BIOPROTA

Key Issues in Biosphere Aspects of Assessment of the Long-term Impact of Contaminant Releases Associated with Radioactive Waste Management

Report of First Workshop

Oslo, 29-31 October 2002

Hosted by NRPA

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History

Draft report Version 0.1 prepared by Enviros Consulting Ltd, distributed to those organisations which provided input.

Preface

This report sets out the discussion of a proposed work programme to end the of September 2003 for the BIOPROTA Project. It then concludes by setting out the agreed work activities under different Themes and Task Groups, including the target schedule and deliverables. The report is presented as working material for information. The content may not be taken to represent the official position of the organisations involved.

Contents

1 SUMMARY RESULTS, WITH SCOPE AND OBJECTIVES OF WORKSHOP

Key issues in biosphere aspects of assessment of the long term impact of contaminant releases associated with radioactive waste management were identified at a Preliminary BIOPROTA Workshop, hosted by Andra in June 2002 [BIOPROTA, 2002a]. Common issues and a way forward were set out in a BIOPROTA Concept and Definition Document [BIOPROTA, 2002b].

Following the Preliminary Workshop, it was agreed to host a Workshop in Oslo, October 2002, at the invitation of the Norwegian Radiation Protection Authority. The aim of the Workshop was to reach decisions on a series of proposed Task Group activities set out in Appendix A.

This report of the workshop records the discussion of these proposals. Not all organisations will be interested in all Tasks or will have resources to actively participate in all of them. It is proposed that BIOPROTA participants become involved in the Themes and Tasks discussed according to their special interests. However, all the organisations can benefit from the output.

Accordingly, it is anticipated that the main effort will be carried out by small Task Groups with special expertise and technical interest in the Task. Each Task will work under a Task Group Leader (TGL) whose role is to help plan, promote and chair the work of the Group, not to do all the work. Output from the Task Groups can be reviewed more widely within BIOPROTA, but it is not the intention to develop an overall consensus, only to check for major errors or omissions.

Section 2 records discussion of technical and administrative issues, including the priorities of the Workshop participants, who are identified in Appendix B. Several organisations provided presentations to promote discussion at the workshop. Presentation material can be found on the BIOPROTA Workspace on 'Business Collaborator'[1]. Not all the interested organisations were able to participate in the meeting, but their input provided before the workshop was taken into account.

Section 3 sets out the BIOPROTA work programme for the period to the end of September 2003, with related target deliverables and outputs from BIOPROTA[2]. There is clear scope for continuation of some tasks beyond September 2003.

It is important for BIOPROTA to complement other international programmes, such as BIOMOVS and BIOMASS from the past, BIOCLIM and BIOMOSA on-going, and EMRAS for the future. All involved are fully informed. In addition, BIOPROTA should not duplicate work that has been organised within national or international programmes. Rather, BIOPROTA should support many existing projects by helping to deal with difficult issues such as including the effects of environmental change, providing a forum for testing and comparing models, and improving the information base for data and

[1] All organisations that have expressed interest in BIOPROTA have individuals who have been given access to this internet accessed information system. If you would like to be given access, please contact emma.kerrigan@enviros.com

[2] This programme has since been confirmed by the BIOPROTA Steering Committee.

models. Collectively, the programme is designed to addresses issues giving rise to a lack of confidence in important assessment results. In turn this should reduce the level of caution required in assessments and contribute to better safety cases.

IUR Task Group on Waste Management and Radioecology

A special example of how to ensure that the best opportunities are made for accessing skills, relevant research and projects arises through the International Union of Radioecology (IUR). The IUR has set up a working group on waste management and radioecology, with an emphasis on long term radioactive releases and related issues. There are 4 objectives of this working group, to identify:

- gaps in knowledge associated with key radionuclides,
- strategies for assessments,
- geosphere – biosphere interface zone, and
- models for long term behaviour.

The working group will have close links with BIOPROTA, and several individuals are participating in both. It will be very useful to maintain updates with the IUR Working Group.

After the Oslo meeting, it was confirmed that the IUR Task Group plans to hold a workshop on behaviour of C-14 and Cl-36 in the environment 27/28 February, at Merlewood, UK. More information on this can be obtained from b.howard@.... or avila….

2. DISCUSSION OF THE THEMES AND TASKS

These following notes are informal and designed to reflect an open style of working intended to promote exchange of views and information. They do not reflect any official position from the organisations concerned, nor are they intended as a precise record of everything that was said. Rather, they are to provide background and support to the decisions made on the BIOPROTA work programme.

2.1: Theme 1: Specialised Data-Base for Key Radionuclides and Process Data

The aim of this theme is to create a Specialised Database. The main issues to consider are:

- Want information do we want to include?
- What design do we want and how can this be constructed?
- How to investigate what data to enter?
- How to identify where the gaps are?

The IUR have several historic databases, that compile data for transfer parameters, soil k_d and soil to plant transfer. They are usually robust as one person is the (expert) administrator, therefore there is a robust vetting process examining the information entered. However, past information is not balanced, e.g. 18 values for iodine for grass, from one author, 5000 values for Cs, but very few data for most radionuclides of interest to long term waste management. In the past, standard deviations were used and there is an

issue associated with whether there is averaging of the data before entry, or whether all values should be entered. They were made available to all members of the IUR, however this was pre-1986, and they are difficult to obtain now. There is no equivalent for animal data.

It can be difficult to decide on the correct structure of a database to ensure flexibility, the ability to add a parameter more than once (with a unique value being given to specific circumstances not the parameter) and to identify the data value dependencies. The VALORA database developed by CIEMAT uses a Parametric database design. The information source is associated with the value and circumstances of measurement (and hence the data dependencies), not only the parameter value. As a flexible system, VALORA has no fixed tabular output; each entry has its own and an entry can be a best estimate, a range or a specific value. It does not do all the work for the user, knowledge of radioecology is still needed to extract the correct information. It is possible to advance search using a string or anything related to the dependencies of a parameter and reports can be reproduced in other applications using the data.

