

Radioactive Waste Management



Strategic Areas in Radioactive Waste Management

The Viewpoint and Work Orientations of the NEA Radioactive Waste Management Committee



N U C L E A R • E N E R G Y • A G E N C Y

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- to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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FOREWORD

The NEA Radioactive Waste Management Committee (RWMC) is a forum of senior operators, regulators, policy makers, and senior representatives of R&D institutions in the field of radioactive waste management. The Committee assists Member countries by providing objective guidance on the solution of radioactive waste problems, and promotes safety in the short- and long-term management of radioactive waste. The cross party representation of industry, safety authorities, and governmental policy bodies and the wide range of expertise it musters amongst the NEA Member countries, make the RWMC a uniquely placed international forum to address issues in radioactive waste management.

Since its inception in 1978, the RWMC has addressed both strategic and technical issues in waste management, especially disposal in the more recent years, and RWMC documents have proved valuable in the NEA Member countries at both decision-maker and technical levels. This report identifies some of the major challenges currently faced by national waste management programmes, and describes the strategic areas in which the RWMC should focus its efforts in future years.

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INTRODUCTION

Radioactive waste arises from commercial nuclear power generation as well as from other industrial activities and from the use of radioactive materials in several human activities. Radioactive waste also exists as a result of past practices, and needs to be managed in a safe, economical, and environmentally and publicly acceptable manner.

In recent years, the programmes under the Radioactive Waste Management Committee (RWMC) have focused primarily on technical aspects related to deep underground disposal of long-lived radioactive waste. One of the achievements reached by these programmes is the establishment of a consensus between experts in the various participating countries that sites can be properly identified and characterised, that geological repositories can be designed so that no short-term detriment to populations will result from the waste disposal, and that an acceptable level of safety is provided for times far into the future, up to and beyond any period of regulatory concern. There also exists consensus, among the experts, that the current generation, who have benefited from the nuclear energy produced, should provide future generations the means to dispose permanently of the waste.

The confidence of the experts in the short- and long-term safety of the geologic disposal option has been confirmed, at national level, in several technical and licensing reviews of safety assessment studies of deep repository systems, but is not necessarily matched by an equally favourable attitude within non-expert groups. In particular, several repository-development programmes have recently undergone increased public scrutiny and despite notable exceptions, e.g. the granting of a nuclear licence to operate the WIPP geological repository, this has resulted in delays in the implementation of some site development programmes. Long-term surface storage and partitioning and transmutation are still being investigated as potential components in an overall waste management strategy leading to disposal. In addition, deregulation of the electricity market and attendant financial pressures affect the whole nuclear-fuel cycle and impact on waste management organisations. These considerations raise issues concerning how best to achieve confidence, and consensus,

regarding the economic, political, technical and ethical aspects of a waste-management strategy.

In this document strategic areas are defined and further described in which RWMC feels that progress would be most beneficial towards further development of radioactive waste management, and particularly disposal programmes. It is accepted that the RWMC, building upon the technical areas in which it has demonstrated strength, extend its endeavours to the interfaces between technical advances, regulatory developments, societal concerns and their input to the decision making process.

IDENTIFICATION OF STRATEGIC AREAS

Background

Considerable experience has been accumulated in the field of radioactive waste management over the years, particularly in the areas of:

- The handling, treatment, storage and disposal¹ of short-lived low- and intermediate-level waste.
- The conditioning (vitrification) of high-level waste and the storage of high-level waste and spent nuclear fuel.
- The minimisation of waste production during plant operation.
- The management of “historical” waste and the management of older waste facilities under changed legislative and regulatory frameworks.

It is accepted among experts that geological disposal represents an ethical and appropriate solution to the long-term management of long-lived radioactive waste. Furthermore, the feasibility of geological disposal of long lived waste, including spent fuel, has been established at a technical level, and many OECD Member countries are now pursuing repository development programmes. This has led to notable advances in:

- The establishment of organisational structures and regulatory frameworks to govern the construction and licensing of such facilities.

1. As used in this text, “storage” indicates possible intention to retrieve waste and the need for continued monitoring; disposal indicates the lack of intention to retrieve and a passively safe long-term solution.

