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NUCLEAR ENERGY AGENCY  
RADIOACTIVE WASTE MANAGEMENT COMMITTEE

NEA/RWM/IGSC(2005)4  
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**Integration Group for the Safety Case (IGSC)**

**EBS WORKSHOP ON**

**INTEGRATION OF ENGINEERED BARRIER SYSTEMS IN THE SAFETY CASE: THE ROLE OF  
MODELLING**

**Final Programme**

**La Coruna, Spain  
24-26 August 2005**

*Workshop organised by the OECD/Nuclear Energy Agency*

*in co-operation with the European Commission*

*and hosted by ENRESA, Spain*

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English - Or. English





*WORKSHOP ON*

*INTEGRATION OF ENGINEERED BARRIER SYSTEMS IN THE SAFETY CASE:  
THE ROLE OF MODELLING*

*LA CORUNA - SPAIN*

*24-26 AUGUST 2005*

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## TABLE OF CONTENTS

1.	INTRODUCTION .....	7
2.	GENERAL CONTEXT .....	7
3.	WORKSHOP AIMS .....	10
4.	WORKSHOP STRUCTURE.....	12
5.	WORKSHOP CHAIRPERSONS AND RAPPORTEURS .....	12
6.	WORKSHOP PROGRAMME COMMITTEE.....	13
7.	PRACTICAL INFORMATION/ORGANISATION .....	13
8.	PARTICIPATION .....	13
9.	WORKING LANGUAGE.....	14
10.	ORAL PRESENTATIONS.....	14
11.	REPORTING .....	14
12.	INSTRUCTIONS FOR AUTHORS.....	14
13.	LOCAL ARRANGEMENTS .....	14
14.	REGISTRATION AND PARTICIPATION.....	16
15.	SECRETARIAT AND CONTACTS.....	16
<i>Annex 1:</i>	AGENDA .....	19
<i>Annex 2:</i>	QUESTIONS TO BE ADDRESSED BY WORKING GROUPS.....	25
<i>Annex 3:</i>	INSTRUCTION FOR AUTHORS .....	29



## 1. INTRODUCTION

In 2001, the Integration Group for the Safety Case (IGSC) of the Nuclear Energy Agency (NEA) wished to reassess the need for a project to develop a greater understanding of how to achieve the necessary integration for successful design, construction, testing, modelling, and performance assessment of engineered barrier systems (EBS)<sup>1</sup>.

To this end a workshop was held under the joint auspices of the EC and the NEA, hosted by United Kingdom Nirex Limited (UK Nirex Ltd), at Keble College, Oxford on 25-27 September 2002<sup>2</sup>. The workshop provided a status report on engineered barrier systems in various national programmes<sup>3</sup> and defined the outline scope, timetable and *modus operandi* for a continued international project on the EBS.

The EBS project is being progressed through a sequence of further workshops as follows:

Workshop 1: Design Requirements and Constraints, held in Turku, Finland in August 2003 and hosted by Posiva Oy<sup>4</sup>.

Workshop 2: Process Issues, held in Las Vegas, USA in September 2004, and hosted by US-DOE.

Workshop 3: The role of modelling, held in La Coruna, Spain (theme of this programme)

Workshop 4: Design Confirmation and Demonstration to be held in Japan, in 2006.

At the 4<sup>th</sup> IGSC meeting of 2002, the IGSC members agreed to continue with a project including a series of workshops as proposed above.

*This paper presents the programme for Workshop 3 in the sequence, which will consider “the modelling of the EBS in the safety case and in the design process”.*

## 2. GENERAL CONTEXT

The safety strategy for geological disposal of radioactive waste generally relies on a multi-barrier system. The purpose of this disposal system is to contain the waste and isolate it from the biosphere. This safety strategy enhances confidence that the waste will be successfully managed and disposed. The multi-barrier system comprises the natural barrier provided by the geological environment, and the engineered barrier systems (EBS).

