would be available to other European countries.

This kind of access/exchange platform is necessary in a rapidly developing emergency situation in order to achieve more coherent decisions in different European countries.

The Area 3 deals with stakeholder involvement, local preparedness and communication strategies in an emergency situation. In this area, communication and information issues are of great importance due to requirements for huge amount of information and measurements, use of modern social media through Internet, and possible contradictory information being available. The nuclear accident at Fukushima demonstrated that new European stakeholders were engaged in decision making to protect European citizens in Japan. Foreign governments advised different protective actions to their citizens, which created confusion within the public. Iodine tablets were sold out in Europe without any reasonable reason, some countries introduced restrictions on food import, many embassies relocated from Tokyo, etc. All these confusing actions derived at least partially from misinformation delivered by the Western media. Although the earthquake and the tsunami killed tens of thousands in the North-East Japan, the Western media has mainly focused on the nuclear accident and its radiological consequences. So far, radiation from the Fukushima accident has caused no death in Japan.

4. KEY TOPICS OF THE STRATEGIC RESEARCH AGENDA (SRA)

Research and development in the field of emergency management at the European level calls for co-operation between authorities, emergency centres, research organisations and the academic community in different countries. The goal of R&D co-operation is to enhance European countries' capability to response to and recover from nuclear or radiological emergencies in a coherent way. In this SRA, a logical framework (log frame) approach (NORAD 1999) is used as a tool for planning and analysing the Key Topics. In doing so, the goal is to identify the reasons why certain kind of R&D is necessary in Europe, what resources the co-operation calls for, and what obstacles there might be to intervene or hamper the desired activities. The SRA does not contain specific projects but broader areas where further research and development are needed. Logical Framework Matrix (LFM) is used to describe various R&D areas. Subtopics of the broader R&D areas are given as activities needed in implementation of the topics. Normally the LFMs contain also indicators which are the factors against which the progress and the achievement of goal, purpose, results and activities are assessed, and also sources where the indicators will be available. Here they are used when appropriate. The indicators can be both quantitative and qualitative.

Seven Key Topics were identified in the brainstorm workshop in Brussels in September 2011. The Key Topics are grouped in the three research areas as follows:

New challenges in atmospheric & aquatic modelling – Needs for improvement

1. Key Topic 1: Atmospheric dispersion modelling
2. Key Topic 2: Aquatic dispersion modelling

New challenges for better dose assessments and decision support based on improved knowledge: source term, scenarios, etc.

3. Key Topic 3: Improvement of existing Decision Support Systems
4. Key Topic 4: Data mining, information gathering and exchange including providing information to stakeholders and mass media

5. Key Topic 5: Usage of the existing tools in the best possible way

New challenges in stakeholder involvement and local preparedness and communication strategies.

6. Key Topic 6. Stakeholder engagement and dialogue
7. Key Topic 7: Social media/networking technology

These topics are described as the Logical Framework Matrixes in the following pages.

4.1. New challenges in atmospheric & aquatic modelling – Needs for improvement

4.1.1. Key Topic 1: Atmospheric dispersion modelling

Atmospheric modelling	Indicators:	Source of verification:	External risks and assumptions:
Overall objective: To provide decision makers and other actors in emergency management with more reliable picture of the emergency situation and dose assessments.	Decision makers' readiness to protect the public against harmful effects of radiation.	1. Feedback from the decision makers and the public. 2. Emergency response exercises	Reluctance or scepticism of decision makers to use / adopt new approaches
Purpose: To make more reliable and precise forecasts on atmospheric dispersion of radioactive materials in different environments.	Decision Support Systems (DSSs) with extended capabilities: 1. Applicability for radiological emergencies 2. Incorporation of experience and lessons learned from recent events	1. Performance of emergency response exercises using the new capabilities of Decision Support Systems (DSSs) 2. Feedback and conclusions from the exercises 3. Degree of installation and adoption of new features of DSSs	Emergency centres are not using the new extended capabilities of DSSs because: 1. Users find the new tools difficult to use 2. Users do not trust the new tools performance 3. Insufficient training of users to the new tools
Expected results: 1. Methodologies for simulation / prognosis of dispersion and radiation doses in complex environments in the frames of operational DSSs. 2. Dispersion models capable to treat non-conventional emissions (explosions, two-phase, aerosol sprays, fires) and particular dispersing substances (aerosol, phase-changing, particles) in the frames of operational DSSs. 3. Extended modelling capabilities in operational DSSs to handle cases proven important from	Improved dispersion models, modeling methodologies and data assimilation tools that are: 1. Suitable for integration and operational use in the frame of DSSs, according to certain specifications 2. Evaluated against specific quality criteria through, e.g., benchmark exercises and comparisons to experimental data sets	1. Degree of integration of new modelling tools in existing DSSs 2. Performance evaluation of new models through benchmark exercises and comparisons to experimental data sets, by the models developers 3. Performance evaluation of new models by independent users	1. There is not enough competence in Europe to develop new models and tools. 2. There are insufficient resources (financial and/or human) in Europe to develop new models and tools 3. Insufficient availability of experimental data sets to evaluate new models performance