- Conceptual designs for the facilities and the technology that is required to implement the designs.
- The formulation of procedures for site selection and the technology for site characterisation.
- The development and application of methods to assess the safety of the proposed repository systems.
- The overall confidence in the design and characterisation processes, and the evaluation of safety.
- The achievement of important milestones, e.g. in selecting sites.

There is interest, and resources are being spent, in research in the partitioning and transmutation (P/T) of long-lived nuclides in order to reduce the amounts of long-lived waste; the overall balance of financial and practical aspects of this process is, however, still debated. In particular, it is accepted that P/T would not remove the need to dispose permanently of long-lived waste. Some Member countries have a continuing interest in the possibility of regional, or multi-national, repositories.

Finally, lessons have been learnt as well from difficulties and setbacks in carrying forward waste management programmes.

Broad identification of strategic areas

Against the background of experience that has been accumulated in the past few years, six broad strategic areas have been identified which the RWMC is prepared to address in the coming years. These strategic areas are briefly introduced hereafter and are described in more detail in the next chapter. All areas will need to be addressed by the RWMC. The priority that these areas will receive may vary in time. The strategic areas identified are:²

I. Overall waste management approaches

- (a) ***Environmental concerns, safety and sustainable development*** – including demonstration that safe and environmentally

2. In no order of priority.

acceptable strategies can be applied, that respect principles of sustainable development.

(b) ***Comparison of the principles of radioactive and non-radioactive waste management and of the evaluation of their impacts***, including evaluation of the consistency of management principles across different types of radioactive materials.

(c) ***Economic concerns*** – evaluation of the impact of financial pressures on waste management programmes, e.g. due to deregulation of electricity markets, as well as the impact of waste management on the continued economic sustainability of nuclear power.

II. *The process of repository development for long-lived radioactive wastes* – particularly to continue the present work on (i) assisting in the resolution of technical issues to promote safety and provide grounds on which to base decision making, and (ii) developing common understanding between independent bodies such as implementers, regulators and policy makers on the goals to be achieved and respective responsibilities. The generation of societal confidence on how to move forward at the various stages of a repository development programme is also important.

III. *Management of materials from decommissioning and dismantling, and of Very Low Level Waste (VLLW)* – including technical information exchange and maintaining dialogue between implementer and regulator, with a view to arriving at consensus on safe, practicable, cost effective and environmentally sound solutions.

IV. *Public perception and confidence* – including understanding the concerns of stakeholders, communicating effectively, sharing practical experience from outreach/consultation exercises and public decision-making processes. Especially important to the RWMC are intermediaries between the public and the technical community, e.g. scientists in other fields and policy makers. Issues of public perception and confidence apply across topics I, II and III.

V. *Implications of, and participation in, international guidance and agreements* – identifying implications for waste management programmes of, for example, the new ICRP radiological policy applied to waste disposal and forthcoming update of ICRP 46, and the

Joint Convention on Safety of Spent Fuel Management and Radioactive Waste Management.

- VI.** *System analysis and technological advances* – identifying the emerging waste management and disposal technologies, for exchange of information and consideration of their implication at the system level.

Reinforcement and rationalisation of the OECD outreach activities to the world's major emerging and transition economies, will require that the NEA as a whole increases its commitment to co-operation with the Russian Federation and, possibly, other countries. The RWMC will provide the necessary support to the NEA in the areas of RWMC remit. This commitment by the RWMC is recognised in the NEA Strategic Plan.

Most organisations represented in the RWMC already have activities in the areas identified above. The RWMC will play a role of co-ordination at an international level enabling the sharing of experience, development of consensus, and advancement of the status of the art.

