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**NUCLEAR ENERGY AGENCY
RADIOACTIVE WASTE MANAGEMENT COMMITTEE**

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**Summary Record of the Reversibility and Retrievability Project Meeting
held in Washington D.C., United States, 2-4 December 2009**

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**MINUTES OF THE RWMC REVERSIBILITY AND RETRIEVABILITY PROJECT MEETING,
DECEMBER 2-4, 2009, WASHINGTON DC**

INTRODUCTION

0.a Welcome

Catherine Haney welcomed the attendees on behalf of the host organization, the United States Nuclear Regulatory Commission (NRC), and also on behalf of the RWMC Bureau. She noted that the RWMC Bureau considers the work of the Working Group to be important. The RWMC is very interested in the work of the Group. She also noted the full and aggressive agenda of the meeting.

With respect to the current situation in the US, she stated that the NRC is continuing its review of the Yucca Mountain application, but is also thinking about what to do in the event that a significant delay in disposal should occur. The NRC, in concert with the relevant US Government agencies, is considering options for an integrated strategy for management of high-level wastes and spent fuel. She noted that the work of the R&R working group will be helpful in this.

0.b Review of project status

Logistics issues for the meeting were briefly presented. There were self-introductions of all participants. The agenda that had been distributed to members before the meeting was adopted. Claudio Pescatore gave a brief presentation on the current status of the Reversibility and Retrievability project.

**SESSION 1 – Retrievability/Recoverability:
actual experience and lessons to be learnt
including on cost**

1.a Retrievability requirements at WIPP

Chuck Byrum (EPA) gave a presentation on regulatory retrievability requirements for the Waste Isolation Pilot Plant (WIPP) and their rationale. WIPP is a deep geological repository for transuranic wastes¹, mainly Pu and Am, in a bedded-salt formation. This presentation was a joint one with Russ Patterson, who later presented the implementer's experience (see Item 1.b)

1. Part of these correspond to long-lived ILW and part to long-lived LLW

There are two levels of EPA regulatory requirements: generic and site-specific. The generic regulations require that waste removal from the repository must not be precluded for a reasonable time period after disposal. This is seen as a safety-assurance requirement, as distinct from a safety requirement. The site-specific regulations add the condition that removal must be feasible with technology existing at the time of granting of the operating license. A document describing the technological feasibility of removing the waste and presenting a conceptual plan for removal was required as part of the licensing support documentation. The plan was required to describe the sequence of steps that would be needed to perform removal, any infrastructure that would be required to support it, as well as an estimate for how long removal of wastes would continue to be feasible after closure.

The rationale behind these requirements was not to ensure that recovery of wastes would be easy or cheap, but simply to demonstrate that it would be technologically feasible, “because the **Agency believes that future generations should have options to correct any mistakes** that this generation might unintentionally make”, and that any disposal concept should be reversible.

A Waste Removal After Closure plan was presented in 1996 as part of the DOE licensing documentation, which estimated that removal was feasible for 10,000 years. DOE also supported this plan with demonstration experiments using robotic equipment. A video was shown of the DOE experiments.

Chuck Byrum presented then the following recommendations and lessons to be learnt from the WIPP experience:

- If retrieval (during operations) or removal (after closure) is expected then the facility should be designed with this in mind.
- Make removal a legal and regulatory requirement.
- Have the facility submit a proposed plan before site approval and emplacement begins.

1.b Experience with waste recovery at WIPP

Russ Patterson (DOE) gave a presentation on retrieval of wastes that had recently been carried out at WIPP. During 2007 and 2008, when it was discovered that some waste packages had not undergone complete characterization, it was decided to retrieve the suspect packages and re-characterize them. Operations at the repository were suspended while waste packages were moved to provide access to the suspect packages. The suspect packages were retrieved, inspected and characterized, and then re-emplaced. The most important impact of this retrieval was on the operational schedule of the repository: waste deliveries to the repository had to be halted for approximately a month while the retrieval took place, which entailed relatively important costs (in the tens of millions of dollars).

As a result of this experience, control and documentation of the waste characterization process at the sites where the waste is characterized and packaged have been improved in order to reduce the likelihood of recurrences.

1.c Retrieval plans at Dounreay

George Hunter (SEPA) described the situation of wastes disposed of in two places at Dounreay, and current plans for their retrieval.

The “Dounreay shaft” was originally excavated as part of the construction of an effluent discharge tunnel. It was not originally intended as a waste disposal site. During early operations at the site, it was decided, however, to dispose of low- and intermediate-level wastes in the existing shaft, with the approval of the regulator. By today’s standards, disposals were poorly controlled. There have been hydrogen

explosions and fires, and the shaft is hydraulically linked to the nearby ocean. In 1971, an engineered “silo” was built to accept Dounreay waste unfit for land disposal, but although the silo is authorized only for storage and not disposal, there was no provision made during its design for retrieval of waste.