- 
1. The “Engineered Barrier Systems (EBS)” represents the man-made, engineered materials placed within a repository, including the waste form, waste containers, buffer materials, backfill, and seals. The “near field” includes the EBS and those parts of the host rock in contact with or near the EBS, whose properties have been significantly affected by the presence of the repository.
  2. Engineered Barrier Systems (EBS) in the Context of the Entire Safety Case Workshop Proceedings, Oxford, UK, 25-27 September 2002, OECD/NEA 2003.
  3. Engineered Barrier Systems and the Safety of Deep Geological Repositories, State-of-the-art Report, OECD/NEA 2003.
  4. Engineered Barrier Systems (EBS): Design Requirements and Constraints Workshop Proceedings, Turku, Finland, 26-29 August 2003, OECD/NEA 2004.

The EBS may itself comprise a variety of sub-systems or components, such as the waste form, buffer, backfill, seals, and plugs. The purpose of an EBS as a whole is to prevent and/or delay the release of radionuclides from the waste to the repository host rock. Each sub-system or component has its own requirements to fulfil, either by providing the initial isolation of the waste (e.g. the waste form and the container), or by providing retardation and retention capabilities once the waste is in contact with water, or by providing favourable conditions so that other barriers can fulfil their intended function (e.g. the buffer surrounding the container).

Design and performance assessment (PA) of EBS require process models that describe how the EBS and near-field behave under anticipated repository-relevant conditions. Research or process models justify, or demonstrate, the scientific and technical basis for simplified performance assessment models. These process models must describe coupled hydrologic, thermal, chemical, transport, and mechanical processes. In addition, the future evolution and potential disruption of the environmental conditions in the near-field and EBS must be considered. Such an integrated assessment of the EBS is further complicated by uncertainties that arise from incomplete understanding of processes, limited information, and lack of data. A systematic approach to EBS model development must be taken to alleviate these complexities, to ensure adequacy of EBS models, and to help build confidence in a safety case.

PA models are used to develop an assessment of overall system performance for comparison with safety standards and other requirements. Uncertainties in disposal system performance can be accounted for using conservative assumptions, probabilistic techniques, deterministic sensitivity studies, and “what if?” calculations.

Uncertainties often relate to the determination of parameter values that are representative of the large spatial scales and long time scales of interest to radioactive waste disposal (e.g. long-term metal corrosion and glass dissolution rates, large-scale radionuclide dispersion coefficients). Other relevant performance assessment uncertainties include parameter values for thermodynamic data, geochemistry and radionuclide retardation, long-term buffer stability and spatial heterogeneity.

In view of this analysis, it was found helpful at the Workshop on Process Issues to define the modelling framework. It was recommended that a systematic approach to EBS model development and EBS performance assessment should include in this context the following key elements:

1. Implementation of a FEPs Approach –

Assurances must be provided that the selection of FEPs, and the exclusion of FEPs, has been carefully and correctly done in a systematic, traceable manner. Those FEPs that are not excluded should be represented in the EBS models.

- Identify potentially relevant FEPs.
- Screen FEPs using defined criteria.
- Construct relevant scenario classes.

2. Quantification of Uncertainty and Variability –

Uncertainty is an inherent part of EBS studies. Information gathering activities should be directed at reducing uncertainty as much as is practical. However, because of variability in

the near-field and EBS, and limited understanding about how processes will operate in the future; uncertainty cannot be totally eliminated and should be explicitly addressed.

- Epistemic uncertainty – arises because of imperfect knowledge, can be reduced by additional information.
- Aleatory uncertainty – refers to, for example, future events where it is not certain that the event will occur.
- Model uncertainty – arises because of incomplete understanding and characterization of FEPs.
- Data uncertainties- arises because of epistemic and aleatory uncertainties.
- Heterogeneity in physical and performance characteristics.

### 3. Sensitivity Analyses –

Many EBS processes are complex and/or nonlinear and model input parameters are so uncertain and/or variable. It is difficult to obtain an understanding of what the critical uncertainties and sensitivities are from a simple evaluation of model results. To this end, a structured approach must be used to examine sensitivity of model results to uncertainties and assumptions in model inputs.

- Determine which uncertain variables have greatest impact on the overall uncertainty in model outcomes.
- Determine variables, which have greatest impact on the overall outcome of the models.
- Examine what happens when the system is stressed via unfavourable parameter values, assumptions, or alternative conceptualizations.
- Help identify relevant aspects of individual process models for incorporation into the safety analyses.

