

# Towards an ‘implementing geological disposal technology platform’ in Europe

M. PALMU<sup>1</sup>, T. ENG<sup>2</sup> AND T. M. BEATTIE<sup>3\*</sup>

<sup>1</sup> Posiva Oy, Olkiluoto, Eurajoki, Finland

<sup>2</sup> Svensk Kärnbränslehantering AB, Stockholm, Sweden

<sup>3</sup> Nuclear Decommissioning Authority, Radioactive Waste Management Directorate, NDA Harwell Office, Building 587, Curie Avenue, Harwell, Didcot, Oxfordshire OX11 0RH, UK

[Received 19 March 2012; Accepted 02 September 2012; Associate Editor: Nicholas Evans]

## ABSTRACT

Several European waste management organizations have started work on creating a technology platform to accelerate the implementation of deep geological disposal of radioactive waste in Europe. There is an increasing consensus in the international community about geological disposal as the preferred option for solving the long-term management of spent fuel, high-level waste and other long-lived radioactive wastes. At the same time, European citizens have a widespread desire for a permanent solution for high-level radioactive waste disposal. A majority of European countries with nuclear power have active waste-management programmes, but the current status and the main challenges of those programmes vary. The most advanced waste management programmes in Europe (i.e. those in Sweden, Finland and France) are prepared to start the licensing process of deep geological disposal facilities within the next decade. Despite the differences between the timing and the challenges of the different programmes, there is a joint awareness that cooperation on the scientific, technical and social challenges related to geological disposal is needed, and that it is beneficial for the timely and safe implementation of the first geological disposal facilities. Such a demonstration of a viable solution for the management of high-level radioactive waste will enhance stakeholder confidence in Europe. It is envisaged that a technology platform would enhance European cooperation in this area. The platform will provide a tool for reducing overlapping work, to produce savings in total costs of research and implementation, and to make better use of existing competence and research infrastructures. From 2008, SKB (Sweden) and Posiva (Finland) led the preparation work to set up the implementing geological disposal of radioactive waste technology platform (IGD-TP). Since then other implementers from France, Germany, Switzerland, United Kingdom, Spain and Belgium have joined the project. To date a strategic research agenda for the platform has been prepared and consulted upon, which is now the basis for taking the platform into a deployment phase.

**KEYWORDS:** platforms, geological disposal, radioactive waste.

## Introduction

THE main objectives of the implementing geological disposal technology platform (IGD-TP) are to initiate and carry out collaborative

actions in Europe to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level waste, and other long-lived radioactive waste by solving the remaining scientific, technological and social challenges, and thereby to support the waste management programmes in the member states (IGD-TP, 2009). The platform intends to enhance confidence in the solutions and implementation of

\* E-mail: Tara.Beattie@mcm-international.ch  
DOI: 10.1180/minmag.2012.076.8.57

geological disposal, to reduce overlapping work, to produce savings in total costs of research, development and demonstration (RD&D), and to make better use of existing competences and research infrastructures. The IGD-TP's work is driven by ten waste management organizations (WMOs) and one governmental body, that share a common vision that "by 2025, the first geological disposal facilities for spent fuel, high-level waste, and other long-lived radioactive waste will be operating safely in Europe" (IGD-TP, 2009). In 2011, the IGD-TP's strategic research agenda (SRA) has been prepared, consulted upon and published which identifies the main RD&D issues that need a coordinated effort over the next years in order to reach the 2025 vision (IGD-TP, 2011).

### Framework of the strategic research agenda

Despite the differences between the timing and the challenges in the different waste management programmes, there is a consensus that continued and strengthened cooperation on the scientific, technical and societal challenges and issues related to deep geological disposal is necessary for the safe and timely implementation of the first geological disposal facilities. Therefore, the

approach taken in the IGD-TP has been to adopt a framework within which the broad range of challenges and issues can be structured. In doing this in combination with considering the mature state of both the understanding of the geological disposal systems as well as the development of emplacement technologies and safety related components, the challenges and issues considered generally fall in one of the three main categories: (1) demonstration of long-term safety; (2) development and demonstration of disposal techniques and components; and (3) site characterization and confirmation of site suitability.

These broad challenges and issues comprise a wide range of RD&D from those on waste forms and site characteristics to disposal and sealing techniques involving various scientific and engineering disciplines (Fig. 1).

Adoption of a logical framework for which the SRA will fill in the areas where implementation-oriented research is needed facilitates the stepwise process to compile, characterize and prioritize RD&D issues that can be addressed to: (1) realise the vision of 2025; and (2) be deployed through enhanced cooperation and coordination among member states that the IGD-TP considers desirable and practically achievable.

