Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

16-Apr-2010

English - Or. English

NUCLEAR ENERGY AGENCY
RADIOACTIVE WASTE MANAGEMENT COMMITTEE

Cancels & replaces the same document of 04 September 2009

SUMMARY RECORD OF THE 2ND MEETING OF THE REVERSIBILITY AND RETRIEVABILITY PROJECT

Held at NEA Headquarters, 3-5 June 2009

This summary record presents the main conclusions as well as a summary record of the meeting. Additionally, the list of participants and the list of written materials made available for the meeting are also included.

Please send any queries regarding this document to claudio.pescatore@oecd.org

JT03281943

NEA/RWM(2009)10 Unclassified
English - Or. English

TABLE OF CONTENTS

1. KEY POINTS FROM THE RWMC R&R PROJECT MEETING, JUNE 3-5, 2009, PARIS

The second meeting of the Working Group on Reversibility and Retrievability took place on 3-5 June, 2009 at the NEA's offices in Issy-les-Moulineaux. Delegates from 12 countries, the IAEA and the EC took part. There were lively and fruitful discussions on a number of topics. The main points raised during these discussions are summarized below.

2.1 Safeguards

Safeguards and retrievability have important similarities: both need control and monitoring, and they are complementary in security and safety. Safeguards measures are more focused on diversion (security), while R&R monitoring may be more environmental impact- or safety-related.

- Safeguards measures include international surveillance as well as monitoring and institutional control. All of these can be important contributors to building public confidence. Hence, safeguards experts are a stakeholder group.
- Safeguards can contribute to the public confidence building process.
- Safeguards measures may be seen as another feature of the repository development process.

All non-nuclear weapon States are subject to IAEA safeguards. All facilities that manage nuclear materials (i.e., uranium, thorium, rand plutonium) are subject to direct safeguards verification activities. Other nuclear facilities, including in nuclear weapon states, may also be submitted to safeguards. There is no time limit to safeguards requirement: they are supposed to last for as long as the State's safeguards agreement with the IAEA remains in force.

2.2 Pre-closure vs. post-closure

For the purposes of this project, we use the following terms:

- Reversibility, meaning the ability to reverse decisions or processes;
- Retrievability, meaning the ability to retrieve entire waste packages (i.e. with intact containers);
- Recoverability, meaning the ability to recover emplaced materials (regardless of the state of the containers).

"Reversibility" (a decision making concept) really only applies before closure, but "retrievability" (a technical concept), or "recoverability" on time scales long enough that containers may have degraded, may continue well beyond closure.

To many local stakeholders, a repository is never really "closed", because the waste is still physically present. It would be better in this context to use a term such as "long-term safety case" rather than "post-closure safety case".

At the present time, it is not possible to predict when or even if monitoring and control will eventually no longer be needed for establishing confidence. We must be careful not to assume that closure, as defined in the Joint Convention, also implies the end of institutional control, of monitoring, or of

retrievability/recoverability. Closure is an important milestone, but it is not necessarily the end of the issue and of the process of taking care of it. Lack of clarity on this has consequences on public confidence and on how reversibility, retrievability and recoverability are presented.

3.1 Reversibility and operational safety/control/management

Some aspects of reversibility, e.g., being able to retrieve and re-emplace containers, might be considered to be good engineering practices that would be followed even if there were no formal requirements for reversibility.

Retrievability appears to be implicit during the operational stages of most programmes, and recoverability in a broad sense is almost always possible even in the absence of retrievability requirements (although perhaps only at great expense). Political or societal drivers may require more explicit reversibility and retrievability provisions.

There is a complex interaction between retrievability and safety requirements for design and monitoring. This interaction varies during different stages of repository development, and the effects of the interaction on different aspects, such as long-term safety, operational safety, radiation protection and security, also varies.

Part of the difficulty in understanding the links and relationship of various retrievability features is that these features have not yet been well-defined in most programmes. There are uncertainties regarding the operational procedures as well as regarding the motivations and demands of societal stakeholders. As programmes develop further in implementing their programmes (developing operational safety cases, etc.), the role and safety functions of reversibility and retrievability features may become more evident.

3.2 Implementing flexibility and stepwise decision making in the pre-closure phase

Reversibility and retrievability requirements may be motivated by both safety/engineering considerations and societal demands. Often, the measures taken to address operational considerations and good engineering practice go in the direction of "retrievability" that also satisfies societal needs. However, it is not always the case that good engineering design and practice enhance retrievability (or vice-versa) during operations. This depends on the stage of operation and the degree of retrievability that is desired for different needs.

The pre-closure phase cannot be considered as a monolith. There are different stages of operations, from emplacement through backfilling and sealing. Generally, with each "sub-stage" of the pre-closure, the waste is less readily retrievable but the passive safety features are increased. This means that, over time with a given waste, the motivations for retrievability and the circumstances foreseen for it evolve.

The links between key programme considerations -- safety, societal motivations, design provisions, good engineering practice, retrievability, etc. – and the tradeoffs between them, need to be assessed on a case-by-case basis. We cannot say categorically that R&R is either consistent with, or in competition with, good engineering practice for the pre-closure phase. However, as a general principle, and all else being equal, techniques that leave maximum room for maneuver in the future should be favoured over irreversible techniques.

The stepwise development of repositories, which is closely linked with R&R, is an important factor in both good engineering practice and providing flexibility.

3.3 Planning and financial aspects

Waste should only be emplaced in a repository if it is confirmed to be a waste and not a resource. Also, waste should not be emplaced if there is doubt about safety. Nevertheless, while retrieval is not foreseen, it cannot be entirely ruled out.

Planning to facilitate any such future retrieval is beneficial primarily to flexibility, but possibly also to safety and/or costs. Retrieval requires the will to retrieve, the means to accomplish it, and the necessary knowledge. Planning in advance is a means to better ensuring that the needed knowledge exists.

Financing for future retrieval is a more philosophical question. Cost estimates may be prepared for future retrieval at various stages of repository development, but financing is not generally set aside for unplanned or hypothetical actions.