The situation of the wastes in the two sites is not acceptable by current standards, and it has been decided by the Scottish Government that the wastes must be retrieved. Approximately 1500 m³ of waste are to be removed, at a cost which has been estimated at 300 million pounds.

This may be considered an example of a retrieval to be undertaken because of changes in regulatory standards. The activity will be much more difficult and expensive than it would have been if retrieval had been anticipated and planned for before disposals began.

1.d Closing options for the Asse disposal site

On behalf of Jürgen Larue (GRS), who was unable to be present, Claudio Pescatore gave a presentation on options being considered for closing the Asse disposal site in Germany. This site was a pre-existing salt mine that was subsequently used for research into disposal of low- and intermediate-level wastes. Groundwater ingress into the non-nuclear part of the mine has made it necessary to take a decision on closure and, with it, whether the low-level waste should be retrieved, either in whole or in part². If retrieval were pursued, then two more options are possible for the retrieved LLW: re-emplacement in a different part of the mine to be newly excavated or disposal at an alternate site. Retrieval would be an elaborate process requiring building radiologically-secure facilities for waste handling and repackaging. The expected costs are in the range of 1 to 3 billion Euros depending on the option chosen. A decision on which of the alternatives to take is expected before long, based on a comprehensive set of assessment criteria.

1.e Discussion

During the discussion, it was noted that retrieval is an unusual situation, even if retrievability provisions exist. The existence of retrievability provisions does not reduce the seriousness of a decision to retrieve, which is in principle a new process requiring a new safety assessment, regulatory permission, etc. Retrievability provides assurance that the situation is not beyond remedy, but it does not deal with the reality of an actual retrieval.

It was also noted that, at WIPP, the regulatory requirements for retrievability are intended for post-closure. The actual retrievals described in the presentation were during operation in response to operational events (failures of characterization). From the WIPP experience it should be noted that retrieval can be a regulatory enforcement measure, as one of the retrievals there was demanded by the regulator. Retrievability also has a role as demonstrations of trustworthiness and willingness to live up to the implied social contract; one of the retrievals was voluntarily carried out without waiting for the regulators to require it. This was an opportunity to build and strengthen the relationship between the facility and its stakeholders. In both retrievals, safety was not at stake.

The cost of retrieval seem to be at least as high as those for emplacement, and if retrieval during operations is foreseen as a possibility it is perhaps a good idea to design the repository so that not all emplacing operations may have to come to a standstill if retrieval of a few packages were to be effected.

It was suggested that detailed requirements for retrieval, as distinct from requirements for retrievability, should probably not be set out in regulations, because retrieval is expected to be an

2 There is apparently no issue with the single, ILW disposal cavern.

extraordinary event requiring specific approval, but it was also suggested that it may be appropriate to have requirements on the process to be followed before taking a decision on whether or not to retrieve wastes.

SESSION 2 – Limitations on recovery/retrieval

2.a Limitations from materials and equipment aging

Jean-Michel Hoorelbeke (Andra) gave a presentation on limitations to retrieval arising from aging of equipment and materials, with particular reference to the Andra disposal concept.

Limitations on retrievability can arise due to operational safety or long-term safety considerations, or as a result of costs. Technical limitations linked to repository design relate to such items as vault geometry and size, layout and separation of vaults, rock support to ensure structural stability, chemical compatibility, and operational equipment and procedures.

Once wastes have been emplaced, retrieval operations are more complex than above ground operations, and may require significant resources for ventilation, maintenance and operational safety. Because of limited accessibility within disposal cells, maintenance of waste packages, if needed, is likely to require retrieval. Retrieval, even in a repository designed for retrievability, will not be a quick operation.

With the passage of time, chemical alteration and creep of the host formation, as well as corrosion and other container alteration phenomena, combined with aging and alteration of underground electrical and mechanical equipment will make retrieval increasingly challenging, such that retrieval may take longer than emplacement. The current French requirement is for a retrievability period of 100 years, which is considered to be compatible with current equipment capabilities³.

2.b Technical requirements posed by retrievability

Brendan Breen (NDA) provided a presentation on the impacts of retrievability demands on the design of a repository. In contrast to the French concept, this presentation focused on a concept in which vaults were backfilled with bentonite clay immediately after emplacement. As the backfill takes up water, it will swell, making retrieval more difficult as time passes⁴. If multiple packages are emplaced in a single borehole or tunnel, retrieval is more difficult. Retrieval is also likely to be more challenging for vertical emplacement as compared to horizontal emplacement. These limitations must be balanced against other factors, including operational safety.