The Nirex Data Book has been constructed like a book; with chapters, and individual pages with tables or lists of data. It is designed to accommodate assessment data that may be required and is based on the Microsoft Access application. The database is dynamic and will evolve over time, so in future, new structures may be created to accommodate new datasets. The data can be shared (import/ export) from various databases to the Data Book or from it into other Microsoft applications. There is also a link to the Nirex bibliographic database where reports that justify the data can be found. There is only one administrator with the ability to read and write in the database; however there can be multiple read only users. The system ensures that units are entered and values within cells can be associated with references as well as connected to the bibliographic database. The tables can be manipulated for ease of comparing entries.

A presentation by SKB discussed what you need to complete a safety assessment: The focus is on nuclide documentation, for example element dependent data divided into physical data, sorption properties, uptake in biota, metabolism, translocation, etc, which has been reported in an SKB report. It can be difficult to cite a database, therefore justification is often simplified.

SKB reported on bioaccumulation factors in aquatic ecosystems, for which they obtained large amounts of data (3000 entries), from a much smaller number of references (300), of which an even smaller amount were useable (100). There are many reasons for this, not least that it is often difficult to find recent up to date reports from new studies, i.e there could be even more data and references in grey literature from each country.

A database administrator needs to be careful when filtering the data, and considering how to classify the data into organised lists and fill gaps in the data. The administrator also needs to consider the quality and applicability of values from experimental data, which can relate to how accessible data is in the literature.

Implications for BIOPROTA:

- The database will be a supportive tool providing generic or specific information.

- The design of the database must consider the requirements of the user, e.g. for quantitative assessments or Post-Closure Safety Assessment studies.
- The database should be flexible because it may need a different structure for each radionuclide as key parameters are different for different elements.
- Original sources should be considered, and could have compilations of data that apply to particular range of circumstances.
- May be useful to add experimental data/ parameters and then the outputs for assessment purposes with qualifiers as how to get from the primary data sources to the values for parameters required in an assessment database.
- It must be able to be easily modified, given, for example, the need to consider different endpoints from those related to protection of man.
- It is preferable to have a single administrator and multi-use read-only access. The administrator would add datasets as required that were sent from other people, in a simple excel format (no further technical consideration would be required as it would be too time and resource intensive). However, a process is needed to ensure that only appropriate information is added to the database, or that, once added, that information is properly reviewed.

There was widespread interest in populating a Specialised Database and participation in a Task Group to do so. The table below indicates which organisations are especially interested in each contaminant identified in BIOPROTA [2002a] and some additional comments are tabulated below that. The priority radionuclides to consider are Cl-36, C-14, I-129, Np-237 and Tc-99.

Radionuclide	Andra	Nirex	BNFL	Posiva	OPG	EdF/ IRSN	Studsvik/ SKB	Ciemat/ Enresa	UKAEA	Numo
Cl-36	X	X	X	X	X	X	X	X		
Np-237		X	X			X	X	X		X
C-14	X (LLW)	X	X	X	X	X	X	X	X	
U-series		X	X			X	X (not all chain)		X	X
B	X					X				
Pb	X (LLW)					X				
I-129	X	X	X	X	X	X	X	X		
Se-79	X	X				X	X			X
Tc-99	X	X	X		X	X	X	X		X
Cs	X							X		X

Andra	Will have some resources to commit and past information to supply
Nirex	Have some resources to commit and has data on Cl-36, I-129 and Tc-99, and can provide the Data Book. Biokinetics data will be in the public domain from a UK Food Standards Agency study, which can probably be included
BNFL	Are unlikely to be able to commit resources but can probably supply past data
Ecomatt	Anticipate interest in this in Canada and may have some resources to commit.
EdF	May be able to supply information, via IRSN, on all radionuclides but will need to discuss internally.

SKB	have data on most of the radionuclides of interest but not all of the U-series, would supply
Ciemat/Enresa	Very interested in obtaining C-14 data and would like to add Cs to the list. Likely to be able to commit resources to Cl-36 and Np-237
Numo	May have some resources, only interested in radionuclides in vitrified wastes.
UKAEA	Expected to be interested in C-14 and U-series data, possibly others.

2.2: Theme 2: Modelling

2.2.1 Task 1: Develop guidance on irrigation modelling

This task was previously referred to as aspersion modelling. This objective is to provide guidance on modelling the uptake of radionuclides into relevant crops as a direct result of use of contaminated water for irrigation.

Albrecht compared Aquabios with Ecosys providing a comparison involving different scenarios (radioactive waste management and an accident scenario) and use of Leaf Area Index (LAI). Subsequently retention coefficients, method and rate of and irrigation and LAI were discussed in relation to their incorporation in other models. Some models also considered the depth of water that can accumulate on the leaf post irrigation. Often these models include oddities and have data inconsistencies, but could correlate standing biomass with LAI (actual and projected), and there are time considerations to include e.g. irrigation to harvest, and environmental half-time (which is very similar for all particles, with an average 14 days). Other issues to consider include: surface chemical issues, e.g. number and competition for sorption sites, site saturation, anion vs cation sorption and translocation following incorporation within plant material. New translocation data are due to be published by Andra, including new information from studies by IRSN.

The Task Group could consider what level of complexity in a model is required to assess long term impacts and whether data exist to support the models. To achieve this, the Task could consider major alternative modelling concepts, and compare as part of the Task Group work, e.g. Aquabios model, special C-14 model developed for ANDRA, GENII, models used in SAFE project, and so on, and models described in BIOMASS, which consider different ways of accounting for the time between irrigation and harvesting.

Those organisations interested in participating, and provisionally can offer of a model or data for comparison are detailed below:

Andra	Interested. It will be very useful to compare models and specific issues.
Posiva	Unable to contribute significantly, interested in output
Nirex	Unable to contribute significantly, interested in output
Mike Thorne	informal participation
BNFL	Unable to contribute significantly, interested in output
Ecomatters	informal participation – can include a model in the comparison
Nagra	interested
EdF	interested and can supply a model

Studsvik	interested and can supply a model
JSI	will check whether colleagues have useful information to contribute.
Alexandria Sciences	interested
Enresa/Ciemat	interested as main pathway considered. May consult with CSN.
Numo	Interested as already considered in H12, could contribute to the work.
YMP	It is expected would want to be included in a comparison for this

2.2.2 Task 2: Develop guidance on the inhalation pathway for actinides accumulating in soils/sediments

. For long lived alpha, inhalation is a high dose pathway dependent on the source term, and scenario within performance assessment, with the potential for long term accumulation in soils or lake bed sediments or from irrigation water and subsequent ploughing. Current assessments in this area tend to be cautious, and a study similar to that for Task 1 is suggested

More consideration may need to be paid to the chemical form (lung residence time), possible enrichment due to particle size, adhesion, resuspension (and correlation with human activity) spray, hydroscopic aerosols based on new ICRP models, thinning soils over 1-2k y may affect the resuspension if modelling long term. etc, which are all linked to how large a dose can be achieved through inhalation. Animal inhalation and transfer to milk and foodstuffs is a pathway that the regulators in Canada are considering and the UK FSA have already thought about. However, in this study, due to time and resource constraints the focus will be on humans first and suggest that some issues would be applicable to animals (either direct dose to animals or via animals to humans).