DESCRIPTION OF STRATEGIC AREAS

Area I: Overall waste management approaches

(a) Environmental concerns, safety and sustainable development

There is a heightened awareness in society for the role of energy in the context of sustainable development, with emphasis on conservation of resources, the possible adverse environmental impact of the exploitation of natural resources,³ and long-term protection of the environment. Thus:

- While it is recognised that many relevant concepts are already incorporated in policy statements for the management of long-lived waste – e.g. the principles of “the polluter pays”, “reasonable assurance” and “not placing undue burdens on future generations” – it will be helpful to clarify the meaning of waste management principles and terminology within the context of sustainable development.
- While geological disposal is broadly accepted by technical experts and decision-makers as a technically sound, safe, and feasible solution for disposing of long-lived wastes, it will be helpful to examine, in parallel, long-term-storage and other potential approaches such as partition and transmutation (P&T) in an overall waste management strategy within the context of sustainable development. At issue are the implications, for the whole life-cycle, of the different options as well as the assessment of long-term environmental impacts.

3. There is increasing awareness of the scale of the remediation problems to be faced as a result of some former, unsafe practices regarding the management of various forms of waste (non-radioactive, chemically-hazardous waste and radioactive waste) that may lead to the need for intervention.

- While it is recognised that a geological repository provides the possibility of retrievability and reversibility in the early periods of time, it should be helpful to examine how far the present concept of deep geological disposal would need to be modified to ensure retrievability/reversibility at several time scales. This also introduces the issue of how to determine the timing of closure based on environmental and ethical concerns.
- It is important that, whatever the approach considered for long-term waste management, it be consistent with the principle that knowledge, research capability, know-how and funding are preserved in the intervening years. This issue remains important even if nuclear energy is not preserved as an option for future generations.

There is a need to examine the place of waste management within the broader debate on environmental and ethical issues, in particular to gain a better understanding of long-term waste management options from the point of view of sustainable development.

(b) comparison of the principles of radioactive and non-radioactive waste management and of the evaluation of their impact

It is often perceived that different safety standards and regulatory and licensing approaches are applied to radioactive and non-radioactive wastes. The chemical toxicity of some radioactive waste – as well as toxicity due to biological agents – is also becoming a more prominent issue.⁴

It will be helpful to review:

- The principles and regulations adopted in the management of non-radioactive, chemically-hazardous waste, and naturally-occurring radioactive materials, including tailings from uranium mining.
- The burden of proof of compliance that is expected for radioactive waste disposal facilities relative to other hazardous waste disposal facilities. In particular how this is reflected in Environmental Impact Statements/Assessments (EIS/EIA) studies.

4. “Mixed waste” also exists, and is part of the remit of RWMC interests. This waste is recognised to be, at the same time, radio- and chemo-toxic.

- The role of the EIS/EIA as required in several national programmes, in bringing an integrated perspective on the radiological and non-radiological impacts of repository development.
- The potential environmental impact of radioactive-waste disposal, compared to that of the by-products of other energy sources.

It may be that a comparison that places nuclear-waste disposal in perspective with other practices that impact the environment, including regulation and licensing, is required before nuclear-waste disposal can be widely perceived as being sufficiently safe.⁵ Consistency amongst practices should also favour the allocation of resources in a way that is more attuned to the actual needs of society.

(c) economic concerns

Financial pressures, that affect the whole nuclear-fuel cycle, (e.g. resulting from deregulation of the electricity market) may tend to favour short-term goals, at the expense of long-term objectives. In particular, even though at the decision-maker level, a wide acceptance has been achieved that deep geological disposal represents a safe and ethical path, (i) short-term economic factors may tend to favour delaying final disposal, and (ii) political factors may tend to favour the proposition of indefinite or very-long term surface storage of all types of long-lived waste or the proposition of approaches, such as P/T, misleadingly depicted as alternatives which would preclude the need to pursue disposal.

New economic forces need to be better understood and incorporated into the understanding of the decision-making process, e.g. on decommissioning, repository development and waste generation. There is also a need better to understand the interplay of financial and “political” factors, and the way that they will affect the decision base.

5. Indeed, co-disposal of radioactive waste and chemically-hazardous, non-radioactive waste has been proposed by some, to take advantage of the safety provisions that proposed repositories would incorporate.

Area II: The process of repository development for long-lived radioactive waste

At the international level, the achievement of understanding of key concepts of repository development among and between implementers, regulators and policy makers, has the potential to facilitate the enhancement, and wider communication, of the process of repository development (step-wise approach); and to identify, discuss and rationalise national specifications and differences in regulatory, policy and policy-implementation approaches. Interaction between implementers and regulators brings further benefits in that the regulator understands the concepts and strategy by which the implementer intends to demonstrate that a proposal is acceptable, and the implementer is made fully aware of what is expected by the regulator in a proposal.