### 4. Model Validation and Limitations –

Case needs to be made that the models adequately (reasonably or conservatively) represent the behaviour of the EBS – on the basis of:

- process understanding;
- selection of inputs and examination of alternative conceptualisations, data;
- justification of assumptions, analogues and simplifications; and
- reasonableness of outputs, and sensitivities with consistent treatment of uncertainties between EBS models.

At the 2<sup>nd</sup> Workshop held at Las Vegas in September 2004, participants discussed how processes are determined to be important, how they are considered in the design and performance assessment of the EBS, and how they are accounted for in a systematic, defensible, and traceable manner.

At this 3<sup>rd</sup> Workshop, discussion on the role of modelling when integrating the EBS in safety case should focus on the necessary integration of successful design, characterisation and performance assessment, reflecting lessons learnt from performance assessments which include:

- Adopt a methodical, systematic and fully documented approach to repository design and optimisation.

- Define simple designs that are easier to implement and verify.
- Apply models of different level of complexity (abstraction process).
- Integrate EBS design and performance assessment activities within iterative optimisation cycles.
- Ensure, and demonstrate, design feasibility.
- Continue to build confidence in performance assessment.
- Focus on the most important issues (e.g. through the use of risk-informed approaches).

### 3. WORKSHOP AIMS

Following on from the 2<sup>nd</sup> workshop on process issues, the **3<sup>rd</sup> workshop** aims to consider the strategy for selection of models to deal with uncertainties and to reflect the level of understanding that has been achieved. In particular, it will focus on the role of modelling in reflecting key functions of the EBS and the extent to which the functions are fulfilled:

- to consider how performance assessment and process models can be used to: i) inform the choice of appropriate EBS designs, e.g. through the consideration of design alternatives; and ii) to identify key design and research and development priorities;
- to demonstrate the use of models in the approach to EBS design optimisation for deep geological disposal; and
- to consider the development of guidelines on the level of detail required in modelling to ensure appropriate input to EBS design and optimisation.

#### **The goals of the workshop are to:**

- share ideas and experiences in the consideration and implementation of the four key elements of EBS model development outlined in the previous section;
- promote a common understanding of what the four key elements entail and to seek approaches to their implementation;
- discuss specific examples where one or more of the key elements have been implemented in the context of EBS assessment and design; and
- propose and discuss additional and/or alternative elements of EBS model development and analysis that will help build confidence in the safety case.

#### **The following main topics of the working groups are envisaged:**

- **Working Group A: *Process Models***

This group will be devoted to the discussion of the features, requirements, approaches, applications, etc, which characterise process models that support design and performance evaluation. It will have to address issues such as:

- Approaches to detailed modelling of EBS in PA and design.
- Treatment of uncertainties and consideration of variability.

- Selection of FEPs represented.
- When and why do couplings need to be translated to the assessment models?

- **Working Group B: *Performance Assessment Models***

This group will analyse the different performance assessment models which are utilised to assess the performance of EBS, addressing issues such as:

- When are simplifications in PA models acceptable? Why are they needed at all?
- Application in uncertainty and sensitivity analyses.
- When do these models have to address the time evolution of the EBS?

- **Working Group C: *Interactions between Process Level Models and Performance Assessment Level Models in the Context of the Safety Case***

Performance assessment models and process level models are related to each other in a number of ways: in the logic of the abstraction process, setting boundary conditions and input values, giving scientific support and justification to modelling decisions, paving the way in the confidence building process, etc. The group will gain insight in these relationships by answering questions such as:

- How are process models and PA models best articulated in the arguments for safety?
- How do both types of models relate to each other in the modelling work (e.g. assumptions, choice on input values, simplifications, etc)?
- Does the present state in PA call for improvements in models?

- **Working Group D: *Feedback from the Safety Case (especially from Process Level Models and Performance Assessment Level Models) on Repository Design, and Design Optimisation, and on the Experiments Required to Develop Understanding and Build Confidence in the Contribution of the EBS to the Overall Safety Case.***

Models are fundamental tools in the design and design optimisation processes. This group will focus on the role of models in the iterative design process of the EBS systems, discussing questions such as:

- How modelling and in particular sensitivity analysis can be used to demonstrate the robustness of an EBS design?
- What is the role of PA in the design process; for example, in relation to articulating the information needed from experiments?
- Is there any need for further model development to give feedback to repository design?
- How experiments (in particular, modelling of experimental results) can be transferred to repository conditions?