recent experience (very long-term releases, deposition due to snow etc.) . 4. Data assimilation tools in operational DSSs to estimate location of emission and strength of emission rate.			
Activities: 1. Development of modelling approaches that allow existing DSSs to handle – intentional or accidental – atmospheric releases of radiological or nuclear material in complex settings (urban or confined spaces); combination of complex (CFD – Computational Fluid Dynamics) with simpler modelling and other appropriate methodologies. 2. Development and / or integration of computational tools in existing DSSs for assimilation of atmospheric measurements (e.g., gamma radiation dose rates, concentration) and/or inverse modelling to estimate unknown source term (location, emission rate) in urban areas and in open spaces. 3. Extension of capability of dispersion models in existing DSSs to treat detailed information for particular types of sources (e.g., explosions, two-phase, aerosol sprays, fires, general short-term releases), and to simulate dispersion of particular substances (aerosol, phase-changing, particles with	Improved dispersion models, modeling methodologies and data assimilation tools – software and related documentation – that are: 1. Suitable for integration and operational use in the frame of DSSs, according to certain specifications 2. Evaluated against specific quality criteria through, e.g., benchmark exercises and comparisons to experimental data sets	1. Degree of integration of new modelling tools in existing DSSs 2. Performance evaluation of new models through benchmark exercises and comparisons to experimental data sets, by the models developers 3. Performance evaluation of new models by independent users 4. The performance evaluation should be quantitative and qualitative, using means established in the literature (e.g., statistical indices, graphs, etc.). The performance evaluation should also be well documented. 5. Publications in peer-reviewed scientific journals	1. There is not enough competence in Europe to develop new models and tools. 2. There are not enough money and other resources in Europe to start or complete the activities. 3. Insufficient availability of experimental data sets to evaluate new models performance

spectrum of different sizes, chemical transformations). 4. Extension of capability of dispersion models in DSSs to treat phenomena that currently are not considered, such as deposition due to snow 5. Assessment of models uncertainties. 6. Research on short-duration (e.g. explosions) releases: assessment of doses, estimation of source-term. 7. Extension of existing DSSs to simulate very long-duration releases (e.g. one month to one year) both to air and to sea by automatic update of meteorological data, restart of dispersion models and user update of source term information.			

4.1.1. Key Topic 2: Aquatic dispersion modelling

Aquatic modelling	**Indicators:**	**Source of verification:**	**External risks and assumptions:**
Overall objective: To provide decision makers and other actors in emergency management with more reliable picture of the emergency situation and dose assessments.	Decision makers' readiness to protect the public against harmful effects of radiation.	1. Feedback from the decision makers and the public. 2. Emergency response exercises	Reluctance or scepticism of decision makers to use / adopt new approaches
Purpose: To make more reliable and precise forecasts on aquatic dispersion of radioactive materials in different environments (urban hydrology systems and coastal waters).	Decision Support Systems that include improved dispersion models of radioactive materials in water systems (urban hydrology systems and coastal waters).	1. Performance of emergency response exercises using the new capabilities of DSSs 2. Feedback and conclusions from the exercises 3. Degree of installation and adoption of new features of DSSs	Emergency centres are not using the new extended capabilities of DSSs because: 1. Users find the new tools difficult to use 2. Users do not trust the new tools performance 3. Insufficient training of users to the new tools.
Expected results: 1. Capability of existing DSSs to assess the vulnerability of urban hydrology systems to nuclear emergencies regarding the freshwater supply system and waste water contamination from deposited radionuclides. 2. Implementation and operational use of coastal models into existing DSSs to estimate dispersion of radioactivity in coastal waters and radioactivity levels in fish and sea-food in the (possibly long) emergency phase of an accident with a nuclear installation.	Improved radioactivity dispersion models in urban hydrology systems and coastal waters that are: 1. Suitable for integration and operational use in the frame of DSSs, according to certain specifications 2. Evaluated against specific quality criteria through, e.g., benchmark exercises and comparisons to experimental data sets.	1. Degree of integration of new modelling tools in existing DSSs 2. Performance evaluation of new models through benchmark exercises and comparisons to experimental data sets, by the models developers 3. Performance evaluation of new models by independent users	1. There is not enough competence in Europe to develop new models and tools. 2. There are insufficient resources (financial and/or human) in Europe to develop new models and tools 3. The newly developed models fail to fulfil the evaluation criteria 4. Insufficient availability of experimental data sets to evaluate new models performance
Activities: 1. Development and	Improved dispersion models,	1. Degree of integration of new	1. There is not enough competence

