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RADIOACTIVE WASTE MANAGEMENT COMMITTEE

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RWMC Regulators' Forum (RWMC-RF)

**REGULATING FOR THE LONG-TERM SAFETY OF GEOLOGICAL DISPOSAL OF
RADIOACTIVE WASTE: PRACTICAL ISSUES AND CHALLENGES -
Summary of viewpoints, papers and written reports**

**28-30 November 2006, Paris
LTSC Workshop**

Full Proceedings, including copies of the papers presented, are in preparation and will be issued during the coming months. Meanwhile, this interim document is being provided with the aim of making widely available the summary outcomes of the workshop on a short timescale.

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FOREWORD

The Regulator's Forum (RF) of the NEA Radioactive Waste Management Committee (RWMC) is working to understand similarities and differences in waste management regulatory programmes around the world to ensure that experience can be shared and the legal, cultural and societal factors influencing this experience are well understood. To this end, a workshop was held in November 2006 to explore different perspectives on long term safety regulation, from the starting point that:

- (1) this process involves not only technical considerations but necessarily reflects societal values on issues such as the appropriate balance between risks from hazardous activity given the associated benefit; and
- (2) differences in criteria between different countries are likely to result largely from such non technical considerations.

The workshop was attended by 43 participants of varied backgrounds (philosophy, theology, sociology, political science, as well as technical experts) representing regulators, implementers, consultancies, research centres, academic institutions, the NEA and the EC. The Working Groups of the RWMC, i.e. the IGSC and the Forum on Stakeholder Confidence (FSC), were well represented in the workshop.

Full Proceedings, including copies of the papers presented, are in preparation and will be issued during the coming months. Meanwhile, this interim document is being provided with the aim of making widely available the summary outcomes of the workshop on a short timescale. It comprises two main sections:

- (1) a synthesis of the expressed viewpoints; and
- (2) a detailed summary of the papers presented and of the ensuing discussions.

The workshop facilitated the exchange of different perspectives on long term safety regulation, in expanding awareness and in considering how ideas discussed might be captured and communicated more widely.

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1. SYNTHESIS OF EXPRESSED VIEWPOINTS

Introduction

A variety of viewpoints were voiced at the workshop either in oral presentations or in the ensuing discussions. These viewpoints have been collected and organised in six broad areas. Workshop participants have contributed by reviewing and commenting on the present collection of viewpoints, which is provided for convenience. More detailed and precise information is provided in the summary of the workshop and the contributed papers.

The Workshop programme is shown in Annex 1 to this report.

Necessary diversity of regulatory processes and regulation

- There appear to be wide variations in numerical criteria. However, these should be looked at in the broader frame of
 - assessment approaches (e.g. “conservative/bounding” vs. “realistic”, and how to address sources of uncertainty),
 - the basis for criteria (absolute risk; dose based on current radiation protection criteria; or dose based on comparisons to natural levels),
 - compliance judgements (limit vs. target, “hard” vs. “soft”, ...), and
 - on whether and how the criteria should change with time scale.
- For the above reasons, simple direct comparison of long-term numerical criteria used in different member countries may provide a misleading picture unless the broader context of how the criteria are implemented is taken into account. Other reasons amplified in the discussion paper include the complexity and non-uniformity of the regulatory decision-making process across nations; different approaches on how to characterize and define protection in the distant future; different approaches to dealing with ethical issues related to the nature of current society obligations to the future; and, reflecting all of this, international guidance that has been evolving in time and still is in the process of evolution (e.g., the recent ICRP guidance development process)
- Regulatory policies and decision making are not solely based on technical matters. They take into account expectations of civil society, international experience, ethical considerations and the practical needs of implementation. Accordingly, it is important to consider “the regulatory system” or the societal decision making process, rather than simply “the regulator”. The decision making process involves a range of national institutions encompassing government, parliament and other players besides the lead technical regulatory authority that is responsible for the licensing and approval process.
- Since it must be assumed that, eventually, institutional control of a disposal facility will no longer be maintained, licensing of geological disposal may be seen an act of trust not only in the regulator, but in the broader regulatory system and decision-making process
- In general, the workshop participants agreed with new ICRP recommendations (draft 2006), which recognise that decision making processes may depend on a variety of

societal concerns and considers that the involvement of all concerned parties is needed to achieve more flexible and sustainable decisions.

Assuring long-term radiological protection

- There was common ground amongst all participants on the importance of providing a high level of protection. On the other hand, the lack of capacity for perpetual active protection should be acknowledged in regulations.
- The public and those affected by implementation of a repository are more likely to accept repository proposals if their cultural, societal and ethical views have been considered alongside the technical considerations in formulating a strategy for testing repository performance. The regulator may want to interact with the public on this specific aspect and receive feedback.
- In Cordoba (1997) there was consensus that numerical criteria for radioactive waste disposal should be considered as references or indicators, addressing the ultimate safety objectives, rather than limits in a legal context. A number of important aspects were emphasized such as the nature of long term performance assessments, which are not predictions but rather illustrations of long-term behaviour and safety. The notion of potential exposure¹ was emphasized.
- The evolution of the international guidelines over time (see ICRP-81) indicates that dose and risk may lose their significance as measures of health detriment beyond a few hundred years, however calculated dose and risk over the long term can be utilised as indicators of protection provided by the disposal system. Virtually any other indicator may be subject to uncertainty over the long term, which has led to increasing attention being placed on sound engineering practices, and the progressive introduction of additional concepts that reflect the level of confidence that the disposal system can discharge its defined safety functions (e.g. constrained optimization, BAT, and application of sound managerial principles to repository design and implementation).
- There appears to be today an *increasing* use by implementers of the concept of safety functions, whereby one or several system components can contribute to a single safety function or, vice versa, where a single component may contribute to several safety functions². Implementers use the concept of safety functions in order to design, describe and help evaluate the performance of the disposal system.
- The Cordoba Workshop (1997) observed that there may be no widely accepted basis for the use of timescale cut-offs, although they may provide a pragmatic basis for regulatory decisions. Accordingly, some nations may choose to focus on a time frame which avoids consideration of a new ice age when all aspects of life may be so impacted that the repository may be minor in comparison; other nations may decide that impacts to the first several generations are more important than those occurring after millions of years. The different approaches respond to different national contexts. It was observed, that where cut-offs are used, their basis and use ought to be explained.³

¹ Dose and risk – as used in the context of long-term management of waste – are potential doses and risks in the sense of ICRP-81. According to the latter: “The term “potential exposures” refers to situations where there is a potential for exposure but no certainty that it will occur, i.e., the type of situations of concern in the long term following closure of a solid radioactive waste disposal facility” [see par. 24]

² see for instance Sect. 3.1.3 of the “Timeframes” document of the IGSC <http://www.nea.fr/html/rwm/docs/2006/rwm-igsc2006-3.pdf>

³ (a) There was a plea that regulation not go beyond times that can be reasonably predicted (b) Cut-offs based on ingestion radiotoxicity are undermined by the fact that external exposure due to gamma

- As shown by the timeframes study of the IGSC, the direct radiation hazard from some high level radioactive wastes remains at significant levels for very long periods, beyond hundreds of thousands of years and beyond conventional periods of regulatory concern⁴. *Isolation* (removal of waste from the accessible environment) thus adds value for much longer times than indicated solely by dose calculations based on ingestion (radiotoxicity) considerations.
- It would be helpful, for decision-making purposes, if the safety case provided comparison with other management options and an indication of the fate of the repository in the very long term.
- In formulating a radiation protection strategy and test for long term performance of the repository, societal, cultural and ethical views along with technical perspectives may be important in the selection of national performance criteria and time frames. International efforts should be directed at promoting exchanges among nations to understand the bases for safety objectives and performance strategies to identify similarities and differences.

Tools to demonstrate repository performance

- The workshop expressed a common view that assuring a high level of radiation protection requires tools to demonstrate acceptable performance of the repository system. To enhance public confidence, many countries are examining a range of complementary indicators to dose and risk, including multiple lines of reasoning. Where complementary indicators are used, it is important to consider the practicality of implementing such indicators in terms of demonstrating compliance with regulatory standards. Also, such indicators should focus on repository system functions most important to repository performance.
- There appears to be an increasing attention to approaches supporting constrained optimization, use of best available techniques (BAT), use of multiple lines of argument, including and use of supplementary indicators to dose and risk. The concepts of As Low As Reasonably Practicable (ALARP) or Best Available Techniques (BAT) would require, however, additional clarification and international reflection. Some reflections are as follows:
 - Optimization is constrained by a variety of factors, including societal, economic and technological constraints. Optimization may thus be applied not only to calculated outcomes of performance analyses, but also to other aspects.
 - Optimization requires a balance between short- and long-term protection. For instance, keeping a repository open for reasons other than safety needs to be balanced with the risk of increased accidents for mining personnel.
 - Some programmes make a distinction between optimization and BAT. The former is concerned with reducing (radiological) impacts to ALARP based, e.g., on a dose target; the latter is about choosing techniques that minimize, to the greatest reasonable extent, the potential for releases through the barrier systems to occur (system robustness, sound siting and well-proven engineering practices).
 - Given that it is not certain that impacts will occur (“potential exposures”), BAT may be regarded as the ultimate guarantee for safety. It is important to recognize that the BAT concept embodies not only technological aspects but

radiation from SF (and HLW) continues at high-level for several millions of years. (see also next bullet point)

⁴ The IGSC study, NEA/RWM/IGSC(2006)3, shows that a relatively small piece of HLW glass or SF – if unshielded – is able to give doses in the order of millisieverts per hour over periods of millions of years.