4.1 Are there "analogues" to reversibility and irreversibility?

The use of "examples" to explain issues of radioactive waste management may be counterproductive. In any case it is necessary to be careful to avoid giving the impression of trivialisation of the issue. It is important to learn from the past without criticising past actions. Stakeholders and the general public are more and more interested in having open options allowing for reversal, retrievability and research, demonstrating that, although there is a cost, retrieval will be feasible.

The use of analogues involves difficult concepts, which have to be applied and explained carefully. Historical examples may be used to explain the philosophy of reversibility and retrievability, but we have to keep in mind that there are also negative examples.

It is important to communicate clear messages, among them: Wastes will only be emplaced in a final repository when there is assurance of safety, without the intention of retrieval. The potentiality for reverse decision and actions exists, and can be facilitated by preparing plans for reversibility and retrievability from the early stages of development.

4.2 R & R Scale

The Scale is intended to be used as a tool to enable dialogue on R&R. There was general agreement that the Scale has value in identifying where Reversibility, Retrievability and Recoverability could feature in a long term radioactive waste management disposal process. In presentational terms the Table combined with the Diagram illustrates, in a clear and simple manner, where the "R" issues will feature in a process. It could be used to aid understanding and as a tool for discussion with "informed" stakeholders, providing a succinct overview for the consideration of technical and ethical issues. It was agreed that, whilst it is a generic document, it could be adapted by individual countries to reflect their own timetables and processes for decision making.

It was agreed that, as the intention is for the Scale to be used internationally, then internationally accepted descriptions and definitions should be used. For discussions at a national level, less technical language might need to be used. It was also proposed that the document should use terms already recognised by stakeholders, for example, "site characterisation".

It was agreed that the R&R scale document has the potential to be a helpful tool but in its present form could not be given to stakeholders without more information. It would probably need to be used by implementers, regulators and others with responsibility for stages in the process to assist in their discussions with stakeholders, rather than to issue it to stakeholders as a standalone document.

The drafting team will consider the comments made and provide a revised version for the next working group meeting.

4.3 Nordic country attitudes to R & R

Although there is no regulatory or legislative requirement for retrievability in Sweden, the implementer has chosen as its own requirement to design for retrievability and to demonstrate it for the operational phase of the repository. It has been made very clear during public consultation that while post-closure retrieval is possible, it will likely be only at large expense to future society. The reason for including retrievability among the design requirements comes from recommendations by the Swedish Nuclear Waste Advisory Council, KASAM, that disposal should not unnecessarily restrict future freedom of action. The implementer also considers this a "what if" scenario, for which it is advisable to be prepared.

Public groups in Sweden had contrasting views on the topic of retrievability. One group is in favour of disposal at intermediate depths (approximately 200m) in order that retrieval would be facilitated; Another group prefers much deeper disposal (2000-5000m), in part in order to make retrieval very difficult.

4.4 The latest Eurobarometer and the coming one

The recent survey did not include any questions specifically related to reversibility or retrievability. The EC is currently considering whether or not to include a question or questions on this topic in the next survey in 2011. Ms. Necheva noted that it would be very difficult to design questions with simple language that could be used in a survey, but that the R&R group had provided important, useful suggestions that will be considered by the Commission.

5.1 Review of the NEA-3140 report on R & R

It was concluded that the 2001 report is still a good basis, and from the point of view of project participants and insiders, it could be used with relatively minor modifications to take into account recent developments. However, it was felt that a new approach to the subject could be an opportunity to present a clearer message to stakeholders and others less familiar with the subject.

It was decided that a draft of a new document would be a useful input to the conference planned for December 2010. This would be prepared in parallel with a more detailed project report for use by the RWMC. Following the conference, the draft would be revised to take the discussions at the conference into account.

The Secretariat will prepare a vision for a new report to be distributed to working group members by 7 September for comments.

5.2 Initial Planning for NEA international conference on R&R, Reims, France, 15-17 December 2010

The conference will be informed by the group's work on this project. It will cover all aspects of reversibility and retrievability, including social, technical, regulatory, and policy aspects. The audience therefore will be broad, and the emphasis will be on dialogue. The purpose being mutual learning, one of the main outcomes will be better awareness of issues and status. The conference will also serve to test the findings of the project and refine the project's conclusions.

France (Andra) will host the conference. The UK and US working party members both offered to support the programme committee. The Secretariat will distribute a vision for the conference to working group

members by the end of June, and a more detailed conference proposal taking these comments into account will be distributed by 7 September.

5.3 Near-term way forward for the R&R project

A discussion was held on the future directions for the R&R working group. The following actions were planned:

1. A vision of the December 2010 conference to be sent to group members by end of June, responses to be received by the end of July, and a more detailed conference proposal to be distributed by 7 September.
2. Minutes of this meeting to be prepared by mid-July, for the use of group members.
3. A progress report on the group's work to be prepared by 7 September for distribution to the working group members for comments before sending it to the RWMC Bureau for their November meeting.
4. A vision of a project report to succeed NEA-3140 to be sent to working group members by 7 September.
5. The scale task group to continue its work with a view towards finalizing the proposal for the December 2009 working group meeting. The scale would then be tested on member country programmes in early 2010.
6. The next working group meeting will be held in or near Washington, DC on December 2-4, 2009. Possible topics for discussion include monitoring, step-wise decision making, limitations on R&R, and benefits/costs of retrieval.

2. MINUTES OF THE RWMC REVERSIBILITY AND RETRIEVABILITY PROJECT MEETING, JUNE 3-5, 2009, PARIS

AGENDA PART I: INTRODUCTION

1. 3 Review of project status, including feedback from RWMC-42

After the opening of the meeting and the adoption of the agenda, Claudio Pescatore gave a presentation on the current status of the Reversibility and Retrievability project. This was based on document NEA/RWM(2009)3/REV1, which is the phase-2 report that had been distributed earlier to project members and to the RWMC.

