



BIOPROTA

BIOPROTA Comments

Mike Thorne

BIOPROTA Secretariat and

Mike Thorne and Associates Limited

BIOPROTA is an international collaboration forum that seeks to address key uncertainties in the assessment of radiation doses in the long term arising from release of contaminants as a result of radioactive waste management practices. It does not seek to present a consensus view of its members. The views expressed in this presentation are those of the author and should not be taken either to be a consensus BIOPROTA position or to reflect the official positions of any of the BIOPROTA participant organisations.

See: <http://www.bioprota.org/>

Membership (Sponsoring Committee)

Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA)

Belgian Nuclear Research Center, Foundation of Public Utility (SCK.CEN)

Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT)

Electric Power Research Institute (EPRI)

Electricité de France (EDF)

Bundesamt für Strahlenschutz (BfS)

L'Institut de Radioprotection et de Sûreté Nucléaire (IRSN)

JGC Corporation

Korea Atomic Energy Research Institute (KAERI)

LLW Repository Ltd

National Cooperative for the Disposal of Radioactive Waste (Nagra)

Norwegian Radiation Protection Authority (NRPA)

Nuclear Decommissioning Authority, Radioactive Waste Management Directorate (NDA, RWMD)

Nuclear Waste Management Organization (NWMO)

Nuclear Waste Management Organization of Japan (NUMO)

Posiva Oy

Slovenian Agency for Radioactive Waste Management (ARAO)

Svensk Kärnbränslehantering AB (SKB)

Swedish Radiation Safety Authority (SSM)

Swiss Federal Nuclear Safety Inspectorate (ENSI)

Academic Associates:

Norwegian University of Life Sciences

Oregon State University



Aims and Objectives

- To make available the best sources of information to justify modelling assumptions made within radiological assessments constructed to support radioactive waste management.
- Particular emphasis is placed on key data required for the assessment of long-lived radionuclide migration and accumulation in the biosphere, and the associated radiological impact, following discharge to the environment or release from solid waste disposal facilities.
- The work is driven by assessment needs identified from previous and on-going assessment projects. Where common needs are identified within different assessment projects in different countries, a common effort can be applied to finding solutions. **This is done by bilateral or multi-lateral arrangements of BIOPROTA members.**

Modelling Studies

- These are not the only studies conducted within BIOPROTA, but they are thought to be the ones with greatest relevance to STAR.
- Modelling issues considered:
 - the treatment of various features, events and processes (FEPs) of the systems under investigation;
 - the development of conceptual models which correspond to an adequate approximation to those systems;
 - mathematical representation of those conceptual models; and
 - the choice of parameter values to adopt within those mathematical representations.

Mechanisms for Achieving the Objectives

- Holding an annual information exchange meeting;
- Holding workshops on special topics;
- Providing a mechanism for setting up collaborative projects.

Next meeting: Slovenia, May 2013

Publications - 1

- Process modelling:
 - Spray irrigation
 - Inhalation exposure
 - Accumulation of long-lived radionuclides in soil
- Radionuclide-specific Modelling:
 - Releases of C-14 to soils and uptake by plants
 - Behaviour of Cl-36 in the environment (international workshop plus various model inter-comparison studies on soil-plant systems)
 - Behaviour of Se-79 in the environment (international forum plus conceptual model development and a comparison of traditional and innovative approaches to modelling the behaviour of Se-79 in soil-plant systems)
 - U-238 series model inter-comparisons
 - International workshop on the environmental behaviour of radium

Publications - 2

- Assessment data
 - Applications of biotic analogue data in safety assessments
 - Development of a database for key radionuclides and process data
 - In situ studies of the long-term sorption of iodine onto organic matter
 - Development of guidance on site-specific biosphere characterisation
- Modelling processes in the geosphere-biosphere interface zone
- Studies on non-human biota
 - International forum on application of guidance and methodologies in the context of geological disposal of radioactive wastes
 - Sensitivity analysis and knowledge quality assessment
 - Development of a structured approach to dealing with situations in which screening criteria are breached

Current Work

- Development of a reference approach to human intruder dose assessment for geological disposal facilities
- Further C-14 assessment studies
- Relevance of temporal and spatial scale to non-human biota dose assessments
- Arrangement of a workshop on the scientific basis for long-term radioactive and hazardous waste disposal assessments

The Importance of Radioecological Research to BIOPROTA - 1

- In general, BIOPROTA members have applied objectives – they aim to demonstrate the environmental safety of existing or planned facilities or evaluate safety submissions relating to such facilities
- There is a need to have robust, coherent and internationally agreed standards for protection of human health and the environment, so that compliance with those standards can be clearly and unambiguously demonstrated
- There is a need for justified, well-supported models for the transport of key radionuclides* released from the sub-surface into and through the biosphere

Key radionuclides are long-lived and tend to be relatively mobile in the environment. They include C-14, Cl-36, Se-79, Tc-99, I-129 and the U-238 series. In general, there is a greater interest in transport in terrestrial and freshwater environments than in estuarine and marine environments.

