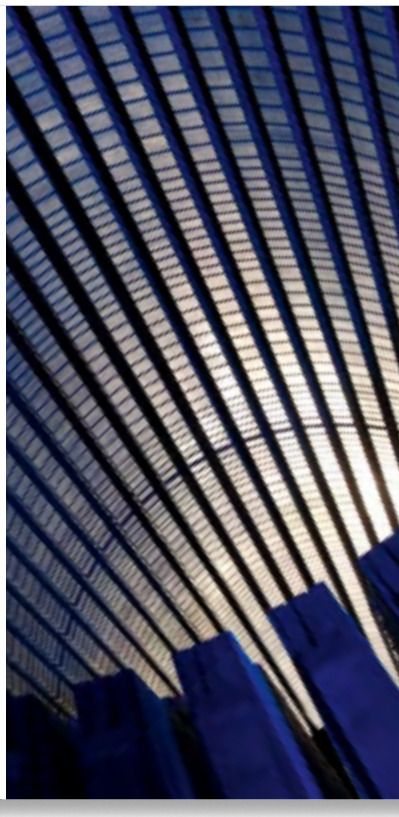
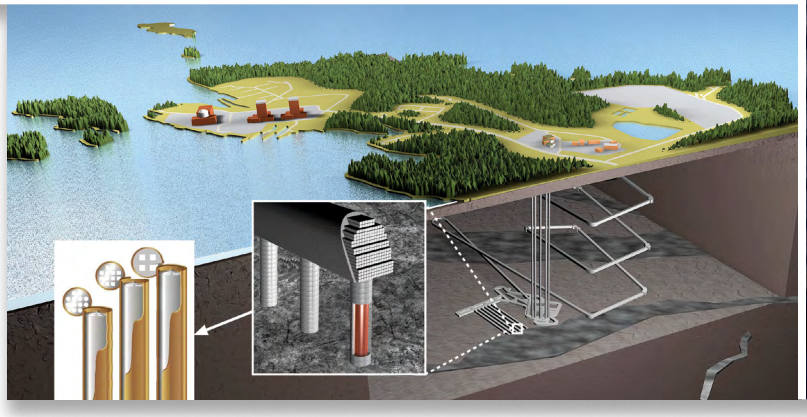
Radioactive Waste Management
2020

International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel

Summary Report



Message on international co-operation from high-level government representatives

OECD
BETTER POLICIES FOR BETTER LIVES

NEA
NUCLEAR ENERGY AGENCY

International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel

Summary Report

Message on international co-operation from high-level government representatives

NEA No. 7529

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of 37 democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, Colombia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Korea, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

This work is published on the responsibility of the Secretary-General of the OECD.

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1 February 1958. Current NEA membership consists of 33 countries: Argentina, Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Poland, Portugal, Korea, Romania, Russia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission and the International Atomic Energy Agency also take part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international cooperation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes;
- 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 analyses in areas such as energy and the sustainable development of low-carbon economies.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management and decommissioning, 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.

Cover photos: Ikata Nuclear Power Plant, Japan (Creative Commons); Stakeholder (Shutterstock, SFIO CRACHO); The Onkalo spent nuclear fuel repository (Posiva, Finland).

Foreword

The Nuclear Energy Agency (NEA) is the only intergovernmental body that brings together experts from the countries with the deepest experience and capabilities in the broad range of civil nuclear energy technology and policy issues from the Americas, Europe and the Asia-Pacific to achieve common understanding, positions and projects to advance the state of the art in the application of nuclear energy technologies. The United States Department of Energy and the Ministry of Economy, Trade and Industry of Japan provide leadership in their countries for planning, developing and implementing respective national policies on the supply, trade and consumption of energy including nuclear energy.

Senior-level representatives from these three organisations jointly organised international roundtable discussions on the final disposal of high-level radioactive waste and spent fuel, with the participation of 15 countries and the International Atomic Energy Agency, during 2019 and 2020. The objectives of the discussions were to: 1) strengthen international co-operation to advance the development of disposal solutions for high-level radioactive waste and spent nuclear fuel; 2) share experience and knowledge in developing and implementing final disposal policies for high-level radioactive waste and spent nuclear fuel; 3) facilitate potential bi- or multilateral collaborations through research and development activities or via staff exchange programmes.

It is hoped that these discussions will facilitate co-operation among countries in this context. Relevant organisations in all countries addressing nuclear waste are encouraged to take the results of these meetings into consideration.

Table of contents

List of abbreviations and acronyms

Andra	National Agency for Radioactive Waste Management, France
Äspö	SKB underground hard rock laboratory, Sweden
CDLM	Committee on Decommissioning of Nuclear Installations and Legacy Management, NEA
COVRA	Central Organisation for Radioactive Waste, Netherlands
DECOVALEX	Development of Coupled models and their Validation against Experiments
DGR	Deep geological repository
DOE	Department of Energy, United States
EC	European Commission
EU	European Union
EDRAM	International Association for Environmentally Safe Disposal of Radioactive Materials
EPA	Environmental Protection Agency, United States
ERDO	European Repository Development Organization
EURAD	European Joint Programme on Radioactive Waste Management
EURATOM	Euratom Supply Agency
FEPDB	Features, events and processes database, NEA
FEPS	Features, events and processes
FSC	Forum on Stakeholder Confidence, NEA
G20	Group of Twenty
GRIMSEL	Underground research laboratory in crystalline rock, Switzerland
HLW	High-level radioactive waste
IAEA	International Atomic Energy Agency
IFNEC	International Framework for Nuclear Energy Cooperation
IGSC	Integration Group for the Safety Case, NEA
INSAG	International Nuclear Safety Group
KAERI	Korea Atomic Energy Research Institute
KURT	KAERI Underground Research Tunnel
METI	Ministry of Economy, Trade and Industry, Japan
NDA	Nuclear Decommissioning Authority, United Kingdom
NEA	Nuclear Energy Agency
NEST	Nuclear Education Skills and Technology framework, NEA
NPP	Nuclear power plant
NRC	Nuclear Regulatory Commission, United States

NUMO	Nuclear Waste Management Organisation, Japan
NWMO	Nuclear Waste Management Organization, Canada
ONDRAF/NIRAS	Agency for Radioactive Waste and Enriched Fissile Materials, Belgium
OECD	Organisation for Economic Co-operation and Development
Posiva	Organisation responsible for the final disposal of spent nuclear fuel, Finland
R&D	Research and development
RD&D	Research, development and demonstration
RIDD	Expert Group on Building Constructive Dialogues between Regulators and Implementers in Developing Disposal Solutions for Radioactive Waste, NEA
Rosatom	State Atomic Energy Corporation, Russia
RWM	Radioactive Waste Management Limited, United Kingdom
RWMC	Radioactive Waste Management Committee, NEA
SKB	Nuclear Fuel and Waste Management Company, Sweden
SNF	Spent nuclear fuel
TDB	Thermochemical Database, NEA
URF	Underground research facility
URL	Underground research laboratory
V&V	Verification and validation

Executive summary

The growing inventories of high-level radioactive waste (HLW) and spent nuclear fuel (SNF) in many countries has led to a need to expand storage and to continue efforts to develop disposal solutions. Government officials of countries pursuing disposal solutions regard international co-operation to be of high value when finding efficient and effective ways to enhance public acceptance and design state-of-the-art technological solutions for achieving final disposal repositories.

In June 2019, during the G20 Ministerial Meeting on Energy Transitions and the Global Environment for Sustainable Growth in Karuizawa, Japan, the Minister of Economy, Trade and Industry (METI) of Japan, the Deputy Secretary of the United States Department of Energy (DOE) and the Director-General of the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA), joined by the governments of Canada, Finland, France and the Russian Federation, announced the launch of an International Roundtable on final disposal of high-level radioactive waste and spent fuel (when regarded as waste). In total, representatives of 15 countries, the NEA and the International Atomic Energy Agency (IAEA) participated in the two roundtable discussion sessions, the first one being held on 14 October 2019 and the second on 7 February 2020.

This report collects key findings and policy messages from these roundtable discussions about the role of governments and how to strengthen international co-operation for stakeholder and public engagement and technological collaboration, as well as the major findings stemming from the policy experiences shared by the participating countries.

The first roundtable was conducted over three separate sessions. Each session began with discussions of a general nature, followed by a more detailed set of discussion points. Senior government officials from participating countries discussed the role of government, stakeholder engagement (public confidence), and technological capabilities. In the second International Roundtable participants discussed government policies, approaches and methodologies adopted by the relevant radioactive waste management organisations and therefore considered as best practices and lessons learnt from their experiences to date. The practices and lessons learnt encompassed those addressed and implemented by policymakers and regulators as well as radioactive waste management organisations. The general topics addressed during the second roundtable included: i) lessons learnt with regard to stakeholder engagement, including policy frameworks and governmental strategies; and ii) new proposals for international technological collaboration and the identification of areas where existing international collaborations could be strengthened.

During both sessions of the roundtable, senior government officials and attending representatives of implementing organisations in charge of radioactive waste management agreed on the importance of sharing experiences on national and international policies and enhancing international co-operation.

Key messages

The key messages associated with decision-making processes that are “core” to a successful deep geological repository (DGR) project that emerged from the roundtable discussions were as follows:

- A stepwise, adaptive and fully transparent decision-making process that involves key stakeholders, including implementers, regulators and the general public is effective. Beginning at the outset of the national programme, step-by-step implementation builds confidence in a DGR project and increases the probability of success. Engagement with stakeholders should be recognised as a long-term process that occurs continually throughout the decision-making process and lifecycle of a DGR.

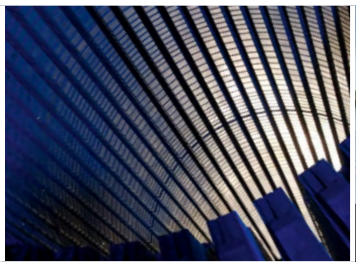
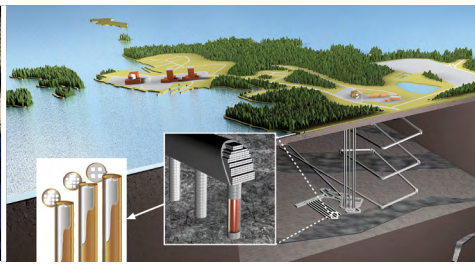
- According to their national policies, some countries have industry-led approaches, others have government-led approaches, but the approach an organisation takes does not matter as much as long as the process used involves the public and all other stakeholders effectively.
- Stakeholders' trust and confidence in the local DGR project increases when they can see that other countries are approaching the solution to HLW and SNF disposal in the same way as the local project. It is good practice for the international community to support countries during the advancement of the process.
- While financial support for the host community can be important, it is not deemed to be a primary factor in gaining confidence in and assuring the final success of a DGR. There needs to be an "added-value" aspect. The support plan needs to indicate benefits of a DGR project over the long term to the host community. Affected communities and local governments are more inclined to accept support if it is aligned with regional economic development, improvement of the overall well-being of the community or educational support, for example. There are cases, for example in Finland, where countries are able to make positive progress with a support plan that does not include financial support.
- Involving younger stakeholders in the decision-making processes is not only imperative, as they will inherit the project in the future, but also effective. Engaging with young stakeholders may require new and innovative communication approaches. Social media and use of video, for example, helps to establish and maintain dialogue with younger stakeholders.
- Clear communication about safety using the safety case can be a challenge for a regulatory body and for the radioactive waste management organisations (RWMOs). If communication is unclear, even academic experts may challenge the concepts of the repository and the associated safety case. Communication and dialogue should be explored with a wide range of scientists and experts, including those outside of the domain of nuclear science and engineering. In order to bolster public confidence in the safety of a DGR, it is important to make an effort to ensure confidence in the safety case.

