Environmental Radioactivity: Legacy Sites, Chernobyl and Fukushima

- **Organisers**
  - Thomas Hinton; Coordinator, STAR Network of Excellence in Radioecology; French Institute of Radiation Protection and Nuclear Safety (IRSN)
  - Francois Brechignac; President, International Union of Radioecologists; IRSN, France
  - Brenda Howard; Centre for Ecology and Hydrology (CEH), Lancaster, UK
  - Astrid Liland, Norwegian Radiological Protection Authority (NRPA), Oslo, Norway
  - Tamara Yankovich; Remediation Project Manager, Environment Division, Saskatchewan Research Council (SRC), Canada
  - US Environmental Protection Agency (confirmation pending)
  - Representative from Japan (confirmation pending)

- **Symposium Justification**

Significant environmental contamination by radionuclides exists in many parts of the world, particularly for abandoned or legacy sites that operated at a time when regulatory requirements were less stringent than today. The contamination is due to activities, such as nuclear weapons production and testing; wastes from the uranium mining and milling industry; operation of nuclear facilities; nuclear accidents; disposal of radioactive materials; and releases from non-nuclear industries, such as phosphate, oil and gas production.

Human and environmental exposures to these radioactive substances need to be quantified as part of the risk assessment process and for developing long term remediation strategies. In most radiological assessment models, simplistic, empirical ratios (ERs) are used to simulate contaminant transfers between environmental compartments. ERs are favoured because of the pragmatic ease with which they facilitate modelling. Their use, however, significantly increases the uncertainty of model predictions because they do not account for the underlying processes that govern spatial and temporal variation.

Major improvements are needed to make models more process-based and capable of simulating the kinetics of contaminant transfers. A major challenge is to identify where the greatest advantages can be gained in: (i) reducing model uncertainty and understanding variability, (ii) developing criteria to identify when the additional research required to parameterise dynamic-mechanistic models is warranted, and (iii) identifying the level of model complexity needed for specific exposure scenarios.

Even with these improvements, however, we will likely never be in the position of having sufficient empirical data to cover the wide range of radionuclides and exposure scenarios that exists. Thus, there is also a need to consider alternative approaches to improve predictions. For example, alternative approaches are needed to extrapolate data across the periodic table using chemical analogues, across species (using phylogeny, common ancestry and allometric-mass dependent relationships to categorise transfers), as well as in the use of methods such as Bayesian statistics, that allow a low number of empirical observations to be supported by inferences from more comprehensive datasets.

Additionally, each nuclear accident has demonstrated that major challenges remain in post-accident management, and that there is a need to optimise management approaches for radioactive contamination that go beyond simple consideration of radiation dose. The many legacy sites around the world face similar challenges. The optimisation process will require the integration of Decision Support Systems, used in the radiological sciences, with knowledge and decision-aid tools from other disciplines (e.g., urban planning, economics, sociology) so that contaminated environments are managed in a holistic way to the maximum benefit of society. The presence of multiple, often

conflicting criteria suggests that methods such as multi-attribute analysis may be useful in guiding the post-accident decision process towards a satisfactory solution.

- **Symposium Aims**

The aim of the symposium is to bring together expertise from diverse disciplines and provide an open forum for those interested in radionuclide contamination of terrestrial, freshwater and marine ecosystems. We welcome presentations that present state-of-the-art knowledge on fate and transport of radioactive contaminants; the use of radionuclides as tracers of biological/ecological processes (particularly relative to marine systems or soil/sediment transport); influence of source term characteristics; remediation; modelling; uncertainty analyses; risk assessment; post-accident management; optimisation; decision support systems; multi-attribute analyses of radioactively contaminated sites; or other relevant topics. Some questions of specific interest include:

- What are the key processes and variables controlling radionuclide transfers at contaminated sites?
- What are the potential benefits of process-based models and can they be quantified?
- Do we have process-based models sufficiently developed such that they can be applied at different sites?
- Which knowledge gaps did the Fukushima accident reveal?
- What viable alternatives exist to reduce model uncertainty when empirical data are lacking?
- How important is speciation of the radioactive substances, including radioactive particles, versus environmental variables and does this change with time or space?
- What is the impact of the presence of non-radioactive contaminants on the behaviour of radionuclides?
- Are new technologies and methods needed?
- Will climate change impact radionuclide ecosystem transfers?
- How can optimisation and multi-criteria analyses be used to better manage contaminated sites?

- **Proposed Speakers**

We envision a full day symposium with three to four distinguished scientists delivering keynote presentations and then leading subtopics of the symposium (e.g., environmental transfers; dynamic modelling; post management optimization; remediation), where additional presentations will emphasize legacy sites, Chernobyl and Fukushima. Please submit your abstracts on the topics suggested above using the ICOBTE submission systems (http://198.124.230.16/abstract).

- **Publicity Plan**

The symposium will be advertised on the ICOBTE website; the STAR Network of Excellence website (www.star-radioecology.org); the website for the European Radioecology ALLIANCE (www.er-alliance.org); the site of the International Union of Radioecologists (www.iur.org); and the IAEA MODARIA modelling project (http://www-ns.iaea.org/projects/modaria/default.asp?s=8&l=116)

- **Publication Plan**

Select papers from the session will likely be published as a special issue in the *Journal of Environmental Radioactivity*.

- **Proposed Financial Support for Speakers**

Funding will be sought from numerous organisations, with emphasis on funding students.