AGENDA PART II: EMERGING ISSUES

2.1 Safeguards

As an introduction to this issue of safeguards B. Neerdael (IAEA) gave a presentation on the history of safeguards thinking in geological disposal, and on current IAEA work on the subject.

IAEA safeguards are generally acknowledged as the single credible means by which the international community can be assured that nuclear material and facilities are being used exclusively for peaceful purposes. Integrated safeguards approaches are implemented in non-nuclear weapon States[1] (NNWS). Complementary accesses are conducted under the Additional Protocol to a comprehensive safeguards agreement in the NNWS. Complementary accesses are conducted on a selective basis to locations that possess uranium, thorium, or plutonium (e.g., mines and concentration plants) and on the basis of a question or inconsistency to nuclear fuel cycle related locations without nuclear materials (e.g., R&D or equipment manufacturing)[2].

The International Atomic Energy Agency (IAEA) has managed a number of Member State Support Program (MSSP) projects for the development of safeguards for spent fuel conditioning plants and geological repositories, including the Programmes for the Development of Safeguards for the Final Disposal of Spent Fuel in Geological Repositories (SAGOR I and SAGOR II) and the Experts Group on the Application of Safeguards to Geological Repositories (ASTOR).

[1] Because a nuclear weapon State (NWS) has undeclared activities associated with its declared nuclear weapons programme, the IAEA cannot reach a broader conclusion regarding no undeclared activities in the State. In addition, the IAEA implements safeguards at only a few selected facilities in the NWS, and can draw a conclusion of non-diversion only for those selected facilities. Agency safeguards, especially integrated safeguards, are designed and mostly implemented for NNWS.

[2] The 5 NWS have additional protocols in force; however, to date, the IAEA participant was not aware of any complementary accesses being performed in a NWS.

Safeguards approaches have generally been based on recommendations made through the MSSP tasks and IAEA safeguards policy and guidance regarding integrated safeguards implementation. Safeguards requirements were not discussed in relation with R&R because it has been assumed that the repository designs will proceed without any need for reversal or retrieval. The model safeguards approach does state that any container leaving the repository must be verified. It provides guidance for preparing a safeguards approach for a spent fuel conditioning plant or geological repository in a State under integrated safeguards.

The presentation was followed by a discussion on the relationship between safeguards and retrievability of spent fuel and of the influence that safeguards measures may have on the design concepts of a repository.

As a result of the question: "How have safeguards issues influenced your country's repository design and programme?" a wide range of responses were given. There seems to be no clear consensus on the role of safeguards measures either on repository design or on reversibility or retrievability provisions.

In most countries safeguards issues have not been considered in detail and so far they have not influenced the repository national design or disposal programme. The modality of incorporation of retrievability has had more influence on design concepts than safeguards measures. One reason for this could be that most countries are in an early stage of their national disposal programme, and there are few national requirements on this issue. It should also be noted that safeguards obligations apply to the State rather than directly to the implementer. As such, the detailed implementation of safeguards measures is not likely to be finalized until well into the licensing process.

In the country responses to the questionnaire, safeguards measures were mentioned most often in the context of monitoring (operational, closure, pre- closure, post-closure phase). Therefore it seems that safeguards measures have not influenced R&R, but R&R may influence safeguards measures.

As a first country, Finland started discussions on preparations for safeguards implementation (IAEA, EC and the Finnish authorities) regarding Finland's geological repository in 2008. Negotiations are in progress between the State representatives (STUK), the Commission and the IAEA. Based on the geological repository design stated in the Design Information Questionnaire (DIQ) that is to be declared by Finland and verified by the IAEA, the IAEA will use the Model Integrated Safeguards Approach for repositories to determine facility-specific safeguards measures for Finland's repository. Nevertheless pending detailed requirements from authorities, they have not had any major impact on design work of POSIVA.

The questions as to whether safeguards would apply only to spent fuel (SF) disposal and the time frame of safeguards cannot clearly be answered. The spent fuel will remain subject to IAEA safeguards as long as the State's safeguards agreement remains in force. There is no restriction on time frames in the IAEA safeguards requirements ("as long as requirements exist"). Therefore requirements for oversight measures in order to meet safeguards obligations may continue to apply indefinitely, even after closure of the repository.

As result of the discussion it can be concluded that:

All NNWS are subject to IAEA safeguards. All facilities that manage nuclear materials (i.e., uranium, thorium, rand plutonium) are subject to direct safeguards verification activities. Other nuclear facilities may also be submitted to safeguards. There is no time limit to safeguards requirement: they are supposed to last for as long as the State's safeguards agreement with the IAEA remains in force.

Safeguards provisions and retrievability have important similarities: both need control and monitoring, and they are complementary in security and safety. It was pointed out that while safeguards measures are more focused on diversion (security), R&R monitoring may be more environmental impact- or safety-related. On

the other hand, it is safe to say that the more "retrievable" or "reversible" is the design, the more susceptible the design is to potential diversion of its materials.

- Safeguards measures include international surveillance and imply monitoring and institutional control. All of these can be important contributors to building public confidence. Hence, safeguards experts are a stakeholder group.
- Safeguards can contribute to the public-confidence building process.
- Safeguards measures may be seen as another feature of the repository development process.

2.2 Pre-closure vs. post-closure

The text introducing the session on Pre-closure vs. Post-closure in the agenda was as follows:

> "Has the transition from an open to a closed repository been thought through? And what are the rules afterwards vis-à-vis the previous phase? Related questions are: How is closure defined? Is there a clear definition of when closure occurs? Is the transition a continuous progression, or is there a point where there is a step change? Has it been described/defined what kinds of control, monitoring, and reversibility or retrievability capabilities will continue to exist post-closure, and if so for how long?"

In preparation for the meeting, a brief questionnaire was distributed to participants. Included in the questionnaire were the following two questions:

> "In your country's programme, has the transition from an open to a closed repository been thought through? What are the rules afterwards vis-à-vis the previous phase, e.g., have responsibilities post-closure been assigned to specific agencies or bodies, the role of monitoring, etc.?"

