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PROCEEDINGS OF THE JOINT RWMC-CRPPH TOPICAL SESSION ON THE RADIOLOGICAL PROTECTION ASPECTS OF LONG-LIVED RADIOACTIVE WASTE MANAGEMENT

21 March 2012
OECD Conference Centre, Paris, France

As the ICRP is finalizing its guidelines on the application of ICRP-103 to geologic disposal, the RWMC and the CRPPH held a joint session to discuss the ICRP forthcoming guidelines and interpretation issues.

For any queries regarding this document, please contact Claudio Pescatore (claudio.pescatore@oecd.org)

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Background

The objective of this Topical Session was to discuss the radiological protection aspects of long-lived radioactive waste management in order to move towards a common view of the concepts and processes that have and will be developed and implemented in policy, regulation and practice.

SESSION 1: DISCUSSION OF THE NEW ICRP RECOMMENDATIONS ON GEOLOGICAL DISPOSAL OF LONG-LIVED SOLID RADIOACTIVE WASTE

This session set the scene for discussions of the new ICRP draft recommendations on geological disposal. Wolfgang Weiss, Chair of the ICRP Task Group, presented the main contents of the draft ICRP document, Juhani Vira gave a general view of the document as an implementer, and Clive Williams discussed in which respect the long term view is affecting radiation protection concepts.

Marie-Claude Dupuis, Chair of the RWMC, stated that it was important to make radioprotection aspects related to geological disposal in the long term and the corresponding optimisation process understandable to the public, and expressed wishes that the new ICRP document will cultivate progress in this direction.

Jacques Lochard, Chair of the session and Chair of ICRP Committee 4, indicated that the final draft was submitted to ICRP for approval on 5 March 2012, and a decision on the adoption of the draft recommendation will be taken in April, in Versailles, by the ICRP Main Commission.
The objective of the draft ICRP document, as presented by Wolfgang Weiss, was to update ICRP publications 46, 77 and 81 addressing the application of ICRP principles to the disposal of long-lived solid radioactive waste with respect to the approach taken in the recent ICRP Publication 103. In this new general recommendation the ICRP has evolved from the previous process-based protection approach using practices and interventions, by moving to an approach based on the exposure situation. ICRP 103 distinguishes between planned, emergency, and existing exposure situations, and applies the fundamental principles of justification, limitation of doses and optimisation of protection to all of these situations. It defines the terms of normal and potential exposures. It reinforces the principle of optimisation of protection, which should be applicable in a similar way to all exposure situations.

The draft ICRP document is strictly devoted to geological disposal of solid radioactive waste and therefore does not address near surface disposal facilities. It covers all phases of a disposal facility including the pre-operational phase (siting, design and construction), the operational phase (which consists in the emplacement of the waste in the repository, in the construction and sealing of disposal cells and is followed by a period of observation and closure of the facility) and the post-operational phase which begins after closure of the facility. During the operational phase direct oversight may be exercised whilst after closure of the repository only indirect oversight may be exercised. In the very long time frames memory of the disposal may be lost, and there is no guarantee that any oversight can be kept.

Since the level of oversight affects the capability to reduce or avoid exposures, the ICRP document, in light of ICRP 103, describes the different types of exposure situations that may occur depending on the level of oversight corresponding to the different phases of the disposal facility.

The following major findings can be drawn from the presentation of the draft ICRP document:

On general principles and links with previous ICRP publications

- The Commission recommendations relying on the basic tenet that individuals and populations in the future should be afforded, in principle, at least the same level of protection as the current generation [ICRP 77, 81].

- In application of the optimisation principle, the reference radiological impact criterion for the design of a waste disposal facility recommended by ICRP is an annual dose constraint for the population of 0.3 mSv in a year, without any weighting of doses in the far future (corresponding to an annual risk constraint for the population of 10^{-5} per year for less likely events) [ICRP 103].

- The general statement of ICRP Publication 81 still applies: "Although the Commission continues to recommend dose limits, it recognises that `dose limits for public exposure are rarely limiting in practice'. Furthermore, it considers that `...the application of dose limits to waste disposal has intrinsic difficulties' and that control of public exposure through a process of constrained optimisation will `obviate the direct use of the public exposure dose limits in the control of radioactive waste disposal' (ICRP 77)."