The roundtable participants recognised the value of international collaboration to maintain and strengthen the technological capabilities in the management of HLW and SNF disposal programmes. Collaboration in the development of technological capabilities can also have a positive influence on improving confidence in stakeholders.

- There has been a history of successful international collaboration on technical aspects of DGRs since the 1980s. Participation of both the present and next generations in such programmes should be encouraged. Examples of those programmes are: the international research project Development of Coupled Models and their Validation against Experiments (DECOVALEX); or the Clay, Crystalline and Salt Clubs of the NEA for developing and exchanging scientific information. The Integration Group for the Safety Case (IGSC) of the NEA assists countries in the development of effective safety cases supported by a robust scientific technical basis. The IAEA organises various DGR-related projects, for example the Underground Research Facilities Network for Geological Disposal – URF Network. European countries have also established international co-operation projects such as the Implementing Geological Disposal of radioactive waste Technology Platform (IGD-TP) and Engineering Studies and Demonstrations of Repository Designs (ESDRED) to support their radioactive waste management programmes. Many other international projects are undertaken through the European Commission, IAEA and NEA mechanisms.
- Financial and human resources for R&D related to DGR development can always benefit from wider exchange within the international community. International collaboration on technical aspects, utilising facilities and research in other countries, is a cost-effective way to further strengthen the technical understanding for DGR programmes. Some countries are actively participating in and collaborating on international R&D programmes under bilateral or multilateral frameworks.
- Underground research facilities made available in other countries are invaluable resources, especially for those countries in early stages of the DGR decision-making process that have not yet identified a host rock environment, for example. Developing those resources domestically involves a substantial investment, and both the timing (i.e. whether in the siting or licensing phase) and configuration (i.e. as a separate facility or one integrated with the intended DGR) of a URL should be carefully assessed.
- An additional benefit of international collaboration is being able to demonstrate to stakeholders that the efforts undertaken locally (on safety assessment, risk communication and dialogue with stakeholders) are similar to those being undertaken worldwide. This approach has been proven to be effective through groups such as the NEA Forum on Stakeholder Confidence (FSC).

1. Introduction



Development of disposal solutions for high level waste (HLW) and spent nuclear fuel (SNF) is a growing priority in many countries and, after decades of research, disposal in a deep geological repository (DGR) has gained global acceptance as a scientifically and technically credible long-term solution capable of meeting internationally agreed safety criteria. While some specific technical and scientific problems still remain to be solved, the major challenge for developing a DGR is the establishment of societal support and public confidence in the selection of sites and the design of disposal facility tailored to the selected sites. This is country specific. Some countries have made considerable progress towards implementation, for example: Canada, Finland, France, Sweden and Switzerland, but others are finding societal acceptance to be a significant barrier.

The International Roundtable was established to offer a forum for international co-operation through sharing experiences and lessons learnt in developing best practices for enhancing public acceptability of disposal solutions, which has been found to be effective in supporting national efforts. The objectives of the roundtable discussions were to:

- Strengthen international co-operation, to advance the development of disposal solutions for high-level radioactive waste and spent nuclear fuel.
- Share experience and knowledge in developing and implementing final disposal policy for high-level radioactive waste and spent nuclear fuel.
- Facilitate potential bi- or multilateral collaborations among interested countries through research and development activities or via staff exchange programmes.

The first roundtable was held on 14 October 2019 and the second roundtable was held on 7 February 2020. This report summarises the results of both roundtable discussions and aims to compile the country-specific best practices and strategies identified by participating countries that could advance radioactive waste disposal solutions. The agendas of both meetings are reproduced in Annexes A and B.

Standard containers for high-level (right) and medium-level (left) waste at the Meuse and Haute-Marne underground research laboratory in Bure.

1.1 General principles

General principles put forth by the organisations responsible for the roundtable discussions include:

- The present generation which have benefitted from nuclear power should take responsibility for ensuring the sustainability of the use of nuclear technologies. This generation should establish tenable processes for the management of waste and a policy framework to address the challenge of its disposal. The disposal programme, including knowledge and funding, should be actively managed until the closure of the repository.
- Deep geological disposal is widely accepted as a technically sound method for providing long-term safety, as the appropriate combination of engineered barriers, concept of operations and site properties can offer the potential for isolation and containment of radionuclides for as long as the waste presents a potential hazard.[1] Many studies over the decades have evaluated various disposal options internationally, and in many countries deep geological disposal remains both technically and economically feasible and thus is internationally recognised as the appropriate disposal solution for HLW and SNF. This approach is the culmination of decades of R&D of technologies and techniques.
- All participating countries recognise that the path towards achieving implementation of final disposal depends on country-specific factors, such as the geological environment and societal aspects.
- Waste minimisation and reduction of the radiotoxicity of the wastes, including reducing the overall volume of HLW to be disposed of, are principles endorsed worldwide.
- One of the most important factors in successfully implementing DGRs is stakeholder confidence, for which it is essential to ensure the long-term safety of geologic repositories. In many countries, public safety concerns and societal opposition to repository projects are, in large part, related to the extremely long timescale – or rather to the apparent difficulty of conveying a sense of confidence that risk assessments can be conducted, and protection goals can be verified for such long timescales. Such experience shows that robust decision making to develop geological repositories should be based on stakeholder confidence and requires an open and transparent approach that involves stakeholders.

1 For example; National Research Council (1957), *The Disposal of Radioactive Waste on Land;* and Committee on Radioactive Waste Management (2006), *Managing our Radioactive Waste Safely.*

- International frameworks that promote and assess the safety and security of radioactive waste management activities including geological disposal are helpful in addressing stakeholder concerns.
- As the timescales for the development and implementation of a repository are long, involving the younger generation and ensuring knowledge transfer between generations are both important so that the DGR projects can be implemented sustainably.
- International policy co-operation can contribute to national radioactive waste management solutions. Geological repository programmes in different countries encounter comparable challenges. Collaborations create opportunities to share available resources and provide significant benefit and efficiency to individual research programmes and studies.
- Global co-operation in the scientific and technical fields has already been well established among both countries that have made significant progress and countries that have encountered challenges and setbacks. International dialogue at the strategic and policy levels have also been facilitated by sharing policy approaches and experiences in each country. Such co-operation enables senior policy makers to cope with issues based on shared views across countries.

The International Roundtable sessions discussed the importance of strengthening international co-operation in the area of final disposal of radioactive waste.

- Since geological disposal is a common challenge for countries utilising nuclear power, regardless of the nuclear policy in each country, it is the responsibility of policy makers to provide a framework within which the successive phases and associated decisions towards final disposal of radioactive waste can be carried out. As the implementation of a DGR project requires several decades or more, strengthening and facilitating long-term international collaborations between governments can be important in advancing plans for disposal.
- There is general agreement that the socio-economic issue of radioactive waste disposal needs to be promptly considered, without detracting efforts from technical development and progress. Confidence in the reliability of DGRs is well established in the technical community by virtue of the research and development performed in past decades; however, this same confidence is not widely held by public stakeholders. Further engagement with stakeholders could be undertaken to address concerns and develop societal confidence. This is a scenario where government could take initiative.

1.2 The role of government

During the first session of the first International Roundtable, participants were invited to discuss fundamental ideas regarding international co-operation on final disposal, along with the following discussion point:

What is the basic role of government, specifically concerning its role in facilitating bi- or multilateral collaborations?

Primary role of government

Participants pointed out that the primary roles of government in DGR development, as well as in relation to other aspects associated with nuclear programmes in general, should include:[2]

- defining clear radioactive waste management policies that establish the required waste management institutions and set standards for compliance and enforcement;
- promulgating legislation to establish an independent regulatory authority with the required competency;

2 These elements are reflected in IAEA Nuclear Energy Series No. NW-G-1.1, *Policies and Strategies for Radioactive Waste Management,* and IAEA Safety Standard Series SF-1, *Fundamental Safety Principles.*

- ensuring that there is a clear allocation of responsibilities within the national waste management system, in particular among government, regulators and implementers;
- making certain that the national policy defines strategy for ensuring and demonstrating safety, providing the necessary financial provisions and allowing for programme development;
- confirming that arrangements are in place for the development of the required competencies in all organisations with responsibilities related to geological disposal;
- promoting transparency at all stages of HLW and SNF management;
- supporting research development and demonstration (RD&D) aimed to improve the safety of disposal, including international projects on partitioning and transmutation technologies to decrease the volume and long-term radiotoxicity of HLW to be disposed of.

While the development of a DGR requires scientific and engineering competence, socio-political aspects are key factors in determining the success of the development and implementation of a DGR. The roundtable participants agreed that government, regardless of the country, plays important roles not only in identifying legal, safety, security compliance and technical issues to be addressed, but also in promoting communication and engagement with stakeholders and in supporting the corresponding RD&D programmes. Governmental roles (or government's rules for RWM implementing organisations) identified by the roundtable participants include:

- in the early stages of the site selection process, and possibly even during the development of a national policy and strategy on DGR, the nuclear regulatory agency as well as the implementing agency should be actively involved in dialogue with the public and local communities to enhance public confidence in a DGR;
- government should provide a framework to encourage the regulatory body to actively participate in the dialogue;
- government or bodies designated by government to deliver geological disposal should build and maintain interactions with the public and local communities where radioactive waste management facilities are being developed;
- a primary factor for the government support in international co-operation is to ensure adequate funding and appropriate human resources to conduct the collaboration activities;
- government should recognise the value of international co-operation as it contributes to the development of an internationally common framework useful for the national programme.

Other aspects and considerations related to the role of government

The following are other viewpoints and issues relevant to the role of government that were brought forth by the participants.

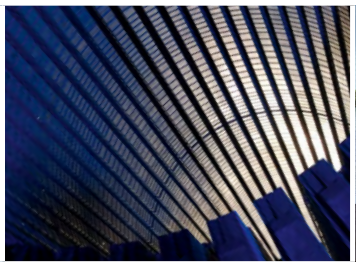
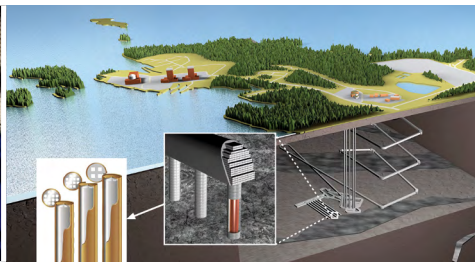
- "The polluter pays principle" is the basis for the financing of radioactive waste disposal in most countries.
- The challenge of HLW and SNF is that the implementation of disposal is passed on to successive generations and not only dealt with by the generations that benefited from the technologies. The message "the generation that realised the benefits must therefore deal with it" may lose credibility, particularly with younger stakeholders who say, *"Well, since it's 60 years since nuclear technology was established, it's clear that the generation that benefited from it has not dealt with the waste."*
- International co-operation is of great importance to exchange both ideas and best practices as well as to convey the message in particular to local stakeholders that other countries are also developing DGRs and that, even though solutions are tailored to the specific national context, there is a general consensus on what to do and how to do it. This thereby informs local stakeholders that they are not alone in the development of DGR (see NEA, 2015).

- There are currently many well-established international collaboration and co-operation activities focused on the technical R&D for DGR. However, since societal issues have at least just as much, if not more, influence on the success of radioactive waste management programmes, similar collaborations could be sought for addressing socio-political issues, including stakeholder matters, stakeholder engagement and communication. In fact, there have been numerous delays and cancellations in the development of radioactive waste management facilities due not to technical problems, but to societal issues.
- Transparency and flexibility are identified as key elements in sustainable radioactive waste management. These elements must be in place from the very beginning and maintained all the way through final implementation. It is very important not only to describe the step-by-step procedures of HLW and SNF management, but also to demonstrate a high-level of safety at every step, including post-closure safety assessments, so that stakeholders have confidence that the disposal facility is safe.
- There are some innovative and progressive approaches being investigated that might considerably simplify or change the challenges in HLW and SNF disposal. Fast neutron reactors are an example of such potential innovations. By HLW partitioning and subsequent transmutation of the minor actinides the lifetime of HLW radiotoxicity could be decreased from 250 to 300 years, and the gross volume of the HLW to be disposed of could be decreased drastically. Governments developing fast neutron reactors and implementing the research could demonstrate the benefits of such technology to DGR through international co-operation.