To summarize the responses to these questions, in response to the first question (about planning for closure), some countries said that no definite plans yet existed. Some noted that the responsibility would be the State's (to which one might reply: How is this different from the first response, i.e. no definite plans yet?). In a few cases, specific responsibilities have been assigned.

In response to the second question (about responsibilities to be assigned and rules to be applied post-closure), in most cases, rules (if any) that will be applied post-closure have not been defined. Two exceptions were Germany (rules for closed mines will apply), and the US (requirements and responsibilities for monitoring, markers, records have been defined). In a number of countries, it is anticipated that post-closure activities (notably monitoring) are likely to be required, but rules are not yet in place.

In the introductory presentation for the session, given by R. Ferch, the following two questions were posed for further consideration:

– If a stepwise, flexible or adaptive program is planned, is it even possible at the outset to define how the process will terminate?
– Which is more important: the specific changes that occur at a time defined as closure, or the entire transition process from the end of operations out to the end of all planned activities and controls?

In summarizing the discussion that followed, we can start by noting that "closure" is defined in the Joint Convention as: "*the completion of all operations at some time after the emplacement of spent fuel or radioactive waste in a disposal facility. This includes the final engineering or other work required to bring the facility to a condition that will be safe in the long term.*"

The question is therefore not so much "how do we define closure?"; it is perhaps more appropriately stated as: "for purposes of the discussion at hand, does the point we are considering coincide with closure, or should we be making a distinction between, for example, closure vs. the end of retrievability requirements, or closure vs. the end of institutional control?"

In this connection, it was noted that "reversibility" (a decision making concept) really only applies before closure, but "retrievability" (a technical concept), or perhaps more accurately "recoverability", may continue well beyond closure.

A French representative (from Andra) noted that in France, closure does not necessarily represent the end of the project. The regulator, for example, requires that at times longer than 500 years after closure, it must be assumed that institutional control no longer exists and that memory has been lost. Before 500 years, institutional control is assumed to exist. This presumably means that only deliberate human intrusion (by persons aware of the hazards) is assumed to be possible before that time (e.g. in order to retrieve), whereas inadvertent human intrusion without any knowledge of the hazards involved must be assumed to be possible after 500 years.

It was noted that to many local stakeholders, a repository is never really "closed", because the waste is still physically present. It was suggested that the term "post-closure safety case" was not a good one to be used in this context. It would be better to use a term such as "long-term safety case".

In general, local stakeholders do not want to feel abandoned, and therefore they do not want the repository to be abandoned. Local communities demand continued institutional control and monitoring as an important component of establishing confidence. Even though repositories must be designed to be passively safe without needing monitoring or control, in fact it is likely that monitoring and control will still be demanded in order to establish the necessary degree of confidence. At the present time, it is not possible to predict when or even if monitoring and control will eventually no longer be needed for establishing confidence.

It was also pointed out that the same people who do not want a repository to be closed and forgotten may not want a real facility for retrieval to be built at the repository site either. In other words, they may want reversibility or retrievability as an element of establishing confidence, but once the waste is emplaced they do not want retrieval to take place unless it is really necessary. This resonates with the point made in a later session that disposal should be carried out only after we are certain that the materials we are disposing of are truly wastes, and only after we are certain that disposal is safe. Nevertheless, we should have the capability to be able to retrieve, in case that "certainty" turns out to be wrong.

In summary, we must be careful not to assume that closure, as defined in the Joint Convention, also implies the end of institutional control, of safeguards measures, of monitoring, or of retrievability/recoverability. These issues may continue to be of concern at times well beyond the defined time of "closure". To put it another way, "closure" may be a well-defined term, but it really only represents one milestone in an ongoing process that may continue, at a reduced level of activity perhaps, even after closure has been reached. Closure is an important milestone, but it is not necessarily the end of the issue and of the process of taking care of it. Lack of clarity on this has consequences on public confidence but also on how reversibility, retrievability and recoverability are presented.

AGENDA PART III: FOCUS ON THE PRE-CLOSURE PHASE

3.1 Reversibility and operational safety/control/management

This session started with a presentation by *J-M Hoorelbeke* followed by a general discussion.

Good engineering practice would ensure a flexible management approach to the facility during construction and parallel or subsequent operation. This is an integral part of management of the operational period.

Some aspects of reversibility, e.g., being able to retrieve and re-emplace containers, might be considered to be good engineering practices that would be followed even if there were no formal requirements for reversibility. Pre-closure safety considerations might lead to certain types of reversibility provisions simply in order to be able to mitigate postulated accidents. Some design features associated with long term safety, such as robustness of containers, also contribute to retrievability. A performance confirmation programme during the operational period, to validate achievement of the design and safety requirements, is another common design provision that contributes to reversibility and retrievability. An analogy with decommissioning also suggests that designing for reversibility may have positive impacts on maintainability and safety during the pre-closure phase.

While retrievability is thus to a certain extent already present during the operational stages of most programmes, and recoverability in a broad sense is almost always possible even in the absence of retrievability requirements (although perhaps only at great expense), political or societal drivers may require more explicit reversibility and retrievability provisions. During the operational period, retrievability provisions could have a positive effect on design, for example by contributing to enhancing operational safety in emergency cases. On the other hand, maintaining access to a repository for an extended period for retrievability reasons might increase problems with assuring radiation protection (e.g., by having to use and maintain active shielding elements instead of sealing the packages immediately after emplacement).

Thus, there is a complex interaction between retrievability and safety requirements for design and monitoring. This interaction varies during different stages of repository development, and the effects of the interaction on different aspects, such as long term safety, operational safety, radiation protection and security, also varies.

3.2 Implementing flexibility and stepwise decision making in the pre-closure phase

Brendan Breen, NDA, provided a presentation on "Implementing flexibility and stepwise decision making in the pre-closure phase". The key questions intended to be addressed were:

- What processes, procedures, policies or philosophies have been put in place in your country's programme to enable flexible repository implementation in harmony with societal step-wise decision-making?
- How much more flexible does a design need to be to be adaptable to societal decision making as distinct from purely engineering-based needs?

