The Strategic Research Agenda in Radioecology: the seed for integration

J. GARNIER-LAPLACE (on behalf of STAR)

STAR Final Dissemination Event, Aix-en-Provence, 9-11 June 2015

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Supported by the European Commission, contract number: Fission-2010-3.5.1-269672, and the Research Council of Norway, contract numbers: 209101 and 209102.

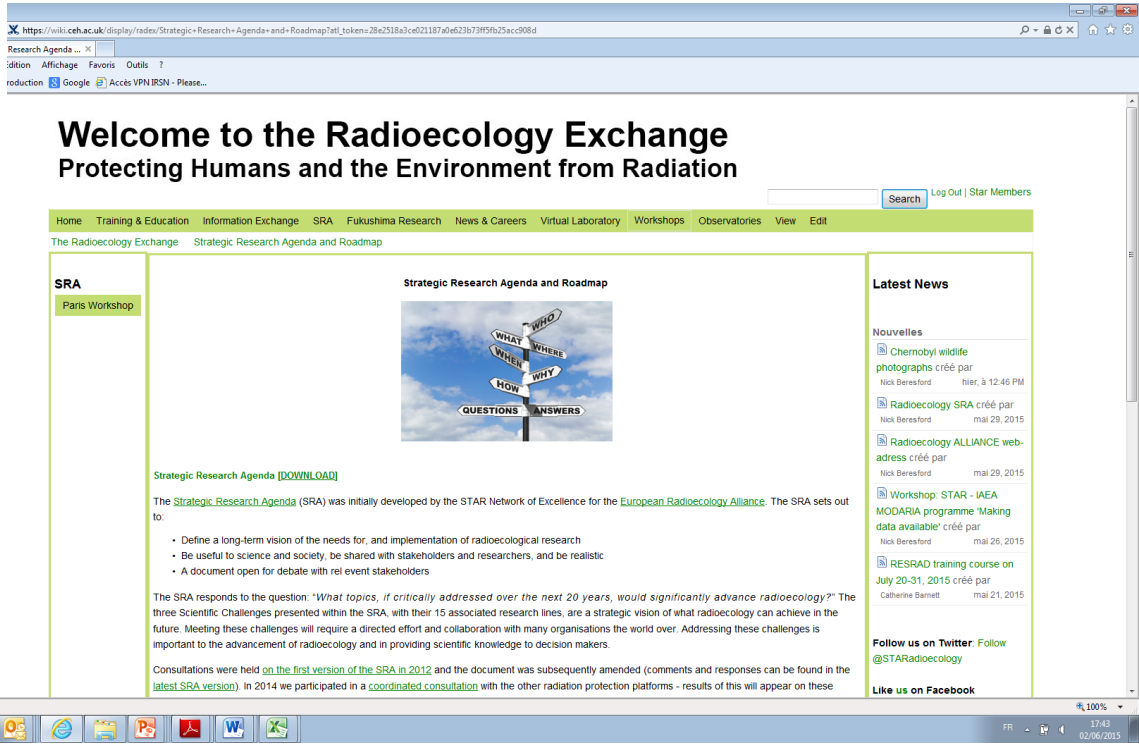
The different components of the SRA for Radioecology – the vision for…

- the science to be developped (*this talk*)
- the infrastructures and knowledge management
- radioecological observatory sites
- education and training

The SRA for Radioecology: a key document to guide the research strategy

- The SRA in radioecology expresses the priority research lines and expected advances for the next 15-20 years. The SRA is the key document to guide the research strategy for radioecology in Europe.

- STAR initiated this exercise for radioecology, delivered the first version of the SRA for Radioecology (May, 2012), and updated it (Jan 2014) on the basis of an open consultation (e-questionnaire) combined with a consensus workshop organised by STAR-ALLIANCE (Nov 2012, Paris).
- *ca.* 100 various items from a comprehensive panel of stakeholders were incorporated in the present version



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The SRA for Radioecology: What were the key drivers?