implementation in existing DSSs of models to predict the activity concentrations in the urban fresh water supply system due to contamination of freshwater basins from radioactive cloud. 2. Development and implementation in existing DSSs of models to estimate the activity concentration in the waste water due to washout of deposited radionuclides in urban areas. 3. Development and implementation of relocatable hydrodynamic 3D models of coastal circulation for real time predictions of transport of radioactivity in the coastal zone. 4. Coupling with weather forecast models to provide forcing for wave models for running in the automatic mode of a DSS, and with sediment transport models. 5. Coupling with runoff (land to sea) models for the emergency phase calculations in the case when the power installation is located near the coast – combination with deposition maps of fall-out on the land near the coast. 6. For prolonged emergency phase of a nuclear installation accident and for long-term assessment, the existed	modeling methodologies and data assimilation tools – software and related documentation – that are: 1. Suitable for integration and operational use in the frame of DSSs, according to certain specifications 2. Evaluated against specific quality criteria through, e.g., benchmark exercises and comparisons to experimental data sets	modelling tools in existing DSSs 2. Performance evaluation of new models through benchmark exercises and comparisons to experimental data sets, by the models developers 3. Performance evaluation of new models by independent users 4. The performance evaluation should be quantitative and qualitative, using means established in the literature (e.g., statistical indices, graphs, etc.). The performance evaluation should also be well documented. 5. Publications in peer-reviewed scientific journals	in Europe to develop new dispersion models and tools. 2. There are not enough money and other resources in Europe to start or complete the activities. 3. The newly developed models fail to fulfil the evaluation criteria 4. Insufficient availability of experimental data sets to evaluate new models performance

compartment models should be transformed into finite-volume models fully driven by time and space averaged hydrodynamic, sediment transport and ecosystem models to predict dose from food ingestion, inhalation (sea spray and re-suspended particles), and beach sediments (beach occupancy, boating, swimming) in coastal areas			

4.2. New challenges for better dose assessments and decision support based on improved knowledge: source term, scenarios, etc.

4.2.1. Key Topic 3: Improvement of existing Decision Support Systems

Decision Support Systems	Indicators:	Source of verification:	External risks and assumptions:
Overall objective: To provide decision makers and radiological advisors in emergency management with improved Decision Support Systems (DSSs)	Decision makers' readiness to protect the public against harmful effects of radiation	Feedback from the decision makers and the public.	Reluctance or scepticism of decision makers to use / adopt new approaches
Purpose: To get a better analysis of the radiological situation and support the decision making in all phases of an emergency.	Improved DSSs	Usage of the improved DSSs	Emergency centres are not using the Decision Support Systems.
Expected results: 1. Better source term input to the dispersion models 2. Improved radioecological modelling 3. DSS better customised to local information 4. Better response to malevolent acts	Improved DSSs	Usage of the improved DSSs	1. There is not enough competence in Europe to develop new models and tools. 2. There are insufficient resources (financial and/or human) in Europe to develop new models and tools 3. The newly developed models fail to fulfil the evaluation criteria 4. Insufficient availability of experimental data sets to evaluate new models performance
Activities: 1. Source terms: Particularly, an identification of release-process specific parameters for physicochemical characterization of the source term from different types of nuclear accidents 2. Customising of the existing environmental models into the regional circumstances in Europe	1. Better information in source term estimation and coupling to the DSS 2. Consistent data set for Europe for the radioecological and dose models 3. Better adjustment of countermeasure strategies to local conditions 4. DSS improved for CBRN	1. Feedback from end user 2. Degree of integration of new modelling tools in existing DSSs 3. Performance evaluation of new models through benchmark exercises and comparisons to experimental data sets, by the models developers 4. Performance evaluation of new models by independent users	1. There is not enough competence in Europe to perform the requested activities, in particular the monitoring and radioecological activities. 2. There are not enough money and other resources in Europe to start the activities.