#### 4. WORKSHOP STRUCTURE

**ENRESA will host the workshop in La Coruna, Spain, with the support of Universidade da Coruña (UDC). The workshop will last two and a half days, and will be structured as follows:**

- **Plenary Session on 24 August 2005:**

The first day of the workshop will consist of a plenary session. After the introductory address by hosts and organisers, the session will be devoted to technical presentations related to the theme of this workshop, followed by short discussions. They will start with a reminder of the achievements and conclusions of the 2<sup>nd</sup> workshop, in Las Vegas (U.S.A.). Then a series of oral presentations will discuss practical examples on topics within the scope of working groups A, B, C and D issues as described in section 3.

- **Working Group Sessions on 25 August 2005:**

The second day will be devoted to working group (WG) sessions. Working groups will be reminded of their objectives and intended means of working at a brief introductory plenary session at the start of the day. The topics and issues of each WG are described in section 3. The working groups will be asked to address a small number of key questions relevant to their topic among the list within Annex 2. Each WG will include a range of relevant specialists with expertise in modelling, performance and safety assessments, representing implementers, regulators and R&D body. WG participants are invited to bring with them publications, figures or in general, materials which can be helpful for the group.

- **A Round-Up Plenary Session on 26 August Morning:**

The morning of the third day will comprise a round-up plenary session at which the working groups will report back to the full workshop on general lessons that can be drawn regarding the key questions. The day will continue with a plenary discussion on the findings from both of the previous days. It will include exchanges on any recommendations for the 4<sup>th</sup> and last EBS workshop and agreement of logistical steps for publication of the 3<sup>rd</sup> workshop proceedings.

#### 5. WORKSHOP CHAIRPERSONS AND RAPORTEURS

A chairperson, who will be assisted by a rapporteur, will lead all workshop sessions. Chairs and rapporteurs for the plenary sessions will be confirmed in the final agenda. Chairs and rapporteurs for the working group sessions will be determined and/or confirmed prior to the workshop by the Workshop Programme Committee based on nominations from organisations intending to participate in the workshop and these will be identified to all participants in the final programme, which will be sent two weeks before the workshop at latest.

During the plenary sessions, the work of the chairperson will be to introduce speakers, keep the session on schedule, keep in mind the objectives of the workshop, and motivate participants for discussion. During the plenary session, the rapporteur will maintain a record of the discussions for subsequent use in developing the workshop proceedings.

Working Group Chairs will have the role of leading the work of their group and ensuring that all participants will have the opportunity to share their experience, and that the group remains focussed on the relevant questions. On the third day of the workshop, the Working Group Chair (or rapporteur) will present the findings of the group to the full workshop; these findings being prepared in collaboration with the rapporteur.

WG rapporteurs will maintain a record of the group's discussions for use in developing the oral presentation on the last day and to support the workshop proceedings.

## 6. WORKSHOP PROGRAMME COMMITTEE

The Workshop Programme Committee consists of:

ALONSO, Jesus (chair)	ENRESA, Spain (Host)	jald@enresa.es
HOOPER, Alan	UK Nirex Ltd	alan.hooper@nirex.co.uk
JOHNSON Lawrence	Nagra, Switzerland	lawrence.johnson@nagra.ch
PLAS, Frédéric	Andra, France	frederic.plas@andra.fr
RAYNAL, Michel	EC	michel.raynal@cec.eu.int
SELLIN, Patrick	SKB, Sweden	skbps@skb.se
WOLLRATH, Jürgen	BfS, Germany	JWollrath@bfs.de
TOVERUD, Oïvind	SKI, Sweden	toverud@ski.se
UMEKI, Hiroyuki	JNC, Japan	umeki.hiroyuki@jnc.go.jp
VAN LUIK Abe	US-DOE, USA	abe_vanluik@notes.ymp.gov
VOINIS, Sylvie	OECD/NEA	sylvie.voinis@oecd.org

The role of the Workshop Programme Committee is mainly to organise the workshop, and specifically, to:

- define the format of the workshop and conditions of participation;
- identify and describe the technical sessions and working groups to be convened;
- identify chairpersons and rapporteurs for plenary and working group sessions;
- suggest speakers and prepare the instructions for the authors; and
- review the proceedings.