In most concepts, the design must be sufficiently robust to address operational problems such as dropped or incorrectly placed canisters, and this robustness contributes to retrievability. Nevertheless, there are limits to retrievability imposed by the need to ensure long-term safety and integrity of packages.

As retrievability is becoming one of the factors considered during design, it is difficult to clearly identify the provisions for retrievability separately from those that would be considered good design

3 At present, there is no other requirement than what is stated by the 28th June 2006 Act, which doesn't specify the date of start of the reversibility period. Andra has proposed to consider that the reversibility period be counted from the start of operations. This, however, would need to be accepted and confirmed in future decisions.

4 Bentonite may take, however, a very long time to swell: possibly as long as several hundred years.

practice. In fact, focusing on retrievability early during the design process can actually reduce the likelihood that retrieval will be necessary for operational reasons (e.g. maintenance).

2.c Other limitations and lessons learned

Hughes van Humbeeck (ONDRAF/NIROND) began the session with a brief presentation on limitations imposed on retrievability by geology. By extending the transient period during which the repository is open and/or by changing the extent of the excavation damaged zone, retrievability can complicate the modelling of repository performance. Specific monitoring measures required to support retrievability can constitute a perturbation on the repository, which can be difficult to model or which could compromise long-term safety; this may limit the types of monitoring that are possible.

The act of retrieval of only part of the wastes, if undertaken, would most likely constitute a significant perturbation on the remainder of the repository. This would have to be taken account in decision making.

In the ensuing discussion, it was noted that during the operational period, the ability to retrieve waste packages might be considered to be part of the ability to respond to operational problems, and may therefore be a requirement for safety-assurance reasons during the operational period. The regulatory focus in some programs has been on the long term, both for safety and for retrievability, but as the experiences described in Session 1 demonstrate, having retrieval plans during the operational period can give significant operational, safety and financial benefits.

SESSION 3: Relationship of R&R to monitoring and memory keeping

3.a Report from FSC on R&R-related activities

Janet Kotra (NRC), chairman of the RWMC's Forum on Stakeholder Confidence (FSC), gave a presentation on the FSC's activities related to reversibility and retrievability. The FSC conducted a workshop in Bar-le-Duc, France, in April 2009. One topic was the expectations and motivations for reversibility. This was followed up with a discussion at the FSC annual meeting in September.

Although the workshop topic was reversibility, the discussions focused mainly on retrievability. There were differing views on the proper definitions of the terms, highlighting the need for continuing dialogue. Even though not all countries include retrievability in their national programmes, there was general convergence on several points:

- The importance of developing shared views of the aims and implementation of reversibility, to ensure that societal preferences influence technical solution
- The need for public debate and discussion on reversibility/retrievability to make expectations known and feed them into decision-making
- The need for debate to take place when designs are being considered for the repository, so requirements can be integrated into design
- The need for clear decision points throughout the waste management process and for stakeholder input
- Some participants felt that the timescale for retrievability and any limits placed on it must be part of the debate.

Participants recognized that there are costs and limitations to retrievability, and that maintaining a constant level of retrievability indefinitely is not feasible. Information about costs and limitations, and how these change with time, needs to be fed into the debate in order to help in decisions on tradeoffs. There is a need for regular review, a planned stepwise implementation and continuous dialogue during the process.

The workshop concluded that retrievability helps build confidence and trust incrementally, and that building flexibility into the system has several advantages.

At the FSC meeting in September, FSC members noted that it can be difficult to find centralized, up-to-date information on how countries are approaching reversibility and retrievability. They concluded that the introduction of retrievability considerations has improved repository science, as well as contributing to acceptance. Several issues were noted for further follow up:

- The issue of what is meant by closure (close and monitor vs. close and walk away) should be considered further, since the concepts, actions, regulatory criteria and numbers implied by these two options are very different
- Regulators appear often to be guarding their neutrality by not commenting on the desirability or downsides of R&R. This may not be satisfactory to civil society, who may wish regulators to be more active as “champions of safety”
- There is a potential for a future topical session on stakeholder involvement in monitoring
- FSC wishes to continue to support and participate in the R&R Working Group, and also to contribute to the work on the R-scale.

In the ensuing discussion, it was noted that different regulators may have differing views on the question of retrievability and retrieval. This becomes particularly important when there are multiple regulators involved in a single project, as is often the case. It is important to have clear roles and responsibilities in such cases.

3.b NRC requirements for R&R and memory keeping for Yucca Mountain

Tim McCartin (NRC) presented the NRC requirements for retrievability and memory keeping for the Yucca Mountain repository.

He noted that a final decision at closure is only meaningful if retrievability, either prior to or as a result of the decision, is an option. He also emphasized the importance of the performance confirmation programme during repository development, both in support of the final licensing decision and as a component in confidence building.