(close co-operation with the Radioecology Alliance) 3. A limited program for resuming measurements of Chernobyl contaminants on different surfaces (and if possible Fukushima-measurements) 4. Revision of FDMT parameters in ARGOS and RODOS 5. Local or regional scale prioritization, preparation and implementation of countermeasure strategies 6. Improvement of existing DSS with radiological capabilities (explosions in large buildings, underground stations, uncertain source term information, hidden sources etc.) 7. Multiple stressors: might also be a topic for consideration in emergency preparedness, as countermeasures implemented to solve a radiological problem might otherwise create an irreversible problem of a different nature. Also of relevance in relation to malicious dispersion (CBRNE) 8. Coupling of the existing strategic DSS such as ARGOS and RODOS to Command and Control (C2) systems	5. More realistic estimation if countermeasures can be carried out under the given resources	5. The performance evaluation should be quantitative and qualitative, using means established in the literature (e.g., statistical indices, graphs, etc.). 6. The performance evaluation should also be well documented. 7. Publications in peer-reviewed scientific journals	

4.2.2. Key Topic 4: Data mining, information gathering and exchange, providing information to stakeholders and mass media

Data mining	Indicators:	Source of verification:	External risks and assumptions:
Overall objective: To provide decision makers, stakeholders and mass media with consistent and timely information	More coherent decision making in Europe before, during and after an incident	Feedback from the decision makers, the public and media experts	1. There are no mandatory (binding) agreements or requirements for exchange of data and information in Europe 2. Decision makers and other stakeholders do not use the agreed procedures on data and information exchange
Purpose: Foster the information exchange between all interested stakeholder and provide means for a transparent decision making process	Improved decision making and data exchange in Europe before, during and after an incident	Usage of the improved data mining tools	1. New tools not accepted by radiological experts, stakeholders and media experts 2. Emergency centres do not share data
Expected results: 1. Information exchange platform for all relevant organisations in Europe 2. Lessons learned from historic events are available for decision making in new incidents	Improved decision making and information exchange in Europe	Usage of the improved data mining tools	There is not enough competence in Europe to develop new tools
Activities: 1. Establishment of a Europe-wide portal for operational data and information exchange in nuclear and radiological emergencies 2. Access/exchange platform collecting and distributing results from governmental and non governmental organisations 3. Information material of general nature on radiation emergencies and countermeasures: A simple, catchy, easy-to-read book to kill	1. Better usage of existing information in the decision making process 2. More transparent information management and decision making	Feedback from end user	1. There is not enough competence in Europe to perform the requested activities, in particular the data mining activities 2. Willingness to share data is missing 3. There are not enough money and other resources in Europe to start the activities

strange myths and counter the host of incompetent bestselling books currently producing them 4. Development of a knowledge data base with scenarios and response, including lessons learned from historic events and tools developed in international handbooks such as the European handbooks 5. Use of formal decision analysing in decision making in the recovery phase of an accident			