On the nature of the calculated doses in the far future, the links with the measures of health effects and the application of numerical criteria

- Given the long timeframes considered in waste disposal, the evolution of society, human habits and characteristics is such that effective dose loses its direct connection to health detriment after the time span of a few generations. Therefore, doses and risks should not be regarded as direct measures of health effects beyond timescales of around a few hundred years into the future. Rather, they represent indicators of the protection afforded by the geological disposal system.

- Moreover and due to increasing uncertainties, the scientific basis for dose and risk assessments at very long times into the future becomes questionable and the strict application of numerical criteria may be inappropriate. What is at stake is the assessment of the robustness of the protection system provided by the disposal system in the long-term which does not need a precise knowledge of the evolution of the general health of the population in the far future.

- At the design stage, the objective is to estimate, in an optimisation process through a comparison (using dose and risk indicators) of alternative options, the levels of protection achieved by a given disposal facility system and to judge if the estimated protection level of the chosen strategy is acceptable in the light of the level of protection accepted today. Hence, the annual dose constraint of 0.3 mSv in a year is to be used for the sake of comparison of options rather than as means of assessing health detriment or protection of specific individuals or populations.

On the aim of the safety case, the treatment of design-basis evolution and disruptive events

- The safety case provided by the developer of a disposal facility must address the operational and the post-operational phase and, specifically the distant future, when controls and interventions cannot be relied upon. The aim of the developed safety case is to provide convincing evidence of the intrinsic protective capability of the system. It should recognise the residual uncertainties in both the long-term processes and potential future events that may affect the performance of the disposal facility and why these have been considered as not reducing protection unduly.

- The Commission recommends now separate consideration of natural disruptive events that are included in the design-basis evolution and those that are not in the design basis. For the first ones, the Commission recommends application of the dose or risk constraints for planned exposure situation. For the severe natural disruptive events not taken into account in the design-basis evolution, the Commission now recommends application of the reference levels for emergency or existing exposure situations, depending on the severity of the consequences and the presence or not of a regulator.

On the cessation of direct and indirect oversight

- The cessation of direct oversight of the site will not occur before tens to hundreds of years after the start of operations. It is not possible to specify the criteria that will be used by the people making decisions at that time. The different decisions to be made related to the evolution of the oversight should be discussed with the stakeholders.

- As such, the assumption that cessation of indirect oversight will occur does not correspond to a regulatory decision to release radioactive materials from regulatory control.

On the optimisation process

- Protection can be considered optimized from an ICRP viewpoint provided that:
    1. due attention was paid to the long-term safety implications of various design options at each step in the development and operation of the disposal facility;
    2. there is a reasonable assurance that the assessed doses and/or risks resulting from the generally expected range of the natural evolution of the disposal system satisfy the appropriate constraint, over timeframes for which the uncertainties are not so large as to prevent meaningful interpretation of the results;
    3. the likelihood of events that might disturb the performance of the disposal facility, so as to give rise to higher doses or risks, has been reduced as far as reasonably possible by the siting or design.

The view of the implementer on the draft ICRP document was presented by J. Vira. His general observations were that the ICRP document clarifies some concepts, gives more coherence to the series of ICRP publications, adds realism to thinking on long-term protection and clarifies end-point considerations. It will call for some changes in regulatory requirements but will not cause major changes in implementer's safety practices or regulatory compliance assessments. It gives a more robust basis to the international guidance and recommendations. However some ICRP concepts are still difficult to apply, in particular the method and scope of optimisation and the demarcation between exposure modalities.

The draft document takes into account the current views and NEA collective opinion concerning the difficulty to assess whether a desired level of long-term protection will be achieved. The aim of the developed safety case is to provide convincing evidence of the intrinsic protective capability of the system, and not to assess health effects in the far future or rigidly apply numerical criteria in these long time frames.

It was felt that the principle not to apply a weighting of doses in the far future clarified the situation as long as the annual dose constraint is no longer a numerical criteria but a reference indicator of the level of protection which has been achieved. However it was felt that some semantic confusion was remaining in the draft document concerning the possibility to use health detriment for long-term assessments and the relationship between safety indicators and (potential) future consequences (i. e. health effects on some individuals).

If the evaluation of exposures in the far future serves only the purpose of "comparing alternative facility design options and reaching a regulatory judgment regarding the capability of the system to contain and isolate the waste", J. Vira wondered why the ICRP did not put the focus on releases instead of doses as does the Finnish regulation.

It was found that the statement: "In the long term, optimisation of protection can only be demonstrated if oversight is maintained", is somehow a paradox and it was also recognized that possibilities for indirect oversight may be fairly limited (i. e. MoDeRn project).