- The multiple lessons learnt from the Fukushima and the Chernobyl accidents
- The evolvement of policy in the field of radiological protection at the European and international level
- The need for improving communication with stakeholders and to better interact with society
- The need for filling gaps of knowledge and/or reduce uncertainties in our science with a priority level consistent with the needs from users (NGOs, industry, regulators, international organisations)
- The ultimate goal of improving radioecological expertise for a variety of environmental situations dealing with the nuclear fuel cycle, NORMs, contaminated sites ... (planned, existing, emergency)

What do we expect from the SRA ?

- Integrate skills, knowledge and tools from various partners in order to gain capabilities of answering complex and multidisciplinary issues
  - The SRA describes the basic research lines to be combined to answer high complexicity issues and advance radiological protection
  - Questions raised by STAR are good examples: e.g., "are radiation protection benchmarks protective enough in a multiple stressor context?"

- Be the reference document for the roadmaps under construction where the sequence of research activities is planned:
  - Following the objectives of
    - (i) improving the level of expertise in ERA;
    - (ii) understanding the underlying mechanisms of major processes of transport, transfer and effects;
    - (iii) gaining the knowledge needed for
      -supporting policy changes,
      -enhancing public credibility,
      -managing issues at contaminated sites (e.g., Fukushima)

  - With prioritisation through the application of a set of criteria : impact, achievable, relevance and public perception, good science

The SRA overview in a nutshell

- Built around the three major components of the Risk Assessment for man and environment
  - from sources to exposure;
  - exposure (to dose) to effects;
  - risk characterisation, communication and management

- Articulated into 3 challenges (and 15 research lines)
  - Predict human and wildlife exposure in a robust way by quantifying key processes that influence radionuclide transfers and exposure
  - Determine ecological consequences under realistic exposure conditions
  - Improve human and environmental protection by integrating radioecology

- For enhancing its visibility worldwide, a short version has been published in a peer-reviewed journal

Journal of Environmental Radioactivity 115 (2013) 73–82

Contents lists available at SciVerse ScienceDirect

Journal of Environmental Radioactivity

journal homepage: www.elsevier.com/locate/jenvrad

Short communication

An invitation to contribute to a strategic research agenda in radioecology

T.G. Hinton [a,*], J. Garnier-Laplace [a], H. Vandenhove [b], M. Dowdall [c], C. Adam-Guillermin [a], F. Alonzo [a], C. Barnett [d], K. Beaugelin-Seiller [a], N.A. Beresford [d], C. Bradshaw [e], J. Brown [c], F. Eyrolle [a], L. Fevrier [a], J.-C. Gariel [a], R. Gilbin [a], T. Hertel-Aas [f], N. Horemans [b], B.J. Howard [d], T. Ikäheimonen [g], J.C. Mora [h], D. Oughton [f], A. Real [h], B. Salbu [f], M. Simon-Cornu [a], M. Steiner [i], L. Sweeck [b], J. Vives i Batlle [b]

[a] French Institute of Radiation Protection and Nuclear Safety (IRSN), Bat 159, BP 3, 13115 Saint-Paul-lez-Durance, France
[b] Belgian Nuclear Research Centre (SCK•CEN), Belgium
[c] Norwegian Radiation Protection Authority (NRPA), Norway
[d] Natural Environment Research Council (NERC), United Kingdom
[e] Stockholm University (SU), Sweden
[f] Norwegian University of Life Sciences (UMB), Norway
[g] Radiation and Nuclear Safety Authority (STUK), Finland
[h] Research Centre in Energy, Environment and Technology (CIEMAT), Spain
[i] German Federal Office for Radiation Protection (BfS), Germany

CH 1 - To predict human and wildlife exposure more robustly

- **RL1 - Identify and mathematically represent key processes that make significant contributions to the environmental transfers of radionuclides and resultant exposures of humans and wildlife**
  - Help to (i) reduce uncertainty and understand variability, (ii) justify additional research required to parameterise dynamic-mechanistic models and (iii) identify the level of model complexity needed for specific exposure scenarios.