- also the managed process of implementation, e.g., sound siting and engineering practices; and to recognize as well that it embodies the element of practicability (see the definition of BAT in the IPPC Directive⁵ of the EC).
- Accepting the priority of BAT vis-à-vis optimization is a way of saying that safety is an intrinsic property of the system as designed and built. If safety is an intrinsic property of the system as designed and built, it can only be illustrated by means of some indicator (test or measures) related to the system features and functions, i.e., ultimately, indicators related to BAT. This had led to proposals for developing complementary indicators such as radionuclide fluxes through components of the system and radionuclide concentrations in the groundwater.
 - The reliance that can be placed on calculated doses and risks decreases with time⁶, leading to an increasing need to consider also other indicators linked to the application of BAT.
- The circumstances in which generic reference values for safety indicators can be drawn from nature are not universally agreed.
 - The safety case needs to explain the basis for the assumption that future scenarios are adequately bounded. It must be realized that, at times, hypothetical scenarios are created to in order to perform calculations of exposures. For instance, we have come to accept *reference biospheres* and that safety assessments assume that future human beings will not change from those of the present-day. Yet, human beings have existed for only about 200,000 years⁷.
 - The workshop agreed that a range of technical tools is available for illustrating potential repository performance over the long term. Each of these tools has advantages and disadvantages for implementation and for use in a regulatory system. In selection of these tools for use by different countries, broad perspectives should be considered in determining their value for enhancing public confidence and well as serving as indicators in satisfying regulatory criteria.

Ethical concerns: burdens vs. responsibility and duties vs. capacity

- Ethical considerations are important when deriving regulatory requirements.
- Many waste management programmes have concentrated almost exclusively on technical aspects, or have used technical specialists to deal with ethical issues. This can and should be improved.
- Most⁸ ethicists accept that one generation has responsibilities towards succeeding generations, though views differ on the nature of these obligations and on their duration. There is the view that this responsibility extends so long as the impact persists, i.e. there is no cut-off. This absolutist view is countered by the more pragmatic position that responsibility necessarily must diminish in time reflecting capacity to discharge the responsibility. Even if it is argued, in the context of responsibility towards future generations, that the *duty of protection* does not change over time, it is clearly accepted that our *capacity* to fulfil the duty is time dependent.

⁵ <http://ec.europa.eu/environment/ippc/index.htm>

⁶ It must be recalled that ICRP-81 suggests that dose and risk should not be seen as measures of health detriment beyond a few hundred years (from emplacement of the waste).

⁷ Indeed, could one not use this argument as one of the basis for cut-off in regulation? [Note that we do similar types of reasoning when we say that (a) no archives may be reasonably kept for more than 500 years, (b) monitoring and active surveillance can operate for a couple of hundred years only, (c) that our obligations are strongest during times that we can comprehend and are the typical times of our democratic institutions (200 years).]

⁸ There are some ethicists who hold that one generation does have responsibilities to later generations, but the rationale for this view is not widely accepted.

- Timescales over which we must reflect about burdens and responsibilities to future generations might be sub-divided as follows:
 - the socio-cultural time scale (a few generations);
 - the timescale over which we have reasonable confidence in the safety assessment calculations;
 - the timescales for which materials performance and geological processes are reasonably predictable;
 - the timescales beyond which processes are beyond any reasonable quantitative prediction⁹.
- There is an increasing recognition that the timescale for implementation of any repository, even one that does not explicitly involve retrievability, nevertheless involves several generations, i.e. perhaps equivalent to the socio-cultural timescale mentioned above.
- Transferring burdens to succeeding generations cannot be avoided. Consistent with the sustainability principle, if burdens are transferred, then opportunities/rights should also be given
- It would be useful to have tests for assessing that (a) duties that can reasonably be carried out are, in fact, performed; (b) remaining duties are transferred as responsibly as possible to subsequent generations in order to offer them maximum flexibility to discharge their duties; (c) transferred burdens (cost, risk, effort) are, at least partially, compensated by transfer of information, resources and continuity of education/skills/research.

Making the long-term disposal objectives clear and transparent

- The regulations have to be explained and understood by the public and it is crucial that regulatory criteria and requirements are formulated in such a way that “demonstration of compliance” is facilitated in a credible manner. It is also important to ensure some level of international consistency on fundamental safety and radiological protection objectives and issues. In this context:
 - One of the challenges for the regulator is not to promise, nor require, the impossible.
 - Concepts such as “safety”, “reasonable assurance”, “potential dose” and “potential risk”, complementary safety indicators, etc., used nationally or internationally, ought to be defined clearly. Internationally agreed definitions would be especially beneficial for concepts where here the relevant high-level objectives are common to all programmes.. A case in point is the concept of “safety”.
 - Regulatory tests need to communicate clearly and honestly what is meant by “safety” (e.g., “no harm” is not the same as “no exposure”), promise no more than can reasonably be delivered by the disposal system, and provide for safety case information that supports and illuminates safety decisions appropriate for different time frames.
 - Sustainability is a concept that is not well defined in the context of disposal of long-lived radioactive waste. It would useful to reflect on the opportunities and difficulties that the concept may provide to the regulator and implementer. It is not clear that the sustainability language of the Joint Convention (“needs and aspirations of future generations”) is implementable in the normative way that is expected of regulations.
- The precautionary principle applies to all the considered alternative waste management options, including the “do nothing” alternative and any undue delay in taking decisions.

⁹ For such timescales there is no capacity for exercising responsibility

- The public appears to have higher demands with respect to protection from hazards from radiotoxic wastes than from chemotoxic wastes¹⁰. It may be useful to investigate the reasons for this, in order to ensure that policy and objective-setting aspects of the regulatory process address it effectively.

Foreseeing and explaining the decision making process

- In the context of the long duration of the project (perhaps more than 100 years) there will be technological progress and incremental development of the repository. Regulators and regulatory guidance will have to adapt to this reality. In this context:
 - There is an increasing attention to the connection between regulation and stepwise decision making. Relevant questions include: Should the formulation of regulations be understood as a stepwise process? If so, how can this process and the requirements it creates best be explained? How are judgmental issues going to be addressed? In the same vein, how should short- and long-term protection goals be balanced? What are the attributes of a robust process? How to guarantee a certain degree of stability regulatory positions, e.g., in order to allow a certain degree of legal and investment security for the implementers?
 - Dialogue between regulators and implementers is important in any licensing process. In the case of a stepwise decision making process it is crucial that this dialogue start in the early phases of the process and continue all along the process. The dialogue ought to be managed so that the independence of the regulator is clearly maintained.
- The ability to intervene (control) is central to normal regulatory practice and to the concept of safety. Relinquishing control requires an act of trust - in the technology and the legal and regulatory systems - taken by the current generation on behalf of future generations. Decision-making process components ought to be designed to improve the perceived legitimacy of the process and therefore lead to improved trust.
- Factual and value-laden components of regulatory guidelines and licensing decisions need to be distinguishable, for the benefit of the public and for political decision makers. One difficulty faced by citizens is that the practical implementation of the regulations is an expert task and may not be transparent to members of the public. For this reason, some member countries recognise that host communities may wish to have access to expert advice on the technical issues under consideration.
- The general public is often concerned that decision making for implementation follows a legitimate process, i.e. one that is established in advance and is subject to democratic ratification. Key elements for success generally appear to include: openness and transparency, a staged process, participation, right to withdraw, partnership, and community benefits. This approach for decision making may also have implications for regulators, such as openness in decision making, greater consistency of regulation and integration of societal concerns.

¹⁰ According to the UK Sustainable Development Committee: “it is impossible to guarantee safety over long-term disposal of (nuclear) waste”, which implies that nuclear fission power should be shut down; at the same time, in the same country, CoRWM, the committee on Radioactive Waste Management, recommended geological disposal for existing wastes as a broadly acceptable solution.

- It may be argued that models of participation that have emerged during recent decades require further evolution in terms of providing for appropriate levels of public access to decision making.

2. SUMMARY OF PAPERS AND WRITTEN REPORTS

SESSION 1: SETTING THE SCENE

Carl-Magnus Larsson, chairman of the LTSC and former chairman of the Regulator's Forum, welcomed the participants. He recalled the background and objectives of the workshop. The RWMC-Regulators' Forum (RWMC-RF) has worked on regulatory issues since 1999, and has started, through the LTSC (Long-Term Safety Criteria) initiative, to analyze differences in approaches to long-term safety, as depending on and affected by the regulatory environment. He stated that, since the work of the LTSC Group has been communicated to RWMC, it is now timely to make this work known and debated by a broader audience.

He outlined the workshop objectives which were to:

- check where we stand in this field and confirm the findings so far
- list open as well as closed issues
- identify agreed-upon results and challenges to take home
- identify a road map to future work

He pointed out the tight agenda, which is supported by the discussion document previously distributed, and asked participants to concentrate on the major points rather than details. He acknowledged the work done by Carmen Ruiz-Lopez, David Bennett, Piet Zuidema, Richard Ferch, Allan Duncan and Claudio Pescatore.

Allan Duncan, expert to NEA and former Chief Inspector for Pollution (UK), elaborated on the regulatory function in the domain of radioactive waste management. The preparation of a document and a brochure on the subject has been one of the main tasks of the Regulators' Forum since its creation in 2001. He stressed that management of NORM waste was generally subject to different standards than similar radioactive waste from a nuclear source, for no obvious reason than that of public perception. He also pointed out the large number of "regulatory bodies" involved in the regulation of radioactive waste management facilities and particularly geological disposal facilities, and their links to the Government. He gave the example of the UK. He stressed the fact that, since there will not be continuous control, licensing of geological disposal is an act of trust in the regulatory system.

A. Duncan gave the position of two Commissions in England on deep geological disposal. The UK Sustainable Development Commission says, "it is impossible to guarantee safety over long-term disposal of (nuclear) waste" which implies that nuclear fission power should be shut down; CoRWM, the committee on Radioactive Waste Management, recommends instead geological disposal for existing wastes as a broadly acceptable solution.

As a concluding remark A. Duncan focused the attention on the general question of what current society needs to do in order to meet its obligations to future generations with respect to disposal of long-lived wastes.

Carl-Magnus Larsson detailed then the work of the Regulators' Forum and the origin of the LTSC initiative. He explained that one of the objectives of the LTSC was to identify a set of issues on long term protection criteria and collate findings in a report. He explained why the

idea of a “collective opinion” was abandoned and why it should be replaced by a common understanding where differences between countries ought to be explained and understood.

