X Congreso Regional Latinoamericano IRPA de Protección y Seguridad Radiológica
"Radioprotección: Nuevos Desafíos para un Mundo en Evolución"
Buenos Aires, 12 al 17 de abril, 2015
SOCIEDAD ARGENTINA DE RADIOPROTECCIÓN

BIOPROTA AN INTERNATIONAL COLLABORATIVE FORUM FOR IMPROVE THE SAFETY ASSESSMENT IN RADIOACTIVE WASTE MANAGEMENT

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RESUMEN

BIOPROTA is an international collaborative forum, started in 2002, designed to support resolution of key issues in biosphere aspects of the assessment of the long-term impacts of potential contaminant releases associated with solid radioactive waste disposal. The focus is on the application of good science to provide a good understanding of relevant biosphere system processes and address important uncertainties. This in turn supports decision making related to waste management and the appropriate allocation of resources to solve problems. The forum is tailored to enable opportunities for sharing, reviewing and interpretation of information used in the biosphere component of post-emplacement assessments of solid radioactive waste disposal. This includes methods for system characterization and description, modelling of system evolution subject to assumptions for environmental change, exposure modelling according to those possibilities for evolution, and data to support all the assessment assumptions and model parameter selection. The working method is based on an annual meeting for information exchange and identification of key issues of common interest. Out of that discussion, opportunities for collaborative projects and topical workshops are developed. This paper reviews recent progress in BIOPROTA and related international and national level activities, and present ideas for the focus of future work.

1. INTRODUCCIÓN

BIOPROTA is an international collaborative forum, started in 2002, designed to support resolution of key issues in biosphere aspects of the assessment of the long-term impacts of potential contaminant releases associated with solid radioactive waste disposal. The focus is on the application of good science to provide a good understanding of relevant biosphere system processes and address important uncertainties. This in turn supports decision making related to waste management and the appropriate allocation of resources to solve problems. Membership of the forum includes regulators, operators, technical support organizations and academic institutions from North America, Europe and Asia. Member organizations have representation on a Sponsoring Committee, currently chaired by Danyl Pérez-Sánchez (CIEMAT) and supported by a Technical Secretariat.

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Out of that discussion, opportunities for collaborative projects and topical workshops are developed.

Not all activities are of interest to all organizations and participation in each topic is open to those who wish to contribute. Subject to agreement from contributors, the final results are made openly available. The full set of published workshop and project reports is accessible at www.bioprota.org. In many cases the reports are also published in the report series of one of the participating organizations.

2. THE KEY ISSUE

Given the long timeframes which are required to be addressed in post-closure assessments of radioactive waste disposal facilities, thousands of years or even longer, the range of assessment issues is very large. In essence, the key issue is related to the scope for environmental change and the behavior of humans and ecosystems in response to such change, including their contribution to the change itself. The assessment therefore has to include consideration of climate change, landscape evolution, the dynamics of ecosystems, and then, the behavior of radionuclides within those changing systems and the ways by which their presence may give rise to radiation exposure, to humans and other biota. It is scientifically multi-disciplinary, combining hydrology, geology, geochemistry, radioecology, agronomy and radiological protection. It also involves assumptions about human behavior which are less amenable to scientific investigation.

With a view to obtaining international consensus on how to address this issue, the International Atomic Energy Agency's (IAEA) BIOMASS Theme 1 provided a clear basis for identifying, justifying and describing biosphere systems for long-term dose assessment. The methodology for development of conceptual and mathematical models was set out and a protocol developed for the application of data to these models. Example so-called “reference biospheres” were provided which illustrated the application of the methodology. That work involved was completed in 2001 and published in 2003 [1].

This methodology has been applied, in part of in full, in post-closure assessments for a wide variety of assessment contexts including both deep geological and near-surface disposal. Examples and a general description of the evolution of assessments up to 2010 is provided in [2].

It is important to recognize that results of these assessments are not taken as predictions of impact, but as illustrations of what might occur for comparison with regulatory or other protection objectives. Since protection objectives, site characteristics, and radionuclides of interest (i.e. those that could be released to the biosphere from the geosphere) vary from assessment to assessment, it stood to reason that no single reference biosphere could be effective internationally. However, the adoption of a common methodology that encourages the consideration of a common set of issues has been useful.

Experience from these applications has identified common issues which could benefit from further joint consideration, for example, through BIOPROTA.

3. OVERVIEW OF PROGRESS AND RESULTS

Initial work focused on examination of key features events and processes relevant to the more common types of radionuclide release to the biosphere. In general, this lead to the

development of more process orientated models than those used previously, reliant on a stronger understanding of conditions at the site in question. Such understanding was increasingly accessible based on monitoring of old sites and detailed site characterization work at specific proposed new sites. The iteration between site characterization and assessment was recognized, for example in [3]. Further description of the results up to 2011 is provided in [4].

