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NUCLEAR ENERGY AGENCY
RADIOACTIVE WASTE MANAGEMENT COMMITTEE

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"Preparing for the construction license of deep geological repositories"

Draft proposal for a joint IGSC/RWMC-RF workshop

The Regulator's Forum of the RWMC and the IGSC have both identified the need to explore the challenges and good practice in view of preparing for the conctruction license of a deep geological repository. They have concluded that it is important to address practical aspects associated with the corresponding issues and therefore that "case studies" be considered and more particularly operational safety, the implementation of an optimisation process and in this respect the balance between operational and long term safety requirements.

A joint workshop is proposed to be held in January 2012, in order to deal with these issues and draw lessons from all initiatives so far. This text presents premiminary ideas to be discussed and amended by the Regulator's Forum and the RWMC and the IGSC, and to be developed further by the Programme Committee that will be constitued in due course.

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English - Or. English

"PREPARING FOR THE CONSTRUCTION LICENSE OF A DEEP GEOLOGICAL REPOSITORY: CHALLENGES AND GOOD PRACTICES"

JOINT IGSC/RWMC-RF WORKSHOP

Draft proposal

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1. Description/Motivation

1.1 Introduction

Preparing for the construction license of a deep geological repository constitutes a series of challenges for all institutional organizations that are involved in the process: implementer, regulator and decision makers. Example challenges include:

- **For the implementer:**

  Preparing for and ensuring, the transition from a R&D mode to an industrial mode of construction and operation, and thus:

  - Demonstrating the industrial feasibility of the proposed solution.
  - Demonstrating the effectiveness of the proposed techniques, in particular of those that are not commonly used in other industries, or are used under conditions that are not representative of those expected during construction and later operation of the facility.
  - Presenting a detailed design that balances potentially competing targets such as operational safety and long-term safety requirements.
  - Illustrating the design choices within the framework of an optimisation process (BAT including costs, feasibility, etc).
  - Staffing (introducing new competences).
  - Developing knowledge management aspects.
  - Updating QA.
  - Preparing for increased dialogue with, and scrutiny by, stakeholders.
  - ….

- **For the regulator:**
  - Updating earlier, generic regulation and guidance:
    - Defining site-specific regulation or guidance.
    - Placing conditions on the implementer for regulatory compliance during the construction phase. These conditions may specify hold points in the construction for regulatory involvement or interaction.
    - Adapting classical regulation concerning issues such as nuclear operational safety and radiation protection, occupational safety, mining safety to an underground, nuclear situation.
    - Specifying aspects of the regulatory procedure for subsequent phases such as requirements for documentation and demonstriation to be provided to the regulator before authorization to operate the facility may be granted (including periodic updates).
  - Staffing (introducing new competences).
  - Preparing for increased dialogue with, and scrutiny by, stakeholders.
  - …
- **For the national decision makers:**
  - Making decisions on solutions ensuring both safety and public acceptance.
  - Ensuring a transparent process.
  - Ensuring stakeholders participation in the process.
  - Not postponing decisions.
  - …
- **For the international organizations (NEA, IAEA, …):**
  - Reviewing of best practice and provide forums for exchange of information and experience, e.g., regarding:
    - R&D needs.
    - Optimisation and BAT.
    - Operational safety requirements.
    - Role of stakeholders.
  - Update guidance and provide recommendations.
  - ….

In order to help meeting these challenges it is important to review existing licensing experience, identify good practices and better understand the challenges that the new tasks will entail.

2. Description of proposed Workshop

2.1 Focus areas

At this stage of the national disposal programmes, and considering the identified challenges and needs of the IGSC and RF, concerns concentrate on three major areas:

(1) Preparing, as an organization, to submit or to review a construction license.

(2) Understanding operational safety drivers, constraints and requirements and taking them into account without jeopardizing long-term safety.

(3) Placing the design development and licensing procedure in an optic of optimisation over decades of repository development.

2.2 Structure and modus operandi

Session 1 will introduce the workshop and set the scene.

Session 2 will provide the opportunity to cover main challenges and good practices in two or three countries from the point of view of the implementer, regulator and decision maker in order to set the scene.