Most programmes have a stepwise process embodied in their law or licensing arrangements. Common milestones in such a process include site investigations, construction, operation/waste emplacement, closure and surveillance. However, these stages can differ according to programme, and sub-stages may also be identified. At each stage the decision to move to the next stage of development may depend on

safety considerations or on acceptability – or most commonly, on a combination of these. The philosophy of stepwise implementation provides opportunities for flexibility and adaptation of the waste strategy and design.

Nearly all programmes have a capability for retrievability during the operational phase. Even in programmes that have not specifically designed for this purpose, it is often the case that retrieval of waste would be technically feasible, if not necessarily easy. However, it is acknowledged that there are some limitations on reversibility, in addition to the generally-accepted limitation that it should not compromise long-term safety. In fact, the approach to retrievability depends partly on the philosophical views on the level of effort that it should require (and attendant level of accessibility needed). The degree of flexibility and retrievability is also affected by both the geological setting and the disposal concept. These, in turn, often depend on the type of waste under consideration (ILW vs. SNF or HLW)

Many programmes link the need for flexibility and retrievability to societal drivers, especially the desire to allow the possibility of changes or decision-making by future generations. As described in the preceding session, however, there are also facets of retrievability that are important during operations and that serve good engineering practice. On the other hand, there are some aspects of engineering practice (and design implementation) that are not oriented towards retrievability. This includes, notably, the implementation of EBS components such as buffer emplacement, seals, etc., which are essential in many safety concepts.

It is not easy to distinguish clearly between aspects (or degree) of retrievability that are due to engineering considerations and those due to societal needs. It is unusual for societal needs to imply specific requirements on the mode, timing or mechanism of retrievability; the societal need tends to be in the form of a general directive that "Retrievability is necessary." On the other hand, engineering constraints and needs can drive quite specific aspects of how exactly retrieval needs to occur. Similarly, it can be difficult to determine whether a given design feature is attributable to the requirements for safety of operations or the desire to increase retrievability.

The following discussion reinforced certain points of the presentation and brought up some new issues. The main points of the discussion were as follows:

Reversibility and retrievability requirements may be motivated by both safety/engineering considerations and societal demands. Engineering "good practice" during operations could include a design, and associated flexibility in the design, that allows the ability, for example, to:

- repair aspects of the disposal system or waste package,
- monitor the disposal facility, and
- respond to unexpected events or accidents.

Societal reasons for providing retrievability include the ability to recover material as a resource, to allow the application of a different disposal concept or technology, and to provide confidence that unexpected events or errors can be addressed.

Limits on the retrievability of waste can be imposed by philosophy and regulation (i.e., not to compromise long-term safety). They depend quite significantly on the type of waste, which relates in turn to the disposal concept. They are also influenced by practical and technical considerations related to the geology and design – i.e., structural stability, rock creep, etc.

Often, the measures taken to address operational considerations and good engineering practice go in the direction of "retrievability" that also satisfies societal needs. Providing (and sometimes demonstrating) the ability to respond to accidents or unexpected events is a common requirement of emergency planning for

many nuclear facilities. It is usual that monitoring and other measures are taken to do "design confirmation" for major engineering projects, especially those underground. These are "good engineering practice" and should not imply that there is not confidence in safety or in the disposal concept, during operations or post-closure.

However, it is not always the case that good engineering design and practice enhance retrievability (or vice-versa) during operations. This depends on the stage of operation and the degree of retrievability that is desired for different needs. How the design and emplacement procedures (and postulated retrievability procedures) affect radiation protection during operations also need to be balanced, for example. Furthermore, some aspects of the design that serve containment and isolation may depend explicitly on measures that restrict accessibility.

The foregoing points raised the important issue that the pre-closure phase cannot be considered as a monolith. There are different stages of operations, from emplacement through backfilling and sealing. Generally, with each "sub-stage" of the pre-closure, the waste is less readily retrievable but the passive safety features are increased. This means that, over time with a given waste, the motivations for retrievability and the circumstances and possible scenarios foreseen for it evolve. It also implies that, at any given time during the pre-closure phase, there is not necessarily the same degree of accessibility/retrievability for all waste across a repository. It can be said that, in nearly all concepts, the containers are expected to remain intact throughout the operational phase and this implies, furthermore, that retrievability is expected to be technologically feasible.

The links between key programme considerations -- safety, societal motivations, design provisions, good engineering practice, retrievability, etc. – and the tradeoffs between them, need to be assessed on a case-by-case basis. We cannot say categorically that R&R is either consistent with, or in competition with, good engineering practice for the pre-closure phase.

Part of the difficulty in understanding the links and relationship of various retrievability features is that these features have not yet been well-defined in most programmes. There are uncertainties regarding the operational procedures as well as regarding the motivations and demands of societal stakeholders. As programmes move towards implementation and therefore more detail is developed (developing operational safety cases, etc.), the role and safety functions of reversibility and retrievability features may become more evident.

It was emphasised that the stepwise development of repositories is an important factor in both good engineering practice and providing flexibility. These are evidently (even based on current programme status) linked with R&R. Often, the licensing process delineates key "hold points" at which information is assessed (or re-assessed) and decisions are made to proceed to further development. Examples include the periodic review of national strategies and inventories for radioactive waste, as well as the expected license reviews/updates during operation of a disposal facility. Even if this is not done in a regulatory context, the implementer would be expected to periodically re-assess and update as part of the normal engineering design and confirmation process.

3.3 Planning and financial aspects

P. Zuidema gave an introductory presentation by telephone link. He began by pointing out that waste should only be emplaced in a repository if it is confirmed that it is a waste, and not a resource. Also, waste should not be emplaced if there is doubt about safety. Retrievability must not be used as an excuse for sub-standard disposal. In either of these cases of doubt, the action to be undertaken is interim storage rather than permanent disposal.