The NRC’s retrievability requirement for Yucca Mountain only applies prior to closure, and it is envisaged for safety reasons only, that is, in case the performance confirmation programme shows that the repository as implemented would not be safe. Retrievability is thus not part of the long-term safety concept but is an operational feature that supports achieving long-term safety. Nevertheless, both retrievability and the information obtained from the performance confirmation programme may assist retrieval decisions and operations also after closure, and/or for non-safety reasons.

With respect to memory keeping and post-closure controls and monitoring, the existing regulatory requirements are generic in nature. These include requirements for *permanent* markers and archiving of records after closure, as well as a programme of post-closure oversight and monitoring that would be the responsibility of DOE. More detailed specification of the post-closure requirements is not considered

necessary at this time, as closure would not take place until several decades in the future, and there is ample time to develop more detailed requirements before they are needed.

3.c Memory keeping requirements for WIPP

Tom Peake (EPA) presented the EPA's requirements for passive institutional controls as applied to WIPP. The primary goal of these requirements is to deter inadvertent intrusion. The regulations permitted DOE to propose to take credit in the performance assessment for a reduction in the likelihood of inadvertent intrusion due to passive controls.

The DOE proposal included markers, a berm around the site, information rooms and off-site archival of information. It also proposed a reduction in the assumed probability of intrusion in the safety assessment, but in the end the EPA did not consider the arguments sufficiently persuasive to support the proposed reduction, as there was no clear basis to support a numerical estimate of the probability.

The focus of these requirements is on human intrusion after closure, but in fact the requirement to preserve information for this purpose also facilitates retrievability. As in the case of the NRC requirements for Yucca Mountain, the post-closure requirements for passive institutional controls are still fairly generic, since there are several decades before specific controls will need to be put in place.

3.d Discussion

The discussion in this session was based on the question: Is a walk-away policy from a closed repository compatible with a reversible/retrievable approach?

It was suggested that in the event, completely walking away from a repository once it was closed was very unlikely as long as current societal institutions continue, regardless of R&R considerations. Control and monitoring would most likely continue, even though the need for them on technical grounds will decline over time. The need to maintain the relationship of local communities with the site continues. Sustained involvement is needed in order to preserve knowledge in an active, understandable and usable form. It was noted that different types of information are needed to support different uses (e.g. general location information to deter intrusion vs. detailed design information for purposes of retrieval).

The safety case posits a walk-away, in order that safety be preserved even in this situation. However, this does not mean that there is an actual intention to walk away. Judging by today's standards, as long as there is societal and institutional continuity, it is unlikely that walking away would actually take place. All of this is beneficial to retrievability even if retrievability is not required.

SESSION 4: Stepwise decision making and reversibility

4.a The role of reversibility/retrievability in Adaptive Phased Management

Gloria Kwong (NWMO) described the role of retrievability in the Canadian Adaptive Phased Management approach. She reviewed the historical development of retrievability in Canada, noting that during the consultations leading up to the introduction of the current approach, Canadians had expressed strong views that retrievability was an essential component of a socially acceptable plan for radioactive waste management. Retrievability is essentially a precautionary approach to disposal. Continued learning

from research and development in waste management is also considered to be a vital component of the plan.

For these reasons, retrievability is considered to be an important feature of the Canadian approach to repository development. It is understood that retrievability will pose some design challenges, and that retrieval will become progressively more difficult and resource intensive as implementation proceeds.

During the discussion, it was noted that in Sweden, in contrast to Canada, the general attitude towards retrievability is one of suspicion, as retrievability can be seen as possibly contrary to non-proliferation and long-term safety and isolation of the waste. By contrast, in Canada there appears to be a feeling that future technology will come up with better ways to deal with the waste. In part because so far the disposal concept has been only a general concept without a specific site in mind, confidence in the concept of geological disposal is lacking.

4.b The RWMC document on stepwise decision making

Claudio Pescatore gave a presentation on the RWMC document “Stepwise Approach to Decision Making for Long-term Radioactive Waste Management” (NEA-4429) that was published in 2004. This report was an outcome of work done by the RWMC’s Forum on Stakeholder Confidence (FSC).

Stepwise Decision Making (SDM) is a process

- in which the public, and especially the local public, are meaningfully involved in the review and planning of developments;
- that rests on the concept of flexibility (through reversibility and retrievability) to provide reassurance that decisions can be reversed if experience shows them to have an adverse or unwanted effect;
- that allows the development of a competent and fair discourse through public involvement and social/collective learning and foresees adaptation to societal changes;
- that allows the stakeholders to gain familiarity with - and a degree of control over - RWM technologies and institutions. This in turn builds trust and confidence.