## 7. PRACTICAL INFORMATION/ORGANISATION

The workshop is an NEA workshop supported by the EC and organised in the framework of the OECD Nuclear Energy Agency, Integration Group for the Safety Case – IGSC.

ENRESA is kindly hosting the workshop at La Coruna, Spain on 24-26 August 2005.

## 8. PARTICIPATION

The EBS Project is open to organisations of all NEA Member Countries active in the field of radioactive waste management, particularly with respect to disposal system design, assessment and optimisation. It is intended that, to a large extent, workshop attendees will come from, or represent, the IGSC member organisations.

All attendees are required to take active part in the workshop and are encouraged to bring or eventually send in advance to the workshop relevant examples and materials (e.g. reports, software) from their disposal programme.

## **9. WORKING LANGUAGE**

English will be the working language of the workshop and the proceedings.

## **10. ORAL PRESENTATIONS**

Presenters are requested to provide an electronic version of their oral presentations in advance of the workshop in order to provide a CD-ROM of all presentations and available information at the workshop.

## **11. REPORTING**

The workshop will be reported in a proceedings volume, which will comprise a synthesis of the presentations, discussions and findings of the workshop, and the written contributions from the Working Groups. The Programme Committee will review the proceedings before publication. A copy of the proceedings will be distributed free of cost to all workshop participants.

## **12. INSTRUCTIONS FOR AUTHORS**

Authors are requested to structure their papers by following the four topics as described in section 3 and so that they address:

- Methodology.
- Specific examples.
- Issues and problems.

Authors are requested to provide an electronic copy of their complete paper (at least 4 pages and maximum 10 pages) to the NEA Secretariat with a copy to the Workshop Programme Committee (e-mail addresses: see section 6 of the programme).

In order to facilitate the publication of the proceedings, authors are requested to follow the instructions presented in Annex 3 very carefully.

## **13. LOCAL ARRANGEMENTS**

The workshop will take place at the University of La Coruña, Rectorado (headquarters) Building, located in the old town, close to Jardín de (Gardens) San Carlos, Calle Maestranza 1, 15001 A Coruña (Spain).

### ***Accommodation***

- **40 rooms** (maximum allocated) had been pre-booked at:

Hotel NH Atlantico  
Jardines de Méndez Nuñez,  
A Coruña  
Phone: +34 981 226500  
Fax: +34 981 201071  
Website: [reservas.nhatlantico@nh-hotels.com](mailto:reservas.nhatlantico@nh-hotels.com)

Price: 99 € individual room, plus TVA (7%). Breakfast included

- **10 further rooms** had been pre-booked at:

Hotel Melia Maria Pita  
Avenida Barrié de la Maza 1  
A Coruña  
Phone: +34 981 205000  
Fax: +34 981 205565  
Contact : [susana.alvarez@solmelia.com](mailto:susana.alvarez@solmelia.com)

Price: 110 € individual room, plus TVA (7%). Breakfast included

**PARTICIPANTS ARE ASKED TO MAKE THEIR HOTEL RESERVATION  
INDIVIDUALLY BY FAX OR E-MAIL  
Do stipulate: “EBS Workshop”.**

### ***Lunch***

Lunches for Workshop participants will be served at the meeting building. The price, from 10 to 15 €/lunch (to be confirmed) will be paid individually at the time of registration. The number of lunches required (two or three) will be specified by participants to the host organisation before the start of the workshop.

There will be a social program on Wednesday 24, including a workshop dinner offered by ENRESA.

### ***Transportation***

Participants are advised to fly directly to the A Coruña Airport.

Alternatively, the airport of Santiago de Compostela is located at a distance of about 60 km. The taxi fare may range from 60 to 70 €.

Hotels are both within walking distance from the place of the meetings (about 15 min. walk)

La Coruña/A Coruña enjoys a humid mild climate. Sunshine is not guaranteed! There is often a breeze, as the city is sited on a peninsula projecting into the ocean.