Nevertheless, even in the presence of certainty (or "practical" certainty) about waste vs. resource, and about safety, there may still be a possibility of future desire for retrieval ("you never know"). Thus, while retrieval is not foreseen, it cannot be entirely ruled out. Therefore the Swiss law requires that retrieval be possible, although the level of difficulty changes during the stages of development of the repository.

Planning to facilitate any such future retrieval is beneficial, noting that it is possible that there may be small changes that can be made during design and implementation that would greatly help future retrieval, if that were ever to be decided upon. This represents a balance among the burden on future society, passive safety and the effort of retrieval (freedom of choice). Before closure, the Swiss plan for retrieval in detail without planning what to do with the retrieved waste, since this would depend on the reasons for retrieving it. This planning for retrieval starts early.

Financing is considered a philosophical question. Cost estimates may be prepared for future retrieval at various stages of repository development, but the Swiss do not require financing for unplanned or hypothetical actions.

The following discussion touched on a number of topics, including: burden of leaving a repository open vs. burden resulting from lack of freedom of choice; the meaning of "certainty"; responsibilities for funding both pre- and post-closure; the meaning of "feasibility" (in principle only, or following a fully developed demonstration?).

There was also some discussion on the possibility that there may be financial benefits to be obtained by planning for retrievability. For example, deliberately delaying closure, as one means of allowing for reversibility and retrievability pre-closure, benefits from the time value of money by reducing the present value of the investment required. Technological changes may also allow advantage to be taken of technological improvements. However, it was pointed out that these arguments would also apply to a lengthened time scale adopted for implementation even in the absence of retrievability or reversibility provisions.

Regarding the responses to the questions in the pre-meeting questionnaire: In response to a question on whether designing for reversal or retrieval would simplify planning, responses were somewhat mixed. In response to a question about financial benefits of designing for reversal or retrieval, it was mentioned that doing so can enable optimization of future costs for backfilling and sealing.

AGENDA PART IV: FOCUS ON STAKEHOLDERS

4.1 Are there "analogues" to reversibility and irreversibility?

The FSC topical session on Use of Analogues for Confidence Building in June 2008 suggested that it would be good to have analogues to the concepts on which reversibility relies. A presentation was provided by *C. Pescatore* on the FSC topical sessions and on initial ideas for the project to discuss. This presentation touched on analogues from decommissioning for reversibility, and also on some historical analogues that may cast some light on reversibility vs. irreversibility. This and the discussions provided avenues to new ideas for explaining reversibility and irreversibility to stakeholders.

The FSC Topical Session highlighted the distinction between *analogue*, *analogy* and *anecdotes*, according to the similarity with the process or system in consideration. Analogues include both natural analogues and anthropogenic (archeological and contemporaneous) analogues. Some suggestions for further development made at the Topical Session include the application of contemporary analogues as input to the design and

choice of material with a view to reversible disposal, and the topic of socioeconomic analogues (probably recent contemporary ones involving similar projects in terms of the investment….).

The responses to the question in preparation for this working group meeting included some examples, among them the retrieval of waste packages at WIPP; archaeological analogues regarding durability of materials (e.g metallic pieces); studies carried out for the retrieval of waste from the Asse Mine; retrieval experiments at URLs (buffer-container experiment at AECL, canister retrieval at Äspö, etc); and remediation of earlier uranium mining tailing deposits (open pit in Ronneburg) (Germany). However, one response doubted that such analogues would really help, and one pointed out that comparing radioactive waste management with more familiar issues could be counterproductive *(*lessons learnt in discussion with some stakeholders in France).

The introductory presentation gave some examples for reversibility, including historical examples of the de-construction of facilities and their structures, namely the dismantling, relocation and restoration during the 1960s of the Abu Simbel rock temples, and the example of Todai-ji, the largest wooden structure in the world, which has undergone continual refurbishing since its construction in 750 AD. Contemporary examples in the nuclear field include the dismantling of nuclear facilities and removal of large components, considering cost differences depending on the applied technology (modern vs older), and lessons learnt from decommissioning, that provision in the design for removal/decommissioning facilitates the reversal of the actions.

Mr. Pescatore's presentation also highlighted the following quote from the US National Academy of Sciences in 1966 (quoted in NUREG-0300): "Other things being equal, those technological projects or developments should be favored that leave maximum room for maneuver in the future. The reversibility of an action should thus be counted as a major benefit; its irreversibility, a major cost." This statement is closely aligned with the ethic of reduce, reuse, recycle, and represents one of the criteria of "good practice" in today's world. The presentation concluded that while reversibility may not be a term widely used in engineering, it is a societal trend in consumer products, appliances, construction in general, even when the word is not used. In conclusion, while there may not be exact analogues for reversibility and retrievability, analogies may nevertheless serve for explaining the philosophy behind the concepts.

During the discussion, it was pointed out that there are also "negative analogues" for the application to reversibility and retrievability; reversal of actions (even in an open repository) may depend on interest, knowledge, and the availability of technical and economical means to perform the reversal, Reversal of the actions needs the preservation of the documentation generated during the life of the facility since its design.

The use of "examples" to explain issues of radioactive waste management may be counterproductive. In any case it is necessary to be careful to avoid giving the impression of trivialisation of the issue. It is important to learn from the past without criticising past actions. Stakeholders and the general public are more and more interested in having open options allowing for reversal, retrievability and research, demonstrating that although there is a cost, retrieval will be feasible..

The use of analogues involve difficult concepts, which have to be applied and explained carefully. There may be some good examples for reversibility of actions and decisions, but before applying them we have to ask ourselves basic questions: why, what, to whom, and how. Historical examples may be used to explain the philosophy of reversibility and retrievability, but we have to have in mind that there are also negative examples.

It is important to communicate clear messages, among them: Wastes will only be emplaced in a final repository when there is assurance of safety, without the intention of retrieval. The potentiality for reverse

decision and actions exists, and can be facilitated by preparing plans for reversibility and retrievability since the early stages of development.