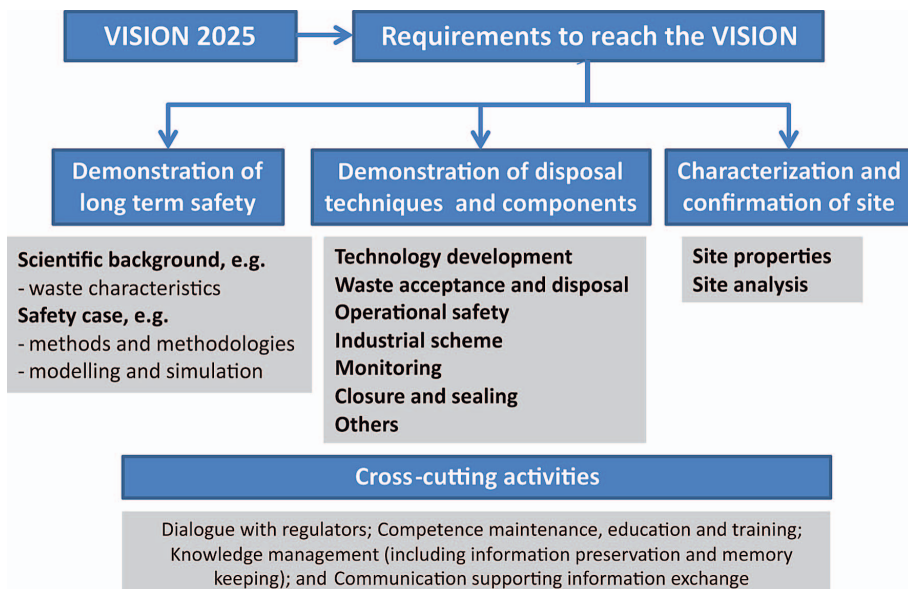


FIG. 1. Issues to be considered (grey boxes) during the SRA development and how these can be categorized (blue boxes).

**Staged approach to identify, characterize and organize issues of the SRA**

The IGD-TP has adopted a staged approach to identify, characterize and organize RD&D issues of the SRA, which consists of five steps undertaken through iteration and feedback to guide further development. These are each described below and illustrated in Fig. 2.

**Step 1**

Compilation of RD&D issues achieved by compiling those issues which are presently being worked on, or which are in the process of planning to achieve the vision of 2025, and are considered to be of high importance for each specific WMO programme (ONDRAF/NIRAS, 2001; Andra, 2005; BMWi, 2007; Enresa, 2009; Nagra, 2009; Posiva, 2010; PURAM, 2010; SKB, 2010; COVRA, 2011; Nuclear Decommissioning Authority, 2011; Radioactive Waste Repository Authority, 2011). This compilation takes into account the state-of-the-art understanding of the issues, and the existing forums and international

cooperation in the different scientific and technical areas.

**Step 2**

Classification of RD&D issues that most directly support implementation of the first geological repositories for spent fuel, and high-level waste and other long-lived radioactive waste, is therefore critical for the vision of 2025. Remaining RD&D issues have been evaluated using the so-called ‘knowledge gap’ by considering the current state of knowledge, against what each specific waste management programme needs to know in the current stage of their programme. This has focussed in particular on RD&D issues for programmes planning to submit a construction license application and for construction of a repository by 2025.

**Step 3**

Identification of common RD&D issues that could be addressed through international cooperation that do not overlap with existing collaboration and cooperative forums or exchanges. In