Sessions 3-4 will start with one or two brief presentations in plenary sessions, recapitulating the main lessons learnt so far and the issues to be discussed. In some cases these may be based on a "seed" document[1]. Following these presentations, participants, who will already be grouped at tables (e.g. 6-10 tables with about 8-10 people each), will discuss the subject for about one hour. These discussions will be guided by lists of questions prepared in advance by the programme committee. A spokesperson from each table will present the results to the plenary at the end of the session, and the session chair will wrap up the session. A rapporteur for each session will document key points of the discussion, both for the stocktaking in the final plenary session and for the workshop proceedings. Overall this will be a highly interactive workshop similar to the Tokyo Workshop of the RF or the workshops of the FSC.

Session 5 will be devoted to stocktaking.

1. If so, the Programme Committee will decide how and by whom.

PRELIMINARY PROGRAMME

Day 1

Session 1: ***Introduction***

(09:00 – 10:30)

1. A welcome address from the NEA (RWMC?).
2. A Statement of the objectives of the workshop by the Chair of the Programme Committee.
3. Organizational information, explanation of mode of working.
4. A keynote speech that sets the scene.

Break

Session 2: **Challenges and good practices**

(10:30 – 12:00) **Implementors**

- Presentations of challenges for preparing for licensing construction in individual countries by implementers of geological disposal (ANDRA, SKB, …)

Lunch

(13:30 – 15:30) **Regulators**

- Presentations of challenges and progress for the regulators by national representatives (ASN, BMU, …)
- Progress made towards harmonization of regulatory approach in member countries (Example: EPG report on the regulatory review of the safety case in the framework of a stepwise approach)

(15:30 – 16:30) **Decision makers**

- Presentations on challenges for the Ministers and elected representatives (French example with DGEC, Minister of Environment or Member of Parliament, similarly for other countries)

(17:00 – 18:00) **Panel session on key findings from day 1**

Day 2

Session 3: Operational safety

(3/4 of day 2)

Presentations on case studies[2],[3] and on capturing main issues on the subject by both implementers and regulators.

Example questions :

1. What are the main operational safety issues in a deep geological repository – e.g. conventional hazards, ventilation, package handling, construction, radiation protection, fire prevention, accidents? How is operational safety being achieved and assessed and what are the regulatory requirements and expectations?
    - Normal operation safety (e.g. radiation protection of staff and population, radionuclide release to the environment by water or air pathways, layout, ventilation, zoning, shielding, separation of construction and emplacement activities, criticality issues, heat generation issues) and resulting WAC
    - Management of disturbances of normal operation (e.g. derailing, failure of relays, …)
    - Accidents (internally initiated, e.g. fire, handling accident, human error, rockfall; externally initiated e.g. earthquake)
2. How do these constraints vary according to key aspects of the disposal system concept, including: type of waste, host rock, planned operational lifetime, requirements for retrievability?
3. What issues are raised by the need to balance operational safety and long-term safety requirements?
4. What kinds of solutions have been proposed to address the above design constraints? What lessons can be learned?
5. Are there methodological issues, or best-practices documentation, that can be usefully addressed by NEA IGSC or RF?
6. Are there interfering requirements e.g. from nuclear and mining legislation?
7. Are there specific regulations in some member countries combining mining law and nuclear law requirements for the operational phase?

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2. Konrad, Cigeo (ANDRA), WIPP, SFR, … (see also Annex 2)

3. Basically, we have three relatively advanced stages of facilities (and of course less advanced ones):
    - facilities preparing for the construction license (Bruce, SNF projects in Sweden and Finland, Cigeo in France)
    - facilities which obtained the license and are now being constructed (Konrad)
    - facilities already in operation (WIPP, SFR, Olkiluoto and Loovisa LILW disposal)

    For the latter two stages, it might be interesting to get implementers' and regulators' views on one and the same project

Day 2 and Day 3 (am)

Session 4: Practical Experience in implementation of optimisation and BAT from case studies

This session could begin with a couple of invited talks on experience from countries that have regulatory requirements for BAT (Sweden, Germany, …) and/or optimisation and/or from implementers who have applied such techniques.

Presentations

- 2-3 National case studies

Example questions:

From RF's Tokyo workshop

- If your approach involves both optimisation of design and a stepwise development process, how do these interact?
- Is optimisation of design evaluated at different stages of the programme?
- If so, how do the criteria differ (and the judgment of compliance) for each stage?
- Is there a point at which design optimisation is considered to be complete or sufficient?
- Are economic factors included as a consideration in optimisation of design?