- **RL2 - Acquire the data necessary to parameterise the key processes that control the transfer of radionuclides**
  - Develop specific laboratory-based work and field studies or develop extrapolation methods

- **RL3 - Develop transfer and exposure models that incorporate physical, chemical and biological interactions, and enable predictions to be made spatially and temporally**
  - Describe processes at interfaces (e.g., atmosphere - water surfaces, geosphere - biosphere, oxic - anoxic, external media- biological membrane,..)

- **RL4 - Represent radionuclide transfer and exposure at a landscape or global environmental level with an indication of the associated uncertainty**
  - Incorporate process based model into a GIS tool in order to identify sensitive environmental areas

CH 2 - To Determine Ecological Consequences under Realistic Exposure Conditions

- **RL5 - Mechanistically understand how processes link radiation induced effects in wildlife from molecular to individual levels of biological complexity**
  - How may those elementary mechanisms result in adverse outcomes at the cellular and individual levels (e.g., reproduction, growth, survival, behaviour)?

- **RL6 - Understand what causes intra- and inter-species differences in radiosensitivity (among cell types, tissues, life stages, among contrasted life histories, influence of ecological characteristics including habitats, behaviour, feeding regimes)**
  - How do those findings, combined with a phylogeny/homology-type approach, support inter-species extrapolation?

- **RL7 - Understand the interactions between ionising radiation and other co-stressors**
  - What are the combinations of mixtures situations or co-contaminants that are likely to show interacting effects with radiation?

- **RL8 - In a broader ecological context, understand the mechanisms underlying multi-generational responses to long-term ecologically relevant exposures (maternal effects, hereditary effects, adaptive responses, genomic instability, and epigenetic processes)**
  - To what extent does multigenerational exposure make the consequences worse (or better)?

- **RL9 - Understand how radiation effects combine at higher levels of biological organisation (population dynamics, trophic interactions, indirect effects at the community level, and consequences for ecosystem functioning)**
  - How does ionising radiation affect the ecological integrity (structure, composition and function)?

CH 3 - To Improve Human and Environmental Protection by Integrating Radioecology

- **RL10 - Integrate uncertainty and variability from transfer modelling, exposure assessment and effects characterisation into risk characterisation**
  - Integrate over the period of interest for the risk assessment (from weeks to thousand years) the temporal variability of transfer, exposure and effects (from age-dependent differences to multigenerational responses)

- **RL11 - Integrate human and environmental protection frameworks**
  - Determine where harmonisation of approaches for man and environment is justifiable and beneficial

- **RL12 - Integrate the risk assessment frameworks for ionising radiation and chemicals**
  - Reinforce the consistency between risk assessment frameworks for chemical and for radiation and develop a risk assessment framework applicable for a mixture of stressors

- **RL13 - Provide a multi-criteria perspective in support of optimised decision-making**
  - Introduce MCDA to combine quantitative and qualitative factors and to guide the decision process

- **RL14 - Integrate ecosystem services, ecological economics and ecosystem approaches within radioecology**
  - To integrate the concept of sustainability, environmental indicators and sustainable use of resource into the definition of specific protection

- **RL15 - Integrate Decision Support Systems**
  - To develop DSS for integrated assessments of both man and environment

The SRA for radioecology needs to be...

- **A living document** (through the actions of COMET and the ALLIANCE) with regular update and regular stakeholders consultation to ensure research is fit-for-purpose and in adequation with the context for radiological protection in Europe and worldwide: the SRA «vitality» and «visibility» can be considered as markers of integration

- **A reference document** to inspire the development of the associated roadmaps which are objective-driven: Underpinning science for an enhanced basis for fit-for-purpose human and environmental impact assessment by mechanistic modelling, improved parametrization, improved databases

- **A must** to have in mind for being able to exchange with others (e.g., EJP CONCERT – update of SRA & roadmaps; focus on interactions)

Thanks to :

STAR EAB members, IRPA, BIOPROTA, IUR, SETAC, ICRP, IAEA, UNSCEAR
HERCA, IGD-TP, NCoRE, NERIS, MELODI
COR ENVI (French stakeholders initiative)
EDF France, P-plant Tessenderlo Belgium

And many individuals from industries, universities, authorities, ministries, ...etc

For their valuable inputs into the present SRA.....