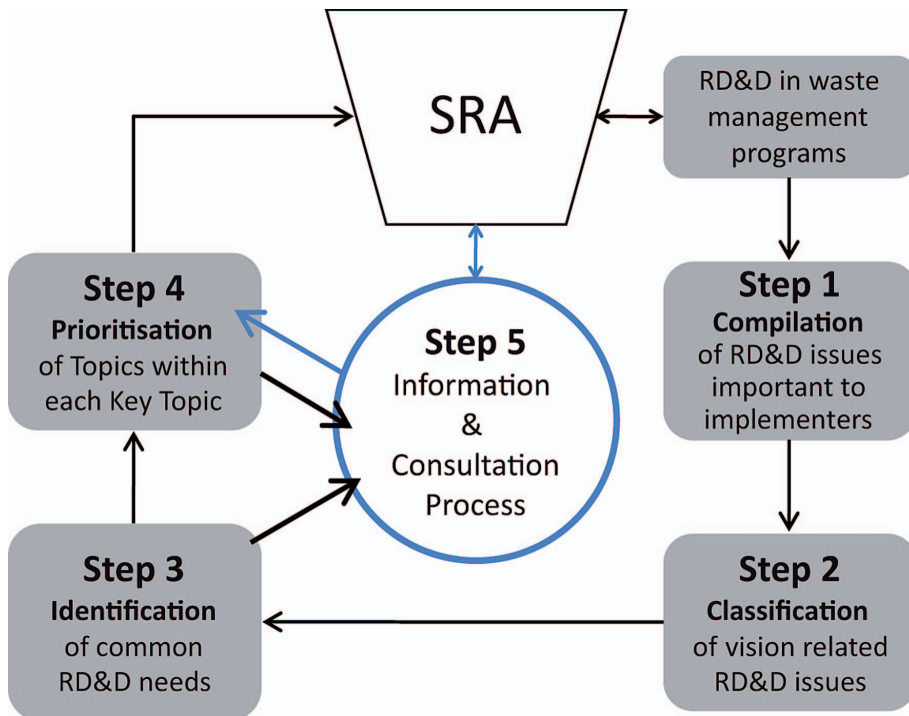


FIG. 2. Systematic and stepwise approach for developing the SRA.

doing this common RD&D issues have been identified, titled as *topics* and grouped according to their subjects into *key topics*.

#### Step 4

Prioritization of *topics* within each *key topic* by rating these according to their importance and urgency with respect to when the knowledge gap needs to be addressed aligned to WMO schedules for license applications (i.e. considering the date when the information or technological development is needed). The outcome of this step has been presented in the form of a simplified matrix diagram for each key topic by plotting time (using the dates of 2012 to 2025), *versus* importance (using high-medium-low) for each topic.

#### Step 5

Information communication and a consultation process has been carried out to gather input from stakeholders on their views of the outcome of steps 1 to 4. Input received from consultation of the draft SRA and a seminar held with participants of the IGD-TP (including organizations and individuals not endorsing the vision of 2025) provided constructive feedback used to influence the final SRA document and provided a degree of confirmation and approval from IGD-TP participants and stakeholders of its contents. Input received from the large number of reviewers who provided comments led to identification of seven thematic areas that were confirmed as key topics, mainly focussed on scientific and technical aspects of implementing geological disposal. The RD&D carried out to address each of these key topics, although individual thematic areas, will all contribute to, and impact on, overarching issues such as confidence building and acceptance of geological disposal among stakeholders.

### Key topics of the strategic research agenda

The seven main thematic areas defined as key topics are:

(1) *Safety case* focussed on improving confidence in the testing and refinement of the tools used in safety assessments (concepts, definition of scenarios and computer modelling codes), and improving safety case communication.

(2) *Waste forms and their behaviour* focussed on improving release fraction data and understanding of the dissolution behaviour for spent fuels (including spent uranium oxide fuel and magnesium oxide fuel), and improving data and

understanding for radionuclide release mechanisms and chemical species for long-lived intermediate-level waste.

(3) *Technical feasibility and long-term performance of repository components* focussed on the confirmation of repository components against predefined design specifications to determine their state before closure, and demonstrating that the disposal system will provide the required safety functions needed to fulfil the long-term safety criteria.

(4) *Development strategy of the repository* focussed on improving methodologies and developing strategies and approaches to be used during construction and operations to manage design adaptation and optimization of the disposal system.

(5) *Safety of construction and operations* focussed on improving methodologies, approaches and documentation on the safety of construction and operations, particular focussing on the assessment and management of risk with respect to safe working conditions.

(6) *Monitoring* focussed on improving the monitoring strategies and technologies for performance confirmation of the repository, including monitoring of the environmental baseline prior to operations.

(7) *Governance and stakeholder involvement* focussed on improving methods for the communication and integration of technical, social and economic information in an open and transparent decision-making framework.

For each of the key topics the SRA document illustrates the relative impact and urgency for undertaking work to achieve the 2025 vision. This is illustrated using 'impact vs. urgency' matrix diagrams together with a description of the key topic definition, high-level objectives, rationale and benefits. In addition, a summary of ongoing work in support of addressing each key topic is described, together with suggestions for the form of collaboration and cooperation that could be considered during deployment of the SRA.

### Cross-cutting and waste management programme specific activities

During the process of identification of RD&D topics for inclusion in the SRA, several cross-cutting activities have been identified that are a component of each of the 'key topics'. Such activities include: dialogue with the regulators; competence maintenance; education and training;

knowledge management; and communication and use of RD&D results.

In addition, several activities have also been identified that are required for meeting the 2025 vision, but which are considered highly dependent on the specifics related to each geological disposal programme. Most of these issues have been omitted from the SRA due to their programme specificity. Nonetheless, these activities continue within each waste management programme and identification of commonalities between the various programmes should be made and where beneficial, collaborative work for developing common approaches should be pursued. Such activities include: site characterization issues; transportation; requirement management systems; waste acceptance (quality assurance and safeguard issues); industrial scheme (engineering resource, procurement and manufacturing aspects); and economics of funding and planning.