C.-M. Larsson detailed the different types of approaches to regulating long-term safety and the different approaches for numerical targets. He gave some explanations of the reasons for the differences in regulatory targets between countries (level of conservatism, progress in the safety case methodology, etc.). The regulatory function takes into account the nature of the demonstration (illustrations and societal demands). C. M. Larsson referred to the evolution of IAEA safety fundamentals and stressed that the “sustainability” concept, introduced by the Joint Convention, is not mentioned in the new safety standard. The term “adequately protected” is now preferred in relation to future generations. The ICRP recommends that less emphasis be placed on assessment of doses in the long term. C. M. Larsson concluded that one of the challenges for the regulator is not to promise nor require the impossible.

Alan Hooper (UK Nirex), presented the issues on long term regulation raised 10 years ago at the Córdoba workshop. The main issue was the identification of “soft” approaches which, for the long term, should be preferred to “hard” approaches, since concentration on compliance with strict limits tends to obscure the concept. The consensus was that numerical criteria for radioactive waste disposal should be considered as references or indicators, addressing the ultimate safety objectives, rather than limits in a legal context. The notion of potential exposures was emphasized and it was recognized that risk, even though it has drawbacks, was in principle a more appropriate criterion than dose. A number of important aspects were emphasized such as the nature of long term performance assessments, which are not predictions but rather illustrations of long-term behaviour and safety. Other subjects were considered such as the application of optimization, the stepwise approach to setting up regulation, the possibility of progress towards convergence of regulations even though criteria are strongly national, the benefits of dialogue between implementers and regulators, the important role of multiple lines of reasoning, the need for regulatory guidance on protection of the environment, and the need to establish timeframes for the application of numerical criteria and the basis for setting a time cut-off.

Alan Hooper listed improvements to be made which were identified at that time, including treatment of uncertainty; the elicitation and use of expert judgment; the clarification on what is meant by concepts of confidence building and/or reasonable assurance; the need for transparent, auditable presentation of methods and results for the benefit of political decision-makers and the public; the need to publish safety criteria well ahead of license application; and the need for the establishment of a stepwise approach for the process,

Alan Hooper presented the main conclusion of the Córdoba workshop which was that a common basis exists in terms of the methods used and of the understanding of the main issues. Some issues are relatively generic such as the stylized approaches, management of uncertainties, and the risk concept; therefore they are amenable to resolution through international studies. Other issues are strongly influenced by national administrative, legal and cultural considerations, so national differences would be expected. A concluding comment was that international harmonization makes sense at the level of the overall safety objectives, rather than in detailed regulatory criteria.

Peter de Preter (ONDRAF/NIRAS) presented the findings from the Timescales Initiative of the IGSC. He explained why considering the long term is important for safety assessment and what are the challenges. Some ethical questions were raised such as how far our responsibilities reach and what is the flexibility that should be given to future generations for their own decision making, and the implications of this for the phased planning of the repositories. He acknowledged that coming to a balanced and socially accepted view is still a matter of debate in many programs and internationally.

P. de Preter explained that regulations specify what needs to be shown, and in some cases over what time frames. He presented the conclusion that the limits to the predictability of the repository and the environment need to be acknowledged in safety cases, and that calculated doses are only “potential doses” since actual dose and risk to future generations cannot be forecast with certainty. He recognized that stylized assumptions are used regarding the biosphere and human lifestyle or actions, and that conservative assumptions are made in order not to underestimate future impacts. The Timescales Group reached a consensus on the fact that the safety case (not necessarily calculations) should cover at least $\sim 10^6$ years - when meaningful prognosis is possible for well chosen site/design.

An important issue is the argumentation for safety in the very long term because of the limited meaningfulness of some indicators and assessments in the very far future. Complementary lines of evidence or other more qualitative considerations are therefore often given more weight at longer times. These include comparisons with natural situations, arguments for continuing isolation, and more qualitative concepts (optimisation and BAT). P. de Preter questioned our ability and responsibility to protect the environment in the very remote future.

Peter de Preter concluded that the range of timescales to be addressed in safety cases presents considerable challenges and that consideration of ethical principles is required. He acknowledged also that competing ethical principles need to be balanced.

THE EVOLVING COUNTRIES’ SCENE IN TERMS OF DRAFTING AND IMPLEMENTING REGULATIONS FOR LONG TERM SAFETY

Juhani Vira (Posiva Oy, on behalf of Esko Ruokola from STUK) presented the history of the development of regulations for spent fuel disposal in Finland. The government decision 478/1999 introduced safety criteria which depend on the time frames: dose constraints in the first 1000s of years, radionuclide release constraints up to 100,000 of years and qualitative arguments in the longer time frames. J. Vira stressed the importance of ethical considerations for deriving the regulation. Since these criteria met a wide acceptance it is not felt advisable to revise them in the near future.

Philippe Bodenez (ASN) presented the situation in France. The Dossier 2005 was reviewed on the basis of the RFS III.2.f issued in 1991. The RFS asks for compliance with a strict dose limit for at least 10.000 years. This dose limit becomes a target in the longer time frames. An update of the RFS is underway but there is no intention to change the safety criteria. International consensus on the biosphere and on operational safety are important issues.

Klaus Röhlrig (GRS) presented the ongoing revision of the safety criteria for underground disposal in Germany. They relate to the recent development of international recommendations. This implies the implementation of a stepwise approach to repository development with a view to optimization. A set of performance indicators orientated on safety functions are being defined. As far as possible, they focus on system components which are essential for safety and the evolution of which can be predicted with reasonable assurance. Their reference values are derived from natural conditions (e.g. background radiation, natural concentrations)

Takaaki Kurasaki (NISA) and Hiroyuki Umeki (JAEA) presented the situation in Japan. T. Kurasaki exposed the Japanese policy on geological disposal and the setting up of a report of a METI subcommittee on the regulatory framework. The retrievability of waste will be maintained until post-closure safety is confirmed. A guide for licensing review will be established before the licensing review itself, which is planned in mid 2020. H. Umeki presented on-going discussions on the NSC (the Nuclear Safety Commission) new guidelines for LLW to be disposed in a repository at an intermediate-level depth: risk-informed approach; timeframe for the assessment with emphasis on the first few 1,000 years; three

categories of dose criteria based on a disaggregated approach (e.g. the dose constraint for normal evolution is set at $10\mu\text{Sv/yr}$).

David Bennett (UKEA) presented the situation in the UK. The guidance and regulation for near surface and geological disposals were issued in 1997. They specify safety criteria based on a risk approach and application of ALARA in the long term. They will be revised in 2008 taking into account developments at the international level.

SESSION 2: THE CHALLENGE FOR REGULATORY POLICY AND DECISION MAKING

INTRODUCTION

Janet Kotra (USNRC) introduced session 2, stating that regulatory policies and decision making are not solely based on technical matters. They should take into account expectations of civil society, international experience, ethical considerations and practical needs of implementers. She introduced the main questions to deal with during the discussion at the end of the session and asked a list of concerns relative to the two first questions.

On the first question: “Is there a shared understanding of risks and burdens from disposal over long and very long times?” she recognised that this leads to another question “What are the consequences to current and future generations from a failure to decide on workable long-term safety criteria for disposal?”

On the second question: “Which are our duties over time and can we deliver them?” she raised a number of points: Do duties remain constant? Is it legitimate to apply varying principles of justice to increasing remote generations and to impose less quantitative measures in the far future? “If duties remain constant, is it reasonable to select different tests for assessing compliance, in a manner appropriate to a given time frame?”

J. Kotra asked the question if regulators can establish tests to provide that 1) - duties that can reasonably be discharged are, in fact, performed, 2) - remaining duties are transferred as responsibly as possible to subsequent generations in order to offer them maximum flexibility to discharge their duties 3) - transferred burdens (cost, risk, effort) are, at least partially, compensated by transfer of information, resources and continuity of education/skills/research?

J. Kotra stressed that, to be workable, regulatory tests need to communicate clearly and honestly about what is meant by “safety” (i.e., “no harm” is not the same as “no exposure”), promise no more than can be delivered, and provide for safety case information that supports and illuminates safety decisions appropriate for different time frames. It should be possible to demonstrate whether or not compliance is achieved.

RÉSUMÉ OF FIRST DAY

Klaus Röhlrig (GRS) reported the discussions from session 1 on the issues listed by J. Kotra for further treatment during the workshop

On the question “Do we have a shared understanding of risk from disposal in the long and very long term?” K. Röhlrig reported about the discussion concerning the importance of ensuring the internal consistency of assumptions underlying the assessments and not creating a “fictional world” of consequence assessment. The question “Whom will we protect?” has implications for technical questions. While, as stated by the Timescales Initiative, the use of biosphere stylisations is now generally agreed upon, the issue of geosphere (i.e. upper aquifer) stylisation is less well explored and discussed. The approaches followed during the German

criteria development (“get closer to the predictable parts, take nature as yardstick”) can be seen as an attempt to avoid inconsistencies, but some deficiencies will remain.

On the question “How do we deal with the ethical question as to the level of protection that may be aimed for as a function of time?” it was stated that the workshop “moves very deliberately into the ethical direction”, but – given that ethical positions are by their nature contestable – no agreement was reached about whether this is good or bad. With regard to time perspectives, there exist different pictures about what general public is concerned about. It needs, however, to be kept in mind that “accepted” does not necessarily mean “ethical”. There is a general agreement that one should not impose obligations on future generations (e.g. about water testing), but some assumptions might be possible. It was also stated that there is some question whether waste containment in itself is a good thing for the very long term.

On the question “Is it legitimate to introduce cut-offs?”, it was stated that the issue needs to be expanded, given the “never-ending hazard” of the waste but also the need to address chemotoxicity of radioactive as well as of other wastes. A time-dependent choice of indicators and/or criteria is worth discussing. “Limits of practical possibilities” and “Points where optimisation becomes meaningless” are arguments to be considered in the cut-off discussion. This is in line with the findings of the Córdoba workshop and the conclusions of the Timescales Initiative and should be further discussed.