A large fraction of the draft ICRP document is devoted to the optimisation process. It was felt by J. Vira that the corresponding recommendations included strong requests but indecisive guidance.

It is stated in the draft document that the process of optimisation will be considerably different for the pre-operational, operational and post-operational phases. However most part of the optimisation of the design will be performed in the pre-operational phase and will concern both operational and post-operational safety. [BAT] elements complement and support radiological optimisation when potential impacts in the far future have to be dealt with.

It is recognized that optimisation of protection is the responsibility of the developer but is complex to implement since it involves liaison with safety and environmental protection authorities, local communities and other stakeholders, and multiple decisions have to be taken.

The draft document, therefore, acknowledges that no specific guidance can be given on the optimisation process in the sense that "it is not possible to define a priori the path for a sound optimisation process for a geological disposal system, or the acceptance or success criteria for the end result of an optimisation process."

J. Vira described the optimisation process in current implementer's practice. He indicated that, as for any industrial facility, system optimisation of geological repositories is a normal part of design and development. It aims at cost and time efficiency and design improvements, and leads to comparison of options. He stresses however that the implementation of optimisation as defined in ICRP 103 may be impossible to pursue.

For the implementer of a geological disposal the driver for optimisation is often the need to reduce uncertainties. The comparisons between options are usually focused on the technical performance of the repository subsystems, e.g., in the BAT sense, and the degree of robustness is better reflected by the level of residual uncertainties than dose/risk measures. This means that :

- a systematic, consistent set of performance targets is needed for the repository system as regards its principal safety functions of isolation and containment
- focus should be put on (scientific and technical) assessment of whether performance targets can be met
- development work should aim at reducing uncertainties in the assessed performance of the repository system

The efforts should be concentrated on developing technical standards for geological repositories instead of idealistic requirements for optimisation.

Clive Williams from the Environmental Agency in the UK gave the view of the regulator on the application radiological protection concepts in the long-term.

He made a first remark that, as regards the future, there will be unanticipated changes which means inability to predict, and control, what will happen in only a few years.

For an operational geological disposal facility, reliance on human abilities may be reasonable. After control over a geological disposal facility is relinquished this reliance will not exist any longer. The implementer has only an ability to assess what might happen in a range of plausible circumstances.

Setting limits or constraints on radiation exposure in the long-term future implies an ability to predict and control. Therefore these limits and constraints in the long-term future will have little value in terms of regulatory compliance. Geological disposal aspires to make radioactive waste safe in the very long-term which means that we need to put our trust in the disposal system rather than people. Only estimates of dose and risk, as indicators of long-term safety, may be used. We can only compare assessed doses or risks in the long-term to benchmark guidance levels.

In a complex project, optimisation is a continuing and imperfect process, not a single, perfect act. It needs "balance" between: optimising for construction and operation (stages under control), and optimising for the longer-term during the post-closure stage.

After control has been relinquished, a geological disposal system (which we may not fully understand to begin with) may evolve in a variety of ways. There is a need to consider a range of scenarios as part of the optimisation process, as well as a range of conceptual models of the system.

Justification is linked with considerations involving optimisation.

In conclusion it can be recognised that ICRP's "exposure situations" are designed for current radiation exposures and we may wonder if it is helpful to refer to those exposure situations, when considering periods of indirect oversight and no oversight, in the long-term future.

General discussion

It was underlined that the new ICRP document brought a good clarification on the subject and is needed for those entering the licensing process. It is not fully clear on all subjects but provides useful information. Specific issues were raised:

- There is a need to address doses, not just releases, because the objective is to protect. However the nature of the criteria to be used for making judgements needs to be flexible.
- The context of planned and existing situations, depending on control, needs clarification.
- The nature of constraints in the long term, for which it was emphasized that constraints indicated by ICRP are benchmarks in the long term, needs further elaboration.
- The question of emergency situations in the far future, which presupposes that actors will take actions. It was noticed that this issue will be hard to explain to the public.

Considering the comments given and the questions raised by the presentations one may wonder if it is not too early to submit the document to the Commission for approval. Wolfgang Weiss answered that complete agreement would take 10 years and that this document is only a first step. The clarifications brought by the document are important ones and its publication is needed to establish a robust basis for national programmes entering a licensing process.