### Deployment of the SRA

The cooperation of programmes, which are at different stages of implementation and follow different time schedules, is an essential part of the IGD-TP. Joint research to address the topics of the SRA using the foundation of the IGD-TP is beneficial not only to the WMOs directly engaged but also to the other programmes, and to some extent also to the stakeholders concerned. It is acknowledged that cooperation will mean active involvement in specific projects, as well as sharing results and knowledge between programmes at different stages. The forms of cooperation and technology transfer are currently being further developed in the IGD-TP's deployment plan. This is currently piloting a subset of projects to support the development of appropriate contracting arrangements and legal frameworks to facilitate the continued and enhanced cooperation on key topics going forward.

### Acknowledgements

Development of the IGD-TP SRA was carried out by the SRA working group, consisting of representatives from all of the IGD-TP member organizations, together with the assistance of the SecIGD (Secretariat IGD-TP) project supported by the EUROATOM 7<sup>th</sup> Framework Programme. Member waste management organizations include Andra (France), BMWi (Germany), Enresa (Spain), Nagra (Switzerland), NDA (United

Kingdom), ONDRAF/NIRAS (Belgium), PURAM (Hungary), Posiva (Finland), SKB (Sweden). The authors of this paper gratefully acknowledge the support from Christophe Davies, the EC, and each member organization and respective individuals in developing this summary of the IGD-TP SRA, which is aimed at increasing the awareness of the IGD-TP among interested stakeholders in the geological disposal of radioactive waste in the UK and overseas.

### References

- Andra (2005) *Dossier 2005: Andra research on the geological disposal of high-level long-lived radioactive waste*. Andra, Chatenay-Malabry, France.
- COVRA (2011) *Research Plan*. COVRA report OPERA-PG-COV004. COVRA, Nieuwddorp, The Netherlands.
- BMWi (2007) *Schwerpunkte zukünftiger FuE-Arbeiten bei der Endlagerung radioaktiver Abfälle (2007–2010), Förderkonzept des Bundesministeriums für Wirtschaft und Technologie*. BMWi Ref. IIIB3, und Projektträger Karlsruhe, Wassertechnologie und Entsorgung (PTKA-WTE). BMWi, Berlin ([http://www.ptka.kit.edu/downloads/BMWi\\_FoerderkonzeptFuE\\_Dez2007\\_067909\\_en.pdf](http://www.ptka.kit.edu/downloads/BMWi_FoerderkonzeptFuE_Dez2007_067909_en.pdf)).
- Enresa (2009) *Plan de I+D 2009–2013*. Enresa Publicación Técnica. Enresa, Madrid.
- IGD-TP (2009) *Implementing Geological Disposal of Radioactive Waste Technology Platform, Vision Report*. Published as EC special report EUR 24160 EN.
- IGD-TP (2011) *Implementing Geological Disposal of Radioactive Waste Technology Platform, Strategic Research Agenda 2011*. IGD-TP report.
- Nagra (2009) *The Nagra Research, Development and Demonstration (RD&D) Plan for the Disposal of Radioactive Waste in Switzerland*. Nagra Technical Report NTB 09-06. Nagra, Wettingen, Switzerland.
- Nuclear Decommissioning Authority (2011) *Geological Disposal: R&D Programme overview, Research and development needs in the preparatory studies phase*. NDA Report NDA/RWMD/072.
- ONDRAF/NIRAS (2001) *SAFIR 2 Report*. NIROND 2001-06 E. ONDRAS/NIRAS, Brussels.
- Posiva (2010) *Nuclear Waste Management at Olkiluoto and Loviisa Power Plants Review of Current Status and Future Plans for 2010–2012*. Posiva, Eurajoki, Finland.
- PURAM (2010) *A Radioaktiv Hulladékokat Kezelo Kozhasznu Nonprofit Kft. tizedik kozepes hosszu tavu terve a Kozponti Nuklearis Penzugyi Alapbol finanszirozando tevenyesegekre*. [The tenth mid and long term plan of public agency for radioactive

- waste management for the activities to be financed from the central nuclear fund, in Hungarian]. Public Limited Company for Radioactive Waste Management (PURAM), Budapest.
- Radioactive Waste Repository Authority (2011) *Koncepce vědy a výzkumu v oblasti ukládání RAO a VJP pro období 2011–2015*. [Research and development concept in the field of raw and spent nuclear fuel disposal for years 2011–2015, in Czech]. Radioactive Waste Repository Authority (RAWRA), Prague.
- SKB (2010) *RD&D Programme 2010. Programme for research, development and demonstration of methods for the management and disposal of nuclear waste*. SKB Technical Report TR-10-63. Swedish Nuclear Fuel and Waste Management Company (SKB), Stockholm, Sweden.