Dry storage containers are made of reinforced high-density concrete.
Nuclear Waste Management Organization (NWMO), Canada

2. International co-operation and stakeholder engagement in radioactive waste management



The Nuclear Energy Agency (NEA), the International Atomic Energy Agency (IAEA) and European Commission (EC) have been conducting and have completed various activities addressing different aspects of stakeholder involvement. Overall, there is widespread reporting of lessons learnt from both successes and failures in communicating technical information with diverse audiences based on the experiences in individual countries. While certain areas where more research is needed have been identified (e.g. training in risk communication, public outreach techniques and the use of new tools such as social media), there is a need to keep the discussion of what constitutes - and how to establish - an effective dialogue. The NEA Radioactive Waste Management Committee (RWMC) created the Forum on Stakeholder Confidence (FSC) in 2000 (which has conducted national stakeholder workshops in ten countries since its establishment) and recently launched a new two-year initiative, the Expert Group on Building Constructive Dialogues between Regulators and Implementers in Developing Disposal Solutions for Radioactive Waste (RIDD), to further investigate the key elements needed for effective regulator-implementer dialogue when developing geological disposal. More information on the relevant international activities is described in the NEA publications on stakeholder involvement (NEA, 2017a).

2.1 Current activities of international co-operation in radioactive waste management and stakeholder engagement

Overview presentations on relevant activities in international co-operation for developing DGRs were given in the first International Roundtable. The presentations provided the participants of the International Roundtable with up-to-date status of the activities, namely, activities of the NEA's Radioactive Waste Management Committee (RWMC), activities of the International Atomic Energy Agency (IAEA), and activities of the Forum on Stakeholder Confidence (FSC), which works under the auspices of RWMC and the Committee on Decommissioning of Nuclear Installation and Legacy Management (CDLM).

RWMC

The chairperson of the RWMC gave the overview presentation.

The RWMC consists of representatives of 33 NEA member countries as well as the European Commission, the IAEA is an observer. The RWMC provides a neutral forum where policymakers, regulators and implementing organisations can discuss issues of common interest and develop best practices and feasible solutions that meet the diverse needs of its participants. The results of activities are summarised and published in a large number of strategic and technical documents.

The RWMC aims to develop sustainable management of radioactive waste including DGR by application of a holistic approach, integrating three aspects of sustainability - environmental, economic and societal.

Societal issues are addressed through the FSC activities. Responding to the issues of environmental safety aspects, the RWMC implements activities done by task groups of experts relevant to the areas as follows: pre-disposal management of radioactive waste, characterisation of unconventional and legacy waste, dialogue between the regulator and the implementer, safety cases of geological disposal, robotics and remote systems for the back-end of nuclear fuel cycle, long-term management of information, data and knowledge relevant to radioactive waste management.

In addressing economic aspects, RWMC collaborates with the NEA's Committee for Technical and Economic Studies on Nuclear Energy Development and the Fuel Cycle (NDC), which includes discussion on economic factors of geological disposal.

Significant progress has been made in DGR development in many countries, including Finland, Sweden, France and Canada. The international dialogue through the RWMC at the strategic and policy level can foster the development and implementation of the HLW and SNF management policies and enhance regulatory oversight while managing radioactive waste in a holistic manner.

IAEA

The Director for the Division of Nuclear Fuel Cycle and Waste Technology, Department of Nuclear Energy, IAEA, gave the overview presentation covering IAEA activities. A following presentation with more details was delivered during the second roundtable by IAEA Waste Disposal Specialist from the Division of Nuclear Fuel Cycle and Waste Technology.

The IAEA has multiple means of action, including publications, Co-ordinated Research Projects, Technical Co-operation projects, workshops/technical meetings, peer reviews, e-tools, benchmarking and inventory systems.

- Relevant IAEA publications on stakeholder involvement in radioactive waste management are in several categories of IAEA publication series, including INSAG reports, Safety Standard Series, Nuclear Energy Series and TECDOCs.[1] Also, IAEA Safety Standards and Nuclear Energy Series publications cover other areas of radioactive waste management outside of stakeholder involvement.
- The IAEA provides supporting tools, such as the nuclear communicator's toolbox, webinar series, E-learning modules and training workshops, on stakeholder involvement. It also plans to provide additional E-learning modules and training workshops, which are specifically applicable to stakeholder involvement in radioactive waste management.

FSC

The NEA's FSC is a platform to share and build knowledge about stakeholder confidence in radioactive waste management. The FSC is a learning organisation involved in not only sharing of successes but also lessons learnt in member countries.

1 Relevant IAEA publications on this topic are noted in the references at the end of this chapter.

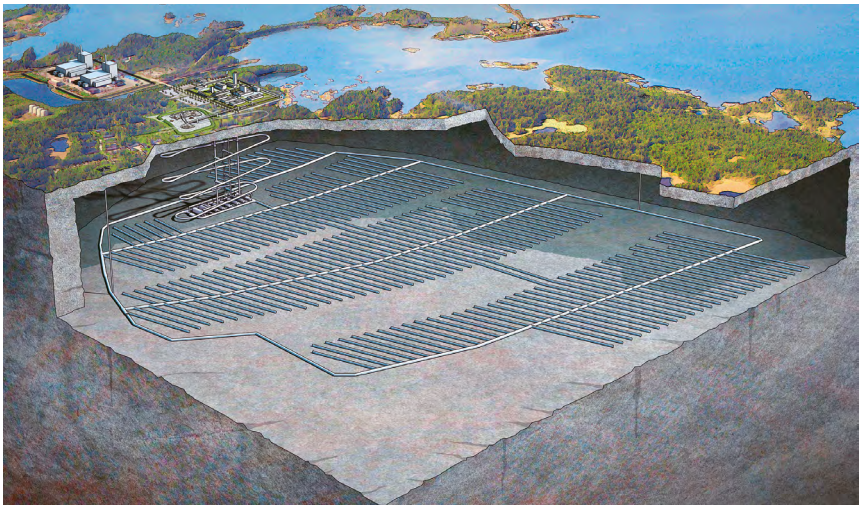
- The FSC has defined a stakeholder as any institution, group or individual who has an interest or role to play in the radioactive waste management processes.
- Transparency in all communications is necessary for successful stakeholder engagement. A clear definition of processes involved is inevitable for effective stakeholder communications as well as a step-by-step approach to decision making.
- Sustainability cannot be ensured solely through financial compensation and development opportunities. Effective and trusted dialogue is necessary to maintain sustainability. An added-value is preferred to simple financial compensation. Added values are what benefits and opportunities are likely to occur for the stakeholders of a radioactive waste management process, and what long-term value will be realised.

2.2 Challenges

Experiences in different countries demonstrate that one of the greatest challenges to realising final disposal of high-level radioactive waste and spent nuclear fuel is securing public support and confidence. The common challenges and issues which need to be addressed in engaging stakeholders around final disposal include:

- **Fairness/acceptance of siting process** – public concerns about the siting of a repository are primarily grounded in distrust of institutions charged with risk management and in equity; for example, the distribution of risks and benefits among those affected by the DGR project. It is essential when siting a DGR to make decisions in a societally acceptable way, leading to an equity in the process.
- **Provision of the information for informed decision making** – While many members of the public may not be ready to decide on implementing a DGR, the technical community may be concurrently attempting to present technical data to build confidence in the repository's long-term safety. Despite regulatory requirements in some countries for the waste to be made retrievable, many members of the public are simply not ready to commit to a decision on a final disposal facility. Promoting dialogue and stakeholder engagement with the provision of required information is needed to enable the decision making by the stakeholders.
- **Development of a shared vision** – the communities affected by DGR projects often report that some of their concerns or interests are not properly addressed. Conflicting values, possibly because of incompatible beliefs and interests that exist among various stakeholders (e.g. the technical community, the affected local communities and the general public) may cause difficulties in reaching consensus. The conflict between the ethical aims of minimising burdens on future generations and maximising their freedom of choice remains unsettled in many communities.
- **Public perceptions of risk** – Conventional safety analysis of a repository for radioactive waste is essential but it should be recognised that it cannot fully cover the public's broad spectrum of concerns, such as local economic impacts by constructing a repository.
- **Confidence in government institutions, safety authorities and waste management organisations** – a DGR project should be achieved based on the national policies and the confidence in technical departments of different organisations when demonstrating and assessing technical solutions and safety principles.
- **Knowledge management and knowledge transfer** – the development of a DGR is a first-of-a kind project in a country and the related information, data and knowledge to the project should be carefully managed. The extended duration of national programmes (often measured in decades and sometimes over one hundred years) inevitably needs knowledge transfer across the generations, preserving the increasing volume of interrelated information, data and knowledge to be produced during the programme implementation stage and even after the closure of the repository.
- **Promotion of communication with local community** – Each community has its own history, culture and values which may be different from those of policy makers, regulators and operators. These factors should be recognised in communications.

Deep geological repository site in Oskarshamn.
SKB, Sweden



- **Assuring long-term safety of a DGR** – Given that there are limited DGRs in operation, data is limited related to post closure, including long-term monitoring, maintaining and licensing of DGR after its closure. For the most fully developed programmes (Posiva, Finland), there is a long-term safety case with natural analogies presented and available. For many others, developers have created predictive models based on the best available scientific information. Ultimately, for any DGR project to proceed, both the long-term safety case and the post-closure monitoring plan must provide detailed, up-to-date information to support the operating license.

2.3 Consensus in the international community

Experience shows that public confidence and acceptance can be achieved via an approach driven by dialogue where decisions are made in collaboration with affected and interested stakeholders from a project's very outset (NEA, 2017b). NEA research of a combination of a "safe and licensable site" and a sound "waste management concept" can assure safety and, it is hoped, gain host community support (NEA, 2012). Robust decision making should be clear, open, transparent, participatory, flexible, adaptive and close to the local community based on understanding the merits (and objectives) of the project.

- **Geological disposal is scientifically and technically sound** – A broad consensus in the scientific and technical community is that the knowledge base is sufficient for site selection and implementing disposal; the biggest challenges are societal in nature. Some countries (e.g. Canada, Finland, Russia, and Sweden) have implemented a stepwise approach with an emphasis on proceeding at a rate with which the community is comfortable.
- **Confidence-building measures could improve acceptance** – Differences in people's views, especially in the case of radioactive waste disposal, often arise around demonstrating the long-term safety of a repository. In light of this, experience has shown that scientific work with more confidence-building measures such as formalised quality assurance, full-scale demonstration, transparent documentation, independent peer reviews, as well as a clear process to enable open discussion among all involved parties, can be effective in enhancing confidence.
- **Consideration of alternatives is important** – Many countries have observed that discussing scientifically sound and objectively balanced alternatives as well as options for geological disposal with stakeholders can help reduce bias and better understand the credibility of the geological disposal. It is necessary to ensure that stakeholders have adequate information to understand the background for why geological disposal has been selected by technical experts as a credible solution. This is identified as an international best practice.
- **Openness and transparency are vital** – All responsible actors (governments, implementers and regulators) should ensure the public has access to as much safety related information as practical. This approach can enhance the trust of the public in both the government and the project itself.