In particular:

- Although there is common acceptance that the development of a repository is a step-wise process, a dialogue between implementers and regulators must be maintained in order that a gap does not develop in how this process is perceived. The repository development process is also a matter of interest to other stakeholders and decision makers. In some countries, there is a need to define more clearly the approaches by which the stages of repository development are derived, to define the requirements in order to progress from one stage to the next, and to ensure that the process is perceived as being equitable outside the community of technical specialists and decision makers. Site characterisation and siting should also be viewed within the stepwise approach to repository development.
- The decision to proceed from one development stage to the next is normally supported by a safety case which entails a quantitative performance assessment and other, more qualitative arguments related to confidence in the quality and reliability of the performance assessment and the quality of the repository system (site and design) with respect to safety. Further progress is required to integrate within the safety case confidence building measures that facilitate the decision-making process.
- Although significant progress has been made in the clarification of the technical aspects of integrated performance assessments there is a need to foster (i) full, satisfactory integration of all aspects of the safety case, including the integration of site data and

understanding; and (ii) the definition of acceptable engineering practice in systems having individual specificity and where both natural and man-made barriers are expected to play a significant role.

- There exists a range of regulatory approaches that are used in the step-wise process to reasonably assure meeting the protection goal. Common understanding should be sought of the meaning and usefulness of these approaches and their implications, e.g. time frames and safety indicators.
- In order to ensure that progress is being made, it is imperative that the technical community also tries to understand stakeholders' interests, answer technical questions that the stakeholders feel need to be answered, and participate in a two-way communication. The needs of the stakeholders must be determined while the technical work is being done.

The area of repository development for long-lived waste is traditionally a strength of the RWMC. This Committee has provided an important mechanism for co-ordination of international R&D programmes enabling the sharing of experience and development of consensus on the state of the art, as well as the development of specific technical tools. Based on its pool of technical experts, the RWMC has also been able to provide timely and authoritative peer reviews of programmes in the area of assessment of long-term safety.

The RWMC is structured as a forum of regulators, implementers and policy makers in respect of waste management systems. Cross-party participation is especially necessary at the present stage of repository development.

It is essential that RWMC continues to provide a forum for cross-party dialogue, that the need for a common understanding should underlie the specific activities of the RWMC, and that RWMC initiatives in repository development should remain founded on an active programme on technical issues.

Area III: Management of materials from decommissioning and dismantling, and of VLLW

As nuclear-power plants reach the end of their lives, OECD Member countries will be increasingly faced with the task of decommissioning and

dismantling⁶ facilities and managing the potentially large amounts of very low activity materials that arise from this process. Characterisation of these materials, along with strategies for its management, will require increased attention as the volumes of waste that may be generated could make disposal in a repository designed for more active waste impractical. The timing of dismantling is also an important strategic issue.

The NEA has a significant role in focusing the private sector and its member countries on the need to balance the risks associated with re-use of materials used in nuclear applications with the cost of treatment and disposal of such materials and potentially the cost involved with providing new materials from natural resources. In this area, the NEA's co-operative programme on decommissioning, administered through the RWMC, has promoted developments in the understanding of the costs involved in the decommissioning and dismantling process; the decontamination of the site, equipment and materials; and the recycling and reuse of materials from decommissioning and dismantling activities. As decommissioning and dismantling technology matures, increased attention should be given to institutional and regulatory issues to allow its full application. In this area, as in others, dialogue between implementers and regulators is needed in order to achieve a mutual understanding of each groups' responsibilities, constraints and requirements, and to arrive at consensus as to a practicable approach to resolving key issues

The RWMC will take up a more analytical role in the areas of timing of dismantling, regulatory aspects of dismantling, recycling and reuse of very low activity materials, and continue to examine the issue of disposal materials arising from several industrial areas and characterised as "very low level waste". In particular, the RWMC will participate in, and foster, the debate on clearance and exemption levels, placing the present approaches in a societal context with due consideration of the classical radiation protection view point.