Those organisations that are interested and have data or models that can be considered are detailed below:

Andra	Not a priority now as not in natural evolution scenario but are interested in output.
Posiva	Not a priority in Finland so no contribution to make but colleagues at the University may have considered this and may be interested
Nirex	Not a priority
MTA	Not a priority
BNFL	Interested as only pessimistic models done so far.
Nagra	Not priority
Ecomatters	Not priority
Edf	Not a priority as has been considered based on Chernobyl data (IRSN report, 1997) which is currently sufficient.
Studsvik	Interested as want to improve confidence when considering this exposure pathway, and have the same peat scenarios as considered in Finland by the University.
JSI	Interested
Alexandria Sciences	Interested as not a lot of recent work done should consider reviewing the mechanism as a pathway and worth looking at because if other

	pathways are reduced through improved knowledge this pathway may become more important.
Ciemat/ Enresa	interested as think the models need to be revisited to include new data. Ciemat still looking at Palomares.
YMP	Expected to be of interest
Numo	Interested

2.2.3 Task 3: Model Review for C-14 Dose Assessment

C-14 continues to be an important radionuclide in waste management, in the context of routine discharges (e.g. in relation to OSPAR) and in solid waste disposal, both shallow burial and deep facilities. There are a lot of areas that could benefit from improved data. The prominence of the Kyoto agreement and the interest in C-14 outside the sphere of radioactive waste management, make valid modelling more important.

Those organisations interested and that may make contributions are identified below:

Posiva	Interested in methane in repository escaping and the GBIZ (microbes in soil). A working group internal to Posiva is investigating, the data can be contributed.
Nirex	Very interested in how it arises and enters biosphere, some work to contribute.
MTA	Interested on behalf of Nirex and the FSA through C-14 in sewage sludge (e.g. added to agricultural land from another source) Can contribute information.
BNFL	Interested and have a model for gaseous releases also interested in marine discharge and C-14 in fish as a dominant exposure pathway.
TechSec	May be able to contribute Amersham dynamic foodchain modelling data once permission received
Nagra	Not on Nagra's agenda at this time
Ecomatters	Interested and a contribution may be possible from OPG as will address C-14 as next HLW issue. Ecomatters have a model for reactor release in Canada and a lot of C-14 data from lake spiking (more data than from BIOMOVS) considering specific activity in sediments, invertebrates and fish.
Edf	Have interest in C-14 around NPP's and can contribute a dynamic river and terrestrial irrigation model with riverine, marine and terrestrial data
Sweden	Interested as C-14 is an important radionuclide. Have a lot of aquatic data that can be made available. Interest in C-14 from routine operation into atmosphere, soil and plant particularly from PWRs. SSI may also be interested.
JSI	Interest from NPP perspective and may join the group at a later stage with contributions
Alexandria Sciences	Interested
Ciemat/ Enresa.	C-14 a new radionuclide in new performance assessment so interested but have no resources to contribute.
Numo	Watching brief

Andra	Watching brief

2.2.4 Task 4: Updated Model-Model Comparison Exercise.

This will involve updating and comparing the entire biosphere assessment for a given release from the geosphere. The last time this was done was in BIOMOVS II (complementary studies),. Therefore BIOPROTA aims to compare newer models with more data than has been done before. Problem is the models do not calculate exactly the same thing, and there are different approaches to the same things, e.g. critical groups.

The Task Group must decide which scenario to focus attention on, bearing in mind the comparisons in Tasks 1-3. The exercise could compare small components, e.g. long term accumulation in soil for key radionuclides (to complement data in Theme 1) or be much larger, for example, system change.. The models (codes) used do not always suit the scenario chosen to be compared, therefore limitations ought to be considered in advance.

BIOPROTA will focus on the science that goes into the models and not the quality assurance that codes are working as intended.

Some of the issues to be addressed are:
- interpretation of scenarios,
- model complexity,
- units awareness,
- user mistakes due to interpretation and complexity (judgements using justification/societal interest),
- uncertainty in data,
- larger systems
- additional problems for models due to interactions.

It was agreed that the best scenarios to consider are ERB2A/ 2B, which has a pre-defined system broadly applicable to a relevant system context, which can be implemented in other codes and the results compared.

It is anticipated that the comparison could use a 3 stage approach:

- first, use ERB2A, which is a constant biosphere, well/agriculture scenario;
- second, use ERB2B, which a more complex constant biosphere involving natural groundwater release into soils and surface waters;
- third, change the assessment context for both 2A and 2B to require explicit consideration of environmental change, making use of BIOCLIM outputs.

The idea is to use these BIOMASS scenarios, but participants apply their own models and data assumptions, not those of BIOMASS. It is expected that all participants can take advantage from recognising that their results are the same or similar, or that they are different for well understood reasons.

This approach will allow consideration of the effect of conceptual model uncertainty.

To summarise, the Task will aim to:

- improve confidence in models and codes
- consider model uncertainty analysis
- include environmental change at a later stage
- compare the 'modeller' assumptions, arguments and results.