SDM towards final disposal is not necessarily a linear, incremental process, as the history of programmes in many nations has shown.

With respect to reversibility, NEA-4429 points out that reversibility denotes the possibility of reconsideration of one or a series of steps. A decision to reverse a previous decision would be taken as a result of careful evaluation with the appropriate stakeholders. Retrievability is one part of reversibility, and represents a technical means by which control over the wastes can continue to be exercised during the development process.

NEA-4429 observes that not all decisions are equally reversible and that, as time goes on, the physical consequences of reversing earlier decisions become increasingly difficult and costly. On the other hand, these decisions can be identified in the SDM process and used as natural hold points for programme review and confirmation. Reversibility thus represents a way to close down options in a stepwise, considered manner, by building on decisions one step at a time.

4.c Discussion

During the discussion, it was pointed out that decision making on waste disposal is related to the issue of decision making on nuclear energy.

There was a discussion on the attitudes of regulators to reversible stepwise decision making. Before a licence to construct or operate is given, the regulator requires the implementer to demonstrate that safety will be achieved. Once having taken a decision that the safety demonstration is adequate, regulators may be uncomfortable with the idea of reversibility of regulatory decisions (other than reversal based on failure of the implementer to meet the obligations and conditions of the licence, of course). Dan Metlay pointed out that when the National Academy of Sciences introduced its “One Step at a Time” study on stepwise processes, the reaction of regulators was not very sympathetic. It was noted that regulation is a means to impose a degree of both control and certainty into a process, and the prospect of reversibility of decisions reduces the level of certainty of the process. However, retrievability may increase the assurance that a safe repository will be built.

Review of Day 1

1.f Review of Session 1

Miroslav Kučerka (RAWRA) summarized the key points from Session 1 on experience with retrieval and lessons learned. He noted that the inclusion of retrievability in a programme does not mean that retrieval will be easy or cheap, only that it will be feasible if required. Retrieval is still an extraordinary action, which becomes progressively more resource-intensive during the life-cycle of the repository.

Retrievability can be aided by a robust and well-characterized repository design. Specific measures will be related to the design concept and host geology. Inclusion of reversibility and retrievability during the development of a repository contributes to transparency and trust.

There was a comment made during Session 1 about not allowing the existence of retrievability to diminish the gravity of a decision to retrieve, i.e. using the existence of retrievability to convert disposal into *de facto* storage. On the other hand, if retrievability is to be meaningful, actual retrieval must be a real possibility, not just theoretical. This tension illustrates the difficulty and importance of communicating the concepts of reversibility and retrievability so as to avoid raising false expectations or talking at cross-purposes. The discussion also demonstrated that there are still significant differences in attitudes towards communications and public involvement even within the working group, which may be signs of a culture shift that is still under way within the waste management technical community.

2.d Review of Session 2

Jean-Pierre Wouters (FANC) summarized the discussion in Session 2 on limitations. Reversibility or retrievability is now being considered as a possibility, at least pre-closure, in most programmes. While it does not affect designs in fundamental ways, it does have impacts, which vary with the specific design and host geology. Retrievability may impose additional design features and require additional infrastructures and maintenance. In addition, it may influence techniques as well as the timing of emplacement of waste packages.

The discussion suggested that before closure, retrievability can be considered to be an operational issue or feature, and may be required as part of the performance confirmation process. After closure, it was

suggested that any decision to retrieve should be considered to be a new activity that would need to meet the justification principle. Retrievability is a feature of the repository design, but once the closure decision has been taken, retrieval is not part of the repository life cycle, but a separate new action.

3.e Review of Session 3

Richard Ferch summarised the discussions in Session 3 on monitoring and record keeping.

The presentation from the FSC had noted that retrievability adds flexibility and generally helps build trust, but that there was a need for further work in several areas. There is a need for dialogue on terminology, both for reversibility and retrievability and also for the concept of closure. There is a need for shared views on outcomes, and for public debate that takes place early enough in the design process to enable choices to be made. The connection between monitoring and reversibility and retrievability deserves more consideration and study. The FSC supports work on the R-scale by the Working Group.

The presentation on the NRC requirements noted that the final decision on closure is only meaningful if there is a real possibility of retrieval; in this sense some form of retrievability is essential prior to closure. It was pointed out that the performance confirmation program carried out during repository development before the closure decision would be an essential component of the development and acceptance process.

There were interesting differences between the requirements of the EPA for WIPP and the NRC for Yucca Mountain. The NRC's requirements for retrievability were intended to address safety reasons pre-closure, although they might also assist decisions about retrieval for other reasons and/or after closure. The EPA's retrievability requirements for WIPP were aimed at preserving future options during the post-closure period, although again they may also assist decisions prior to closure. These differences, together with the differences between Scottish policy and policy in the rest of the UK, illustrate that even within a single country policies and their implementation may differ between projects, as well as changing with the passage of time.