The Importance of Radioecological Research to BIOPROTA - 2

- The main interest is on the area local to the facility (or on areas that could have similar characteristics in future environmental conditions) – the regional or global distribution of contaminants is of less relevance.
- Although assessments are typically focussed on key radionuclides or other contaminants, there is often a need to undertake a comprehensive assessment across a large suite of contaminants, so a self-consistent set of model parameter values needs to be available across the full suite of contaminants of interest.
- Safety assessments of disposal facilities typically take uncertainty and variability into account in the near-field and geosphere – difficult issues arise in relation to how uncertainty and variability should be represented in the biosphere, especially in the far future.
- Over the timescales of interest changes in climate and landscape characteristics need to be taken into account, either by explicit modelling or by the selection of suitable scenarios to span the range of situations that may occur.

Major Comments on the Strategic Research Agenda - 1

- Process-based modelling is essential to demonstrate that justified safety assessments can be made for hypothetical future situations that need to take into account the biogeochemical recycling of contaminants on very long timescales.
- The long half lives and long timescales involved emphasise the need to relate available information on the behaviour of stable elements and radionuclides in the environment – the interactions between radioecology and other environmental disciplines need to be strengthened.
- Although it would be desirable to develop a comprehensive understanding of the mechanisms by which radiation effects are induced and expressed at different levels of biological organisation, it will be sufficient for many purposes to develop a well-defined position on the increment of dose rate (or activity concentration) above natural background below which effects at these various levels of biological organisation are not of significant concern. However, it will also be necessary to consider the actions to be taken if this threshold is exceeded.
- The SRA is very ambitious and clearly cannot be fully achieved on a twenty year timescale. From an assessment point of view, it is important that the knowledge gained from the various research activities is rapidly assimilated and made available to the wider community. This is likely to require the development of flexible databases that do not 'force' the information into an over-constrained conceptual model framework, together with a platform (or platforms) for the modular development of mathematical models, so that the implications of changes in knowledge in a particular area can be propagated through to their implications for system performance.

Major Comments on the Strategic Research Agenda - 2

- Some major objectives of the SRA, e.g. understanding interactions with co-stressors and multi-generational responses, are much wider than radioecology. Thus, the SRA needs to be related to research agenda and other initiatives in these broader areas.
- Although the integration of human and environmental frameworks of protection is important for consistency, it is less important for safety assessment, provided that appropriate compliance conditions can be defined in each area. However, integration of the frameworks of protection is a much less challenging activity than is developing a fundamental scientific understanding of the processes mediating radionuclide transport in the environment or of the mechanisms by which deleterious effects are induced at various levels of biological organisation.
- The SRA does not mention studies of the detectability of radiation-induced changes in environmental systems (habitats, populations, communities etc.) in the presence of other causes of spatio-temporal variability. The identification of 'signatures' of radiation-induced effects is a potentially important research topic.
- One possibility for the SRA would be to focus on a limited number of internationally agreed test locations. These could be sites that are already contaminated or sites located conveniently close to major research centres. These sites would provide well-defined locations for a variety of survey and experimental studies, and the complex multi-disciplinary databases arising would provide a basis for system model development and testing.

Major Comments on the Strategic Research Agenda - 3

- The SRA makes reference to issues of scale, but does not propose a way forward in this area. One approach may be to use nested models. This would address, for example, the issue of effects on local habitats due to contamination (modelled at the small scale) taking into account regional movements of organisms (either individuals or populations, and modelled at a larger scale).
- The need for better wildlife dosimetry is strongly endorsed. However, it is noted that this may require consideration of not only the macro-distribution of radionuclides in organisms, but also the micro-distribution within specific organs and tissues, as this can have significant effects on radiotoxicity.
- In the context of regulation, there is a need to consider interactions between radionuclides and other contaminants. However, there is also a need to consider other types of impact on the environment, e.g. physical disturbance, utilisation of water resources. Therefore, it may be useful to consider whether assessment approaches should be primarily contaminant-based (e.g. through controls on environmental concentrations), ecosystem based or industry based. An ecosystem-based approach would tend to emphasise particular environmental vulnerabilities of the ecosystem in question, whereas an industry based approach would tend to emphasize all the contaminant and other impacts arising from a particular industry, e.g. uranium mining or oil and gas exploration and exploitation. Ecosystem-based approaches would tend to align with protection of biodiversity and industry based approaches would tend to align with EIA requirements.