- **Wide participation in the siting process is important** – The dialogue should be open to all types of stakeholders, regardless of their age, profession and opinion, and material should be prepared to enable a wide range of stakeholders to engage in the debate in a meaningful way. Engagement with the younger generation is very important. The values, principles and objectives of citizens should be respected at every stage. This process should start as early as possible, even before the concept development of disposal facilities.
- **The disposal programme should present flexibility** – The siting, construction, operation and closure of deep geological repositories may last from several decades to over a hundred years. The disposal programme, including construction, operating and licensing, should be flexible enough to allow alternative options to the public and future generations. The flexibility may take into account features such as the possible retrievability of the emplaced waste when new knowledge and technologies become available. The design of disposal facilities should consider how best to address concerns raised by the public.
- **Communication should be adaptive to the specific needs of the audience** – Members of the general public have different cultures, educational levels, work experience, interests, needs, risk perceptions and fears. It is necessary to design different activities and use different tools for different audiences. Communication experts should be involved in this process to facilitate effective communication, a detail that was highlighted during discussions at the NEA Stakeholder Involvement Workshop (NEA, 2017a). The disposal concept, safety arguments, risks and uncertainties should be conveyed in plain language. The public should be empowered with resources and funding to learn about the projects. Face-to-face interaction and effective listening are very important (NEA, 2017a). Creative storytelling skills, new technologies (such as Virtual Reality) and new media can be used to facilitate public dialogue.
- **Each programme must be designed to consider local community specificities** – Each community has unique dimensions: administrative character, location, mode of government, history and shared economic and cultural practices and values, among others. Each community member's sense of belonging may be linked to a perception of the "spirit of the place" and identifying with the group established there. Local community should also be understood as the extension of each member's personal sphere (NEA, 2013a: 19).

2.4 Tried and tested practices and lessons learnt from participating countries

During the first International Roundtable, the participants discussed how international co-operation in public engagement could be conducted based on the experiences in building public confidence within each country. They shared interests and possibilities for contribution towards international co-operation while answering the following questions as a basis for discussion:

I. In decision making during the siting process, what should a government clarify and implement to deepen understanding of public concerns?

II. How to resolve/manage conflicts through public dialogue?

III. Regarding public acceptance of final disposal, what should governments do in the future?

Each country representative was called upon to provide input to the discussion.

During the second International Roundtable, participating countries shared their policies and methodologies regarded as tried and tested practices and lessons learnt from their experiences. Each participating country was invited to make a brief presentation on tried and tested practices and lessons learnt, focused on the following points:

I. Current policies and methodologies for stakeholder engagement, which call for transparency, participative and evaluation measures in developing final geological disposal for radioactive waste and spent nuclear fuel.

II. Policy framework for the development of local communities (local economic development).

III. Government strategies to co-ordinate stakeholder engagement mechanisms and management capacity in achieving an effective regulatory framework.

The following is the summary of the information shared on interests, possibilities, tried and tested practices and lessons learnt captured from both roundtable discussions.

2.4.1 Governmental policy framework

A general consensus from roundtable participants was that a key role of the government was to facilitate and promote clarification in the processes needed for a DGR programme and ensure implementation of these processes as the project moves forth. Specific areas identified by participants include the following:

- Countries need to put forth a formal plan for how a site selection process is to proceed; however, these formal plans must be flexible and adaptive to issues raised by stakeholders and/or changes in technologies over time. Therefore, the plan should stipulate the main principles of the process and avoid being too prescriptive.
- In many countries, government is the driving force in the DGR programme. Others have implementing bodies playing key roles. The functions of the driving force are as follows.
  - to ensure concerted action;
  - to promote flexibility and rework issues within guidelines provided by the law;
  - to promote predictability and clarity in decision making;
  - to rework and commit to issues as early in the process as possible;
  - to innovate in public engagements by seeking to reach people instead of waiting for people to reach out to the government;
  - to facilitate public access to information both in terms of information available and dissemination of information so as to make it accessible to all;
  - to provide information on alternative solutions and explain as necessary why they cannot be used as an acceptable management solution for HLW and SNF instead of a geological disposal approach.

Conflict management and resolution through public dialogue was discussed and the following items were identified as requiring attention.

- Transparency, honesty and openness are required to build trust with stakeholders.
- National DGR projects benefit from international co-operation by learning about what has and has not worked elsewhere, and by including stakeholders in this learning.
- Stakeholder trust and confidence in a national DGR project increases when they can see that other countries are approaching the solution to HLW and SNF disposal in a manner comparable to the local project. Because countries may experience common challenges in achieving the same goal, progress in one country can empower confidence in others.
- A stepwise approach should be taken and involve realistic and manageable phases, each of which is marked by explicit points of decision making. This allows for flexibility and adaptability in the pace and manner of implementation and fosters the sustained engagement of people and communities throughout implementation. An example of such approach is being undertaken in Canada in the form of Adaptive Phased Management (APM). A fundamental tenet of APM is the incorporation of new knowledge. The process aims to adapt plans in response to advances in technical learning, international best practices, ongoing inputs from the public, insight from Aboriginal Traditional Knowledge, changes in public policy, and evolving societal expectations and values.
- Nationwide educational activities can be conducted to improve public understanding of DGR projects. These activities can be coupled with additional efforts to provide more detailed information to specific interested parties. Examples of countries using this approach are Canada, Japan and the United Kingdom.

High Level Radioactive Storage and Treatment Building.

HABOG COVRA, Netherlands

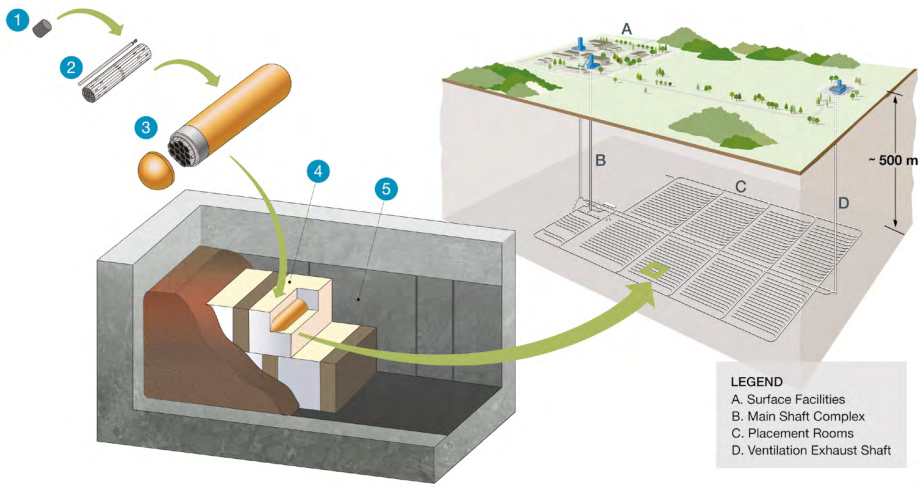
- When developing strategies for conflict management and resolution, three main groups of public attitudes towards a proposed disposal facility should be considered:
  - the first group is represented by people who are opposed to believing whatever information is shared with them;
  - the second group is represented by those who want to better understand the benefits they stand to receive by having a DGR built on their land; and
  - the third group is usually represented by a small number of people who are ready to engage in discussions about the security and safety of the proposed disposal facility.

2.4.2 Public engagement

One focus of the roundtable discussions was engagement with stakeholders and the general public in matters related to a proposed DGR project. Key aspects of such engagement were provided by the participants and include:

- Some countries take industry-led approaches, while others apply government-led approaches. Regardless of the approach, the success of the project depends upon the processes used to involve stakeholders.
- A major lesson learnt is that stakeholders need to be engaged from the very beginning and time needs to be taken to inform the host communities. It may be worth noting that several countries highlighted failures in their initial programmes because they had not adequately engaged with stakeholders.
- Younger stakeholders more actively understand the effects of new media such as social media. Therefore, early involvement of the younger generation utilising these new media more effectively provides opportunities for engagement through workshops, outreach activities and other traditional and non-traditional methods.
- Partnership development with communities may help to get the community buy-in at a much more significant and complete level. However, these partnership development activities take time and continued efforts to become successful. Establishing a structured partnership through formal agreements of co-operation might be one such way to carry out effective dialogue with communities; Canada, for example, has implemented 30 nuclear co-operation agreements covering 48 counties.
- RWMOs demonstrate commitment and sincerity in managing radioactive waste, recognising that without sincerity any form of participation may be purposeless. Being sincere is being transparent and attempting to understand underlying opinions, failures and motives.

- Although geological disposal has been widely accepted by technical experts as a credible, long-term solution, there are cases where stakeholders believe the decision has already been made without them and that other alternatives have not been adequately considered or addressed. It is therefore necessary to ensure that stakeholders understand the background for selecting geological disposal and that the implementers remain empathetic with those stakeholders' concerns.
- In order to help the public understand siting decisions, national maps of geological conditions and their distribution that are used to aid public understanding or decision making for safe geological disposal can serve as a visual aid. Japan, Sweden and the United Kingdom have published such maps, for example.
- It should be ensured that citizens have access to information that comprehensively communicates safety and details on the technologies involving DGRs. They should also be able to participate in public hearings at every stage of the process.
- Stakeholders should have an opportunity to initiate independent environmental assessments of the project.
- One recommendation is to consider building facilities that will liaise with stakeholders and the expert community. For example, Canada uses Community Offices where a centre for expertise is a key part of the project once the NWMO selects a site. Another recommendation is to establish an information centre or a visitor centre, as a means of sharing information with stakeholders.
- Establishing focus groups and panels with citizens, experts and local communities working separately at the initial stages should be considered as part of the design process for identifying a potential site. For example, Canada performs a three-year dialogue with both specialists and the general public on the long-term management of spent fuel, APM, etc.
- An implementer might find it beneficial to continually employ engineers, researchers and experts from local communities, who can quickly and effectively deliver necessary information about the geological disposal to the local public.
- Initiatives could be undertaken to present a new image of radioactive waste to the public, that is to say to present radioactive waste as less eerie and more acceptable. For example, the Netherlands opened facilities of interim storage of radioactive waste for general visitors to be able to walk around inside the site and even in the buildings. Through preserving tapestries hanging on walls inside the storage building, and painting the outer walls of the storage facility of HLW, the owner COVRA tries to reduce the eeriness of the radioactive waste and to appeal to the public with artistic approaches.



The five barriers to used nuclear fuel.

Nuclear Waste Management Organization (NWMO), Canada

2.4.3 Decision-making process

Specific to the decision-making processes, a number of tried and tested practices were identified including:

- implementing an adaptive stepwise process that involves stakeholders as a major key for success;
- maintaining ongoing environmental assessment procedures for public consultation;
- considering looking at decision-making processes associated with successful low- and intermediate-level waste disposal projects within the country as well as those elsewhere around the world;
- for some countries, making a final decision on whether to build a DGR will only be taken with the assent of the community, and communities should have the right to withdraw from the process at any point before public support is tested;
- underlining the importance of engaging with local government and politicians;
- establishing a process where local communities work in partnership with the implementing body throughout site selection and development and operation of the DGR;
- fostering RWM implementing organisations collaboration with international review groups, that help the organisation aligned with international practices and guidance. Many countries regard it worthwhile to receive international peer reviews and feedback for national and organisational approaches and policies. For research purposes, the URF network of the IAEA plays a role as a platform for sharing the practices and for developing and evaluating technologies implementing geological disposal.

2.4.4 Financial support for local economy development

Financial support for the host communities is applied in some countries. Any measures need to be tailored to the local social environment. The following practices were identified:

- Having clarity on what are the benefits is very important. This does not necessarily have to be solely about financial benefits. Although a number of countries put the financial aspects in the forefront of the conversation, most stakeholders seem to want to talk about other kinds of benefits.
- Avoiding any perception of "bribery" or compensation to less affluent communities.
- Including "added-value", which may include co-funding to enhance economic development of the region where the DGR is to be sited. For example, funding may be provided for multiple uses resulting in added-value being realised by the community such as:
  - community investment funding used to provide economic development opportunities or to improve the natural and built environment or to improve community well-being overall,
  - engagement funding, additional to investment funding, used to cover the cost of the community partnership activities and for outreach to the community to help learn about geological disposal and
  - significant investment, continued, ongoing funding provided to the community that hosts the DGR.
- Recognising that financial support is not the sole factor to ensure the sustainability of a DGR project, but instead is a component of an overall project plan.