Those organisations that can participate and have a model or code that can be used, are:

	Andra	Posiva	Nirex	BNFL	Edf	Ciemat	YMP	UKAEA
ERB2A	X	X	Program dependent	X	X		X	
ERB2B	??			X	X?			X
ERB2A* (env change)	?		Longer term aim	X		X		
ERB2B*				X		X		

The interest and level of commitment provisionally attributed to this Task are detailed below:

Posiva	Not priority as used SKB models which have already been compared. Will keep a watching brief
MTA	Interested technically and may be able to involve Newcastle University, in terms of hydrological calculation comparison and possibly non rad contaminants e.g. with nitrate from agriculture.
Nirex	Have already done internal comparisons using similar scenarios. Happy to compare with others and offer information.
BNFL	would be interested, may not have the resources and need to consider ERB2A/ 2B. U-234 decay chain in 2B because of differential migration.
Nagra	no commitment, but interested in outputs and may comment on the comparison.
Ecomatters	not a priority
Edf	consider the scenarios first, but should be able to try 2A in their model. May want to consider another radionuclide, e.g. Chlorine not niobium
Studsvik	Sweden, Don't know if SKB are very interested, Studsvik be kept informed
JSI	Would like to review but not initially participate.
Ciemat/ Enresa	too repetitive now but interested with environmental change, May consider modelling Cl-36. Will focus on conceptual model uncertainty
Numo	interested
UKAEA	interested in comparison
YMP	probably focus on 2A

2.2.5 Task 5: Update and review use of analogue data to resolve the key issues identified

Analogues have an important role in communicating information. The EC 5th Framework Project, Nanet due to commence in December 2002, is a review of natural analogue studies and their applications to repository safety assessment and public communication. The third Work Package will review anthropogenic (such as past irrigation practices) and natural analogues for the abiotic near-surface and surface environment. It is simply a desk study, and no new analogue studies will be undertaken.

This Task will mirror the Nanet project, and hopefully the results will be complementary. The focus of the Task Group will be the biotic environment:

- Soil-plant and animal pathways
- Existing analogues involving biotic pathways
- Current and future foodchain pathways (correlates with accumulation) considering societal influence
- Human interaction with future biospheres as they change and the doses that would arise as a result of natural radionuclides (and migration).
- Identify new biosphere analogues.
- Is the analogue conceptually accurate and is the data correct

At present, the Task Group can judge the relevance of an analogue and it is anticipated that the deliverable will include a database of analogues used, several of which have already been suggested:

- uranium mill heaps
- British Geological Survey, soil, sediment, and water maps of Cumbria. Use the maps to try and trace sources (does include abiotic but would be worthwhile to study here).
- a self-evolving biosphere growing around a stream from a uranium mine.
- clay migration and freshwater lakes that were once shallow seas.
- restoration data from a uranium mine in Sweden,
- Nitrate in hydrological models (Newcastle University possible involvement).
- anthropogenic data:
    - from NPP – Posiva have data from 1984/ 1977 but no interpretation of longer years for all radionuclides ever detected. C-14 not measured
    - Iodine data from Cap la Hague, uptake in cows, and German studies. NORM analogues.
    - Iodine data from Karlsruhe

The work programme of the Task will include; brainstorming, collation of information, interpretation, quantification, use in models and ability to validate models, e.g estimate residence time and bioaccumulation. The model and reality can be compared to develop multiple lines of reasoning (rather than model validation).

Those organisations that are interested, and have data that can be reviewed are:

Andra	Interested and have iodine and chlorine data and information on cold zones that can be used. Could possibly obtain other data from Cogema
Posiva	Have data from Finnish reactor sites that can be used as input but no resources to commit. Could review at a later stage
Nirex	Very interested.
MTA	Technical interest, could introduce Eastern European information from the Phare project e.g. Bulgaria.
BNFL	Not very interested but want to be kept informed. May be able to include past data from Sellafield/ Windscale in the study.
Nagra	Interested, but not a lot of information from Switzerland. Would consider reviewing results at a later stage.
ECOmatters	OPG have considered analogues, this information may be able to be included.
Edf	May have information to submit, e.g. C-14 around NPP but timescales being monitored are very short and measurements of soil are shallow

Studsvik	Interested and have data for some uranium sites. Can revisit Espa data from SKB.
JSI	If it is initially successful could become involved at a later stage.
Alexandria Sciences	Technical contribution at a later stage by creating a model to compare with the data from the real environment
Ciemat/ Enresa	Interested and will examine data to find suitable data for the project (e.g. uranium mines) and can involve colleagues (Pedro Haman).
Numo	Could provide information (including JAERI) but Japanese study is focussing below ground.

2.2.6 Task 6: Develop guidance on modelling environmental change

BIOCLIM is due to provide narratives of climate driven environmental change, but not the details of models for assessing the dose implications. BIOMOSA is considering fixed biosphere systems, but is also considering the sensitivity of results for those systems to some important parameters. The variant parameter values are being chosen, among other things, to reflect different climate conditions. This work is on-going and due for completion in 2003.

It is anticipated that some model parameters will need to, to adequately represent the changing system, e.g. hydrological cycling, topography and erosion change, based on a narrative to determine what to take into account, e.g. landscape modelling for Drigg.

It is suggested the Task Group review models from several countries representing different regions and therefore climatic zones, e.g. depending if getting colder or warmer or dryer or wetter e.g. Sweden <> Spain. The Group can then consider if the change would create an enhanced release and subsequent exposure, e.g. due to release of an accumulation built up at the geosphere-biosphere interface.

The Task Group might also consider:
- Changes to be made to the societal systems to match the physical changes to the system.
- How humans change the system; dams, lake drying, urbanisation.

These human related possibilities for changes to the environment can be considered during 2003, and then combined with consideration of the BIOCLIM and BIOMOSA outputs thereafter.

Those organisations that are interested and have information or resources they can donate to this Task are detailed in the Table below:

Andra	Interested, Bioclim output can feed in and require modelling work to be completed before end of 2003.
Posiva	Not interested in long time frames and climate change but are considering land uplift effects in wetland areas.
Nirex	Interested, but have a lack of resources to support the Task at present
MTA	Technical interest
BNFL	Interested and can probably offer input
Nagra	Have considered long term development in the past so not a top priority now. Previous output can be provided at a relevant time
Ecomatters	Not a priority

Edf	Not interested
Studsvik	Similar position to Posiva, as considering different evolution scenarios, may have information that can be provided.
JSI	In late 2003 will consider the changes implemented in the models and codes.
Alexandria Sciences	Can provide input
Ciemat/ Enresa	Are considering anthropogenic change and problems with credible steady state models. Are primarily interested in anthropogenic change everything else will wait
Numo	Interested and may have contributions to make

2.2.7 Task 7: Develop guidance on modelling transfer of contaminants across the geosphere-biosphere interface zone (GBIZ)

This Task involves modelling the migration of radionuclides across the geosphere-biosphere interface zone. It will use the output from natural analogues, expanding on a suitable analogy of the GBIZ then assess the FEPs of relevance in that zone. Dispersion, dilution, retardation and concentration all occur in this area The Task Group can then develop guidance for how to model across different interfaces based on different analogues.