On the question of “Did we get enough input to define the meaning of previously undefined terms such as “needs and aspirations”, “safety and protection”, “future generations”, etc.? Should these words/concepts be left undefined? Or should they be defined only at some level, e.g. at the national level?” The question arises whether it is really needed to define these terms in order to regulate for long-term safety. It is however necessary to keep the difference between the duty to future generations and the capacity to fulfil it. It might be needed to put the radioactive waste management issue into a broader societal context, connected with the question about what is allowed / accepted / practised in other areas (orphan waste). It should be noted that the Timescales Initiative reached no consensus about an appropriate (“ethical”) timing of repository closure (minimise burden vs. flexibility).

K. Röhlig concluded that the presentations and, to some extent, the discussion focussed very much on numerical compliance. He asked the question, however, about how important this issue is, given the evolving understanding of the Safety Case. He reported about the opinion expressed that accounting for recent IAEA guidance is an important issue when it comes to defining a “roadmap” for future work without being too ambitious. In the future, operational issues might become more important. He identified other issues and observations from session 1. The iterative process with feedbacks between implementers and regulators is important for progress, but also problematic. Regulators should keep their distance when a particular site has to be regulated.

EXPECTATIONS FROM SOCIETY

Prof. A. Blowers (CoRWM, UK) observed that the social context within which radioactive waste management is considered has evolved over time. The early period where radioactive waste was a non-issue was succeeded by a period of intense conflict over solutions. The contemporary context is more consensual, in which solutions are sought that are both technically sound and socially acceptable. Among the major issues is that of intergenerational equity embraced in the question: How long can or should our responsibility to the future extend?

He pointed out the differences in time-scales. On the one hand geoscientific timescales are very long term, emphasizing the issue of how far into the future it is possible to make

predictions about repository safety. By contrast socio cultural time-scales are much shorter, focusing on the foreseeable future of one or two generations and raising the issue of how far into the future should we be concerned?

He listed the primary expectations from society which are: safety and security to alleviate undue burdens to future generations and flexibility in order to enable the future generations to have a stake in decision making. The need to reconcile the two had led to a contemporary emphasis on phased geological disposal incorporating retrievability. However, the long time scales for implementation of disposal provided for sufficient flexibility without the need for retrievability. Future generations would inevitably have some stake in decision making.

Prof. A Blowers pointed out that society is also concerned with participation in decision making for implementation. The key elements for success are: openness and transparency, staged process, participation, partnership, benefits to enhance the wellbeing of communities and a democratic framework for decision making, including the ratification of key decisions and the right for communities to withdraw from the process up to a predetermined point. This approach for decision making may also have implications for regulators, such as involvement in decision making, greater harmonization of regulation and integration of societal concerns.

Kjell Andersson (Karita Research, Sweden) presented the expectations of society on regulators based on his experiences mostly from Sweden. Society expects the regulator to be competent, have integrity, take an active part in participative processes (without losing independence), be the “peoples’ experts”, communicate standards and criteria so that they are understandable and show their practical meaning. Some good results have been obtained in Sweden with respect to trust in national agencies as witnessed by the results of the Eurobarometer on information on radioactive waste in 2005.

The main issues raised by K. Andersson were: responsibility for future generations, period of regulatory concern, extent of ethical obligations, scenario generation, risk dilution, safety indicators, criteria for optimization and BAT. These issues are largely of a value-laden and ethical nature. Regulatory criteria and guidelines about them cannot be grounded in science alone. They need to be mediated with public values. The citizens, but also the political decision-makers, need to see both the factual and the value-laden components of regulatory guidelines and licensing decisions. One problem is the practical implementation of the regulations which has become an expert task and is not a transparent process.

Regulators have therefore a double role. As experts, grounding their regulations on science, they should follow rules of science. As mediators between politics and civil society they are ultimately responsible to the general public, getting their resources from state budget.

None of the models of participation that have emerged during recent decades has given us what we are looking for, namely a system providing society with awareness and accountability. Further work is thus needed to link them to the political and legal systems.

On the question of harmonization of criteria K. Andersson asked if the existence of different regulatory standards is a problem or if it simply reflects that regulatory bodies are responsive to citizens’ values, which may be different in various cultural settings?

EVOLVING EXPECTATIONS FROM INTERNATIONAL ORGANISATIONS

Carmen Ruíz-Lopez, Chair of the Regulators’ Forum, presented the evolving international safety and protection guidance framework for radioactive waste disposal.

She stated that the implementation of the geological disposal concept requires a strategy that provides national decision makers with sufficient confidence in the level of long-

term safety and protection ultimately achieved. The concept of protection against harm has a broader meaning than radiological protection in terms of risk and dose. It includes the protection of the environment and socio-economic interests of communities.

She recognised that a number of countries have established regulatory criteria already, and others are now discussing what constitutes a proper regulatory test and suitable time frame for judging the safety of long-term disposal. Each regulatory programme seeks to define reasonable tests of repository performance, using protection criteria and safety approaches consistent with the culture, values and expectations of the citizens of the country concerned. This means that there are differences in how protection and safety are addressed in national approaches to regulation and in the bases used for that. However, as was recognized in the Córdoba Workshop, it would be important to reach a minimum level of consistency and be able to explain the differences.

The LTSC group's investigations have identified a number of important contributing factors to national differences, among them the complexity and non-uniformity of the regulatory decision-making process across nations, a lack of established consensus on how to characterize and measure protection in the distant future, not fully worked out fundamental ethical issues related to the nature of current society obligations to the future, and, reflecting all of this, international guidance which has been evolving with time and still is in the process of evolution (e.g., the recent ICRP guidance development process).

C. Ruiz-Lopez presented an overview of the development of international guidance from ICRP, IAEA and NEA from the Córdoba workshop up to now, and positions of independent National Advisory Bodies. The evolution of these guidelines over time demonstrates an evolving understanding of long term implications, with the recognition that dose and risk constraints should not be seen as measures of detriment beyond a few hundred years, the emphasis on sound engineering practices, and the introduction of new concepts and approaches which take into account social and economical aspects (e.g. constrained optimization, BAT, managerial principles). ICRP in its new recommendations (draft 2006) recognises, in particular, that decision making processes may depend on other societal concerns and considers that the involvement of all concerned parties is needed to achieve more flexible and sustainable decisions.

There is a recognition that regulating the long-term safety of the disposal of long-lived waste is a difficult task, mainly because the very long time periods and the ethical duty regarding future generations. It will also be very difficult to demonstrate strict compliance with quantitative criteria. The regulations have to be explained and understood by the public and consequently, it is crucial that regulatory criteria and requirements are formulated in such a way that "demonstration of compliance" is facilitated in a credible manner, and it is important to ensure some level of international consistency on fundamental safety and radiological protection objectives and issues.

C. Ruiz-Lopez concluded it would be necessary to try to explore implications of new regulations and to integrate technical aspects on predictions with ethical views on application of our obligation to future generations. It would be particularly useful to set time frames in relation to barrier functions, as was suggested in session 1.

EXPECTATIONS FROM EXPERTS IN ETHICS

Prof. Patricia Fleming, (Creighton College, Omaha, USA), centred her presentation on ethical expectations in regulating safety for future generations. The challenge is to find a just solution—one that provides for a defensible approach to intergenerational equity. The question on equity is about whether we are permitted to treat generations differently and to

still meet the demands of justice. And, the question must be asked regarding these differences: “In what ways do they make a moral difference?”

She asked the question what is the exact meaning of the ethical principle “Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.” Some countries have proposed different standards for different time periods, either implicitly or explicitly. In doing so, have they preserved our standards of justice, or, have they abandoned them?

Prof. Fleming identified six points to provide with some moral maps which might be used to negotiate our way to a just solution to the disposal of nuclear waste.

Point 1: Ethicists disagree about whether we have duties to future generations on the very grounds that are now being used by the nuclear waste community to create multi-level standards across the time span of many generations. Prof. Fleming’s position is that if the future is uncertain, regulators should act more cautiously and provide tighter standards.

Point 2: Ethicists have established reasoned claims that we have duties to future generations. But, they do not develop a *gradation* in the strength of that duty. The standards that are set for the present generation are generally regarded as those which should also be set for near and far future generations.

Point 3: The recent surge in interest in sustainability appears to provide a moral defense of multi-level standards of safety; the use of a continuum of static, strong, weak and minimal principles of justice is used to establish that our duties differ over different time spans. But, use of sustainability ethics does not support the creation of different safety standards.

Point 4: What might allow for multi-levels of standards of safety whereby standards for the future are lowered in favour of resolution of a problem in the present is the moral overriding of needs over interests.

Point 5: Assuming there is no moral overriding of present needs over future aspirations or interest, then a single safety standard should apply across present, near and far future generations. What standard should this be? Is this a wholly arbitrary decision?

Point 6: A distinction between capacity to assume or perform a duty and the strength of the duty itself must be made. The strength of duty itself remains the same, but the capacity to fulfill the duty may justify the shifting of the duty, in this case, from present generations to future generations if capacity increases by virtue of certain uncertainties decreasing with time.

Prof. Bråkenhielm (KASAM and University of Uppsala, Sweden) presented an ethical interpretation of the regulations issued by SSI (Swedish Radiation Protection Authority) and SKI (Swedish Nuclear Power Inspectorate). He identified the utilitarian core of the Swedish regulatory framework, but also identified a number of non-utilitarian elements, for example a number of principles of justice presented in KASAM’s *State of the Art Report* from 2004. Thereby, he also hoped to clarify possible spots of moral silence in the Swedish regulatory framework on nuclear waste.

Seven Principles of a Normative Ethics can be identified : (See for example Karl Popper, *The Open Society and its Enemies*, 1948.)

- the Principle of Utility. Negative utilitarianism considers that an action is right if it – in comparison to all alternative possible actions - realizes the least amount of evil or harm for all those affected by the action.