#### 14. REGISTRATION AND PARTICIPATION

A participation fee of **500 Euro** is requested from all attendees in order to cover:

- The cost of the consultant, David Bennett, GSL, who will be helping the NEA document the workshop, and in particular, drafting the workshop proceedings.

**The registration fee** should be paid in EURO no later than the **25th of August 2005** by bank transfer to the following account:

##### **For French participants**

Bank:	<b><u>JP Morgan Chase Bank, Paris, France</u></b>
Account number:	<b>30628-00001-0060908330294</b>
IBAN:	FR76/3062/8000/00100/6090/8330/294
SWIFT/BIC:	CHASFRPP
Siret:	775 687 957 00016
References:	<b>AEN/EBS Workshop La Coruna</b>

##### **For participants except from France:**

Bank	<b><u>JP Morgan, AG, Frankfurt, Germany</u></b>
Account number:	6161603441
BLZ:	50110800
SWIFT/BIC:	CHASDEFX
IBAN:	DE95501108006161603441
References:	<b>AEN/EBS Workshop La Coruna</b>

<b><u>Attention:</u></b> For Bank Transfer, please inform your bank to mention the following references: “ <b>AEN/EBS Workshop La Coruna</b> ”.
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Alternatively the registration fee may be paid using a cheque made payable to “OECD” and sent to the attention of:

Sylvie Voinis  
OECD/NEA  
12, Boulevard des Îles  
F-92130 Issy-les-Moulineaux

*Unfortunately, payments by credit card are not accepted.*

#### 15. SECRETARIAT AND CONTACTS

- The NEA is responsible for the Scientific Secretariat of the workshop. All technical questions in relation to the workshop should be addressed to the scientific NEA Secretariat:

Sylvie Voinis [sylvie.voinis@oecd.org]

- The NEA representative in practical matters (registrations) is:  
Katia-Karina Le Bot [katia-karina.lebot@oecd.org]
- The representative from the host organisation is:  
Jesus Alonso [jald@enresa.es]
- The representative for the Universidade da Coruña is:  
Javier Samper [jsamper@udc.es]



*Annex 1*

**AGENDA**







<b>2nd day - WORKING GROUP SESSIONS</b>
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**09:00**            **Introduction of Working Groups Sessions**  
*D. Bennett (GSL, UK)*

**09:15-10:30**    **Parallel Working Groups Sessions**

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**10:30-11:00**    **Coffee Break**  
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**11:00-12:30**    **Parallel Working Groups Sessions (*cont'd*)**

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**12:30-14:00**    **Lunch Break**  
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**14:00-15:30**    **Parallel Working Groups Sessions (*cont'd*)**

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**15:30-16:00**    **Tea Break**  
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**16:00-17:30**    **Parallel Working Groups Sessions (*cont'd*)**

See sets of questions in ANNEX 2 and section 3 of the programme

<b>3<sup>rd</sup> Day - PLENARY SESSION</b>
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*Chairperson: P. Sellin*  
*Rapporteur: D. Bennett (GSL, UK)*

**9:00 Working Group Findings: Working Group A**

**9:20 Working Group Findings: Working Group B**

**9:40 Working Group Findings: Working Group C**

**10:00 Working Group Findings: Working Group D**

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**10:20 Coffee Break**  
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**10:50 Discussion of Workshop Findings**

**12:00 Discussion of Recommendations for the EBS Project Forward Programme and Agreement of logistical steps (e.g. for publication of workshop proceedings)**

**12:30 Close of the Workshop**

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**12:30 Lunch**  
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## *Annex 2*

### ***QUESTIONS TO BE ADDRESSED BY WORKING GROUPS***

#### **WORKING GROUP A**

##### **Process models**

**Chairperson:** *to be confirmed on DAY 1*

**Rapporteur:** *V. Jain, CNWRA*

*The group will select a few questions dealing with process models with respect with to the strategy of representing EBS in a safety assessment. This selection will be made among the followings which will be discussed in depth. The outcomes of the working group session will be presented on Day 3 question per question.*

#### ***KEY ISSUES TO BE ADDRESSED:***

- A1) Use of mechanistic vs. empirical models. When? Why?
- A2) How to treat uncertainties: by using conceptual and/or parametric models? How simplifications in the models can be justified?
- A3) What is the place of sensitivity studies: methods and applications? For instance, How to consider the evolution with time in the modelling (component properties, THMCR environmental conditions)? Treatment of variability (e.g. geometric complexity related to different locations within the repository)?
- A4) Model calibration: How parameter values are determined?
- A5) How to define the boundary conditions (in particular by considering the interface with the geosphere)? Modelling of interface between EBS and near-field host rock?
- A6) What are the needs and prospects for improvement of models?