2.4.5 Regulator's role and involvement

The regulator has an important role in DGR programmes. Tried and tested practices associated with the role of the nuclear safety regulator include:

- It is imperative to have a strong, independent and competent regulator.
- Regulators should establish access to independent, scientific and technical information and outsource expertise, if regulatory decisions refer to information of expert organisations. Regulators

also need to provide references to this information for the use by third parties, from the implementer to stakeholders and the general public.

- The regulator, from siting consideration and throughout all phases of the DGR project, should have frequent and in-depth dialogue with stakeholders and the public leading up to the statement of the government approval during every phase of a DGR project.

2.5 Pathways to progress

Role of government regarding public acceptance of final disposal

Based on shared information on tried and tested practices and lessons learnt associated with stakeholder and public acceptance, including both techniques that have and have not worked in the past the co-chairs of the roundtable discussions proposed the following considerations regarding the role of government in the development of waste dispoal facilities:

- Stakeholder involvement during all phases of a DGR project will facilitate common understanding and contribute to success of the project, assuming transparency, honesty and openness are ensured in the project development process.
- Establishing a successful DGR project takes considerable time, generally more than several decades from initiation of the project to the start of construction. Therefore partnerships between stakeholders, implementers and regulators must be well established, maintained and renewed as necessary.
- Recognising that all countries have common challenges and a common goal is important to governments and stakeholders. For this reason, it is important for individual countries to share progress on their national projects as well as to recognise progress of other countries.
- Government leaderships change often throughout the course of the DGR development and must be informed after every change in government about the decisions taken and decisions to come and the reasoning behind choosing DGR.
- Local governments typically play a key role in the consent-based process making it important that radioactive waste management organisations engage effectively with these local elected stakeholders over a long period of time, extending across several electoral periods and changes of local administration.
- R&D programmes, once established, should be reviewed periodically to ensure they remain relevant and are cognisant of advances in technologies as well as stakeholder issues. One example of good practice in this regard was the R&D programme in Sweden that was submitted for review, public consultation and recommendations from the regulatory body of the government for the continued work of the programme every three years.
- R&D addressed to pre-disposal activities could advance DGR projects by demonstrating HLW conditioning, which allows both decreased volume and radiotoxicity of the HLW to be disposed of.

Additional points from the discussions

Additional points of discussion were brought forth by the participants and are considered important issues, while not directly relating to stakeholder involvement (and public confidence). These points are highlighted as follows.

- Stakeholders generally do not question the technical competency of scientists and engineers involved in the project, but transparency is required from the first phase of any DGR project so as not to have stakeholders questioning the motives, openness and transparency of the project. Technical competency is required but is not sufficient for the success of a DGR project.

- Novel approaches, “thinking outside of the box”, such as “art as a communication tool” at the COVRA interim storage facility, can make an important contribution to involving stakeholders and building public confidence.
- Time should be considered as an ally and not an enemy. Over the long period of time required to develop a DGR, a project can:
  - gather, condition and package the waste to be emplaced,
  - accumulate or set aside enough money to realise final disposal,
  - allow for adjustments and attention to stakeholders’ changing positions, and
  - allow for technical developments to be considered and innovations that are likely to follow.
- Peer and technical reviews by international experts from other countries are useful to increase the credibility of the local DGR project. When conducting such technical reviews, meetings to include stakeholders from the local general public and giving them a chance to question the international experts can help to build confidence.
- Stakeholders will ask “why here” and “why not other places”? Trust and transparency are important, but the hosting community must be fully informed of “why here”?
- Many countries successfully operate low-level and intermediate-level radioactive waste disposal facilities. Experience in operating these facilities can help to provide confidence in how HLW and SNF might be managed.

Underground shot of continuous mining machine.
Courtesy of the US Department of Energy

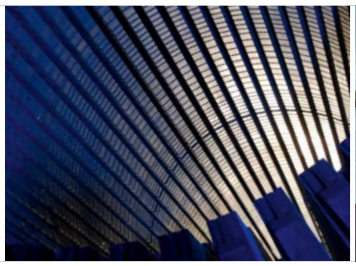
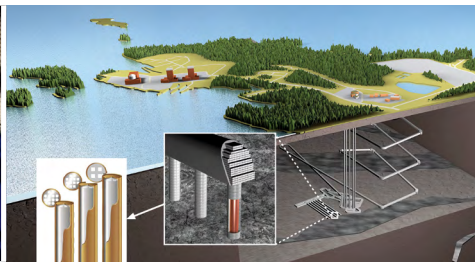
2.6 Key messages

The key messages associated with decision-making processes and that are "core" to a successful DGR project derived from the International Roundtable are as follows:

- A stepwise, adaptive and fully transparent decision-making process that involves key stakeholders, including implementers, regulators and the general public is effective. Beginning at the outset of the national programme, step-by-step implementation builds confidence in a DGR project and increases the probability of success. Engagement with stakeholders should be recognised as a long-term process that occurs continually throughout the decision-making process and lifecycle of a DGR.
- According to their national policies, some countries have industry-led approaches, others have government-led approaches, but the approach an organisation takes does not matter as much as the process used to involve all stakeholders and the public effectively.
- Stakeholders' trust and confidence in the local DGR project increase when they can see that other countries are approaching the solution to HLW and SNF disposal in the same way as the local project. It is good practice for the international community to support countries during the advancement of the process.
- While financial support for the host community can be important, it is not deemed to be a primary factor in gaining confidence in and success of a DGR. There needs to be an "added-value" aspect. The support plan needs to indicate benefits of a DGR project over the long term to the host community. Affected communities and local governments are more inclined to accept support if it is aligned with regional economic development, improvement of the overall well-being of the community or educational support, for example. There are cases, for example in Finland, where countries are able to make positive progress with a support plan that does not include financial support.
- Involving younger stakeholders in the decision-making processes is not only imperative, as they will inherit the project in the future, but also effective. Engaging with young stakeholders may require new and innovative communication approaches. Social media and use of video, for example, help to establish and maintain dialogue with younger stakeholders.
- Clear communication about safety using the safety case can be a challenge for a regulatory body and for the RWMO. If communication is unclear, even academic experts may challenge the concepts of the repository and the safety case. Communication and dialogue should be explored with a wide range of scientists and experts, including those outside of the nuclear science and engineering domain. In order to bolster public confidence in the safety of a DGR, it is important to make every effort to ensure confidence in the safety case.

3. International co-operation to maintain and strengthen the technological capabilities to support final disposal



Geological disposal is widely accepted as a technically feasible method for providing long-term safety and isolation and containment of high-level radioactive waste and spent nuclear fuel (NEA, 2012). The safety of a repository is evaluated and documented in a "safety case", which is a set of documents providing comprehensive arguments for the safety with clear and scientifically objective evidence. Underground research laboratories (URLs) play an important role in the scientific assessment and demonstrations by providing a realistic environment for testing the selected technical approaches and materials (NEA, 2013b). International technical co-operation has been extensive, particularly in the area of characterising and developing geological repositories. There were also some examples of international co-operation in the field of HLW partitioning and minor actinides transmutation, which is directly linked to the reduction of HLW radiotoxicity.

Various international platforms already exist to share the R&D and technologies required for site characterisation and construction of a repository. For instance, the IAEA Underground Research Facilities (URF) Network for Geological Disposal exchanges information on URF and holds workshops and training courses on geological disposal in each country. The European Commission's Implementing Geological Disposal of radioactive waste Technology Platform (IGD-TP) was launched to address scientific, technological and social challenges and share knowledge (EC, 2009). The technical subgroups of the NEA Integration Group for the Safety Case (IGSC) (e.g. Expert Group on Operational Safety, Clay Club, Salt Club, Crystalline Club) were also created to share scientific data and information relevant to long-term repository safety, while the IGSC focuses on developing strategies and practices for enhancing the robustness of the safety case. Specifically, in this regard, the IGSC organises an International Safety Case Symposium every five years to review the latest status and strategies used by countries in compiling robust safety cases for their geological disposal programme. Workshops addressing various safety case-related challenges have also been organised to share knowledge and techniques in demonstrating repository safety. Ongoing international collaborations include, but are not limited to, those at the Grimsel Test Site, the Mont Terri Project, Äspö Hard Rock Laboratory, Horonobe URL and others (NEA, 2013b). The safety case sourcebook (NEA, 2017c) provides more details of these international activities. OECD NEA also initiated an international co-operation in fast neutron reactors and other Generation IV reactor systems development, keeping in mind that these reactors could be very effective in minor actinide transmutation and HLW minimisation.

3.1 Further strengthening the technical understanding for a DGR programme

The technical understanding for a DGR programme of disposal facilities can be further strengthened by the following:

- **Transforming research results into practical and reliable technologies for the long-term implementation of disposal facilities (siting, construction, operation and closure)** – This process demands ongoing investment (research facilities, human resources and funding) as well as innovation in the manufacture of materials and equipment. It is valuable and beneficial to share resources, research results and implementation experience among countries.
- **Evaluating emerging engineering technologies such as automatic transportation or retrieval to geological disposal** – These should be discussed more frequently at the international level.
- **Allowing for long timescales from initiation to final closure** – A radioactive waste repository takes decades to develop. Some decades, or even longer, from initiation to commencing operations is well beyond that of most construction projects.
- **Managing scientific uncertainties associated with long-term safety of nuclear waste repositories** – The safety case for geological disposal typically addresses performance of the repository system and protection of people and the environment for thousands to millions of years into the future. Uncertainties inevitably exist in the scenarios, models and data for the safety assessment (IAEA, 2012). Furthermore, while special uncertainties associated with data and models of the current geological environment may be reduced by the site selection process, temporal uncertainties of long-term predictive modelling and relevant parameters remain; it is difficult to provide definite assurances of performance and protection over longer timescales. Management of uncertainties calls for broad and in-depth international co-operation in the development of disposal projects and their safety cases.

3.2 Current activities in international co-operation

The most effective co-operation in the domain of R&D comes from diversity of opinions and from having a space to converse and exchange ideas openly. The forum provides a most appropriate opportunity for co-operation both in the form of bilateral or multilateral R&D agreements.

In the first International Roundtable session, the participants discussed the fundamentals of maintaining and strengthening the technological capabilities for geological disposal; the follow questions guided the discussion.

I. It is proved effective for countries to share specialist research and development resources such as facilities and human resources in order to maintain and strengthen their technical capabilities for geological disposal. What should governments do to facilitate international collaboration?

II. Regarding international co-operation in research fields, what kind of international collaboration efforts have been made so far, and what kind of collaboration should governments take on in the future?

III. What role should URLs in each country play? Can they function as a base for international research and understanding activities? In order to effectively use URFs, how can the countries collaborate with each other?

In the second International Roundtable session, the participants provided brief presentations on strengthening and maintaining technological capabilities, focusing on the following two points:

I. New and additional proposals, if any, on international co-operation specific activities, in particular R&D.

II. Potential areas of strengthening international co-operation.

The following are the summaries of international co-operation to maintain and strengthen technological capabilities from both roundtable discussions.