- the Principle of Universalizability. All humans should be treated equally - unless there are morally relevant reasons to treat them differently.
- the Principle of Humanism (ultimately echoing the categorical imperative that living individual and present generations are end in themselves and not merely as a means to the welfare of others) justifying the interests of the present generation
- the Minimal Principle of Justice which obliges us to use natural resources (including uranium 238 produced by nuclear reactors) in such a way that we don't threaten any person's – present or future – possibilities of life. This justifies the minimizing not only of collective dose, but also of risks for (future) individuals,
- the Weak Principle of Justice which obliges us to use our natural resources in such a way that future generations can satisfy their basic needs including their right to *freedom* and *autonomy*. This justifies the KASAM-principle that a repository for nuclear waste should be designed so that it makes controls, corrective measures and retrieval unnecessary but also so that it does not make controls, corrective measures and retrieval impossible,
- the Strong Principle of Justice which requires we use natural resources in such a way that future generations might achieve a quality of life equal to our own. This requires therefore that the present generation – benefiting from nuclear power – also takes care of the nuclear waste and do not put such burdens on future generations that might diminish their achieving a quality of life equal to ours (= a principle of responsibility/producer pays principle).
- the Do-Not-Postpone Principle, i.e. do not postpone until tomorrow, what you can already do today.

Claudio Pescatore (NEA) presented Prof. F. Dermange's (University of Geneva, and member of EKRA-I committee, Switzerland) written contribution. This presentation dealt with the requirement of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management which states that "we should not compromise the ability of future generations to meet their needs and aspirations".

He stressed that needs and aspirations are very difficult to define. The general texts dealing with the subject amount to the expression of desirable common social goals, but in terms that are less normative and binding than what would be required for the regulation of nuclear waste.

Prof. Dermange proposes to clarify the expectation from the regulator by interpreting "needs" as safety and "aspirations" as fairness and social acceptance. These concepts should be placed in a hierarchy. Safety is paramount and must not only be understood as the safety of the present generation, but also that of future generations for as long as radioactive emissions can be dangerous to human beings. Fairness is important but not as much so as safety. Democracy is based on fairness, and the latter should be defended, but only after safety is achieved.

The time scales for radioactive waste management are so long, however, that they exceed the possibilities of our society in terms of stability of political and social institutions and in terms of passing on know-how. Ensuring passive safety – that is, independent of human activity – remains the essential requirement. Fairness has not been forgotten, for the principle that assuring safety should constitute as small a burden as possible on future generations was adopted out of a concern for fairness.

On the time scale of the life expectancy of our democratic institutions (two centuries) – the requirements of safety in the interest of fairness mean that human intervention must be possible, at levels that remain to be defined. On time scales where safety is the only factor it must be ensured in an entirely passive way on the basis of our scientific and technological knowledge. It must be possible to shift at any time from an approach to safety based on

human intervention to an approach that is totally independent of any human intervention, without having to marshal any special technological or financial resources.

EXPECTATIONS FROM IMPLEMENTERS

Enrique Biurrun (DBE) presented the expectations from the implementer. He explained that the implementer needs a framework to successfully develop a repository which means the definition of requirements and guidance (for repository system development, analysis, licences, etc.) as well as the decision-making process (step-wise approach, roles of different players,). He needs also a reasonable stability of the regulatory system. The regulatory framework should be developed in a clear, reasonable and consistent manner. In the context of the long duration of the project (100 years) there will be technological progress. In that context E. Biurrun asked what is the meaning of best practice? How to deal with judgmental issues in a step-wise approach?

Regulatory criteria and guidance must deal with the repository system for which an iterative process is necessary where dialogue is needed with the regulator despite the need to maintain his independence. The safety case which is a periodic documentation of the status of the project must provide a synthesis of the underlying scientific understanding and evidence and becomes part of the design process through feed back.

E. Biurrun pointed out that safety is not calculated or assessed, but designed and built into the repository system (by geological and engineered barriers),. He stressed the importance of the operational aspects since the implementer has to build and operate the repository safely. He asked the question: Is it “Ethical” to buy “peace of mind” of some stakeholders with casualties” of the implementer’s staff because of mining accidents if the repository is left open during a phase of reversibility.

The implementer needs dependable criteria, legal security and investment security. He interpreted the “Precautionary principle” as meaning “do it now”. Long lasting solutions are very uncertain. Will we have the money and the technology to do it later? He made some reflections regarding the ethical need to strike a balance between inter- and intra-generational requirements (“think not only about the future generations, but also about the generation on our same boat”)

E. Biurrun made some remarks on key questions relative to the German situation. He noticed that different radiological protection criteria exist for radwaste and uranium mining and mill tailings.

DISCUSSIONS AROUND THEMES OF SESSSION 2

DISCUSSION ITEM 1 : Do we have a shared understanding of what the risk is from disposal in the long and very long time?

Hiroyuki Umeki (JAEA), chairman of IGSC, introduced the subject. He listed the three main points to consider in discussion item 1:

- The Timeframes Group has found that, for all practical purposes, both high-level waste and spent fuel are never radiologically inert and non-hazardous
- The Timeframes Group has also identified the issue of external exposures (or higher releases) that may take place over very long periods of time
- The issue of the long term hazard is germane to long lived ILW and LLW as well

Different questions were raised on point 1 such as the definition, the way to deal with and the communications associated with the almost indefinite nature of the hazard, the reason to put

the emphasis on radiological hazard when chemical hazard is on a par with it, and the existence of different approaches to regulation for either type of hazard.

On point 2 the questions are raised on the definition of the long and very long term risk from the hazard and the risk and benefit in the very long term from “containment”?

H. Umeki identified different points for discussion relative to item 1. On the basis of a typical graphical representation of the exposure levels associated with one ton of spent fuel as a function of time he emphasized the need to develop techniques for visualising the comparative and absolute hazard as a function of time and to choose representative indicators of the hazard. He asked what should be the respective role of different actors for communications on the matter (regulator, implementer or even government).

The conclusions from the discussion stressed that there was a failure of communication to policy makers and that the link should be made with disposal of chemical wastes.

DISCUSSION ITEM 2 : How do we deal with the ethical question as to the level of protection that may be aimed for as a function of time?

Auguste Zurkinden (HSK) introduced the subject asking the following questions:

Is sustainability as currently described in the Joint Convention, Article I(ii), achievable over all time scales ?

Can we confidently deliver upon the promise: “to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation”?

A. Zurkinden stated that he was very confident that the impacts imposed to future generations will not be greater than those permitted for the current one. He supported his positive answer by a list of arguments based on the Swiss situation. The Swiss regulation imposes that the release of radionuclides from a sealed repository subsequent upon processes and events reasonably expectable to happen, shall at no time give rise to individual doses which exceed 0.1 mSv per year.

A. Zurkinden stressed that this positive answer was fully supported by the review of the safety assessment relative to the Nagra Project Opalinus Clay. The main elements leading to the answer were the following: the fact that the repository is built within a stable geological environment, the thorough evaluation of the possible future evolutions, the estimation of the long-term behaviour of the barriers, and the results of the calculation of the movement of radionuclides and of the potential radiological impacts which show that maximum calculated potential doses are 3 orders well below the protection objective of 0.1 mSv/a. This result was obtained even under pessimistic assumptions.

The confidence in these results is linked to the water tightness and the stability of the Opalinus Clay layer, which is 180 million years old and went undisturbed through many geological events including the Alpine orogeny.

Even though the full set of regulatory guides issued by HSK is currently under revision in order to adapt it to the new legislation it is not intended to change the protection objective of 0.1 mSv/a. A. Zurkinden recognized however that the treatment of extremely long times (more than a million years) is an issue to be discussed.

The discussion that followed stressed that many countries have not such a favourable situation as Switzerland and that for instance in discussions in Sweden focused on the long-term fate of a repository, it was concluded that the life time of the geological barrier may be shorter than in the Swiss case, e.g. due to glacial erosion.

DISCUSSION ITEM 3 : Cut-off in time : how and if to choose any ?

Jean-Paul Minon, acting director general of ONDRAF, introduced the subject asking the following questions:

Why cut-offs: because we cannot predict? Because no other human endeavour has taken responsibility for such long time frames?

Can we take responsibility over the long term and in what way and to what extent? e.g. do our obligations to current and near-term generations outweigh our obligations to very distant ones in the future?

J.-P. Minon stated that it is not a real issue since there is no safety basis element for cut-offs. Assessment of compliance should be based on complementary quantitative and qualitative arguments since safety relies on site selection, concept design and quality of construction. Calculations are only virtual. The important thing is the soundness of the engineered system which should be feasible and realistic. Calculations after millions of years are meaningless and cannot demonstrate safety. The important thing is to provide confidence and therefore not promise more than we can do. Our responsibilities on the impact from a repository in the very far future are not higher than from the impact of a uranium ore deposit.

DISCUSSION ITEM 4: Questions of terminology

Claudio Pescatore introduced the subject asking the following questions:

- Did we get enough input to define “needs and aspirations”, “safety and protection” and “future generations”?
- Should these concepts be left undefined or defined at the national level?

C. Pescatore said that the subject was at the same time easy and difficult since it is easy to find definitions but difficult to find a workable one. Regulatory agencies tend not to define safety especially for geological disposal.

He stressed that no vetted definition of safety exists. The Joint Convention cites the terms but does not define them. The question may be asked whether a definition is needed nationally or internationally.

C. Pescatore listed definitions from the Oxford English Dictionary, which defines 'safety' as 'freedom from danger or risk'. Is it a state of mind or an actual situation? For Prof. Dermange/EKRA-I safety is a primal need, important for life as we know it (related to the sustainability concept). From IAEA DS-298 safety is an action. From IAEA Glossary (Sept 06) safety is the achievement of a series of technical actions around control of sources.

For ethicists, to the extent that safety is about protection, the latter should be the same for all generations. To the extent it is about control, it varies with our ability to assure control. There is a moral duty to address all generations equally but practical limitations on how well we can discharge this duty as time goes by.