From topical session of IGSC-12:

- How is the optimisation process defined and implemented throughout the successive phases for repository development?
- How do these concepts affect or direct the decisions taken with respect to repository siting and design during the successive phases of the programme? Can they lead to different solutions or choices?
- How does their use/implementation relate to the safety arguments presented in a safety case at a given stage of repository development?
- What are the end-points for the optimisation process and for applying BAT? What is an optimised level of safety?
- How can these concepts be applied or re-evaluated in a long (decades) programme of repository development, construction, operation and closure, given the likelihood of major technological developments over these time frames?
- How are factors such as cost and stakeholder acceptability (e.g. in selecting a site) taken into account in the optimisation process?
- What are the factors (i.e., components of the "target function", as opposed to variables or boundary conditions) considered in optimisation and options selection – including non-technical factors such as cost or public acceptability?

- Is safety explicitly identified as an optimisation objective or factor? How is it expressed (e.g., dose, robustness…)?
- How are the factors weighted? Is it specified in advance?
- Do you preserve the flexibility to reassess the target function periodically to confirm that it is still appropriate? How?
- What are the tools and approaches used to evaluate and make decisions (e.g., matrix, requirements management systems)?
- What role does safety assessment play in the optimisation process?
- How is uncertainty considered in the optimisation process -- in particular, if there are different degrees of knowledge (or uncertainty) associated with different options or with different components of a target function (e.g. if both operational and post-closure certainty are taken into account)?
- How much detail is required for various options? Is it the same level for all options being considered?
- Who participates in optimisation and options selection, and how do you decide?
- How do you document and defend the analysis and decisions?
- For each of the questions above, what are the relative roles of the regulator, implementer and other parties?
- What else is important about how the process is undertaken (openness, degree of flexibility, etc.)?
- To what extent does evidence of these measures need to be described or otherwise brought into the safety case?

Lunch

Session 5: Stocktaking

A brief session in which each table will make a presentation of a one- or two-page summary of one or two issues, followed by discussion in plenary. The Workshop Chair will make a final wrap-up presentation covering the results of the workshop and suggesting directions for further IGSC and RWMC-RF work, followed by a brief closing address from a host organisation representative.

Annex 1:

OVERVIEW OF IGSC AND RF PREVIOUS LOOK AT THE CURRENT THEMES

1. Operational safety issues

At the early stages of a project, when developing the conceptual design of a deep geological repository—and building the corresponding safety case—implementers have mostly focused on long-term safety, which was the most challenging issue. Operational safety issues were considered a lower priority, because there is substantial experience in the safe operation of nuclear facilities and mines.

However, as programmes move closer to implementation, operational safety becomes more important. This is because operational safety is part of the licensing process, and must be adequately considered in the design, and documented for the regulator. Also, while the design and selection of engineered components and mining techniques are still driven by long term safety requirements, they must take account of operational safety and feasibility of construction. The IAEA safety requirements for geological disposal of radioactive waste (WS-R-4) recognize that the balance between long-term and operational safety is a prime consideration in terms of optimisation:

> "Throughout the development of a geological disposal facility an appropriate understanding of the relevance and implication for safety of the available options shall be developed by the operator with the ultimate goal of providing an optimized level of operational and post-closure safety."

Within the framework of the RWMC both the IGSC and Regulator's Forum have addressed the subject.

RWMC/RF work

The Regulator's Forum of the RWMC acknowledges that in the recent years the development of regulations for geological repositories focuses largely on issues that may impact on long-term performance. Its opinion is that, as a number of programmes approach the implementation phase, greater attention needs to be given to regulations for the operational phase - during which issues of mining safety will also need to be considered. The RF recognizes that there is the possibility that measures to increase safety during the early phase have a negative impact on long-term safety, or vice versa. It is planned to devoting one session of a future workshop to regulations for the operational phase of a repository, including interplay with non-nuclear/mining regulations. As an initial step, presentations of new regulations in a few selected countries (e.g. Finland) were given at RF-11.

IGSC work

As noted in the current IGSC mandate, the scope of the IGSC activities is the whole range of activities to be addressed in a safety case. While focusing on long term aspects, the mandate also notes that:

> "Activities of the IGSC have traditionally focused on long-term safety. However, as some national programmes approach licensing, a higher degree of integration is required, not only for all elements related to long-term safety, but also of engineering and operational considerations. That is, operational constraints may affect decisions on, for example, repository layout or design of engineered components---which then must be incorporated in a safety case. It is, therefore, recognised that to achieve confidence in (and acceptance of) a repository, it must be shown not only that the system will be safe over the long term, but also that it can be built and operated safely."