Since then further projects and workshops have been implemented, as follows, which include greater focus on: better models for the more critically relevant radionuclides (to reduce, where possible, any unnecessary pessimism in assessment assumptions), processes at the geosphere-biosphere interface, and special topics such as the assessment of the impacts of human intrusion.

- Long-term dose assessment models for C-14 [5].
- Review of data and ecosystems relevant to dose assessment for C-14 and identification of experimental, field measurement and other monitoring work which could be used to support model testing and validation [6].
- Representation of Environmental Change in the Near-Surface Environment [7].
- Long-term dose assessments for U-238 series radionuclides [8].
- Approaches to modelling Se-79 in the soil-plant systems [9].
- Demonstrating compliance with protection objectives for non-human biota within post-closure safety cases for radioactive waste repositories [10].
- Human intruder dose assessment for deep geological disposal [11].
- Approaches to representing the geosphere-biosphere interface in assessment models [12].

Work is also in progress on determination and justification of temporal and spatial averaging relevant to the long-term dose assessment of humans and other biota.
All the work has been conducted, taking account the activities in the IAEA EMRAS II and MODARIA projects, especially with respect to treatment of climate and other environmental change, impacts on non-human biota, and assumptions for future human actions.

4. CONCLUSIONS AND NEXT STEPS

Hopefully this approach leads to efficient use of skills and resources to solve common problems. In addition, the information shared and produced is commonly referenced in various project specific assessments and reviews. It is intended to make the most efficient use of skills and resources, and provide a transparent and traceable basis for the choices of parameter values as well as for the wider interpretation of information used in assessments.

The basic BIOPROTA objectives and scope remain the same since the forum's inception in 2002, but there is an increased emphasis on development of research projects to reduce outstanding uncertainties and support safety cases for both generic radioactive waste disposal concepts and to assist in site specific developments and proposals. It has also become apparent that contaminant migration issues and related dose and risk assessments for radioactively contaminated legacy sites share similarities with those relevant to releases from radioactive waste repositories. This recognition invites the participation of researchers and assessors with wider experience and perspectives, including chemical waste management, which can be shared to mutual benefit.

Proposals for continued activities include:

- Model testing and validation for C-14 dose assessment;
- Evaluation of the scope for further validation of
- Addressing correlations, not just between parameters in models but also in assumptions in conceptual model development, including assumptions for human behavior;
- Design of assessments to support demonstration of optimization and/or selection of options for waste management;
- Assessments that address waste containing naturally occurring radioactive material (NORM) and other RW in the same facility;
- Disposal of low-level or very-low level radioactive with other waste in facilities not specifically intended for radioactive waste,
- Review and update of the IAEA's BIOMASS "reference biospheres" methodology, and
- Balancing complexity and simplicity.

The last bullet is common to all assessments but especially important when addressing long-term issues. Simple models can be easier to apply, justify and explain, and rely on relatively limited data needs. However, in the absence of the consideration of more detailed processes, conservative assumptions are generally adopted so as to avoid the under-estimation of impacts. This may lead to overly-conservative results, misunderstanding of the possible impacts and inappropriate allocation of resources. Clearly a balance is needed.

To support the development of that balance, a need has been identified to learn from other areas of expertise and/or other assessment work where similar modelling and assessment issues arise. This includes the communities making assessments for the management of legacies, as discussed at the workshop "Radioecology and Assessment Research in Support of Regulatory Supervision of Protection of the Environment and Human Health at Nuclear Legacy Sites" held in association with the International Conference on Radioecology and Environmental Radioactivity, September 2014, in Barcelona. Both communities could benefit from sharing experience and information, including long-term time.

It further includes other communities, such as those addressing radiocarbon, climate change, environmental impact assessment and other types of hazardous waste disposal. A balanced approach to the management of the risks associated with disposal of all types of hazardous waste is clearly of value to all, but radioactive and other hazardous waste are commonly managed and regulated under distinct and separate arrangements. To explore the implications of different types of assessments, a BIOPROTA workshop is planned on comparison of assessments for disposal of radioactive and other hazardous radioactive waste, to be held in Norway in early 2015, hosted by the Norwegian Radiation Protection Authority.
All the above matters are being progressed and will be further reviewed at the next annual BIOPROTA meeting, which will be hosted by the Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), in May 2015 in Madrid.

5. ACKNOWLEDGMENTS

The authors are keen to acknowledge the support of member organizations of the BIOPROTA Forum and their technical representatives in the implementation of the BIOPROTA program.

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