SESSION 2: RADIATION PROTECTION AND THE LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE

This session addressed the concept and use of optimisation in radioactive waste management. It was chaired by Piet Zuidema from NAGRA. François Besnus from IRSN covered the concept of optimisation in long-term radioactive waste management; Stephanie Bush-Goddard from NRC presented the regulator's view on the subject; G. Ouzounian on behalf of Sylvie Voinis from ANDRA presented the implementer's view; and Klaus Roehlig the Chairman of the IGSC presented the results of the topical session on optimisation organized during the annual meeting of the IGSC in 2010. Piet Zuidema introduced the session, addressing the major role of the implementer in the optimisation process. He elaborated on the complexity of the process involving adequate balance between protection of workers during operations and protection of the public and environment in the long-term.

François Besnus from IRSN presented the concept of optimisation in long-term management of radioactive waste.

Concerning the principles for radiological protection recommended for long-term management of radwaste, the major points raised by IRSN were the following: 1) geological disposal is a relevant option in the justification of the generating practices, 2) limitation of exposures requires means to verify conformity in order to be able to act on the source and therefore fully applies during the pre-closure phase, but cannot be reasonably applied in the absence of oversight of the disposal facility, and 3) constrained optimisation is a meaningful concept for long-term protection but requires careful approach for implementation.

IRSN identified a series of issues for implementing, in practice, optimisation of radiological protection for long-term management of radwaste. It was underlined that all the elements of the ALARA approach may be implemented during geological disposal operations, including the reversibility phase (these elements comprise the verification of doses incurred, and improvement of practices). It was mentioned in this respect that special attention should be devoted to the treatment of hazards induced by co-activity (waste emplacement and construction). However, in the long term, there is a reduced possibility for addressing the ALARA approach since the only tool for its implementation is through an adequate design ensuring protection of the public and the environment without the possibility of coming back for maintenance work. This implies that ALARA will be addressed by 1) the implementation of a multiple barrier system to manage safely the waste in the long term and 2) the demonstration of the robustness of the system. IRSN added that the emphasis should not be given to optimizing dose targets but rather design barriers "as efficient and robust as reasonably achievable " (accounting for socio-economical factors) so as to ensure that radiological impact will stay reasonably low "whatever happens".

IRSN addressed the important issue of the balance between optimisation during operation and in the long-term. The design concept will influence both aspects (i. e. design of architecture or ventilation systems, safety of operation requiring adapting design…) which means that possible conflicts of design options may exist when optimising safety and radiological protection during operations and after closure. There is therefore a need that the choices made be justified while addressing both issues, and that choices be left open for selecting the preferred option after a transparent process. IRSN concluded that :

- Demonstration of optimisation is better achieved if several options are available (geological formations, sites, design options, operational and construction methods…), discussed among stakeholders and finally selected after cautious evaluation ;

- This demonstration relies on the argumentation that the conception of the disposal system provides a good balance between protection of workers during operational phase and protection of the public after closure of the facility ;

- Optimisation is backed up by a structured, open and transparent process of decision making with clear milestones so as to enable comparing technical options in the light of the socio-economical factors by allowing stakeholders to take part to the decision in a timely manner.

Stephanie Bush-Goddard from the US-NRC presented a regulatory view of optimisation in long-term radwaste management.

The NRC identifies three attributes of a geological repository relevant to optimisation: the repository development is expected to last many decades, repository hazard remains for very long time period (e.g., thousands of years) and the possibility for human exposure is mostly in the far future when human actions will be uncertain.

The approach for optimisation of long-term safety is based on the ICRP-81, which distinguishes potential exposures associated with natural processes and with human intrusion. Based on ICRP recommendations, the US-NRC legislation defines standards that limit potential for exposures from natural processes by optimizing the design of the repository on the basis of a dose constraint (e.g., no more than 0.30 mSv per year for members of the public) and reduce the potential for human intrusion by the siting of the facility namely by avoiding locations with valuable resources.

After operations and closure the main measures to mitigate the possibility for human exposures are to preserve knowledge and maintain controls to limit the probability of inadvertent intrusion and potentially assist any future actions. In this respect the NRC considers a series of mitigation actions : permanent monuments identifying the site, placement of records in archives, program of continued oversight of the facility and program of post-closure monitoring.

The different possibilities for monitoring, continued oversight, markers, and records management will be developed in detail throughout repository development and may assist future society understand the hazard. Flexibility is called for in early planning as technological advances will occur over long development periods.

The implementer's view of optimisation in long-term radioactive waste management was presented by Gerald Ouzounian from ANDRA on behalf of Sylvie Voinis.

The optimisation of the disposal concept in France is performed in a stepwise manner.