C. Pescatore quoted A. Duncan's statement that the ability to intervene (control) is central to normal regulatory practice and to the concept of safety; relinquishing control requires an act of trust - in the technology and the legal and regulatory systems - taken by the current generation on behalf of future generations. He stressed that decision-making process components can be designed to improve trust as well as institutional factors. The

practicability of the measures to be taken for assuring and explaining safety clearly plays a role as well.

The role of the technical regulator is to assure to society that licensed projects and licensees (proponents and operators) will meet their commitments for safety. It is thus necessary for the regulator and society to agree on what is meant by safety. C. Pescatore concluded that several views are possible. The important thing is to derive a workable definition free of other non-workable or undefined concepts such as needs, future generations, and control. The discussion document proposes a definition that attempts to overcome those difficulties.

SESSION 3: CONNECTING HIGH-LEVEL PRINCIPLES AND OBJECTIVES WITH PRACTICAL COMPLIANCE CRITERIA

T. Schneider (CEPN, France) introduced the subject. He recalled that evaluation of proposals for geological disposal focuses on radiological hazards and protection of humans since this evaluation is based on comparisons of doses or risks with radiation protection criteria.

The objective of safety assessments is to ensure a high level of confidence that no member of a future generation will be exposed to a dose or risk in excess of present-day regulatory dose or risk constraints. Consideration should be given to risk aversion from aggregating the risk

There are three essential bases for selection of criteria: comparison with current radiation protection criteria for existing operational facilities, comparison with the variability of background radiation exposures and comparison with the generally accepted risk criteria from conventional activities.

As for the assessment of conformity T. Schneider raised some key issues: Use of dose/risk criteria as limits or targets, judgements to be made about choices of parameters and models, degree of conservatism to be taken into account, formal uncertainty analysis to be included and choice of critical group to be made.

He asked the question if the differences in criteria are significant, since the setting of criteria refers to "the definition of acceptable risk" and the assessment of conformity with the criteria refers to the "definition of reasonable assurance". Concerning this question the issues to be considered are the following: it is a continuing process, the meaning of the numerical differences may not be significant with regard to safety, there is a need to balance the benefit and the cost of options and societal aspects should be considered.

Richard Ferch, expert to NEA and former member of CNSC, presented a detailed review of regulatory approaches and related issues. He introduced the main features of international guidance. The objective of ICRP 81 is to protect future generations to at least the same level as current generations. A single dose constraint is given. Nevertheless, the interpretation of the calculated doses that are compared with this constraint changes with time. These doses are considered to be measures of health detriment for the first few hundred years, but only indicators of repository performance at longer time scales. ICRP-81 also recognizes the usefulness of alternative or supplementary criteria such as Best Available Techniques (not entailing excessive cost), particularly at long time scales where direct quantitative measures of detriment are unavailable.

In IAEA WS-R-4: as in ICRP-81 a single criterion is recommended regardless of time scale. However, it is recognized that at long time scales such a criterion is no longer a reasonable basis for decision making. As above, two means of dealing with long time scales are suggested (a) use of the criteria as targets rather than as hard limits (exceeding the criterion need not result in rejection); and (b) possible replacement of the initial criterion with a different one, namely comparison with natural background levels.

With the exceptions noted here, the national criteria reported in the responses to the Regulator's Forum questionnaire in most countries do not explicitly recognize differences in criteria depending on time scales. The clearest examples of this are in the Swiss and the United Kingdom criteria. Five countries choose explicitly to recognize time scales: Germany (cut-off), Finland (change of indicators and cut-off), France (dose limit and then dose target), Sweden (change of indicators then cut-off) and United States (multi-level dose criteria then cut-off).

There is thus a great lack of consensus among regulators at the level of detailed criteria and requirements. There appears to be little agreement not only on values related to the criteria but also on the basis for criteria (absolute risk; dose based on current radiation protection criteria; or dose based on comparisons to natural levels); on whether and how these criteria should change with time scale; and on how to address sources of uncertainty other than long time scales. This diversity might be because each country has different ultimate safety goals, or it might be that we all have the same underlying goals but choose to approach them by different paths. R. Ferch concluded that the only way to find out, and thus to determine whether the observed differences in criteria are meaningful or superficial, appears to be to seek a common understanding about shared (or unshared) goals at a deeper level than that of the criteria.

PLENARY DISCUSSION ON SESSION 3

DISCUSSION ITEM 1 : RP criteria at extremely long times: dose, risk and/or other indicators? Constraints/ targets lower than ICRP?

T. Schneider introduced discussion item 1. He presented the limits of predictability of the various elements of a repository system which decrease strongly in time, from the host rock to the surface environment and the biosphere. He stressed that the first need for harmonization between countries is the definition of extremely long time scales, which can range from 10 000 to one million years. He asked the question of the meaning of calculations for various timescales. Should they show a strict compliance with regulatory limits or are they only indicative calculations for a performance assessment?

In the discussion that followed several consensus points emerged. The dose to an individual of the critical group is not a good indicator at extremely long time scales. Other indicators like fluxes of radionuclides may be used. The selection of these indicators should be in relation to the level of predictability of the different parts of the system. The limit of predictability of the host rock in the range 10^5 - 10^6 years was stressed which puts limits on the credibility on the assessment beyond these time frames. However the use of these indicators in the regulation may be problematic. How to associate reference values to such indicators? Is natural background a reference value? What is the relation with the level of protection? Some attempts to address the first two questions were mentioned by K. Roehlig when he presented the German draft criteria. The risk indicator seems to be better adapted to the long term than a dose indicator however the difficulties associated with the risk approach were emphasized (complexity, risk dilution).

DISCUSSION ITEM 2 : Optimisation: Criteria for BAT?

Björn Dverstorp (SSI) introduced discussion item 2. He presented a pragmatic view on the role of optimisation and BAT in regulating geological disposal. He stressed that risk analyses for geological repositories will always be associated with uncertainties and it will not be possible to check the results of the performance assessment calculations. Therefore there is a need for additional supporting arguments in the safety case (or license application) to convince the regulator and to support decision-making.

In SSI's view (SSI FS 1998:1; 2005:5), requirements on the use of optimisation and BAT are necessary supplements to a risk or dose standard. Both principles focus on the proponent's work on developing the repository system rather than the end results of the safety calculations that should be compared with the standard. Optimisation and BAT are applicable to the whole process of developing a final repository, i.e. all steps from siting, design, construction, operation to closure of the repository. In case of a conflict between BAT and optimisation, measures satisfying BAT take priority.

Three main compliance periods can be identified. In a first period the calculated risk (and environmental impact) is the main compliance measure but the application of optimisation and BAT are important complementary arguments. For the time period beyond 100ka, after a glaciation, risk calculations become more speculative due to large uncertainties and the evaluation of compliance will focus more on the application of BAT than on the uncertain results of a quantitative risk analysis. After 1 million years after closure of the repository no calculations are required but a simple analysis of the fate of the repository and the very long-term consequences of concentrating uranium in geological formations may provide an important basis for high-level comparison with alternative waste management options.

It is important that the safety case/license application contains a road map of the most important BAT considerations, i.e. the ones really affecting safety, throughout the development of the repository system so they can be reviewed and presented to the decision-makers.

B. Dverstorp identified the constraints for the application of optimisation, including societal constraints on site selection, economic constraints on the availability of funds, and technical constraints linked to the availability of technology and the effectiveness of various measures for enhancing the repository's protective capability.

Examples of remaining issues in developing the concepts of BAT and optimisation for geological disposal include:

- How best to report on optimisation and BAT considerations in a safety case/license application?
- How to strike an appropriate balance between weight given to BAT/optimisation versus risk and dose calculations for different time periods? This is particularly relevant for situations where the calculated risks and doses are close to the regulatory targets.
- How to define available technique or technique that reasonably can be developed?

The ensuing discussion focused on the exact definition of BAT: the most effective means to protect man and environment which do not lead to excessive costs. The problem of its evolution with time was raised. The strong link of BAT with subsystems criteria was noticed. The question of contradictory optimization consideration for operational and post closure safety was also raised. One issue raised by J. Kotra was the question of handling the first 100s of years. How would BAT play in the question. Is it better to ask for a cold or hot repository?

DISCUSSION ITEM 3 : The long term and the treatment of uncertainties

Bo Strömberg (SKI) introduced discussion item 3. The Swedish Nuclear Power Inspectorate's regulation SKIFS 2002:1 states that the most important requirement is that uncertainties are described and handled in a consistent and structured manner. The impact of uncertainties should be evaluated by sensitivity analysis, covering for instance the description of barrier performance and the analyses of consequences to human health and the environment.

The guidelines state that there should be a classification of uncertainties into different categories (e.g. scenario uncertainty, system uncertainty, model uncertainty, and parameter uncertainty).

Uncertainties may be handled in many different ways depending on their character, e.g. eliminate them if possible (site selection), account for them in the design, reduce or constrain them as much as is reasonable (non-destructive testing, more site data, R&D), circumvent them in safety assessment (conservative approach), or accept them but discuss them openly (the regulator may prescribe a stylised approach).

In spite of these efforts, a range of uncertainties related to the extreme complexity of the system in consideration must be handled through conservative simplifying assumptions. A thorough justification of such assumptions is needed, since there may be other implications of such assumptions than those originally envisaged. Finally, some uncertainties are not readily reducible or possible to circumvent but are a consequence of the selection of geological disposal (future human action scenarios, intrusion, etc.). Nevertheless they still need to be analysed and discussed.

The regulatory review should examine several points: is there a good justification for elimination of a particular uncertainty? does the implementer have a good programme to reduce uncertainties? are the effects of conservative assumptions taken fully into account? Is there a handling and discussion of those uncertainties that have to be accepted?

SESSION 4: WAY FORWARD

INTRODUCTION BY CHAIR

Carmen Ruiz-Lopez, Chair of the Regulator's Forum introduced session 4. She stated that the purpose of this session is to distil and present the main findings of the workshop, and to draw up a road map with the main lines of the future actions in view of communicating the shared understanding and continuing the discussions on the remarkable open items. She presented the organization of the session and recalled presentations made during the three preceding sessions of the workshop.