4.2.3. Key Topic 5: Usage of the existing tools in the best possible way

Usage of existing tools	Indicators:	Source of verification:	External risks and assumptions:
Overall objective: To assure sustainability of existing knowledge and tools for nuclear and radiological emergency management and long term rehabilitation	Decision Support Systems (DSSs) are stable and a research community cares about the needs of the end users	Tools and methods are widely used	No interest in that area of research due to constraints in resources or bad reputation of the topic in the society
Purpose: Harmonised and state of the art tools for use in Europe in preparedness, training and response	Use of the tools and methods all over Europe	Harmonised training and DSS	1. New tools not accepted by radiological experts, stakeholders and media experts 2. Emergency centres do not share data
Expected results: 1. The status f ARGOS and RODOS reflect the needs of the end users 2. Maintain products from the EURANOS project such as the European Handbooks 3. Tools, methods and data for the local level improved	1. State of the art DSS 2. Sustainability in all important products for decision making 3. Foster the competence at the local level	Feedback from end user	There is not enough interest or competence in Europe to maintain the high level of preparedness
Activities: 1. Maintenance of the European decision support systems RODOS and ARGOS 2. Revision of European handbook sections (creation of addendum): for consideration of malicious dispersion scenarios 3. Development of tools for the usage at the local level as continuation of the EURANOS CAT3 activity 4. Strategies should be defined in advance of a contaminating	Applicability of existing tools with improved performance and for new purposes as needed.	Feedback from end user	1. There are not enough money and other resources in Europe to sustain and further develop the existing tools and methods 2. There is not enough competence in Europe to perform the requested activities, in particular due to decreasing interest in that matter

accident, ensuring that parameters governing the radiological consequences can be identified in time to enable optimized remediation			

4.3. New challenges in stakeholder involvement and local preparedness and communication strategies

4.3.1. Key Topic 6: Stakeholder engagement and dialogue

Stakeholder Engagement	Indicators:	Source of verification:	External risks and assumptions:
Overall objective: To ensure appropriate stakeholder engagement and dialogue between different actors (stakeholders, public, authorities) in emergency response.	Recognition of the importance of stakeholder engagement at all levels: local, national, international	Stakeholder engagement and communication is a central theme in emergency response	No interest from decision makers of stakeholders Stakeholder fatigue
Purpose: Improve the acceptability and social robustness of emergency response. Ensure that stakeholders are involved in decisions that impact on their lives.	Stakeholder engagement in emergency preparedness In the event of an accident, improved communication on response measures	Participation of stakeholders in decision support	Unforeseen social and economic influences
Expected results: Maintain the inclusion of social aspects of emergency response and stakeholder engagement Greater recognition of the importance of stakeholder and public engagement. Improve understanding of the factors and criteria for successful stakeholder engagement	A general recognition and documentation of the multidimensional nature of the accident, medial and authority reactions and the complexity of the stakeholder networks and relationships.		
Activities: 1. Defining stakeholders and framing problems : stakeholder territories and actors 2. Stakeholder engagement			

database 3. Public participation and dialogue – understanding the needs and sustainable 4. Studies on the issue of trade and exchange of goods from contaminated territories in the perspective of a sustainable development 5. Tools for stakeholder engagement – new tools and interaction with existing tools (e.g. decision support systems)			

4.3.2. Key Topic 7: Social media/networking technology

Social media	**Indicators:**	**Source of verification:**	**External risks and assumptions:**
Overall objective: Improved information exchange and communication between actors	Improved preparedness for social media communication within emergency preparedness	Feedback from the end users and stakeholders	Complexity of the system and cultural and situation specific differences
Purpose: To better understand the ways in which social media is used in the flow of information and communication.			
Expected results: Better understanding of the mechanisms by which information is exchanged between actors.			
Activities: 1. Assessment of the use of social media in emergency response 2. Assessment of the mechanisms by which the public gains information 3. Assessment of factors important for public trust			

5. CROSS-CUTTING ISSUES

5.1. Safety and security related activities

Radiation and nuclear safety and radiation and nuclear security have a common goal — the protection of people, society and the environment. In both cases (safety and security), such protection is achieved by preventing a large release of radioactive material. Many of the principles to ensure protection are common, although their implementation may differ. Moreover, many elements or actions serve to enhance both safety and security simultaneously. For example, the containment structure at a nuclear power plant serves to prevent a significant release of radioactive material to the environment in the event of an accident, while simultaneously providing a robust structure that protects the reactor from a terrorist attack. Similarly, controls to limit access to vital areas not only serve a safety function by preventing or limiting exposures of workers and controlling access for maintenance to qualified personnel, but also serve a security purpose by inhibiting unauthorized access by intruders.

The IAEA defines safety and security in the following way (IAEA 2007).

—**(Nuclear) safety:** "The achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards."

—**(Nuclear) security:** "The prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities."