The Dossier 2005 was devoted to the feasibility of the project, especially towards compliance with safety and reversibility requirements. A reference design was presented to demonstrate feasibility with possibilities for further optimisation.

In 2006, an optimisation process was defined in order to improve the facility design without altering the high level of safety of the disposal facility. The process included several steps:

- Identification of design optimisation topics through working groups ;
- Classification of the topics regarding their economical impact with at least the same level of safety and elaboration of the development plan of the optimisation process ;
- Implementation of the topics in Andra's research and development programmes.

The main design, safety and reversibility options were presented to the French government in 2009 (Dossier 2009). Supported by scientific and technical studies, preliminary optimisation topics were included in the presented options. Complementary optimisation topics were identified to be incorporated in the next project steps.

The optimisation of the disposal facility was based on the identification of the safety functions of individual components (waste packages, structures, geological barriers) during operation and in the long term.

Deriving from the “Top” function: “to protect man and environment from hazards induced by the waste”, three main safety functions were identified:

- Preventing groundwater flow ;
- Immobilizing radionuclides and limiting their release to the geosphere ;
- Limiting and delaying the migration of radionuclides ;

Three main categories of components were considered:

- Waste forms and their behaviour in the long term ;
- Engineered barrier systems (EBS) components especially during the decay period ;
- Host formation to protect EBS and especially to retain and limit the release of long-lived radionuclides.

The need for commensurate requirements was identified, with uncertainties depending on time frames (i.e. short-lived or long-lived RN behaviour, HL/IL/LL waste package behaviour, gas release, thermal phase, chemical evolution).

Safety assessments allowed ANDRA to identify a list of safety requirements and criteria for the components of a disposal facility in the Callovo-Oxfordian host rock taking into account specific timescales in relation to the evolution of the radiotoxicity of the waste over time. The required timescales and performance level vary in accordance with the characteristics of the waste, but also with the site properties.

The waste packages contain and isolate the radionuclides during the period of substantial decay (1 000 -10 000 years) when thermo-hydro-mechanical effects are significant. During this period the site properties, depth and lay-out of the facility prevent “intrusion” and natural risk. The geological characteristics limit long-term consequences after the period of substantial decay (>10 000 y). Additional performance is brought by sealings and overpacks (if needed). The control of the residual risk in the very long term is brought by the limitation of concentration in very long-lived radioactive “hotspots” that depend on the lay-out of the waste, the depth of the facility and the slow erosion rate at the site.

The results of assessments of the different evolution scenarios must enable:

- an evaluation of the impact in terms of dose,
- a verification that the performance levels attributed to the different disposal components (packages, sealing, host formation…) make it possible to satisfy safety functions through indicators (concentration, molar flow rates, etc.).

On the other hand:

- They are not a prediction of the impact of the disposal (ICRP 81) given the uncertainties and the time scales involved ;
- They favour simple representations of the phenomena at stake, so as to enable the results to be easily analysed.

The dose to the most exposed individual being an end point of the safety assessment and an indicator of global performance, the conclusions from numerical modeling were that : The Callovo- Oxfordian host rock has a good capacity to delay and spread out the migration of radionuclides, and allows radioactive decay to reduce to insignificant levels the dose contribution from 98% of the inventory of radionuclides present in the waste. The main radionuclides contributing to the dose are I129, Cl36 and Se79. The maximum of the dose appears after 10,000 years and lies two orders of magnitude below the constraint of 0.25mS/year.

In order to clarify the efficiency of the different components of the disposal facility, and to optimize the design and architecture of the disposal facility, the need was identified to chose appropriate indicators to check performance and safety (i. e. concentrations, flow rates, transfer pathways, …).

ANDRA concluded at this step that optimisation required improvements in several domains :

- Better knowledge of inventory, in particular on mobile RN;
- Better knowledge of geological site, including on diffusion coefficient;
- Making use of intermediate indicators (RN flow at the top or bottom of the Callovo-Oxfordian formation), and
- Checking the impact on long term safety of all design evolutions (mainly for mitigating hazards during the operational phase).

Klaus-J. Röhlig (IGSC chair) presented the results of the 2010 IGSC topical session on optimisation.

This presentation was prepared by Lucy Bailey from DA-RWMD, UK for the Joint RF/IGSC workshop : "Preparing for Construction and Operation of Geological Repositories – Challenges to the Regulator and the Implementer".