There is concern about how the GBIZ is considered because it is an artificial concept and a conceptual problem that only occurs in models. Historically there has been a gap between geosphere and biosphere models, when collecting data and modelling. Now want to consider the two together for consistency. It would be very useful to include a geosphere modeller in the Task Group.

It is anticipated that the deliverable will include a list of issues and how to address them, and a glossary depending on type of scientific community.

Interest and participation in this Task is as follows:

Enresa	Interested and will try to include a geosphere modeller.
Numo	Interested and would like to participate
Andra	Interested but doubt they have the resource and time to commit.
Alexandria Sciences	Interested and maybe working on SSI timescales at GBI that could be contribute
Studsvik	Interested, and note the overlap with site investigation/ characterisation
OPG	Recognised that work was needed in this area and subsequently rebuild the interface in models. The emphasis is now elsewhere.
Nagra	Will consider in future when the aims are more clearly defined. Have done some assessments already.
BNFL	Interested have done some work on this
MTA	Technical interest and notes it can be very difficult to couple the near and deep hydrology etc
Nirex	Would contribute from the point of view that there is not a GBIZ issue
Posiva	have some resources from other studies but they may not be available very soon.

2.2.8 Task 8: Model-data validation exercise(s),

This Task involves completing a data validation study, by using models and a system that has been validated, with the aim to get the same results. For example, the French Government are conducting a study using data from Cap la Hague, with results compared between the marine and terrestrial real data and the models. For Caesium, the codes have given higher results than the environmental measurements show.

This Task may be combined with Task 5, natural analogues, because a good dataset from Task 5 can be the basis for this validation exercise.

Nirex have developed a procedure for blind validation, how to complete scientific validation, justification, assess fitness for purpose and deal with data gaps. This information can be compared with other models (in particular look at transport and migration, an area where biosphere models are often poor). However, not all datasets are owned by Nirex which may cause a problem with information sharing.

The Shetran code could be used as a benchmark because it has already been validated against real world data for water flow validation and down-slope chloride studies. If a Task Group includes a member of an agricultural organisation that can supply nitrate data, Shetran would be a good code to use. Lysimeter studies can also be used to validate various components of the system rather than a whole model.

Initially, the Task should identify other (non-analogue) data sets that can be reviewed and commented on before completing an actual data validation exercise. Subsequently, the Group can decide how to validate the data.

Interest in this Task Group is as follows:

Andra	Are interested but too big an issue to be active in the Group because focus is elsewhere. In future, may participate with Aquasim. Edf may have some information.
Posiva	Not a priority as no biosphere models of their own
Nirex	Interested and can contribute datasets and want to know about others.
BNFL	Potentially interested in Shetran bridging the gap between real world and models
Nagra	Not of great interest but possibly some information to submit
ECOmatters	Interested in the analogue side of the validation exercise
Studsvik	Interested in gaining support for scientific justification but don't have that much experimental data to contribute.
NRPA	may have technical contributions to make as linked to agricultural university
Alexandria Sciences	Possible interest in the future from modelling perspective
Ciemat/ Enresa	Interested in review of protocols and models.
NUMO	Not very interested, will keep a watching brief.

2.3 Theme 3: Site Investigation, Experiments and Monitoring

2.3.1 Task 1: Develop guidance on biosphere site specific characterisation

This Task involves developing guidance on how to characterise sites to facilitate the biosphere aspect of a Performance Assessment, e.g. soil characterisation, mobility, phyto-availability of elements, minerality, element dependent parameters, amongst others. It is also relevant to safety compliance and public confidence now, which are issues not so interested in the far future. It can also feed into EIA for the operation of a plant, which prevents doing the same assessment twice.

The Task Group should consider how modellers characterise sites now, and how this relate to conditions expected in the far future. It can be analogous, so the guidance should reflect this. The BIOMASS system description will be used but focussing on the key radionuclides within BIOPROTA Some features or processes will be common to several sites, others more specific, e.g. uplift in Sweden, is used to characterise litho-stratigraphy because it affects the biosphere or will become the biosphere in the future. This Task will also illustrate how good the biomass proposals were for methodology characterisation, include potential evolution characteristics.

The main deliverable of the Group is to develop guidance, however time and resources permitting, the Group could demonstrate it at a site (real or pretend).

Participation interest is detailed below:

Andra	Interested
Posiva	Interested, already selected a site so can provide input EIA are the driver but the data could be used in PCSA.
Nirex	Not a priority, but will watch because of the real work feeding into reference biospheres and can offer past Sellafield characterisation.
BNFL	Drigg characterisation – probably information, eg. Interesting coastal erosion info to offer
Nagra	Not characterised real surface biosphere but have done long term evolution assessments and consequences which may be of interest to this group (in German so usually not so available)
OPG	Canadian considerations are more generic too dangerous an issue
Studsvik	SKB produced reports on characterisation because are considering sites (geologically) but not yet started the biosphere work. Watching brief and interested.
Ciemat/ Enresa	Interested consider based on BIOMASS. ACR wants to keep a watching brief.
Numo	Interested could possibly make a contribution

2.3.2 Task 2: Develop protocols for design of research intended to support long term biosphere assessment

This Task will not be time or resource intensive and is not as urgent as most. It will focus on what sorts of experiments are appropriate, e.g hypothesis related, how to gather data and develop understanding.

Mike Thorne will write a protocol for all to consider and give feedback for what experiments are needed, and the resource implications for interpretation in an assessment context. This can be considered at the next meeting.

2.3.3 New Research to consider

Imperial College, London, have been conducting column experiments for chlorine, iodine and technetium for several years. The next stage of the research includes experiments using selenium. Nirex currently contribute to the programme but the budget has been reduced, leaving the experiment without enough money to continue as planned. Nirex have suggested that BIOPROTA or individual organisations through bilateral support can help fund, and therefore direct the project to enable the programme to continue and the objectives to be met. Any organisation that does contribute will have access to all unpublished data and the radiochemical database. The experiment datasets could be incorporated into models too. The selenium stage of the programme is due to start in April 2003.