The topic of balancing operational and long-term safety was addressed in the Topical Session for IGSC-10 in 2008. This was a first exploration of the topic within the IGSC group. However, the issues and experiences within operational safety themselves were not discussed. Currently, much of this information, where it exists, is documented within radwaste organizations in their internal reports and national language, and has not been widely shared or discussed. Interest has been expressed by several implementers and regulatory organizations in terms of a follow up activity for wider discussion. A workshop has been proposed on a suitable basis.

2. Issue of optimisation and BAT

These principles complement each other. BAT, which originates from the system of environmental protection, is applied with the aim of minimizing potential radioactive emissions to the environment that may originate from a disposal facility; the control of residual doses is driven by the optimisation of estimated radiation doses.

RWMC/RF work

The RWMC/RF launched a series of actions to address the subject. One session at the 1st RF workshop organized in Japan in January 2009 was devoted to how this issue is being addressed in national regulations and in international guidance documents.

A report entitled 'Definition and implementation of the concepts of Best Available Techniques (BAT) and optimisation for geological repositories' was published in 2010 (NEA-6836). It reviews the available literature on this topic, including the origin and differences between the two concepts, and lists a number of open issues which were considered at the Japan workshop.

Since the optimisation of protection is a systematic process that needs to take a long-term view and that in the RF opinion it may be useful to review how this process is undertaken, and regulated, in member countries it was decided to address the issue of the practical application of the optimisation concept process in a second workshop. Inter alia, these will indicate how this issue is reflected in dialogue between implementer and regulator.

IGSC work

The IGSC addressed the issue of optimisation in the framework of a Topical session at IGSC-12 in 2010. The objective was to explore the issues of optimisation including clarifying the principles, learn from experience in national programmes and consider how different factors (such as dose, risk, cost, robustness, etc.) should be weighted and the optimisation arguments regulators are expecting;

In summarising the session, the Chair noted that the discussion had shown a lot of agreement and consensus of views. In particular, it was valuable to note general agreement on the following points:

- Optimisation is a process that can be checked and reviewed and needs to be transparent. It is a learning process in its own right, and hence optimisation can contribute to safety by the demonstration of a learning process.
- Optimisation occurs at each stage of the disposal facility development programme, and is therefore forward looking rather than focussed on re-examining past decisions. Optimisation should be about the right way forward at each stage, not about retrospective decision making.
- Regulators need to be clear about their requirements and these requirements become the constraints on the optimisation process, together with any societal

constraints that may be applied in certain programmes. Optimisation therefore requires a permanent dialogue between regulator and implementer.

- Once dose/risk targets and other constraints have been met, optimisation can be used to move forward as quickly as possible, and this could largely be reflected as cost optimisation.

It was noted that optimisation variables are not well defined and a more explicit discussion of this may be helpful, although the variables could be quite programme-specific.

Annex 2:

CASE STUDIES IDENTIFIED BY THE RF

Case studies in regulatory involvement in siting	• **Sweden**: Choice between Forsmark and Laxemar sites. • **Canada**: Kincardine. • **US:** Texas LLW facility. • **others**	*Practical lessons in such areas as: rulemaking, waste acceptance criteria, optimisation, dealing with multiple regulatory agencies, dealing with parallel EIA processes, involvement of the different categories of stakeholders,*
Case studies in regulatory involvement in acceptance of the concept	• **Finnish/Swedish:** regulatory reviews between the KBS-3V and KBS-3H options (IGSC 12). • **others**	*idem*
Case studies in regulatory licensing of in construction	• **US, Finland, Germany**: Yucca Mountain (IGSC 10), Eurajoki, Konrad, Texas LLW facility. • **others**	*idem*
Case studies in regulatory licensing in operation	• **USA:**, WIPP (IGSC 12), Texas LLW facility. • **others**	*idem*
Case studies in regulatory licensing for post-operation	• **France:** La Manche; • **UK**,: Driggs; • **others**	*idem*
Results of other projects and studies	• European Group, ICRP, IGSC, etc.	*idem*