Some other points raised during the discussions included the need for deeper understanding of the regulator's role in decisions about retrievability and retrieval. The regulator needs to be independent of the implementer (as required by international commitments such as the Joint Convention), and yet is also expected to fulfil a role as the champion of safety on behalf of the public, which puts the regulator into an informational role as well as a decision making one.

It was noted that, based on today's knowledge, there is very weak coupling between the information that can be gained from external monitoring and the processes internal to a repository. Clear communication of this is needed, lest it lead to a mismatch between expectations of monitoring and the results that monitoring can actually achieve. Another communications challenge is the difficulty of communicating the difference between passive or walk-away safety vs. the intention not to simply abandon a repository site once it is closed. The existence of post-closure monitoring, institutional controls and records is an important contributor to public safety in the sense of control/assurance, even if it is not integral part of the long-term safety case for the facility.

4.d Review of Session 4

Carl-Reinhold Bråkenhielm (Swedish Nuclear Waste Council) summarized the discussions in Session 4 on stepwise decision making and reversibility. He noted that while it is expected that reversibility and retrievability may affect public perception, it was not clear to him that there is (academic) research to support this assertion. Some questions to be investigated include: What are the factors that influence public

perception? What is the relative importance of controllability vs. safety? Is there a community of practice, e.g., between implementers, regulators and their supporting consultants? What are the implications of reconsideration of major past decisions?

He pointed out that there is a question of how to achieve a balance between stability and flexibility; the need for stability, and ultimately safety, poses limits to the amount of flexibility that is possible, particularly in the long term (post-closure). The consequences of a reversible stepwise process for different stakeholders need to be further explored.

SESSION 5: Discussion on emerging conclusions from the working group

5.a Review of main messages of the mid-course draft report

Dan Metlay (NWTRB) presented a view of the draft report as seen by a political scientist. He noted that the discussion of retrievability and reversibility has intellectual roots that go back a long time, referring to a report from the US National Academy of Sciences in 1966, which was quoted in the draft report.

He noted some lack of clarity in the report as to whether statements are being made as empirical observations or as normative recommendations. While there is an emphasis on decision making, the discussion in the draft so far is overly abstract and general. There was much specific information from the discussions in the sessions on Day 1 that could be used to make the report more concrete.

He praised the 2004 NEA report on stepwise decision making, but expressed surprise that it had not referenced a rich literature on incremental decision making. Following a review of some of the key literature from political science, he went on to discuss incremental decision making in some depth. He noted that decision making in the radioactive waste disposal field had not always been incremental, even if it has generally been staged. In incremental decision making, the number of decision stages is related to uncertainty; when uncertainty is large, the stages need to be relatively small. However, in our field almost every program has undergone at least one serious reversal, and these reversals are too large to be considered staged or incremental.

The discussion on stepwise or staged decision making is still imprecise. For example, more information should be developed and presented on what might trigger a decision to reverse a previous step. He noted that stepwise decision making does not always promote agreement; some participants may reject it on the grounds that it is biased against major change.

During the following discussion it was noted that decision making in this field is subject not only to uncertainty, but also to a lack of agreement on values. It is questionable whether the incremental decision making process can be relied upon in such a situation. There is no theoretical basis for decision making in a situation with both uncertainty on outcomes and disagreement on values. We need therefore to be careful not to oversell stepwise decision making.

5.b Viewpoints on the current draft of the R&R project report

Claudio Pescatore started this session with a presentation on the current draft. He stated that the draft is intended to be mainly empirical observations and group suggestions/recommendations, but not a

normative document. The document is expected to be finalized in mid-2011. A near-final draft is needed by September 2010 so it can be distributed to participants in the Reims conference.

He went on to describe a change in terminology that had been introduced in this draft: “retrieval” and “retrievability” were used to describe removal of waste without the intention of re-emplacement, whereas “recovery” and “recoverability” were used to describe removal of waste packages for operational reasons, with the intent to re-emplace the waste in the repository. The two different concepts are also present in the EPA presentation on WIPP where two distinct terms, “retrieval” and “removal”, were also used.