Sharing of R&D resources

- There are many opportunities for international co-operation in R&D by identifying technical challenges that are common to many countries. These opportunities show that international co-operation can play a role in addressing shared challenges, while sharing the costs among the interested parties.
- Facilitating international collaborations is dependent upon how much effort, usually financial in nature, each country is willing and able to put into it.
- Collaboration is easier at the earlier stages of implementation of DGRs because as a project comes closer to construction and operation, very large commercial contracts can be put in place and with which there is little or no opportunity to share.
- In addition to research at URLs, there are opportunities at other laboratories such as those able to handle high-level radioactivity in hot cells, those with advanced microscope capabilities or any laboratory with other capabilities not widely available.
- Countries with unique capabilities in the field of minor actinide separation and transmutation as well as hot cells and radiochemistry laboratories could provide potential for international R&D. The main results of the R&D could be distributed by NEA to support the countries in determining alternatives to HLW disposal.

Types of opportunities in international collaboration

There has been a history of successful international collaboration on technical aspects of DGRs since the 1980s. For example:

- The international cooperative effort for research and model comparison collaboration project DECOVALEX (Development of Coupled models and their Validation against Experiments) has been ongoing with a broad range of international collaboration for almost 30 years.
- More than 30 years of European collaborative projects. The most recent, the European Joint Programme on Radioactive Waste Management pools resources among 25 European countries resulting in a funding level of 60 million euros, including more than 37 million euros financed through Euratom grants, for work until 2024.
- The NEA Data Bank's long-running collaborative project on thermodynamic data (TDB Project) and the NEA Features, Events and Processes (FEP) database are utilised worldwide by radioactive waste management organisations when developing a DGR or other nuclear facilities.

In addition, there are several fora promoting information exchange on a range of topics.

- Countries take advantage of NEA and IAEA opportunities such as:
  - The IAEA URF Network.
  - The NEA Nuclear Education Skills and Technology (NEST) framework to address important gaps in nuclear skills capacity building, knowledge transfer and technical innovation in an international context.
- The International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) promotes the exchange of knowledge, experience and information among its members and activities for issues of common interest, allowing member implementers to interact at the leadership level to test strategies through open-minded discussions.

New and additional proposals

During the discussions focused on the technological collaborations that currently exist worldwide, new opportunities for collaboration were identified. The following items represent those proposals from the roundtable discussions:

- Developing an integrated verification and validation (V&V) approach and methodology for the next generation through models and computer codes using big data that are applied for more realistic safety assessment. These models include:
  - a 4D site descriptive model and site specific repository simulator; and
  - more realistic nuclide migration models, reflecting detailed specifications of the design of a repository and geological environment;
- addressing post-closure safety assessments and long-term facility management, in terms of monitoring:
- determining at what level should or could R&D be performed in researching gas migration through the very gas-tight host rocks in a clay repository;
- considering models of economics and social demand linked with R&D and its cost, repository design optimisation, and so on;
- co-operating in engineering disciplines such as optimisation of the design of the repository during construction and operational phrases, and development of robotic technologies for operational efficiency and safety;
- expanding activities in knowledge management to include:
  - assurance of the continuity of knowledge (explicit, implicit and tacit) over decades of development and implementation with reduced budget for R&D;
  - taking into consideration that delays in implementation of geological projects generate huge pressure on a R&D budget to maintain knowledge of what has been accomplished;
  - all efforts to build, advance and preserve the scientific technical expertise and to support young researchers in the area of nuclear waste management;
- considering DGR programmes that are transforming R&D to construction and where transforming from construction to operation will be a major challenge;
- managing dual programme concerns: i) development of a national DGR versus ii) working towards a multinational DGR;
- promoting research on such long-term environmental changes as volcanic activities and glaciation, tectonic movements and earthquakes, and their effects on the performance of a DGR post closure – this is linked with activities for V&V;
- continuing R&D on extended storage of SNF, especially that which is stored and transported prior to DGR, as it will have a strong influence on the repository design;
- moving forward with a holistic approach to waste management that includes pre-waste generation steps: most projects cover radioactive waste and SNF from source up to disposal, but there is a need to include fuel and new reactors in any project in order to be sure that, for instance, an accident-tolerant fuel does not create new challenges for geological disposal;
- taking into account the progress in advanced technologies and approaches to greatly decreasing the hazard, volume and long-term toxicity of the HLW and approaches applying partioning and transmutation.

Areas to strengthen international collaboration

Roundtable participants recognised many opportunities to strengthen international collaborations in DGR programmes. The value of the following collaboration activities was explicitly recognised:

- continued and expanded participation in ongoing knowledge management and knowledge preservation with international facilitators such as the NEA and the IAEA;

- increased use of URLs available for international co-operation, such as those located in Japan, Sweden and Switzerland, and recently opened URLs in the People's Republic of China and Russia
- participation in groups and organisations such as:
  - an international research and model comparison collaboration project DECOVALEX (Development of Coupled models and their Validation against Experiments);
  - the NEA IGSC and its subgroups;
  - the NEA Radioactive Waste Management Committee (RWMC), which has established initiatives such as the Working Party on Information, Data and Knowledge Management (IDKM) and the Expert Group on the Application of Robotics and Remote Systems in the Nuclear Back-End (EGRRS);
- joining the most recent European Joint Programme on Radioactive Waste Management that pools resources among 25 European countries resulting in an overall funding level of EUR 60 million and EUR 37 million financed through Euratom grants through to 2024;
- using the NEA's long-running collaborative Thermochemical Database (TDB) Project and the NEA's Features, Events and Processes (FEP) database when developing a DGR or other nuclear facilities;
- taking advantage of other NEA and IAEA opportunities such as:
  - the IAEA URF Network that provides a platform to assess and share tried and tested practices in developing, evaluating and implementing geological disposal solutions for radioactive waste disposal with an emphasis on the role and use of URFs;
  - the NEA NEST framework to address important gaps in nuclear skills and capacity building, knowledge transfer and technical innovation in an international context;
- utilising the International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) that promotes the exchange of knowledge, experience and information among its members, allowing implementers to interact to test strategies and remain open-minded during meeting discussions;
- strengthening international programmes in HLW partitioning and minor actinides transmutation in bi- or multilateral collaborations among interested countries.

3.3 Future activities

The NEA Co-Chair summarised discussions as key messages and a number of potential opportunities for moving forward. First, it should be noted that unnecessary duplication of ongoing activities should be avoided. The Co-Chair recommended that proposed future activities be assigned to the RWMC for evaluation. The RWMC could recommend ways of addressing any gaps through a flexible framework that enables countries to perform R&D projects. Potential opportunities for future work include the following:

- putting together "modular models" that countries could use, depending on what geology and methodologies they are using, to take advantage of the new technologies available with the simulation technologies; this could include optimisation of the repository design;
- optimising repositories from a more holistic standpoint concerns not only technology R&D, and it is something that requires a lot of thought regarding the holistic approach to repository design, including other elements of the nuclear fuel cycle, e.g., uranium mining through fuel development and NPP use;
- looking at URL programmes (in co-operation with the IAEA) to see if there are specific research topics that could be undertaken within the URLs that are not already underway;
- retaining records and memory: imminent changes in the major phases of a number of DGR programmes, delays in the programmes and the overall long time-frame for DGR projects create real challenges to manage and maintain the explicit, implicit and tacit knowledge that will be needed for future researchers, operators and regulators of the DGR;

- exploring multinational repositories, possibly through co-operative mechanisms such as the International Framework for Nuclear Energy Cooperation (IFNEC), which has been serving as a platform for studying multinational repository approach. Due to political sensitivity associated with multinational repositories, this topic needs to be approached cautiously. The NEA has explored multinational repositories in the context of some of its work with countries in Europe who have been exploring the possibilities of multinational repositories (such as the European Repository Development Organisation Working Group). While multinational or shared repositories could make eminent technical and financial sense, these concepts face substantial policy and legal issues that must be addressed;
- supporting advanced fuel cycle research and development: this work has waxed and waned in many countries over the decades and today there is renewed interest in transmutation technologies;
- studying extended storage with a focus on the effect it will have on the SNF to be disposed of in a DGR: many countries are quite interested in this area of work; the NEA Committee for Technical and Economic Studies on Nuclear Energy Development and Fuel Cycle, (Nuclear Development Committee, or NDC) has done some work on extended storage; and individual countries, the US in particular, have been doing a lot of work on extended storage;
- training the next generation of experts and maintaining expertise: this was highlighted at several points throughout the roundtable discussions. The NEA NEST activity, which is designed to bring young people into nuclear research development activities, has four projects that are getting under way. Perhaps this opportunity for work could be established as a NEST project, or promoted as a new initiative.

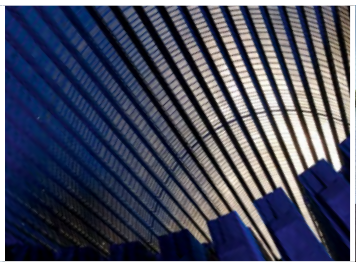
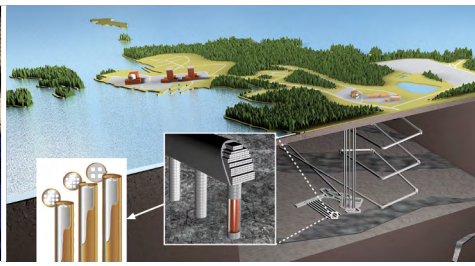
3.4 Key messages

The International Roundtable recognised the value of international collaboration to maintain and strengthen the technological capabilities in the management of HLW and SNF disposal programmes. Collaboration in the development of technological capabilities can also have a positive influence on improving confidence in stakeholders. There has been a history of successful international collaboration on technical aspects of DGRs since the 1980s. Participation of incumbent and new generations in such programmes should be encouraged. Examples of those programmes are:

- The international research project Development of Coupled Models and their Validation against Experiments (DECOVALEX); or the various clay, crystalline and salt clubs of the NEA for developing and exchanging scientific information. The IAEA organises various DGR-related projects, for example, the Underground Research Facilities Network for Geological Disposal – URF Network. European countries have also established international co-operation projects such as the Implementing Geological Disposal of radioactive waste Technology Platform (IGD-TP) and Engineering Studies and Demonstrations of Repository Designs (ESDRED) to support their radioactive waste management programmes. More international projects are undertaken through the NEA, European Commission and IAEA mechanisms.
- Financial and human resources for R&D related to DGR development can always benefit for the wider exchange within the international community. International collaboration on technical aspects, utilising facilities and research in other countries, is a cost-effective way to further strengthen the technical understanding for DGR programmes. Some countries are actively participating in and collaborating on international R&D programmes under bilateral or multilateral frameworks.
- Underground research facilities made available in other countries are invaluable resources, especially for those countries in early stages of the DGR decision-making process that have not yet identified a host rock environment, for example. Developing those resources domestically involves a substantial investment, and both the timing (i.e. whether in the siting or licensing phase) and configuration (i.e. as a separate facility or one integrated with the intended DGR) of a URL should be carefully assessed.
- An additional benefit of international collaboration is being able to demonstrate to stakeholders that the efforts undertaken locally (on safety assessment, risk communication and dialogue with stakeholders) are similar to those being undertaken worldwide.

4. Conclusions



The International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel was the first event of its kind to bring together high-level policy makers from 15 participating countries. The opinions they shared reflected the latest government policies and the present radioactive waste management practices as well as providing future directions for international co-operation. Japan expressed an interest in holding a workshop in collaboration with the Nuclear Energy Agency (NEA) to deepen discussions among experts in the fields of radioactive waste and spent fuel R&D where international co-operation needs to be strengthened. The framework of the International Roundtable and involvement of international organisations is effective and can be a useful tool for participating countries considering further discussions in the future. The Ministry of Economy, Trade and Industry (METI) Co-Chair of the roundtable expressed a desire to continue discussions in the future.