Stemming from their different historical roots, the areas of safety and security have long been treated within separate research communities with their own terminologies and methods. But since almost all systems today are connected to global networks, safety and security have become very much interdependent, meaning that safe systems also need to be secure and vice versa. Recent terrorist events have served as a catalyst for the development of an array of new nuclear security arrangements. Although concern about malicious acts involving nuclear installations is not new, recent terrorist events have demonstrated that an attack on a nuclear facility might be attempted and that terrorists have formidable capabilities and dedication. This has led to an increased focus on defences against terrorists at nuclear facilities, as well as at other critical infrastructures. The development of revised security arrangements arises at a time when the public expects high standards of nuclear safety and security to be met. The challenge in meeting these expectations is predicted to grow in light of the interest in the new construction of nuclear power plants. In the Seventh Framework Programme (FP7) of the European Commission, security related research is centred in the Security Programme and radiation and nuclear safety research in the Euratom Programme (http://cordis.europa.eu/fp7/home_en.html).

As noted above, the fundamental goal of safety and security actions is the same — the protection of people, society and the environment. The acceptable risk is presumptively the same whether the initiating cause is a safety or a security event. Moreover, the philosophy that is applied to achieve this fundamental objective is similar. Both safety and security typically follow the strategy of defence in depth — that is, the employment of layers of protection. The fundamental nature of the layers is similar. Priority is given to prevention. Second, abnormal situations need to be detected early and acted on promptly to avoid consequent damage. Mitigation is the third part of an effective strategy. Finally, extensive emergency planning should be in place in the event of the failure of prevention, protection and mitigation systems. The steps taken to provide protection against malicious acts incorporate specific features to ensure physical protection, but also rely on provisions that may have been installed for safety reasons.

NERIS Platform follows and recommends the R&D activities both in the safety and security areas and encourages scientists in these areas to collaborate with each other to achieve the best possible impact of research in nuclear and radiological emergency management.

5.2. Collaboration with other platforms

In 2003, the European Commission introduced the concept of Technology Platform (Commission of the European Communities, 2003) in order to enhance R&D activities in Europe. The aim is to increase coherence and co-ordination at the level of the various stakeholders involved in the development and deployment of key technologies and methods in Europe. NERIS Platform was created to promote this idea in the management of nuclear and radiological emergencies. NERIS Platform creates close co-operation relationships with other platforms in the areas of radiation protection and nuclear safety in Europe. It is of special importance to follow development in the areas of nuclear technology, radioecology and biological effects of exposure to ionizing radiation. Also co-operation with the European radiation and nuclear safety authorities is of vital importance in achieving the objectives of the NERIS Platform. Therefore NERIS will closely follow the work done in the following platforms and networks.

European Radioecology Alliance, https://wiki.ceh.ac.uk/display/star/) was created in 2011 to strengthen European R&D in the area of radioecology. Radioecological studies are of special importance to management of nuclear or radiological emergencies, because the Decision Support Systems (DSS) used in emergency management include several environmental models whose reliability depends on radioecological parameters incorporated in the models. The Radioecology Alliance focuses not only on radiological protection of humans, but also on protection on wildlife. This aspect has to be taken into account in nuclear and radiological emergencies.

SNETP (**S**ustainable **N**uclear **E**nergy **T**echnology **P**latform, http://www.snetp.eu/) was officially launched in 2007. SNETP addresses the three main objectives; 1) maintain the safety and competitiveness of today's electricity generation technologies, 2) develop a new generation of more sustainable reactor technologies – so-called Generation IV fast neutron reactors with closed fuel cycles, and 3) develop new applications of nuclear power such as the industrial scale production of hydrogen, desalination or other industrial process heat applications. SNETP aims to support fully through R&D programmes the role of nuclear energy in Europe's energy mix, its contributions to the security and competitiveness of energy supply, as well as to the reduction of greenhouse gas emissions. Nuclear energy production and new applications of nuclear power are the main potential sources of radioactivity releases into the environment, although the risk of major releases is getting smaller and smaller. In management of nuclear emergencies, the source term assessment is a key issue, and the best assessments to be adopted in the DSS's will be got from those working with nuclear technology. NERIS will exploit this knowledge in its own R&D work.

MELODI (Multidisciplinary European Low Dose Initiative, http://www.melodi-online.eu/) is an European Platform dedicated to low dose radiation risk research, founded in 2010 as a registered association with 15 members. MELODI aims at identifying R&D priorities for Europe in its field of competence and seeking the views of stakeholders on the priorities for research, keeping them informed on progress made, and contributing to the dissemination of knowledge. Since MELODI focuses on better understanding the health effects of exposure to low dose ionising radiation, its work is directly linked with the work of NERIS when protective measures in response to and recovery from nuclear and radiological emergencies are discussed. NERIS will closely follow the work of MELODI and will investigate how new findings of MELODI could be implemented in the European emergency management procedures.