Those potentially interested in collaborating on this project are:

- The Swiss Control Agency may be interested as have done complementary studies. Nagra suggest Nirex contact them to discuss.
- Andra looking at Se in microbial action in soil, so would be interested in collaborating, and are already working with Imperial College on chlorine experiments.
- Ciemat thinking of an experimental program next year, which didn't include Se, but the other information would be useful. Don't know about money to commit.
- Studsvik will mention to SKB.

3 WORK PROGRAMME AND SCHEDULE

The objective, target deliverables and nominated task group leaders for each Task are listed below:

3.1 Theme 1

Objective: Creation of a specialised database for key combinations of FEPs and radionuclides.
TGL: the TechSec, acting as 'administrator' for application of the Nirex database. Nirex has agreed to make the database functionality freely available to BIOPROTA.
Goals: structure and style of database content to be confirmed by March 2003; working material draft including material for at least 4 key radionuclides, Cl-36, Tc-99, I-129 and NP-237, by 30 September 2003. (C-14 was also identified as a high priority radionuclide, but has a special Task under Theme 2.)

3.2 Theme 2

Task 1:
Objective: Model review and comparison for spray irrigation.
TGL: U Bergstorm (Studsvik).
Goal: working material report comparing the modelling approaches, identifying the data issues, and suggesting relevant approaches for models and data and/or recommending further research, 30 September 2002.

Task 2:
Objective: Model review and comparison for inhalation.
TGL: W. Wu (USDOE YMP, TechSec to confirm USDOE YMP acceptance of this role).

Goal: working material report comparing the modelling approaches, identifying the data issues, and suggesting relevant approaches for models and data and/or recommending further research, 30 September 2002.

Task 3:
Objective: Model review and comparison for C-14 dose assessment.
TGL: to be confirmed. (Organisations, are very interested in this topic. TechSec to contact and advise.)
Goal: working material report comparing the modelling approaches, identifying the data issues, and suggesting relevant approaches for models and data and/or recommending further research, 30 September 2002.

Task 4:
Objective: Comparison of assessment models applied to BIOMASS Example Reference Biospheres, assessment context and system description 2A and 2B.
TGL: A Albrecht (Andra).
Goal: definition of comparison exercises by March 2003 and completion of working material report on comparisons for 30 September 2002.

Task 5:
Objective: Review of biotic natural analogues (combined with Task 8).
TGL P Degnan (Nirex).
Goal: List of relevant biotic analogues, end February 2002, then review of these to identify processes relevant for consideration in biosphere part of performance assessment, qualitative suggestions for how to consider, quantitative suggestions for how to consider and, if possible identification of analogues providing a suitable basis for model testing. Working material report end September 2003.

Task 6:
Objective: Assessing environment change.
TGL: P Pinedo (CIEMAT).
Goal: Working material report September 2003 addressing radionuclide behaviour given human induced change (Later stage may consider other changes taking account of BIOCLIM and BIOMOSA output.)

Task 7:
Objective: Review processes at the Geosphere-Biosphere Interface Zone (GBIZ).
TGL: P Pinedo (CIEMAT).
Goal. Working material report September 2003.

3.3 Theme 3

Task 1:
Objective: Site characterisation in context of biosphere assessment.
TGL: E Leclerc-Cessac (ANDRA).
Goal: Working material report end September 2003.

Task 2:
Objective: Experimental and monitoring research protocols.

TGL: M Thorne (Mike Thorne and Associates).
Goal: Working material report on guidance for site characterisation by September 2003.

All Tasks have specific goals within the coming 12 months. Further work beyond that period on many Tasks can be anticipated, e.g. to test the implementation of recommendations made to date, such as modelling processes of transfer in the GBIZ under environmental change, and application of biotic analogue data to test models, perhaps also using NANet project data for the abiotic component of the system.

3.4 Future Workshops

It is anticipated that work within Task Groups will proceed via email communication. Small meeting may be useful, e.g. between the TechSec and those involved in setting up the specialised database.

A common set of issues arises for Theme 2 Tasks 1 to 4, in terms of the process of possible model comparison procedures. Given this and the collective interest of many participants, and the likely need to discuss and agree issues within all Tasks, a Workshop of similar scale to Oslo, is planned for April 2003. F van Dorp offered to host at Nagra.

A meeting for presentation and discussion on draft working material is also anticipated for September 2003. Such a meeting will also provide a basis for further work in BIOPROTA, beyond September 2003. A location is yet to be confirmed.

Practical suggestions for new experimental and monitoring research may arise at any time. Such suggestions could be taken up within BIOPROTA or by individual organisations, according to priorities and resources available. While a clear set of technical output is suggested above for the first year to September 2003, it is suggested that the BIOPROTA program could continue according to the activities outlined over a period of three years.

4 ACKNOWLEDGEMENT

All participants expressed their thanks to NRPA for hosting the Workshop and providing excellent facilities and hospitality.

5 REFERENCES

BIOPROTA (2002a). BIOPROTA Key Issues in Biosphere Aspects of Assessment of the Long-Term Impact of Contaminant Releases Associated with Radioactive Waste Management, Report of Workshop 12-14 June 2002, hosted by Andra, Chateney-Malabry.

BIOPROTA (2002b). BIOPROTA Key Issues in Biosphere Aspects of Assessment of the Long-Term Impact of Contaminant Releases Associated with Radioactive Waste Management, Project Concept and Definition Version 2, September 2002.

APPENDIX A: BIOPROTA: IMPLEMENTING THE TASKS
Oslo, October 2002

Introduction

The following ideas are suggested for implementation of the BIOPROTA Tasks identified in the Concept and Definition Document under the three Themes:

1. Specialised Database,
2. Modelling, and
3. Site Investigation, Experiments and Monitoring.

These suggestions are intended for discussion at the Workshop in Oslo at the end of October. Any comment or feedback before then is most welcome.

Presentations about and discussion of these ideas can then be fitted into the agenda. The draft agenda is included at the end of this note for your convenience.