The participating countries share a common goal of realising the final disposal of high-level radioactive waste and spent nuclear fuel, even if the situations of the projects and the conditions of disposal systems may vary between countries. Through intensive discussions, the participants renewed the commitments for international co-operation and acknowledged the common nature of the policies related to radioactive waste management, stakeholder engagement, research and development, and knowledge transfer between generations. The following main conclusions can be drawn from the International Roundtable:

- The inputs of senior representatives of all participating countries demonstrated their regard for international co-operation in policymaking, stakeholder engagement, R&D and human resource development as being valuable.
- The involvement of senior government officials is essential for international co-operation projects to succeed.
- Transparency and early involvement with local communities in DGR programmes appear to be crucial for success. The experiences from Belgium, Canada, China, Finland, France, Germany, Japan, Korea, the Netherlands, Russia, Spain, Sweden, Switzerland, the United Kingdom and the United

States could be analysed as lessons learnt for all participating countries. By sharing experiences from each country, future iterations of the International Roundtable could bolster strategies for gaining public confidence. Success or failure relies strongly on public involvement.

- Measures of international dialogues on policy need to remain flexible and should ensure sharing of resources. Areas of common interests and issues should be tackled by sharing available resources, practices and technical capabilities in each country so as to maximise the outcome. Defining the business case for R&D is needed to ensure value is realised.

References

European Commission (2009), *Implementing Geological Disposal of Radioactive Waste Technology Platform: Vision Report*, EUR 24160, Publications Office of the European Union, Luxembourg.

Committee on Radioactive Waste Management (2006), Managing our Radioactive Waste Safely, CoRWM's Recommendations to Government, CoRWM Doc. 700, United Kingdom.

IAEA (2012), "The Safety Case and Safety Assessment for the Disposal of Radioactive Waste – Safety Specific Guide", IAEA Safety Standard Series, No. SSG-23, IAEA, Vienna, Austria

National Research Council (1957), *The Disposal of Radioactive Waste on Land*. The National Academies Press, Washington, D.C.

NEA (2017a), *NEA Workshop on Stakeholder Involvement in Nuclear Decision Making: Summary Report*, OECD Publishing, Paris.

NEA (2017b), *Communication on the Safety Case for a Deep Geological Repository*, OECD Publishing, Paris.

NEA (2017c), *Sourcebook of International Activities Related to the Development of Safety Cases for Deep Geological Repositories*, OECD Publishing, Paris.

NEA (2015), "The OECD Nuclear Energy Agency's Forum on Stakeholder Confidence, radioactive waste management public participation: A synthesis of its learnings and guiding principles", OECD Publishing, Paris.

NEA (2013a), *Stakeholder Confidence in Radioactive Waste Management: An Annotated Glossary of Key Terms*, OECD Publishing, Paris.

NEA (2013b), "Underground Research Laboratories", NEA/RWM/R(2013)2, OECD Publishing, Paris.

NEA (2012), *Geological Disposal of Radioactive Waste: National Commitment, Local and Regional Involvement: A Collective Statement of the OECD Nuclear Energy Agency Radioactive Waste Management Committee Adopted March 2012*, OECD Publishing, Paris.

Annexes

Annex A:

First roundtable discussion: Meeting agenda

Roundtable for International Co-operation on the Final Disposal of High-level Radioactive Waste and Spent Fuel

Monday 14 October 2019
OECD - Paris, France

Time	Main discussion points & decisions	Duration
Session 1: Welcome and Structure of the Roundtable *Chair: Rita Baranwal (DOE) and Tomohiro Kaneko (METI)*		
09:00	**1.1. Opening remarks from METI** *Tomohiro KANEKO, Deputy Commissioner of ANRE/METI, Japan*	5 min
09:05	**1.2. Opening remarks from DOE** *Rita BARANWAL, Assistant Secretary for the Office of Nuclear Energy of DOE, USA*	5 min
09:10	**1.3. Opening remarks from NEA** *William D. MAGWOOD, IV, NEA Director-General*	5 min
09:15	**1.4. Self introduction** *All participants*	15 min
09:30	**Photo Session** *All participants*	10 min
Session 2: Relevant International Activities		
10:10	**2.1. Overview of NEA RWMC's activities in international co-operation for developing DGR** Including issues for the next steps *Hiroyuki UMEKI, NEA RWMC Chair*	20 min
10:30	**2.2. Overview of IAEA's activities in international co-operation for developing DGR** Including issues for the next steps *Christophe Xerri, Director of Division of Nuclear Fuel Cycle and Waste Technology, IAEA*	20 min
Session 3: Theme Discussion		
10:50	**3.1. Structure of the Roundtable Report** *Gloria KWONG, Deputy Head of NEA/RWMD*	20 min

Time	Main discussion points & decisions	Duration
11:10	**3.2. Discussion I:** **Basic Idea for the International Co-operation** Including discussion on roles of the government, reconfirming the importance of intergovernmental co-operation *All participating countries*	50 min
13:10	**3.3. Overview of NEA's Forum on Stakeholder Confidence (FSC)** *Yeonhee HAH, Head of the NEA/RP-HANS*	20 min
13:30	**3.4. Discussion II:** **International Co-operation on Stakeholder Engagement** Especially focusing on the dialogues with the public	90 min
15:30	**3.5. Discussion III:** **International Co-operation for R&D** - Including the interest area, potential facilities for co-operation	90 min
Session 4: Summary and Closing		
17:00	**4.1. Summary of the Co-chairs** *METI, DOE and NEA*	20 min
17:20	**4.2. Closing remarks** *METI, DOE and NEA*	10 min

Annex B:

Second roundtable discussion: Meeting agenda

Second International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel

Friday 7 February 2020
OECD - Paris, France
Meeting Room CC 15

Time	Main discussion points & decisions	Duration
Session 1: Welcome and Structure of the Roundtable *Chair: Dr William Boyle and Mr Hirohide Hirai*		
09:00	**1.1. Opening remarks from METI** *Mr Hirohide Hirai, Deputy Commissioner, ANRE/METI, Japan*	5 min
09:05	**1.2. Opening remarks from DOE** *Dr William Boyle, DOE, USA*	5 min
09:10	**1.3. Opening remarks from NEA** *William D. MAGWOOD, IV, NEA Director-General*	5 min
Session 2: Theme Setting		
09:15	**2.1. Review of the 1st roundtable discussion and the objective of the 2nd discussion** Provide the overview of the interim report, including topics for further discussions at the 2nd roundtable *Ms Rebecca Tadesse, Head of NEA/RWMD*	20 min
Session 3: Theme Discussion		
10:05	**3.1. Discussion 1:** **Best practices and lessons learnt on stakeholder engagement in decision making of deep geological repositories** *Chair: Mr Hirohide Hirai* Participating countries are invited to make a 3-4 minute presentation on best practices and lessons learnt focused on: 1. Their current policies and methodologies for stakeholder engagement, which call for transparency, participative and evaluation measures in developing final geological disposal for radioactive waste and spent nuclear fuel (e.g. risk communication). 2. Policy framework for the development of local communities (e.g. financial support). 3. Government strategies to coordinate stakeholder engagement mechanisms and management capacity in achieving an effective regulatory framework. *All participating countries*	115 min
12:00	**3.2. Key messages on effective stakeholder engagement** *Chair: Mr William D. Magwood, IV* *All participating countries*	5 min

Time	Main discussion points & decisions	Duration
13:50	**3.3. Discussion 2:** **International co-operation to maintain and strengthen technological capabilities** *Chair: Dr William Boyle* Participating countries are expected to make a 3-4 minute presentation on: 1. Newandadditionalproposal,ifany,oninternationalco-operationspecificactivities,inparticularR&D 2. Potential areas of strengthening international co-operation *All participating countries*	105 min
16:05	**3.4. Key messages for further co-operation and potential R&D topics** *Chair: Mr William D. Magwood, IV* *All participating countries*	20 min
Session 4: Summary and Closing		
16:25	**4.1. Summary of the Co-chairs** *METI and DOE*	20 min
16:45	**4.2. Closing remarks** *NEA, METI and DOE*	15 min

Annex C:

First roundtable discussion: List of participants

First International Roundtable on the Final Disposal of High-level Radioactive Waste and Spent Fuel

14 October 2019

BELGIUM

AÏT ABDERRAHIM, Hamid
Deputy Director-General, International Relations
Belgian Nuclear Research Centre (SCK.CEN)
Director, MYRRHA Project

VAN DER BORGHT, Olivier
MYRRHA Stakeholder Manager

CANADA

DELANEY, Jim
Director
Uranium and Radioactive Waste Division
ERB
NRCan

DAULT, Veronique
Director
Government Relations, Nuclear Waste Management Organization

CHINA

XU, Huidong
Second Secretary
Chinese Embassy in France

FINLAND

HEIKINHEIMO, Liisa
Deputy Director-General,
Department of Energy, Ministry of Economic Affairs and Employment,

HEINONEN, Jussi
Radiation and Nuclear Safety Authority STUK

FRANCE

LANDAIS, Patrick
High Commissioner for Atomic Energy
French Atomic Energy Commission (CEA)

CHATY, Sylvie
Deputy Head of Nuclear Public Policy
Ministère de la Transition Écologique et solidaire

HOVINE, Laëtitia
Deputy Head for International Affairs
Ministère de la Transition Écologique et solidaire

PLAS, Frédéric
Head of Research and Development
ANDRA

POISSON, Richard
Head of International Affairs
ANDRA

GERMANY

LIEBSCHER, Axel
FA 2
Federal Office for the Safety of Nuclear Waste Management

PAPE, Hans-Christoph
Head of Division II A6
Federal Ministry of Economic Affairs and Energy (BMWi)

SCHÄFERS, Annika
Nuclear Safety and Disposal Research
Federal Ministry for Economic Affairs and Energy

JAPAN

KANEKO, Tomohiro
Deputy Commissioner for International Affairs
Agency for Natural Resources and Energy
METI

UMEKI, Hiroyuki
Executive Director
Nuclear Waste Management Organization of Japan (NUMO)

FUNAKI, Kentaro
Chief Nuclear Officer
Agency for Natural Resources and Energy
METI

NASU, Ryo
Director
Radioactive Waste Management Policy Division
Agency for Natural Resources and Energy
METI

HIKICHI, Yuta
Deputy Director
Radioactive Waste Management Policy Division
Agency for Natural Resources and Energy
METI

IWATA, Hajime
Assistant Director
Radioactive Waste Management Policy Division
Agency for Natural Resources and Energy
METI

WATANABE, Haruka
Assistant Director
Radioactive Waste Management Policy Division
Agency for Natural Resources and Energy
METI

KOREA

HER, Eunsu
Deputy Director
Nuclear Power Environment Division
Ministry of Trade, Industry and Energy (MOTIE)

NAM, Hyo-on
Division Head
Nuclear Fuel Cycle Strategy
Korea Atomic Energy Research Institute (KAERI)

OH, Juho
Team Head
Korea Radioactive Waste Agency

KIM, Jeong-Young
Second Secretary
Nuclear Affairs Division
Ministry of Foreign Affairs

LEIGH, Sangki
Interpreter
Korea Radioactive Waste Agency

NETHERLANDS

KLOMBERG, Theo
Coordinating Policy Advisor
Environmental Safety & Risks Directorate
Ministry of Infrastructure and Water Management

LINDNER, Henk
Coordinating Policy Officer
Authority for Nuclear Safety and Radiation Protection (ANVS)

VAN DER VOET, Joris
Director
Environmental Risks and Safety Department
Ministry of Infrastructure and Water Management (IenW)

RUSSIA

KRYUKOV, Oleg
Director for State Policy in the field of RW, SNF and SE NROO
Rosatom

ROZHDESTVIN, Andrey
CEO, Rosatom Western Europe
Vice President, Rosatom International Network

LOKHOV, Alexey
Deputy Director,
Rosatom Western Europe

ZALIMSKAYA, L.m.
Special Representative for International Projects
Co-Chair of the Russian-Japanese Working Group on Nuclear Energy
Rosatom