4.2 R & R Scale

The Reversibility and Retrievability (R&R) "Scale" was introduced with a presentation by Jean Noel Dumont (Andra, France) supported by Brendan Breen (Nuclear Decommissioning Authority, UK). This was followed by a presentation on the potential application of the Scale to the Canadian process by Mrs Gloria Kwong.

The Scale is intended to be used as a tool to enable dialogue on R&R. There was a comprehensive and interesting discussion on the topic and on the two page draft document illustrating the R&R Scale. The document, as it currently stands, comprises a page of questions and answers on the use of the Scale and a second page with a Diagram and Table describing the stages of a long term radioactive waste management process to illustrate where R&R would be applicable.

There was general agreement that the Scale has value in identifying where Reversibility, Retrievability and Recoverability could feature in a long term radioactive waste management disposal process. In presentational terms the Table combined with the Diagram illustrates, in a clear and simple manner, where the "R" issues will feature in a process. It could be used to aid understanding and as a tool for discussion with "informed" stakeholders, providing a succinct overview for the consideration of technical and ethical issues. It was agreed that, whilst it is a generic document, it could be adapted by individual countries to reflect their own timetables and processes for decision making.

A number of points were raised in the discussion to be considered in the next draft of the document: these are outlined below.

Language: There was some discussion as to whether there should be an attempt to simplify the language of the document to make it more understandable and accessible for those who may not have detailed technical knowledge. Although this point was accepted, it was agreed that, as the intention is for the Scale to be used internationally, then internationally accepted descriptions and definitions should be used: for example, "emplacement" and "conditioning". Whilst agreeing that this should be the basis for the preparation of this document, it was recognised that, for discussions at a national level, less technical language might need to be used. It was also proposed that the document should use terms already recognised by stakeholders, for example, site characterisation.

Radioactive Wastes Covered by the Scale: The Scale was drafted to reflect deep geological disposal options for higher activity radioactive wastes, but it was agreed that the principles of the Scale could also be applied to Low and Intermediate Level Waste disposal. It was agreed that the main change needed would be the timeframes for the process over which decisions would be made: these would be shorter for these other wastes. It was suggested that, if it is to be used more widely, the Scale should recognise that some wastes will already be packaged and that there may be mixed wastes.

It was agreed that the Table and the Diagram complemented each other and should be used together.

Table: It was agreed that the Table needed further consideration to clarify the text and make it more consistent throughout including, if necessary, to repeat text in different boxes. This included being clear and explicit about where there is institutional (and regulatory) control and not assuming that it will be understood by readers that controls are in place.

It should be clear at what level there is a need to include reference to passive markers. This should recognise that they may be deemed to be a positive step but also that they might invite intrusion and reflect on whether there was still institutional control, or not. It would be helpful to illustrate milestones and recognise timeframes in the text. This recognised that timeframes in terms of years would be specific to national programmes. It was agreed that the Table should recognise the issue of other wastes such as packaged and mixed wastes.

Diagram: It was agreed that Diagram was very helpful in illustrating the stages of a process. It was suggested that, as with the Table, the Diagram could have indicative timescales, not in terms of years but with milestones identifying where decision points were, and who would take those decisions. It was proposed that the terminology should reflect the activity being undertaken, rather than have definitions which may be specific to legislation and regulation in some countries, but not applicable to others. For example, in milestones not using "licensing" but using a term such as "site characterisation". It was agreed that the Diagram should be clear about milestones and where institutional control would be expected to end.

It was agreed that the R&R document has the potential to be a helpful tool but in its present form could not be given to stakeholders without more information. It would probably need to be used by implementers, regulators and others with responsibility for stages in the process to assist in their discussions with stakeholders, rather than to issue it to stakeholders as a standalone document.

It was agreed that it has the potential to be adapted for use in discussing the processes and decision making for disposal of different categories of radioactive waste. It also has the potential to be adapted for use by individual countries to reflect their national programmes and decision making frameworks. It was agreed that the drafting team would consider the comments made and provide a revised version for the next working group meeting.

4.3 Nordic country attitudes to R & R

The Finnish and Swedish repository programmes are in a relatively advanced state. It is interesting for other programmes to understand the impacts discussions on R &R have had on the development of those programmes, and the current role of R & R in the programmes and the views of the public.

S. Engström (SKB) made a presentation by video link. She began by pointing out that the regulations in Sweden do not require retrievability, but regulatory guidance permits retrievability provided that inclusion of retrievability does not impact negatively on safety.

The implementer has chosen as its own requirement to design for retrievability and to demonstrate its feasibility during repository operation. Full-scale tests have been carried out to demonstrate the retrievability of spent fuel containers. The safety report includes an assessment of pre-closure retrieval of a single canister for safety reasons. Retrieval of multiple canisters is considered in the design for other (non-safety) reasons.

The reason for including retrievability among the design requirements comes from recommendations by the Swedish Nuclear Waste Advisory Council, KASAM, that disposal should not unnecessarily restrict future freedom of action. The implementer also considers this a "what if" scenario, for which it is advisable to be prepared.

Post-closure, there is a regulatory requirement that the repository must be designed in such a way that retrieval is not a necessary response to any design basis event, and therefore there is no safety analysis for post-closure retrieval. There is no requirement to fund future retrieval in advance, and it has been made

very clear during public consultation that while post-closure retrieval is possible, it will likely be only at large expense to future society.

Ms. Engström also made the point that public groups in Sweden had contrasting views on the topic of retrievability. One group is in favour of disposal at intermediate depths (approximately 200m) in order to facilitate retrieval, which it considers important. However, another group prefers much deeper disposal (2000-5000m), at least in part in order to make retrieval very difficult.

4.4 The latest Eurobarometer and the coming one

Christina Necheva *(*EC-DGTREN) reported on latest results and on plans for the next Eurobarometer survey.