## **WORKING GROUP B**

### **Performance assessment models**

**Chairperson:** *B. Stromberg, SKI*  
**Rapporteur:** *A. Van Luik, US-DOE*

*The group will select a few questions on the performance assessment of EBS components and subsystems among the followings which will be discussed in depth. The outcomes of the working group session will be presented on Day 3 question per question.*

#### *KEY ISSUES TO BE ADDRESSED:*

- B1) How do we account for uncertainty? For example, should “tolerances” be established to account for uncertainties, and, if so, what approaches might be taken?
- B2) How parameter values are determined when making an EBS PA model? What constraints are imposed on our PA models for one barrier by models of other parts of the disposal system?
- B3) How to consider the evolution with time and the variability with scale in PA models? Methods of characterising variability in processes and properties? Approaches to optimisation of performance (e.g. variable spacing, location-dependent backfill, etc.)
- B4) How are FEP’s selected and represented in PA models? How are interacting FEP’s (coupled process) represented? How simplifications made in PA models be justified?
- B5) Sensitivity studies: which methods and applications are carried out in PA models?
- B6) What are the abnormal conditions/scenarios which need to be modelled?
- B7) What are the regulatory requirements?

## WORKING GROUP C

### Interactions between process level models and performance assessment level models in the context of the Safety Case

**Chairperson:** *L ; Johnson, Nagra*

**Rapporteur:** *X. Sillen, SCK·CEN,*

*The group will select a few questions among the followings which will be discussed in depth. The outcomes of the working group session will be presented on Day 3 question per question.*

#### *KEY QUESTIONS TO BE ADDRESSED:*

- C1) What are the EBS process/FEP's kept when passing from a process level model to a PA level model? How can we use SA to identify key issues and uncertainties related to the EBS?
- C2) Waste form degradation (release of RN, processes); Timing and rate of release of radionuclides from EBS to flowing groundwater within repository?
- C3) Modelling of flow through the repository, including geochemical evolution of fluid?
- C4) Geometric complexity related to different locations within the repository? How to scale up experiments?
- C5) Characterisation and modelling of radionuclide migration and retention processes within the heterogeneous repository and near-field host rock? How simplifications in models are justified?
- C6) What are the needs/prospects for improvements?
- C7) Can PA model results be used to (re)define the scope of process models?
- C8) What are the regulatory requirements?

## **WORKING GROUP D**

### **Feedback from the Safety Case (especially from process level models and performance assessment models) to design, design optimisation, and the experiments required to improve understanding and further develop models**

**Chairperson:** *A. Hooper, UK Nirex Ltd*

**Rapporteur:** *S. Voinis, OECD/NEA*

*The group will select a few questions among the followings which will be discussed in depth. The group will focus on feedback between safety assessment and EBS design. The outcomes of the working group session will be presented on Day 3 question per question.*

#### *KEY ISSUES TO BE ADDRESSED:*

- D1) Needs and prospects for improvements in EBS design resulting from SA?
- D2) Approaches to optimisation of design/performance (e.g. variable spacing, location-dependent backfill, etc.)
- D3) To what extent the safety assessment drive EBS design?
- D4) How to demonstrate the robustness of the EBS system?
- D5) How sensitivity studies could influence the design, help in the optimisation and in the elaboration of experiments?
- D6) How to consider the time frames during the feedback? What are the main difficulties?
- D7) Feedback of regulatory reviews/peer reviews?

### *Annex 3*

## ***INSTRUCTION FOR AUTHORS***

### **IMPORTANT REMARKS**

Please be sure to use the WORD 2000 or XP in A4 format and using TIMES NEW ROMAN as the font, even for equations.

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