DOROFEEV, Alexander
Head of the Project Office
Office on State Policy in the field of SNF
Rosatom

BARYSHNIKOV, Mikhail
Head of Innovations Management
Tenex JRC, Rosatom subsidiary

ZONTOV, Alexey
Translator
Rosatom

SPAIN

REDONDO GARCÍA, José Manuel
Deputy Director for Nuclear Energy
Ministry for the Ecological Transition

RODRÍGUEZ BECEIRO, Álvaro
Technical Director
ENRESA

DEL CASTILLO CAMPOS, Juan Ignacio
Energy Advisor
Permanent Delegation of Spain to the OECD

SWEDEN

ANDERBERG, Johan
Director, Department of Radioactive Materials
Swedish Radiation Safety Authority

UNITED KINGDOM

ARMSTRONG, Dawn
Policy Adviser
Disposal Infrastructure
Nuclear Directorate

TWEED, Cherry
Chief Scientific Adviser
Radioactive Waste Management

UNITED STATES

BARANWAL, Rita
Assistant Secretary
Office of Nuclear Energy
US Department of Energy (DOE)

BOYLE, William J.
Deputy Assistant Secretary for Spent Fuel & Waste Disposition
Office of Nuclear Energy
US Department of Energy (DOE)

DUNCAN, Aleshia
Associate Deputy Assistant Secretary for International Policy and Cooperation
Office of Nuclear Energy
US Department of Energy

RICHARDS, Andrew
Deputy Chief of Staff
US Department of Energy

NOWAK, Alexandra
Program Specialist
Permanent Delegation of the United States to the OECD

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

XERRI, Christophe
Director,
Division of Nuclear Fuel Cycle Waste Technology
Department of Nuclear Energy
IAEA

NUCLEAR ENERGY AGENCY (NEA)

MAGWOOD, William D. IV
Director-General
Nuclear Energy Agency (NEA)

TADESSE, Rebecca
Head
Division of Radioactive Waste Management and Decommissioning (RWMD), NEA

HAH, Yeonhee
Head
Division of Radiological Protection and Human Aspects of Nuclear Safety (RP-HANS), NEA

KWONG, Gloria
Deputy Head
Division of Radioactive Waste Management and Decommissioning (RWMD), NEA

MORITA, Shin
Senior Radiological Recovery Specialist – Fukushima
Division of Radioactive Waste Management and Decommissioning (RWMD), NEA

MCMAHON, Kevin A.
Consultant

LI, Jinfeng
Division of Radioactive Waste Management and Decommissioning (RWMD), NEA

Annex D:

Second roundtable discussion: List of participants

Second International Roundtable on Final Disposal of High-level Radioactive Waste and Spent Fuel

7 February 2020

BELGIUM

LALIEUX, Philippe
ONDRAF/NIRAS

CANADA

DAULT, Veronique
Director
Government Relations, Nuclear Waste Management Organization

FINLAND

HEIKINHEIMO, Liisa
Deputy Director-General,
Department of Energy, Ministry of Economic Affairs and Employment,

FRANCE

CHATY, Sylvie
Deputy Head of Nuclear Public Policy
Ministère de la Transition Écologique et solidaire

HOVINE, Laëtitia
Sous-Direction de l'Industrie nucléaire,
Ministère de la Transition Écologique et Solidaire

LANDAIS, Patrick
High Commissioner for Atomic Energy
French Atomic Energy Commission (CEA)

DELORT, Daniel
ANDRA

GERMANY

SCHÄFERS, Annika
Nuclear Safety and Disposal Research
Federal Ministry for Economic Affairs and Energy

JAPAN

HIRAI, Hirohide
Deputy Commissioner
Agency for Natural Resources and Energy
METI

UMEKI, Hiroyuki
Executive Director
Nuclear Waste Management Organization of Japan (NUMO)

FUNAKI, Kentaro
Chief Nuclear Officer
Agency for Natural Resources and Energy
METI

NASU, Ryo
Director
Radioactive Waste Management Policy Division
Agency for Natural Resources and Energy
METI

HIKICHI, Yuta
Deputy Director
Radioactive Waste Management Policy Division
METI

WATANABE, Haruka
Assistant Director
Radioactive Waste Management Policy Division
METI

AOYAGI, Kazuhei
Assistant Director
Radioactive Waste Management Policy Division
METI

SAWADA, Kazuhiro
First Secretary
Permanent Delegation of Japan to the OECD

KOREA

KIMM, Yong Tae
Counsellor
Korean Delegation to the OECD

YOON, Bu Hee
First Secretary
Korean Delegation to the OECD

NETHERLANDS

KLOMBERG, Theo
Coordinating Policy Advisor
Environmental Safety & Risks Directorate
Ministry of Infrastructure and Water Management

LINDNER, Henk
Coordinating Policy Officer
Authority for Nuclear Safety and Radiation Protection (ANVS)

VAN DER VOET, Joris
Director
Environmental Risks and Safety Department
Ministry of Infrastructure and Water Management (IenW)

RUSSIA

KRYUKOV, Oleg
Director for State Policy in the field of RW, SNF and SE NROO
Rosatom

BARYSHNIKOV, Mikhail
Head of Innovations Management
Tenex JRC, Rosatom subsidiary

ARTISYUK, Vladimir
Advisor to Director-General
Rosatom

KHAPERSKAYA, Anzhelika
Senior Manager of the Project Office on State Policy in the field of SNF
Rosatom

LOKHOV, Alexey
Deputy Director
Rosatom Western Europe

ROZHDESTVIN, Andrey
CEO, Rosatom Western Europe
Vice President, Rosatom International Network

ZALIMSKAYA, Liudmila
Special Representative for International Projects
Co-Chair of the Russian-Japanese Working Group on Nuclear Energy
Rosatom

ZONTOV, Alexey
Translator
Rosatom

SPAIN

REDONDO GARCÍA, D. José Manuel
Deputy Director for Nuclear Energy
Ministry for the Ecological Transition

RODRÍGUEZ BECEIRO, Álvaro
Director for Research and Technology
ENRESA

DE PONGA DEL POZO, Jaime
Head of the General Division of Nuclear Energy
Ministry for Ecological Transition

MOLINA MARTÍN, Mariano
Head of Department
International Relations
ENRESA

DEL CASTILLO CAMPOS, Juan Ignacio
Energy Advisor
Permanent Delegation of Spain to the OECD

SWEDEN

ANDERBERG, Johan
Director, Department of Radioactive Materials
Swedish Radiation Safety Authority

HOLMQVIST, Magnus
President
SKB

PALMQVIST, Jessica
Head of the Research & Development Department
SKB

THURNER, Erik
Senior Advisor
SKB

UNITED KINGDOM

ARMSTRONG, Dawn
Policy Advisor
Disposal Infrastructure
Nuclear Directorate
Department for Business, Energy and Industrial Strategy

TWEED, Cherry
Chief Scientific Adviser
Radioactive Waste Management

UNITED STATES

BOYLE, William J.
Deputy Assistant Secretary for Spent Fuel & Waste Disposition
Office of Nuclear Energy
U.S. Department of Energy (DOE)

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

NIEDER-WESTERMANN, Gerald
Waste Disposal Specialist
NEFW Waste Technology Section
Division of Nuclear Fuel Cycle and Waste Technology
IAEA

NUCLEAR ENERGY AGENCY (NEA)

MAGWOOD, William D. IV
Director-General
Nuclear Energy Agency (NEA)

TADESSE, Rebecca
Head
Division of Radioactive Waste Management & Decommissioning (RWMD), NEA

MORITA, Shin
Senior Radiological Recovery Specialist – Fukushima
Division of Radioactive Waste Management & Decommissioning (RWMD), NEA

BRANDAUER, Martin
Decommissioning Specialist
Division of Radioactive Waste Management & Decommissioning (RWMD), NEA

LI, Jinfeng
Division of Radioactive Waste Management & Decommissioning (RWMD), NEA

RAGOUSSI, Maria-Eleni
Data Bank, NEA

MCMAHON, Kevin A.
Consultant

Appendix E:

Presentation materials used in the roundtable discussions

The presentations are available for download on the NEA website:
https://oecd-nea.org/download/rwm/roundtable/index.html

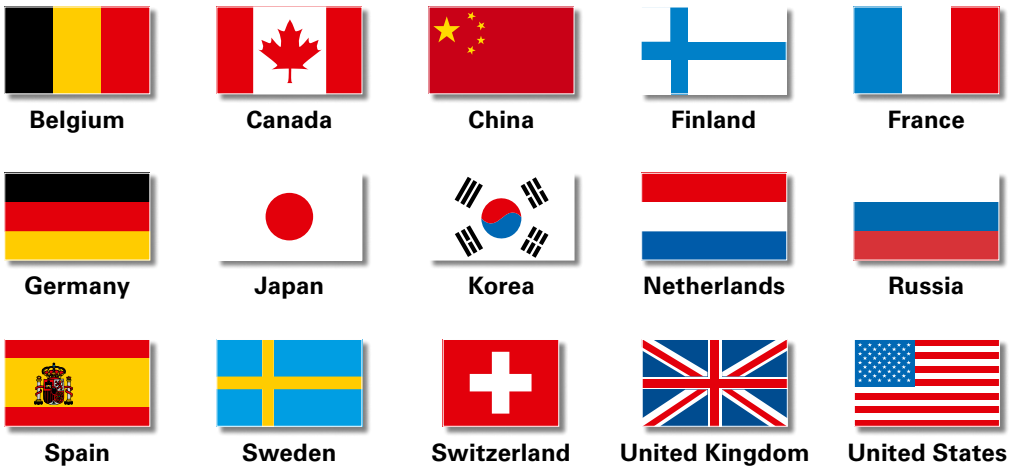
Leading Organisations

METI
Ministry of Economy, Trade and Industry

NEA
NUCLEAR ENERGY AGENCY

U.S. DEPARTMENT OF ENERGY

Participating Countries and Organisations



IAEA
International Atomic Energy Agency

NEA publications and information

The full **catalogue of publications** is available online at www.oecd-nea.org/pub.

In addition to basic information on the Agency and its work programme, the **NEA website** offers free downloads of hundreds of technical and policy-oriented reports. The professional journal of the Agency, NEA News – featuring articles on the latest nuclear energy issues – is available online at www.oecd-nea.org/nea-news.

An **NEA monthly electronic bulletin** is also distributed free of charge to subscribers, providing updates of new results, events and publications. Sign up at www.oecd-nea.org/bulletin.

Visit us on **Facebook** at www.facebook.com/OECDNEA or follow us on **Twitter** @OECD_NEA.

OECD/NEA Publishing, 2 rue André-Pascal, 75775 PARIS CEDEX 16

International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel: Summary Report

Worldwide consensus exists within the international community that geological repositories can provide the necessary long-term safety and security to isolate long-lived radioactive waste from the human environment over long timescales. Such repositories are also feasible to construct using current technologies. However, proving the technical merits and safety of repositories, while satisfying societal and political requirements, has been a challenge in many countries.

The Ministry of Economy, Trade and Industry of Japan, the United States Department of Energy Office of Nuclear Energy and the OECD Nuclear Energy Agency co-organised a forum for discussion with the aim of developing a strategy for addressing this challenge through international co-operation. At the International Roundtable meetings, policymakers from 15 countries and the International Atomic Energy Agency gathered and shared knowledge about public understanding and technological development related to final disposal.

This report is a summary of the discussions held and experiences shared during the two sessions of the International Roundtable on Final Disposal of High-Level Radioactive Waste and Spent Fuel, held on 14 October 2019 and 7 February 2020 in Paris, France.

Nuclear Energy Agency (NEA)
46, quai Alphonse Le Gallo
92100 Boulogne-Billancourt, France
Tel.: +33 (0)1 73 21 28 19
nea@oecd-nea.org www.oecd-nea.org

NEA No. 7529