Following the presentation, each of the participants gave comments on the current draft. A summary of these comments follows:

- Comments on specific choices of words or phrases in the draft that need further attention, notably: phrasing that suggests closure is irreversible; phrasing that suggests the observation phase is infinite in duration; “managerial” to describe reversibility; “potential” for retrievability
- A number of concerns were raised with the newly introduced terminology, particularly noting that this is not an empirical observation of terminology used in member countries
- Suggestions for additional sections or text: reasons for opting for reversibility or retrievability; components of decision making; design consequences of opting for reversibility or retrievability; further development of the section on societal issues; limitations and costs, including issues of who owns the waste and who pays the costs of retrieval; regulation; research, development and demonstration (RD&D); case studies; links to institutional control; information on the application of the findings to other types of waste and other disposal methods; discussion of values (ethical issues); involuntary intrusion; safeguards
- The text needs to be consistent with the R-scale leaflet
- The Annexes are overwhelming; remove them, possibly replace them with hyperlinks
- The text in the Annex no longer reflects the UK situation fully, since policies in Scotland and the rest of the UK are different. The text is out of date for the US as well. The text from Sweden will be provided.
- Text on adaptability and flexibility that had been in a previous draft had been dropped, and should be reinstated
- One participant suggested that the structure be revised to follow the life-cycle development of a repository.

After some discussion, it was decided that a restructuring along the lines suggested would also allow a return to the previous terminology, by allowing discussion of the distinction (between removal for re-emplacement and for other reasons) to be associated with the life-cycle phases in which they were most likely to occur.

SESSION 6: The International R-scale

6.a Latest version of the R-scale leaflet

Jean-Noël Dumont (Andra) presented the latest version of the leaflet on the R-scale. The ensuing discussion focused almost completely on Figures 3 and 4. There was considerable discussion on Figure 3, and several suggestions were made for improvements.

6.b Discussion

During the discussion it was decided that working group members would send comments on the R-scale leaflet, including the figures, to Jean-Noël by 22 December. After some discussion, general agreement was reached that Figure 4 is not needed in the leaflet, although small parts of it may be included elsewhere. It was pointed out that Figure 4 could be a useful aid to implementation of the scale in a national programme, and could perhaps be retained in guidance.

Review of Day 2

Richard Ferch summarized the discussions of Day 2. There were many suggestions from both days' discussions that would be incorporated in the next draft of the report. In addition to new material based on the previous days' sessions, there would also be some overall changes: a restructuring to correspond better with life-cycle phases of a repository; a return to the original terminology; fewer annexes; and restoration of some material from earlier drafts that had been dropped.

Regarding the discussion on incremental decision making in Session 5, the question was posed: are we actually in the domain where it is applicable? We are in a domain where both legitimacy and certainty are questioned. This is a domain where there is little information available on decision making processes. One thing we should be careful of is not to present stepwise decision making as an incremental and linear one, and as if it was a guarantee of success. Almost all programmes have undergone large discontinuities and setbacks. We can attempt to minimise the likelihood of such events, but there can be no guarantee of success.

A number of areas were raised for further development in the final report, including:

- Costs and limitations
- Reasons for reversibility & retrievability
- Research, development and demonstration
- Regulation, including the role of reversibility and retrievability in regulatory policy
- Monitoring and institutional control
- Ethics and values
- Safeguards
- Decision parameters and decision making processes

Some of these have been covered in this or previous meetings, but several will require further work.

Regarding the R-scale, it was pointed out that the R&R report and the R-scale leaflet need to use consistent terminology and descriptions, and therefore need to be developed together. The point was also made that it is necessary to make it clearer that retrievability stages apply to waste life phases rather than to repository life cycle phases. In other words, retrievability stages and repository phases are not in lock step with one another.

SESSION 7: Reims conference

7.a Draft programme and arrangements

Claudio Pescatore presented the current draft programme and related arrangements. The programme had been distributed to members in advance of this meeting.

7.b Discussion

A point-by-point discussion was held on the programme document. It was pointed out that a historical recap, including a discussion of the 2001 report was needed. Such a presentation would fit naturally into the “Setting the Scene” session. This comment also applies to the mid-course report.

It was felt that the title and scope of Session 11 (the panel discussion on stakeholder expectations vs. regulatory policy) needs some work, e.g., for the title: “The roles of reversibility and retrievability in regulatory policy”.

In terms of preparatory work and logistics, there will need to be an invitation flyer, a web site, and an e-mail address set up. Claudio Pescatore stated that he will be engaging an additional person to help with organisational issues.

A new version of the programme document will be prepared within two weeks for feedback by mid-January. In their capacity as members of the programme committee, working group members were asked and agreed to contact organisations in their respective countries to seek their official support for the conference. This support would not imply financial support, but only support for holding the conference as a useful means of dialogue and progress at this juncture in time. They were also asked and agreed to contact or nominate government representatives who could speak to policy matters in Session 3, as well as other prospective speakers from their respective countries for other sessions (in particular, Session 6), to determine whether they would be willing and able to participate in the conference. Responses from working group members were requested by the end of January 2010.