Theme 1: Specialised Database

Task 1. Create Database for Key Radionuclides and Process Data (Initially: Cl-36, Np-237, C-14, U series and B, Pb)

- Specify the data required
- Design and construct the database
- Investigate the particular items, setting the context and the range of applicability
- Populate the database
- Make suggestions for revised models in light of data quality and/or further experimental and/or monitoring work

The above bullets are assumed to be in a logical order. When we know what we want, then we can design the structure, and so on. The overall objective is to provide data recommendations for use in particular circumstances relevant to long term assessment contexts, and the scope is for key contaminants and key processes. (There is also interest in having a database which includes all data for all contaminants. Such a 'one-stop-shop' would be convenient, but a comprehensive database would be very ambitious, eg if it included non-radioactive contaminants too, and applied for all potentially relevant biosphere systems. Perhaps this should be discussed further.)

So, even though the Paris workshop identified some key processes for the contaminants chosen above, all participants are requested to think again about what information they wish to see included and hence how the database should be structured. To help us, Pinedo (CIEMAT) and Thorne (for Nirex) have agreed to make presentations on their experience in development and use of databases in this context. If others wish to offer presentations or actual database systems, please let the Technical Secretariat know as soon as possible.

Discussion should lead to updated requirements for each contaminant and options for implementing on a database.

It is suggested here that two or three participants might then be identified to collate the relevant information (taking account of the BIOMASS data protocol, among other things) for each contaminant. The intention is to identify those with the best existing expertise and to share the workload. Please consider which areas you have most interest and ability to support. An alternative approach would be to identify those with expertise in an environmental sector, e.g. the aquatic environment, and ask a small group to collate data for all contaminants in a sector.

Decisions need to be made on a relatively short time-scale in order for work can proceed. However, parallel working on database design and what to put in it can go on.

This Task is complicated and so quite a lot of time is allocated for discussion on the Agenda.

Theme 2: Modelling

Task 1. Develop guidance on aspersion modelling

2.4 Compare current models, identifying differences and why they arise
2.5 Review and consider adequacy of data
2.6 Develop guidance for modelling and possible further experimental and/or monitoring work

Please will each organisation consider if it would like to offer an aspersion model to be included in the comparison. If possible, please let the Technical Secretariat know in advance of the meeting.

Such comparison should include the context in which it is used, the treatment of FEPs (inclusion and exclusion), the mathematical representation of included FEPs, and the data used in implementing the comparison. (It is suggested here that we are not interested in checking that the mathematical equations are being solved correctly, though others may wish to consider this also.)

Those organisations wishing to offer their model, plus anyone with special knowledge in this area can form a task group. It would be convenient to identify a task leader, though this could be the Technical Secretariat. A structure and timetable for the review and comparison should be developed in Oslo, and it should be possible to arrange an immediate exchange of information. It may be useful to include some illustrative calculations to determine what difference the different modelling assumptions can make. NB BIOMASS Theme 1, Example Reference Biosphere 2A did consider the effect of some modelling differences, e.g. explicit consideration of the effect of including the time between irrigation and time of harvest, instead of an averaging approach. However, BIOMASS did not draw conclusions on this issue, indeed, rather pointed to the lack of data making it difficult to explicitly model all the processes than provisionally appear relevant, especially for some contaminants.

Task 2. Develop guidance on the inhalation pathway for actinides accumulating in soils/sediments

2.7 Compare current models, identifying differences and why they arise
2.8 Review and consider adequacy of data
2.9 Develop guidance for modelling and possible further experimental and/or monitoring work

The same approach is suggested here as for Task 1. Please let the Technical Secretariat know if you would like to include a model in a comparison exercise, or if you would like to participate in

this Task. Again, please note that some sensitivity calculations were made in BIOMASS Theme 1, Example Reference Biosphere 2A, but no conclusions were drawn on some key points: e.g. long term accumulation, relative concentration of contaminant in the soil compared with that in the suspended dust (does the suspendable material have a higher affinity for the contaminant?), AMAD of the suspended material and effect on appropriate choice of dose coefficient, chemical form of dust attached contaminant and effect on appropriate choice of dose coefficient.

Task 3. Review modelling of C-14 behaviour in soil and uptake into crops and develop recommendations relevant in particular circumstances. (May later also consider Cl-36, Tc-99 and I-129, depending on priorities and outcome of work in Theme 1.)

Please will those organisations with a special interest in this topic prepare thoughts and ideas on what they would like to consider further, taking into account the discussion in the Paris Workshop report. If you would like to make a presentation, even just to present one issue, please let the Technical Secretariat know in advance.

Task 4. Updated Model-Model comparison exercise, as in BIOMOVS II [JER, 1999] but taking account of site specific issues, regulatory and other developments. A key issue will be modelling long term accumulation.

Please will those with an interest in this Task prepare a brief note on what they would hope to achieve from a comparison and how they would propose to carry it out.

Without wishing to prejudice that input, we can recognise the generic type of comparison which was made in BIOMOVS II (Technical Report 12, if anyone would like a copy of this report, please ask the Technical Secretariat.) Here, a generically relevant scenario for release into an inland site with several GBIs was considered and the approaches adopted in a variety of models compared, in terms on processes and the results of calculations for an assumed release from the geosphere. A wide range of exposure pathways was considered. Such an exercise could be repeated and brought up to date.

Alternatively, or in addition, more specific scenarios could be developed and those interested could apply their models and then comparisons can be made. This would be similar to Tasks 1 and 2 above, but focussed on topics other than C-14 and aspersion. One aspect would be to consider the models for long-term accumulation in soil, noting the BIOMOVS II Technical Report 16 which compared differently structured models for this process.

NB. BIOMOSA models being developed for sites within Europe could be relevant. Pinedo (Ciemat) participates in BIOMOSA and so she can advise so that we do not duplicate.

Task 5. Update and review use of analogue data to resolve the key issues identified, including data from monitoring of nuclear facilities and data from natural analogues, including those modified by man.

A number of possible analogues for long term release to the biosphere have been identified, see discussion in Paris Workshop report. They include releases of man-made radioactive material from operating plant and waste disposal facilities and well as natural releases. The intention should be that the output can support justification of data included in the Specialised Database, and/or support improvements in models for aspersion, etc.