REPORTS FROM SESSION 2

Juhani Vira presented the implementer's report on challenges for regulatory policy and decision making

The findings of session 2 put forward a need for changes because of the publication of new international recommendations and guidelines and new safety assessments and an approaching licensing phase. J. Vira stressed the recent emphasis in social aspects, the implementation of new policy concepts (sustainability, stakeholder interaction, etc.) and the publication of new regulations.

He raised the question of the extent to which these changes have implications on the fundamental principles or the national regulations. The ethical bases for the regulations were revisited during the session and their application depends on societal choices. The duty of equitable protection through all time periods is therefore upheld with some reservations on balance between near future and very distant future.

J. Vira emphasized that the capacity for perpetual protection was questioned since the toxicity of the wastes remains practically forever but that the proof of protection is subject to growing uncertainty even if the geological stability could be demonstrated over 1 to 10 million years in some countries.

J. Vira concluded that this limited capacity for perpetual protection should be acknowledged in regulations. He recognized that approaches to handle this situation have already been implemented advising optimization by studying alternative available options and using the best available technology. Considerations to avoid burdens but leave flexibility to future generations may be reconciled by reversibility and retrievability.

It was emphasized that the discussion in session 2 showed some difficulties in the application of the principles and the need to clarify the content of some concepts introduced in the regulations. It was acknowledged that the terminology is in some cases vague or ambiguous. J. Vira wondered, however, if that really mattered. Some questions have emerged: “Is a view of safety as an intrinsic property of the system possible?” or “Is safety always dependent on the people concerned?”; “Does harmonisation bring vagueness with it?”

J. Vira recalled the NEA concern about the difficulty to gain public acceptance because of differences in criteria between countries. He stressed that the main difficulty behind harmonization of regulations is the desire of each country to maintain its reliance on a consistent set of national regulations that reflects the national culture and society. He expressed the concern that harmonization may have diluting effects on regulations. It was noted that the idea behind the LTSC initiative was seeking consistency rather than harmonization.

He also stressed the importance of the involvement of the public in the regulation and the importance of the stability of regulation for the public and the implementer.

Allan Duncan provided the regulator’s report of session 2.

A. Duncan acknowledged that the work done by the international bodies (ICRP, IAEA) as presented by Carmen Ruiz-Lopez was of high technical quality but had hardly been mentioned in the context of the current workshop discussion. He stressed in this regard that the NEA work is almost unique in that it is addressing the policy and basic objectives elements of regulation. The advantage of input from a number of ethicists resulted in an important advance in the thinking about regulation of long-lived waste disposal.

He mentioned that Patricia Fleming actually posed two key questions, i.e. “What is the objective?” and “What ought it to be?” However he noticed that the answers are not yet convincing enough in a number of countries. There was a general agreement that in order to gain public confidence these questions should be addressed openly. P. Fleming recognized that the ethical guidance might not be the ultimate determinant of policy since it is usually politicians and policy makers that decide.

It was clear, too, that ethicists do not necessarily agree about such fundamental issues as our duties to future generations. This seems however to be extremely important for the implementers and for the regulators. The fact is that the regulatory cycle was being built without a secure and widely accepted starting point.

Prof. Dermange of Switzerland was reported as being dubious about the merits of considering the “needs and aspirations of future generations” as is done in the Joint Convention. His opinion is that ‘Sustainable Development’ language is actually meaningless for all practical purposes when a very long-term perspective is taken into account.

Andrew Blowers introduced the concepts of geo-scientific and socio-cultural time and seemed to suggest that we have the balance wrong as between protecting the interests of people in the very long term and those in the more immediate timescales. Similar ideas were supported by P. Fleming and E. Biurrin in their presentations

The issue of ‘harmonisation’ was raised in discussion. It seems that the LTSC group would support ‘harmonisation’ in the sense of developing a common understanding of the policy objectives to be achieved in disposal of long-lived waste. It did not seem that there is much support for trying to force all regulatory systems towards a common model. Experience of general environmental regulation, in the European Union at least, suggests that fundamental objectives are being delivered to a common high standard but that the details of how they are delivered are a function of national culture and psyche, and one could doubt that they may be amenable to harmonisation. This point was raised by Klaus-Jürgen Röhlig in connection with the European waste regulators’ feasibility study (“European Pilot Study”) whose primary purpose is aimed at sharing experience and opinions on the expectation of the regulator regarding different elements of the safety case at different steps of the development of a radioactive waste disposal facility. The most interesting finding of the study is that although regulatory frameworks differ between countries to some extent it was recognized that regulatory practice differs to much less an extent.

In regard to clarifying the objectives for disposal of long-lived hazardous wastes, there was some discussion about the incongruity between the relatively short-term objectives accepted for chemotoxic wastes and the very long-term objectives demanded for nuclear wastes. It has to be emphasised that the only merit in pursuing such discussion would be to discover why it is that the public draws such a distinction between apparently analogous hazards.

REPORT FROM SESSION 3

Patrick O’Sullivan (NRG) presented a synthesis of session 3: Connecting high-level principles and objectives with practical compliance criteria.

Concerning radiation protection criteria at extremely long time frames he acknowledged that the basis for setting up the criteria depend very much on the country. They may be directly related to the value of the dose constraints of ICRP 81 but may be also related to the variability of natural background or to the tolerability of risk for society. In all respects the principle of optimisation of protection is applied.

Even though some countries have chosen fixed criteria over all timeframes, more and more countries use a cut-off or multiple criteria depending on the timeframes (e. g. in Sweden four time-frames are distinguished).

Many countries acknowledged that safety indicators complementary to dose and risk may be more adapted to long time frames. These indicators, such as concentrations and fluxes, are particularly useful as indicators of system performance in the far future for a specific site. However it may be problematic to associate reference values to these indicators.

For the issue of potential exposure in the far future the risk approach is better suited than the deterministic approach; however it may only be used to the extent that the likelihood of low probability events can be forecast and the issue of risk dilution is taken care of.

There are different views on how much harmonisation of criteria is needed. The main current opinion is to learn from differences, against a “common” background of understanding. It is generally thought that the level of safety provided should not depend on national differences in criteria.

P. O’Sullivan summed up the results on the discussion on optimization. For ICRP, optimization is a complementary requirement to dose/risk standards. The subject of optimization and the application of BAT, defined as the best available techniques not entailing excessive costs, were thoroughly presented and discussed. BAT has the advantage

over optimization of risk that it concentrates on the performance of barriers and is connected to the application of sound engineering principles as recommended by the ICRP. The question was raised regarding the need for regulatory guidance on the subject, since the regulator cannot foresee precisely what will arise in the proponent's safety case. It was stressed that BAT may be linked to the development of sub-system criteria.

P. O'Sullivan summed up the situation on the handling of uncertainties. It is a fundamental component of the safety assessment in the step wise approach and is an important contribution to public confidence.

P. O'Sullivan drew some general conclusions from the discussions. The greater the focus on optimisation/BAT – rather than compliance with the dose/risk constraint over long time frames – the less important are the variations in the criteria used by different countries. He stressed the importance of having a good system understanding, i.e. a good level of confidence in the safety case assumptions. Concerning harmonization, it is important to have agreement on overarching objectives but the flexibility in implementation (national criteria etc.) is still necessary. The technical community needs to take account of stakeholders' perspectives – assessment of confidence needs to address the needs of stakeholders (e.g. the ultimate fate of the repository)

FINAL FINDINGS AND ROAD MAP FOR FUTURE ACTIONS

David Bennett, vice-chairman of the Regulators' Forum of the RWMC, delivered the final findings of the workshop and a road map for future actions.

He emphasized that considerable material has been discussed which allows us already to identify some major differences between countries, but also areas of agreement. He recognized that many outputs from the Córdoba workshop (1996) are still valid and noticed a consensus around its conclusions. He acknowledged the work performed in the framework of the Regulators' Forum, including the LTSC and the work of other groups or organizations, which have moved forward some issues - IGSC, timescales group and IAEA. He stressed the difficulty of building a "collective opinion" on the subject of RP criteria.

D. Bennett identified the main points of agreement for defining the bases for regulations concerning the hazards relative to geological disposal of spent fuel or high level waste. It is largely recognized that even though there is a dramatic early reduction of 'hazard potential', residual hazards remain for the very long term (similar to conventional or chemically toxic wastes). All regulators agree that there is a need to provide a high level of protection in the long-term but they have to recognize that what can be demonstrated ('capacity') falls short of what they would like to see demonstrated ('duty'). In the shorter term governments can leave resources to transfer duties as is already happening.

There is also a general agreement on the limitations associated with the long term. In the long time frames we cannot transfer duties nor can we predict or measure long-term impacts.

One should acknowledge the existence of different timeframes based on geo-scientific and socio-cultural aspects. Recognizing that these different timeframes should be treated differently is important. It stresses that cut-offs are important considering the scientific limits on prediction. It shows a pragmatic view, as against absolutist ethical positions.

It is also recognized that regulators should show to other stakeholders that they are fully addressing the question of the remote time frames, and in doing so providing a high level of protection for the long-term.

Many aspects contribute to confidence-building. Numerical safety criteria should be defined for periods when safety can be predicted or addressed through stylised assessments. A step-wise approach implies that a regulatory process needs to explain any change in the project. Optimisation and BAT should be implemented in connection with the application of sound engineering and technical standards. Complementary indicators (flux, concentrations, comparisons with background etc.) are potentially powerful tools in supporting the safety case, and in communicating to wider audiences.

Other points of agreement have been identified. One is the implementers' desire for stability of regulations. Another such point is that sustainability is a difficult principle to apply and that further development of intra-generational and inter-generational equity issues is required.