SESSION 8: Future planning of the project

8.a Report to RWMC in March

Claudio Pescatore explained that a report from the Working Group was needed for the RWMC meeting in late March. The first decision to be taken was whether to update and present the mid-course draft report, or to prepare a separate progress report on the project status as of this meeting. It was decided that the mid-course draft report would be presented, after rewriting it to reflect the discussions during this meeting. In order to have the mid-course report ready in time for the meeting, the rewritten draft will need

to be completed by end-January for distribution to group members; comments on this draft will be needed by February 23.

Regarding the R-scale leaflet, comments are to be received by December 22. A revised version will be distributed by January 15 for additional comments by January 29, so that the R-scale leaflet and the corresponding parts of the mid-course report can be finalised in February.

The detailed minutes of this working group meeting will be sent to members by December 21, for feedback by January 15. The same timetable will be followed for an updated programme for the Reims conference.

8.b R&R topics needing further discussion

A discussion was held on the future directions for the R&R working group. Two main outcomes will be the Reims conference and the final report. A “good” final draft is to be prepared as discussion material for the conference, and then finalized following the conference. The project will end in June 2011.

A number of topics still need to be worked on in order to complete the final draft. These include:

- Costs
- Research, Development and Demonstration
- Regulation, including the role of reversibility and retrievability in regulatory policy
- Monitoring and institutional control
- Ethics and values
- Decision parameters and decision making processes

8.c Planning for the June 21-24 meeting in Paris

It was agreed to address the topics discussed above in 8.b at the June meeting. The dates for the meeting will be June 21-24, 2010 (Monday to Thursday). The meeting will start at 9:30 am on Monday June 21 and continue until 12:30 pm on Thursday June 24, in order to allow time for an RWMC Bureau meeting to follow immediately.

8.d Way forward and review of meeting decisions

The decisions taken in the preceding sessions were reviewed and the meeting was closed.

Annex 1: LIST OF PARTICIPANTS

Belgium	Jean Pierre WOUTERS Hughes VAN HUMBEECK
Canada	Gloria KWONG
Czech Republic	Miroslav KUČERKA
France	Jean-Noël DUMONT Jean-Michel HOORELBEKE
Japan	Kaku KENICHI
Sweden	Carl-Reinhold BRÅKENHIELM
United Kingdom	Brendan BREEN George HUNTER
United States	Helen BURNETT Charles BYRUM Alton HARRIS Jay JONES Janet KOTRA Timothy MCCARTIN Daniel METLAY Russ PATTERSON Tom PEAKE Daniel SCHULTHEISZ Shawn SMITH Dwight WALKER
OECD Nuclear Energy Agency	Richard FERCH Claudio PESCATORE

Annex 2: LIST OF MATERIALS MADE AVAILABLE FOR THE MEETING

0	Word Doc: NEA/RWM/A(2009)3 Proposed Agenda of the 3 rd Meeting of the R&R Project	
0	PPT: Reversibility and Retrievability Project: Milestones and Current Status	C. Pescatore
1.a	PPT: Retrievability Requirements for WIPP and their Rationale	C. Byrum
1.b	PPT: Experience with Waste Recovery at WIPP	R. Patterson
1.c	PPT: Retrieval plans at Dounreay	G. Hunter
1.d	PPT: “Quo Vadis” Asse? Retrieval of Radioactive Waste from the Asse Mine	P-J Larue (C. Pescatore, presenter)
2.a	PPT: Limitations from Materials and Equipment Aging	J-M Hoorelbeke
2.b	PPT: Limitations on Retrievability: What are the Additional Technical Requirements in Case Retrievability is Required?	B. Breen
3.a	PPT: Report from FSC on R&R-related Activities	J. Kotra
3.b	PPT: USNRC Requirements for R&R and Memory Keeping for Yucca Mountain	S. Smith, T. McCartin
3.c	PPT: EPA’s Perspective on Long-term Institutional Controls at the Waste Isolation Pilot Plant	T. Peake
4.a	PPT: The Role of Reversibility-Retrievability in Adaptive Phased Management	G. Kwong
4.b	PPT: The RWMC Document on Stepwise Decision-Making and the Roles of Reversibility and Retrievability. (Both leaflet and report available at www.nea.fr/fsc/)	C. Pescatore

5.a	PPT: Review of Main Messages of the Mid-course Draft Report of the R&R Project as seen by a Newcomer to the Group	D. Metlay
6.a	PPT: Presentation on the latest version of the leaflet.	J-N Dumont
7.a	PPT: Presentation of Draft Programme and Arrangements	C. Pescatore
7.a	PPT: Vision for the Reims Conference, December 2010	C. Pescatore
8.b	Word doc: Observations and Suggestions	C. Ruiz
	PPT: Overview of the Draft R&R Project Report	Pescatore