It is suggested that a Task team be created to look at the possibilities for obtaining useful data from analogues and an agenda for that team be developed in Oslo.

Degnan (Nirex) has volunteered to introduce discussion with a brief presentation on the new FP5 EC analogues project, NANET, which will begin this year.

Task 6. Develop guidance on modelling environmental change

- Identify changes of interest (NB. BIOMASS Theme 1 Example 3, and BIOCLIM output)
- Develop guidance on how to deal with these changes in describing the system (NB. Note output from BIOCLIM)
- Identify how to model contaminant migration and exposure under such system change.

Time in the agenda should be allowed for discussion on each of the three bullets above, noting that change could be natural or human induced.

One approach would be to apply the BIOMASS Theme 1 methodology for environmental change to the Example Reference Biosphere 2B, ie, to re-do the ERB2B with an assessment context that says that environmental change must be considered (instead of assuming a constant biosphere).

A Task team should then be identified to carry out the work. Please inform the Technical Secretariat if you have a special interest.

Task 7. Develop guidance on modelling transfer of contaminants across the geosphere-biosphere interface zone (GBIZ)

- Use output from review of analogues (Task 5)
- Develop list of FEPS to consider for different types of interface
- Develop guidance on modelling these FEPs for the different types of interface. (NB BIOMASS Example2B, which includes consideration of different types of near-surface interflow within a catchment.)

Time in the agenda should be allowed for discussion on each of the three above bullets, noting that change could be natural or human induced.

A Task team should then be identified to carry out the work. Please inform the Technical Secretariat if you have a special interest. It is possible that Task 6 and 7 might be combined, as regards environmental changes that affect the GBIZ.

Task 8. Model-data validation exercise(s) based on applying output from Theme 1 and Tasks 4 and 5 above.

Work on this Task naturally depends on the above activities. However, all participants are invited to make suggestions for specific exercises as may be pertinent and practical.

It may be noted that BIOMOVS II attempted to find suitable datasets for model-data validation exercises, but failed to find any suitable very long term time series datasets. However, useful exercises were carried out based on data for Uranium Mill Tailings (BIOMOVS II TR5), for accumulation of C-14 in freshwater lakes (BIOMOVS II TR14) and biota and for uptake into crops from lysimeter experiments (BIOMOVS II TR15). Though of a relatively short-term nature,

decades rather than millennia, the results contributed to confidence in longer term aspects of assessments in these areas. Further datasets may now be available.

Task 9. Develop suggestions for new experiments and monitoring work, based on the above Task output. (Implementation could be carried out by other organisations or within BIOPROTA in subsequent years.)

Suggestions are invited now, but this Task is obviously dependent on the other activities.

Theme 3: Site Investigation, Experiments and Monitoring

Task 1. Develop guidance on biosphere site specific characterisation: identifying types of measurements to be made, why they are useful and including protocols of how they should be made.

The BIOMASS Theme 1 Reference Biospheres Methodology includes the description of the biosphere system. The clearer that description can be, especially in relation to the assessment context, the more likely that subsequent decisions on the assessment biospheres can be better justified. Clearly, site description can be easier if a specific site or sites are under consideration.

This Task is intended to provide guidance on what types of measurements should be made at a specific site, and how they might be made, that would characterise that site in terms relevant to the site description to be used in the post-closure safety assessment. While details would need to be dependent on a variety of site features and also the specific assessment context, such generic guidance would be useful to set the scene for such work.

It is proposed to form a small Task group to consider these issues and develop a Task programme. Andra/ELC will present an example of site characterisation concerning soils characterisation for defining radionuclide mobility relating to critical group localisation. Please inform the Technical Secretariat if you have a special interest.

Task 2. Develop protocols for design of research intended to support long term biosphere assessment

It has sometimes been found that practical research studies and projects supporting assessments do not quite provide the information needed to support the use of the output in the assessments. It is proposed to form a small Task group to provide guidance in this context.

Task 3. Review suggestions coming from Themes 1 and 2 for new work.

Once the Tasks are developed in detail, the main effort is expected to be carried out by small Task Groups with special expertise in the particular areas. Their output may then be peer reviewed by the wider set of BIOPROTA participants. Clearly, this is for later discussion.

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APPENDIX C: OSLO, OCTOBER 2002, WORKSHOP AGENDA

BIOPROTA: Initial Workshop
Oslo, 29-31 October 2002
Tuesday 29 October

AM	Introduction:	- Welcome from NRPA, P Strand - Aims and Objectives of the Programme and Meeting, E Leclerc-Cessac & TechSec - Role of the Steering Committee, and other participants, E Leclerc-Cessac & TechSec - Clarification of key requirements and expected outputs, E Leclerc-Cessac & TechSec - How we will communicate (email/ Task Group meetings/ extranet/ website), TechSec
Coffee		
	Theme 1:	Who/ how is the specialised database going to be created and populated - IUR historic activities on databases, S Sheppard - Presentation of ideas, P Pinedo - Presentation of ideas, M Thorne
Lunch		
	Theme 1:	Continued discussion, review and conclusions
	Theme 2:	Tasks 1-4. Discussion of aspersion modelling

Wednesday 30 October

AM	Theme 2:	Outline structure for model comparison exercise, TechSec Examples of aspersion modelling, Tempere, ECOSYS and BIOMASS ERB2A, A Albrecht & TechSec Discussion of actinide inhalation pathways Discussion of review of C-14 behaviour
Coffee		
	Theme 2:	Discussion about model-model comparison exercises Review and conclusions on Tasks 1-4
Lunch		
	Theme 2:	Tasks 5-8. Discussion about how analogue data can be used - Presentation of ideas, P Degnan Discussion about how to model environmental change - Presentation of ideas, D Texier
Coffee		
		Discussion about how to model the geosphere-biosphere interface zone Discussion on model data validation exercises Review and conclusions on Tasks 5-8

Thursday 31 October

AM	Theme 3:	Discuss biosphere site specific characterisation - Presentation of ideas, E Leclerc-Cessac Discuss protocol development for research Review and conclusions on Theme 3
Coffee		
	Conclusion	Recommendations and conclusions of the meeting, scheduling, prioritisation and Task activities
Lunch		
PM	Summary	Confirmation of Actions Side discussions on individual Tasks