Area IV: Public perception and confidence

Issues of public perception and confidence must be considered across all the three strategic areas discussed previously, with the further understanding

6. In this document, decommissioning means the taking out of active service and associated removal of nuclear fuel, highly active materials and contaminated machinery. This term is often used to include dismantling, meaning the later stage of dismantling of larger structural elements and buildings.

that these issues are not specific to radioactive waste management, but also to the broader acceptance of nuclear power as part of the future energy mix. These issues have been most critical in gaining approval for development of repositories for long-lived radioactive waste at specific sites, which raises the question how best to achieve confidence with a non-specialist audience regarding the ethical, economic, political and technical aspects of a waste management strategy, and disposal in particular. The “public”, however, is not a homogeneous group, and its various components and the concerns they have need to be better identified and understood.

A broad aim of waste management programmes is to promote understanding of, and public trust in, the decision-making process e.g. through an open and fair process for repository development. Considerable progress has been made regarding how to best communicate with local and wider communities as exemplified by the cases of Finland, Sweden and the WIPP project. Licensing of uranium mill stabilisation projects is a reality in many countries. Acceptance of repository siting remains, however, a difficult area for most programmes. An important aspect is that stakeholders should be afforded opportunities to interact as early as possible in the process of repository development. In addition, the process by which proposals are brought forward must be trusted, and decisions made with sensitivity to local concerns. Thus, a specific issue for consideration is how to elicit more meaningful public involvement in the decision-making process.

The RWMC must be useful to its members in their obligation to take into account the input of various audiences in their respective countries. The needs of these audiences may not always be anticipated and dialogue with stakeholders may need to be sought,⁷ while not interfering with the primary role of governments in deliberations and decision-making process. Among the targets are the intermediaries between the public and the technical community, e.g. scientists in other fields.

There is a need to identify audiences, perspectives, and expectations and to develop the RWMC as a forum to share experience in building public confidence and, in particular, in how to obtain the trust of local communities, their representatives, and their intermediaries with the technical decision

7. The need has also been identified to make some of the RWMC work, e.g. the collective opinions, better accessible to the public at large, as well as the media. To that effect, select RWMC documents may need to be drafted with the help of non-specialist writers.

makers. Public input to decision making, while maintaining a workable decision-making process, needs to be explored more fully, especially in relation to the role of the regulator.

Area V: Implications of, and participation in, international guidance and agreements

There have been recent developments in international policy guidelines and agreements, that will have a direct impact on national radioactive waste management programmes. For example, the International Commission on Radiological Protection (ICRP) has formulated a new radiological protection policy (Publication 77) that is applicable to radioactive waste, and the IAEA has fostered a Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The new ICRP position has consequences on what may be recognised to constitute an appropriate safety case. The Joint Convention will impose additional requirements on countries seeking to demonstrate the appropriateness, adequacy and quality of their waste-management programmes. It will also force a higher degree of transparency in national programmes.

It is important that international guidance be formulated in a way that practical implementation is feasible. Thus it must take into account a diversity of viewpoints and should be properly reviewed. The RWMC is well qualified to provide constructive reviews of international guidance under consideration as well as to participate in drafting this guidance.

There is a need to be aware of developments in international guidance, to consider their implications and to integrate these implications in the programme of work of the RWMC. The RWMC should accept/seek interaction with other international bodies.

Area VI: System analysis and technological advances

In principle, waste management considerations should be addressed as early as possible in the design specifications of all new facilities, and new technologies for dealing with the waste should be examined for their integration at the system level. For instance the characteristics of end products (or final waste forms) from treatment and conditioning processes are an important input to the design of waste repositories. Thus, a good understanding is required of the waste treatment options, of the long-term behaviour of waste forms, and their interaction with engineered and natural materials in the repository

environment, in order to achieve a practical mesh between requirements. In addition, the timing of final disposal and, more specifically, the need to provide waste forms that can be safely and economically stored and disposed at a future date, must be considered. An integrated view is necessary to find optimal solutions to these problems. A further issue is quality control and testing of waste products and repository waste acceptance criteria.