The most recent survey, carried out in February-March 2008, showed a general increase in support for nuclear power. Attitudes vary between countries, and are significantly more favourable in countries that have nuclear power generation programmes that in those that do not. It remains true, as in earlier surveys, that demonstration of a safe solution for radioactive waste would likely improve support significantly.

The recent survey did not include any questions specifically related to reversibility or retrievability. The EC is currently considering whether or not to include a question or questions on this topic in the next survey in 2011. Ms. Necheva noted that it would be very difficult to design questions with simple language that could be used in a survey, but that the R&R group had provided important, useful suggestions that will be considered by the Commission.

AGENDA PART V: FOCUS ON THE NEXT STEPS

5.1 Review of the NEA-3140 report on R & R

One potential deliverable from the project is an update of the policy booklet NEA-3140 (http://www.nea.fr/html/rwm/reports/2001/nea3140.pdf).

An overview of comments received so far from project members was presented by *G. Kwong*. A discussion on the comments and on future work plans followed.

It was concluded that the 2001 report is still a good basis, and from the point of view of project participants and insiders, it could be used with relatively minor modifications to take into account recent developments. However, it was felt that a new approach to the subject could be an opportunity to present a clearer message to stakeholders and others less familiar with the subject.

It was decided that a draft of a new document would be a useful input to the conference planned for December 2010. This would be prepared in parallel with a more detailed project report for use by the RWMC. Following the conference, the draft would be revised to take the discussions at the conference into account.

The Secretariat will prepare a vision for a new report to be distributed to working group members by 7 September for comments.

5.2 Initial Planning for NEA international conference on R&R, Reims, France, 15-17 December 2010

The conference will be informed by the group's work on this project. It will cover all aspects of reversibility and retrievability, including social, technical, regulatory, and policy aspects. The audience therefore will be broad, and the emphasis will be on dialogue. The purpose being mutual learning, one of the main outcomes will be better awareness of issues and status. The conference will also serve to test the findings of the project and refine the project's conclusions.

A discussion was held on various topics, such as potential session topics, programme committee membership and modus operandi and timetable, publicity, fees, and other organizational issues.

France (Andra) will host the conference. The UK and US working party members both offered to support the programme committee. The Secretariat will distribute a vision for the conference to working group members by the end of June, and a more detailed conference proposal taking these comments into account will be distributed by 7 September.

5.3 Near-term way forward for the R&R project

A discussion was held on the future directions for the R&R working group. The following actions were planned:

1. A vision of the December 2010 conference to be sent to group members by end of June, responses to be received by the end of July, and a more detailed conference proposal to be distributed by 7 September.
2. Minutes of this meeting to be prepared by mid-July, for the use of group members.
3. A progress report on the group's work to be prepared by 7 September for distribution to the working group members for comments before sending it to the RWMC Bureau for their November meeting.
4. A vision of a project report to succeed NEA-3140 to be sent to working group members by 7 September.
5. The scale task group to continue its work with a view towards finalizing the proposal for the December 2009 working group meeting. The scale would then be tested on member country programmes in early 2010.
6. The next working group meeting will be held in or near Washington, DC on December 2-4, 2009. Possible topics for discussion include monitoring, step-wise decision making, limitations on R&R, and benefits/costs of retrieval.

The meeting was adjourned at 2:40 pm.

Annex 1

LIST OF PARTICIPANTS

Belgium	Jean-Pierre WOUTERS - FANC
	Hughes VAN HUMBEECKE - ONDRAF/NIRAS
Canada	Gloria KWONG - NWMO
Czech Republic	Miroslav KUCERKA – RAWRA
France	Jean-Noël DUMONT - Andra
	Jean-Michel HOORELBEKE- Andra
Germany	Peter-Jürgen LARUE - GRS
Japan	Minoru INAMURA - NUMO
Korea	Heui-Joo CHOI - KAERI
Spain	Miguel CUÑADO - ENRESA
	María del Carmen RUIZ LOPEZ – CSN
Sweden	Carl Reinhold BRAKENHIELM - Uppsala University
By video link	Saida ENGSTRÖM - SKB
Switzerland - By video link	Piet ZUIDEMA - NAGRA
United Kingdom	Brendan BREEN - NDA
	Elizabeth GRAY - The Scottish Government, Environmental Quality Directorate
	George HUNTER - Scottish Environment Protection Agency
United States	Catherine HANEY - US Nuclear Regulatory Commission
	Shawn SMITH - US Nuclear Regulatory Commission

INTERNATIONAL ORGANISATIONS

EC	Christina NECHEVA
IAEA	Bernard NEERDAEL

OECD NUCLEAR ENERGY AGENCY

Radiation Protection and Radioactive Waste Management Division	Betsy FORINASH – Administrator (RWM) Claudio PESCATORE – Principal Administrator (RWM)
Expert to NEA	Richard FERCH

Annex 2

LIST OF WRITTEN MATERIALS MADE AVAILABLE FOR THE MEETING

Item	Supporting Document	Title	Author
1.2	NEA/RWM/A(2009)2	Agenda	
1.3	NEA/RWM(2009)3/REV1; Presentation	RWMC Reversibility and Retrievability Project: Phase-2 Report	C. Pescatore
2.1	Presentation; Supporting document; Rapporteur report	Safeguards	B. Neerdael B. Neerdael P-J. Larue
2.2	Presentation		R. Ferch
3.1	Presentation; Rapporteur report		J-M. Hoorelbeke M. Kučerka
3.2	Presentation; Rapporteur report		B. Breen B. Forinash
3.3	Presentation (video link); Rapporteur report		P. Zuidema S. Smith
4.1	Presentation; Rapporteur report		C. Pescatore C. Ruiz Lopez
4.2	Presentation; Scale table; Scale table; Presentation		J-N. Dumont J-N. Dumont B. Breen G. Kwong
4.3	Presentation (video link)		S. Engström
4.4	Presentation		C. Necheva
5.1	Review of the NEA-3140 report	Reversibility and Retrievability in Geologic Disposal of Radioactive Waste: Reflections at the International Level	
5.1	Presentation		G. Kwong