One of the objectives of the workshop was to explore issues of optimisation, and what this means in practice. The main observation was that there is no single straightforward definition of optimisation, and not all regulatory guidelines use this term. The regulatory documents that provide guidance on what and how to optimise define constraints that must be considered in the optimisation process. Typical factors to be considered in optimisation include nuclear safety and security; radiation protection (operational phase with normal operation and incidents/accidents; post-closure safety with expected/unlikely evolution); worker health and safety; technological issues including "robustness"; environmental aspects during construction, operation and post-closure phase; cost; societal expectations; etc.

The variety of the remarks and views on this subject reflected the diversity of optimisation goals that may be pursued in the framework of a geological disposal programme. While optimisation of protection, as defined by ICRP, is regarded as a process to keep the magnitude of individual doses, the number of people exposed, and the likelihood of potential exposure as low as reasonably achievable with economic and social factors being taken into account, optimisation can also be seen as a way of increasing the technical quality and robustness of the whole waste management process. An "optimal solution" in a wider sense may also mean addressing safety requirements whilst balancing other factors such as the need to use resources efficiently, political and acceptance issues and any other boundary conditions imposed by society. It was noted that optimisation variables are often not well defined and could be quite programme-specific.

Examples of optimisation issues addressed during the IGSC topical session and the workshop included site selection (Germany), location of disposal facility in a selected zone (France), design of the engineered barrier system (Sweden, Finland). Optimisation is a forward-looking activity and continues as well during the operational phase, e.g. in the framework of re-licensing, and it may concern working procedures, installations, equipment (USA, WIPP).

There was general agreement on a series of statements on the subject. The endpoint of optimisation should represent a balance between the different factors considered in the optimisation process while respecting the constraints. Optimisation is normally forward oriented rather than directed on re-examining past decisions (except for situations that require remedial action) and should focus on those issues where (residual) flexibility is available. Optimisation should be taken at several levels, from the overall waste management system (including waste treatment, interim storage, final disposal, etc.) down to individual elements of the repository system. Optimisation also has to find a balance on how long to keep options open and when to take decisions and narrow down the number of options; optimisation, however, should not be used as an excuse to take no decisions and not to move forward.

For optimisation, not only the endpoint counts; equally important is the process of optimisation that should be conducted in a transparent manner and relies on a structured interaction between regulator and implementer. In this respect regulators need to be clear about their requirements and these requirements become constraints on the optimisation process, together with any societal constraints that may be applied in certain programmes. Once the safety objectives (dose/risk targets and other constraints) have been met, further optimisation should be aimed at moving the project forward as efficiently as possible, and this could largely be described as "cost optimisation".

General discussion

The discussion was centered on the clarification of the approach in individual countries in reference with the concepts developed by the draft ICRP document. There was a general agreement that even though, in the optimisation process, the emphasis should be given to increasing the robustness of the system by the reduction of the insensitivity to uncertainties, the calculations of the radiological impacts in the long term and comparison to a dose constraint were useful since they represent indicators of the protection afforded by the geological disposal system.

Closure of the topical session

Marie-Claude Dupuis, Chair of RWMC and Ann Mc Garry, Chair of CRPPH, gave the main conclusions at the end of the topical session.

There was satisfaction that the radiation protection framework could be adapted to radioactive waste management in the long-term, that a good dialogue process between both NEA committees could be established and that the approach for justification and optimisation could be clarified even though improvements of the draft document can still be envisaged.

As for the implementation of the optimisation process by the operator of the disposal facility the most important issues raised were the following:

- Optimisation is directed toward the improvement of robustness of the multi-barrier system rather than optimisation of the dose ;
- Optimisation is an on-going process along the development of the project ;
- The implementer understands an element of optimisation as moving the project forward as efficiently as possible, and this could largely be described as "cost optimisation" ;
- The main issue is the balance between operational safety and long-term safety ;
- Another issue is the balance between needs of the present generation and needs of future generations. An important aspect being to introduce reversibility to allow useful dialogue with 'stakeholders';
- The RWMC project on memory is part of the optimisation of post-closure.

As concerns the information of the public on ICRP recommendations, it was recognized that, at this stage, the draft ICRP document on geological disposal was still too complex to be explained easily to the public. However a collective statement by the NEA on the subject would be most beneficial.

In closing the Topical Session, Mrs. Dupuis observed that it would be good to communicate to the public that there is internationally a good understanding of the radiation protection principles as applicable to radioactive waste disposal. This message could be passed on jointly by the two committees after proper co-ordination. She suggested that the Bureaux of the two committees take up this issue at their next meetings.