A list of points requiring further discussion: the nature of the duty to protect future generations (remove burdens but leave flexibilities); the time cut-offs for compliance; the level of harmonisation to reach (dose or risk criteria, although having common origins, may be used differently); the risk approach versus the deterministic approach; the treatment of low probability - high impact scenarios, the use of supplementary indicators and reference levels; and terminology (safety, BAT, others,...).

D. Bennett proposed the following road map after the workshop:

The proceedings of the workshop should be published rapidly with session reports. The discussion document should be revised in light of the workshop and published. The workshop has helped develop groundwork towards establishing a 'Common Understanding' of the regulation of long-term safety of geologic disposal and the Regulators' Forum needs to take the work forward. There is a need for a future symposium to further develop thinking on focussed aspects.

These points should be taken forward at the RWMC-RF & reported to RWMC - March 2007.

The scope of the 'Common Understanding' document could be the following:

- update position on output of Córdoba workshop and add more recent developments / international guidance
- establish areas of agreement (need to provide long-term safety, minimum consensus on numerical criteria, duties to future generations, concept of transfer of responsibility, step-wise decision making, role of optimisation and BAT, multiple lines of reasoning, complementary indicators and limitations, recognition of uncertainties, importance of stakeholder interactions)
- explain why numerical criteria may and will differ (national influences on numbers, hard / soft criteria; modelling approaches etc.)
- agree on the definitions of some terms e.g. BAT, safety

The audience for the "Collective Understanding" document should be wide ranging (policy makers, regulators, implementers and other interested parties). Can this be done in one document?

Benefits of the Collective Understanding document would be to capture the considerable development of ideas and consensus which have occurred over the last 10 years. This document will have a range of uses:

- explain at high level how long-term safety addressed
- inform development of policy, objectives, regulations, guidance
- explain why some apparent differences between national criteria are not material - the safety case development and regulatory processes are more important.

ANNEX 1: WORKSHOP PROGRAMME

**FINAL PROGRAMME
FOR THE NEA/RWMC WORKSHOP**

**REGULATING FOR THE LONG-TERM SAFETY OF
GEOLOGIC DISPOSAL OF RADIOACTIVE WASTE:
PRACTICAL ISSUES AND CHALLENGES**

**Issy-les-Moulineaux, France
28 November (pm) – 30 November (am) 2006**

This workshop will **commence on 28 November at 13:45 pm and adjourn on
30 November at 12 pm**

**Speakers, rapporteurs and chairs are invited to participate in a preparation meeting at 11
am on 28 November**

The venue is:

**OECD Nuclear Energy Agency
Le Seine Saint-Germain
12 boulevard des Iles
92130 Issy les Moulineaux, France
Building “B”
7th Floor – Meeting Room “A”**

**Register your presence with the usher at the Reception Desk on the ground floor. Then
proceed to the 7th floor (left). You will be issued an identity card for the workshop.**

The NEA web site has information on how to get to the address above as well as on accommodations in this area [<http://www.nea.fr/html/general/welcome.html>].

Delegates participating are advised further that the security arrangements in force at OECD include the obligation to present an identity document bearing a photograph. This document will be requested at the time of issuing identity cards for the event on first entry to the OECD. It should also be presented subsequently with the card every time OECD premises are entered.

English is the working language.

DESCRIPTION OF THE WORKSHOP

Regulatory acceptance criteria - in particular radiological protection criteria for humans and the environment over long time scales - are a prerequisite to the realization of any underground repository for long-lived radioactive wastes. In many, if not most, countries, these criteria are still in an evolving state, and especially so for geologic disposal of high-level waste and spent fuel.

It has been recognized for many years that differences in criteria among different countries may constitute an additional difficulty for repository proposals to gain broad public acceptance. Nevertheless, the differences between national regulatory criteria continue to exist and, indeed, to increase. While differences are expected to exist in concrete design factors such as geology, engineering and approaches to performance assessment, these appear to be greatly overshadowed by differences of a more abstract nature, namely differences in the choice of appropriate indicators for protection in the long-term and differences in the way these indicators are evaluated and interpreted.

The NEA's Radioactive Waste Management Committee (RWMC) has been studying these issues for some time, in particular through the work of the IGSC on time-scales and of the Regulators' Forum's Long-Term Safety Criteria (LTSC) working group. This work has identified a number of factors which contribute to the differences among criteria: among them the complexity and non-uniformity of the regulatory decision-making process, a lack of consensus on how to characterize and measure protection in the distant future, and fundamental ethical issues related to the nature of current society's obligations to the future.

The RWMC considers that it is important to gain a better common understanding of how these differences arise. To this end, the RWMC is sponsoring the present workshop. The intended audience includes a broad range of regulators, implementers, ethicists, and policy-makers. A discussion paper based on the findings of the LTSC group and discussions within the RWMC supports the workshop. All participants are asked to become familiar with it and consider the key questions and issues identified on pp. 15-16 of the text.

In addition to making the work done to date more widely and better known, it is hoped that points of agreement and points for further discussion will be identified, so that a road map may be proposed in support of regulators and policy-makers who are currently charged with developing regulatory acceptance criteria for proposed repositories.

28TH NOVEMBER - DAY 1

SESSION 1: SETTING THE SCENE

13:45 **INTRODUCTION**

C.M. Larsson, Chair

14:00 **THE REGULATORY FRAMEWORK OF
LONG-TERM SAFETY: THE WORK OF THE
RWM REGULATORS' FORUM (RF)**

- The RF brochure on the regulatory function with emphasis on decision making.
A. Duncan
- The Long-Term Safety Criteria (LTSC) initiative and the current discussion papers.
C.M. Larsson, Chair of LTSC initiative

<http://www.nea.fr/html/rwm/reports/2005/nea6041-regulatory-function.pdf>

Discussion Paper
NEA/RWM(2006)13

14:45 **WHICH WERE THE ISSUES 10 YEARS AGO FOR
REGULATING LONG-TERM SAFETY:
THE NEA CORDOBA WORKSHOP OF 1997**

A. Hooper

15:00 **RELEVANT FINDINGS FROM THE
TIMESCALES INITIATIVE OF THE IGSC (2006)**

P. de Preter, H. Umeki, E. Forinash

15:15 **THE EVOLVING COUNTRIES' SCENE IN TERMS
OF DRAFTING AND IMPLEMENTING
REGULATION FOR LONG TERM SAFETY**

- 10 minute presentations from a few invited countries highlighting challenges
Finland: *J. Vira*
France : *P. Bodenez*
Germany: *G. Arens*
Japan (2 presentations): *M. Kurasaki (NISA), H. Umeki (Special Committee of NSC)*
UK: *D. Bennett*
- All other countries are invited to provide a 1-pager on this subject, or the Secretariat will check the national Level -1 contribution.

16:30

Break

Convention, Article 1(ii), achievable over all time scales?

- Can we confidently deliver upon the promise to avoid “reasonably predictable impacts on future generations grater than those permitted for current generations” [Joint Convention, Article 4(vi) and 11(vi)]

DISCUSSION ITEM 3:

Cut-offs in time: how and if to choose any? [*J.-P. Minon*]

- Why cut-offs: because we cannot predict? Because no other human endeavour has taken responsibility for such long time frames?
- Can we take responsibility over the long term and in what way and to what extent? e.g., do our obligations to current and near-term generations outweigh our obligations to very distant ones in the future?

DISCUSSION ITEM 4:

- Did we get enough input to define the meaning of previously undefined terms such as “needs and aspirations”, “safety and protection”, “future generations”, ...?
- Should these words/concepts be left undefined? Or should they be defined only at some level, e.g., at the national level?
[*C. Pescatore*]

16:00

Break

SESSION 3: CONNECTING HIGH-LEVEL PRINCIPLES AND OBJECTIVES WITH PRACTICAL COMPLIANCE CRITERIA

16:30

INTRODUCTION

Chair, Th. Schneider

16:40

DETAILED REVIEW OF REGULATORY APPROACHES AND ATTENDING ISSUES BASED ON ANNEX 3 OF THE DISCUSSION PAPER

R. Ferch

17:00

PLENARY DISCUSSION SESSION AROUND THREE MAIN THEMES:

- 3 main discussion items; 30-40 minutes each
- Each item is introduced by a 5-minute thought-provoking presentation and followed by a plenary discussion. Materials from the discussion paper are highlighted.

DISCUSSION ITEM 1:

- RP criteria at extremely long times: dose, risk and/or other indicators? Constraints/targets lower than ICRP? [*L. Baekelandt*]

DISCUSSION ITEM 2:

- Optimisation: Criteria for BAT? Disposal depth... [*B. Dverstorp*]

In each case, why? Technical? Societal? Comparison to other non RWM practices?

18:00

Adjourn

(continued next day)

30TH NOVEMBER - DAY 3

CONTINUATION OF SESSION 3: CONNECTING HIGH-LEVEL PRINCIPLES AND OBJECTIVES WITH PRACTICAL COMPLIANCE CRITERIA

09:00

DISCUSSION ITEM 3:

- The long-term and the treatment of uncertainties [*Bo Strömberg*]

SESSION 4: WAY FORWARD

09:40

INTRODUCTION BY CHAIR

C. Ruiz, Chair of RF

09:45

- Two rapporteurs with different backgrounds capture the presentations and discussions from **Session 2** (key questions and issues for regulators, points of

agreement and disagreement) in consultation with the Session 2 Chair and propose a joint report for discussion. [*A. Duncan + J. Vira*]

10:10 *15 minutes pause*

- 10:25**
- Two rapporteurs with different backgrounds capture the presentations and discussions from **Session 3** (key questions and issues for regulators, points of agreement and disagreement) in consultation with the Session 3 Chair and propose a joint report for discussion. [*C-M Larsson + A. Hooper*]

10:55 *Break*

11:15 **FINAL FINDINGS AND ROAD MAP FOR FUTURE ACTIONS**

D. Bennett, Vice-Chair of RF

- Points of agreements
- Points deserving further discussion or development
- Road Map for future actions in view of communicating our shared understanding, and continuing the discussion on outstanding items.

12:00 *Closure of Workshop*