HERCA (association of the Heads of European Radiological protection Competent Authorities, http://www.herca.org/) is a collaboration forum of the European radiation protection authorities, founded in 2007. HERCA has recognized the need for a more harmonised approach with regard to the management of nuclear and radiological emergency situations as a top priority. HERCA has also recognised that the events at the Fukushima Daiichi NPP in March 2011 dramatically illustrate that similar needs for a common understanding and, whenever possible, a common approach in the field of nuclear emergency response also exist for accidents happening even at great distance from Europe. National radiation protection authorities are the key players in nuclear and radiological emergencies and therefore the objectives of HERCA and NERIS are common. NERIS is the forum where new methods and tools are developed and the radiation protection authorities, among the others, take care of implementing them. Therefore it is of primary importance that these two forums work closely together.

6. WAY FORWARD

Vision of the NERIS Platform is that all European organizations being involved in nuclear emergency management are sharing common views and common approaches and are developing and using compatible technology and methods for consequence management of the emergencies. This vision presumes commitment of all key players in a joint European approach and existence of necessary technology and methods to be applied in response to and recovery from an emergency situation. Mission of the NERIS Platform is to encourage European, national, regional and local authorities, technical support organisations (TSOs) and other players to co-operate to achieve this vision. The aim is to get national players in different European countries to act in a coherent way in order to avoid confusion and to enhance confidence among the population. Role of the European Commission and other bodies having a mandate to establish binding arrangements in management of nuclear and radiological emergencies have a central role in achieving more coherent European approach.

The NERIS Platform itself shall have a clear vision of what development is needed to achieve a functioning European emergency response and recovery arrangements. The Strategic Research Agenda should include these needs. The SRA is a living document and the Platform shall update it at more or less regular intervals. The Deployment Plan (DP) of the SRA is the next document that includes the steps on how the Platform intends to implement its work and the SRA. The Key Topics in the future research and development are identified in this SRA and the Platform will go all out for getting these topics in the appropriate European research programmes in the coming years. Of course, engagement of the European Commission in the process is extremely important.

The NERIS Platform has a goal that the Platform is a self-sustaining association by 2015. This goal contains, *inter alia*, an idea that the Platform is also financially independent. In other words it has to obtain sufficient funding to cover its own running expenses. One possibility to gain funding is to collect a membership fee and/or to request financial support from different funding organisations. Anyway, financial accounting system is necessary and therefore NERIS plans to be registered under law of one of its member countries. In order to be a registered legal entity, NERIS needs its own statutes. The NERIS Board has decided to prepare the statute under French law since NERIS secretariat is established in Paris.

7. CONCLUSIONS

The Strategic Research Agenda (SRA) of the NERIS Platform was written based on the ideas identified in the brainstorm workshop in September 2011. As the result of this work, seven Key Topics were identified for research and development in the near future. The Key Topics were grouped in the three research areas as follows:

New challenges in atmospheric & aquatic modelling – Needs for improvement

1. Key Topic 1: Atmospheric dispersion modelling
2. Key Topic 2: Aquatic dispersion modelling

New challenges for better dose assessments and decision support based on improved knowledge: source term, scenarios, etc.

3. Key Topic 3: Improvement of existing Decision Support Systems
4. Key Topic 4: Data mining, information gathering and exchange including providing information to stakeholders and mass media
5. Key Topic 5: Usage of the existing tools in the best possible way

New challenges in stakeholder involvement and local preparedness and communication strategies.

6. Key Topic 6. Stakeholder engagement and dialogue
7. Key Topic 7: Social media/networking technology

In this SRA, the Key Topics are described according to the Logical Framework Approach (LFA). This approach contains overall impact, purpose, expected results, and activities of each Key Topics, together with indicators and sources of indicators aiming at being later able to measure how well the objectives of each topic are met. Because there are always uncertainties or risks that are outside the direct control of the process, but have to be fulfilled for successful implementation of the process, these risks are explained by assumptions at each level of the LFA process.

8. REFERENCES

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