There is a large amount of experience in pre-disposal waste management technologies, namely for waste treatment, conditioning, transportation, and interim storage. These technologies are being exploited commercially and some have been developed through international co-operation. Information in these areas has been exchanged through the RWMC and other international fora.

Although the above developments are not necessarily critical at any given time, they are an important part of waste management, and impact the options available. In particular, to the extent that partition and transmutation (P/T) could markedly impact on disposal strategies, progress in these technologies should be followed. Progress can also be expected and should be followed, in the area of mixed-waste.

It is important that RWMC is informed about on-going technological development for waste treatment and conditioning, consider the broader implications of waste technology alternatives, and continue to provide an authoritative forum to develop and promote best practice in relation to the overall system approach. An active role should be taken, especially in the areas of storage, disposal, and decommissioning, to bring the technology and knowledge base forwards, e.g. through international co-operative programmes.

CONCLUSIONS

In order to maintain the effectiveness of the RWMC as a forum that is of value to the Member countries, the mandate, structure, and working programme of the RWMC must recognise and respond to current national situations and international concerns. The present document has identified six strategic areas that will guide the programme of work of the committee in the coming years. Priority setting and resource allocations in these areas may vary with time, and will take advantage of opportunities for co-ordination of efforts and collaboration within OECD/NEA and with other institutions, e.g. IAEA, EC. Building upon the technical areas in which it has demonstrated strength in the past, the RWMC will extend its endeavours to the interfaces between technical advances, regulatory developments, societal concerns and their input to the decision making process.

RWMC members will take a direct and active part in ensuring that the issues are properly identified and addressed, and that the results of these efforts are effectively and widely communicated in a way which is convincing also to outside groups, especially other decision-makers or those that influence them. Collaboration with other parties within and outside the NEA will be important to ensuring this work is successful. In particular, decision makers with different institutional responsibilities need to assure themselves, and also to communicate to other audiences, that they are seeking reasonable solutions to the problems associated with these strategic areas, and that the needs of stakeholders have been sufficiently identified. Effective communication is thus required within the body of the experts and decision-makers from different national programmes, with different cultural settings and different constraints, across the “regulator-implementer boundary”, and between experts and decision makers and the wider community.

The RWMC is uniquely placed internationally to provide the necessary neutral ground and information base for effective and constructive communication on the relevant topics.

Appendix

Mandate of the Radioactive Waste Management Committee

The NEA has an acknowledged role in developing a global strategy for considering aspects of sustainability concerning the use of nuclear power and nuclear materials. The general objective of the NEA in the field of radioactive waste management is to contribute to the adoption of safe and effective policies and practices in Member countries for all types of radioactive waste. In this context, the mandate of the Radioactive Waste Management Committee (RWMC) shall be:

1. To constitute a forum of senior representatives from waste management agencies, regulatory authorities, policy-making bodies, research and development institutions with responsibilities in waste management, and other government-nominated specialists, for the exchange of information and experience on waste management policies and practices in NEA Member countries, and for advancing the state of the art on the technical or society aspects of waste management strategies.
2. To develop a common understanding of the basic issues involved, and to promote the adoption of common philosophies of approach based on the discussion of the various possible waste management strategies.
3. To keep under review the state-of-the-art in the field of radioactive waste management at the technical, scientific, regulatory and societal level, and in public acceptance matters.
4. To contribute to the dissemination of information in this field through the organisation of specialist meetings and publication of reports and consensus statements summarising the results of joint activities for the benefit of the international scientific community, competent authorities at national level and other audiences generally interested in the subject matter.

5. To offer, upon request, a framework for the conduct of international peer reviews of national activities in the field of radioactive waste management, such as R&D programmes, safety assessments, specific regulations, etc.
6. To propose to the Steering Committee for Nuclear Energy:
 - a programme of work of general interest in this field, including medium and long-term priorities as appropriate, for implementation within the available NEA Secretariat resources, such as various types of studies in the relevant technical areas.
 - specific initiatives for implementation by a number of interested countries contributing resources for that purpose, such as the setting up of joint R & D projects, or the development of data bases.

In the fulfilment of its responsibilities, the RWMC will interact with relevant NEA Committees, OECD directorates, scientific bodies, and international organisations.