The Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP) - Main Achievements to Date and Way Forward – 14078

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ABSTRACT

The Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP) was launched on November 12, 2009. This Technology Platform has 107 members sharing the 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".

To achieve this goal, the platform led by eleven European organizations in charge of the radioactive waste management in their respective countries, have produced a Strategic Research Agenda (SRA) and a Deployment Plan (DP) to implement the remaining Research, Development and Demonstration (RD&D) issues through technical projects and cross-cutting activities. The Deployment Plan was published in 2012 and its first annual update has occurred in 2013 taking into account the outcomes of the working groups which were established to address the technical challenges which were identified as issues of common interest for the Technology Platform participants.

Currently there are seven European projects which are aligned with the objectives of the SRA. A new project is about to start and three additional have been submitted in response to the first H2020 call. The IGD-TP expects to initiate in the forthcoming years a minimum of two EU technical projects per year and at least one internal project. Alongside these technical projects, the IGD-TP is engaged in a collaborative work with other European technical platform or projects to identify future technical priorities arising from the evolution of reactor technologies and the evolution of the regulators needs for safety assessment.

In addition, two specific actions are supported by the IGD-TP's Secretariat to address the needs of the new Member States which are identified within the platform as "less advanced programs". The first one is a support for networking, structuring and developing RD&D competences in countries with less advanced geological disposal programs. This action has been specifically set up to help the RD&D in these countries to meet the requirements of the European "Waste Directive". The second action is support for the development, implementation and coordination of Competence Maintenance, Education and Training (CMET) activities in geological disposal in Europe which aims to facilitate the access to expertise and technology and maintaining competence of old and new Member States. A dedicated International conference will take place in in Manchester in June 2014 to achieve this goal.

Four years after its inception, the IGD-TP is now recognized by the nuclear industry as the key actor for the RD&D in radioactive waste geological disposal programs. The Platform takes into account differences between the timing and challenges for the respective national programs. Following implementation of the Finnish disposal program it is expected that within the next five years the construction of the Swedish and French geological disposal facilities will commence.

INTRODUCTION

After decades of bilateral and multilateral cooperation, several European waste management organizations decided, under the auspices of the EC, to join their forces to tackle the remaining research, development and demonstration (RD&D) challenges associated with the implementation of their respective geological disposal programs. The Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD–TP) was launched in November 2009 with a 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"(Vision 2025). Aside from most of European waste management organizations, the IGD–TP now includes 107 members covering most of the RD&D actors in the field of implementing geological disposal in Europe.

CONCEPT AND CREATION OF IGD-TP

European technology platforms (ETPs) were set up, in 2003 as industry-led stakeholder forums with the aim of defining medium to long-term research and technological objectives and developing roadmaps to achieve them [1]. Their aim was to contribute to increasing synergies between different research actors, ultimately enhancing European competitiveness.

The main objectives of the 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 supporting the waste management programs in the Member States. The platform intends to enhance confidence in the solutions to these problems and the implementation of geological disposal, to reduce overlapping work, to produce savings in total costs of RD&D, and to make better use of existing competences and research infrastructures [3].

In 2011, this approach was enhanced in the field of radioactive waste management by the focus provided by the recent European Council Directive 2011/70/EURATOM [4] on establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, alongside with the existing forums of the European Nuclear Energy Forum (ENEF), ENSREG and the technological platforms (SNE-TP, IGD-TP and MELODI).

The IGD-TP's work is driven by ten waste management organizations (WMOs) and one governmental body.

As of June 2013, IGD-TP has 107 participating organizations endorsing the vision and representing stakeholders with a wide range of backgrounds e.g. waste management organizations, industry, research institutes, research centers and academia.

STRATEGIC DOCUMENTS

In line with other ETPs, IGD-TP has brought together stakeholders, reached consensus agreement on a common vision and established a Strategic Research Agenda (SRA). In addition, IGD-TP has developed an implementation plan called "Deployment Plan" (DP) detailing the actions required for implementing the SRA.

The Vision Document

The Vision Document presents the IGD-TP members' Vision 2025 and their commitments for the future:

- Build confidence in the safety of geological disposal solutions among European citizens and decision-makers.

- Encourage the establishment of waste management programs that integrate geological disposal as the accepted option for the safe long-term management of long-lived and/or high-level waste.
- Facilitate access to expertise and technology and maintain competences in the field of geological disposal for the benefit of Member States.

In the framework of the setting up of a common vision, the waste management organizations have agreed that it is timely to proceed with licensing the construction of deep geological repositories despite public and political debate related to the siting of such facilities.

The Strategic Research Agenda

The IGD-TP Vision 2025 can be achieved through the progress of individual waste management programs towards the implementation of geological disposal. Waste management programs are normally based on the assessment of what is needed to proceed from the current state-of-the-art of the program to the practical implementation and operation of the repository. Currently, the Vision 2025 is within reach in a few European Union Member States. In some programs a longer period is still needed for preparation, whilst others are at an early stage of development. Therefore, it is natural that the recognized RD&D needs of the programs closest to licensing receive particular attention in the content of the SRA as these will be critical for achieving the Vision 2025.

For these reasons, the SRA emphasizes those RD&D activities that are critically important for the programs closest to licensing but which, at the same time, produce results that are useful and of interest for other participating programs as well.

The identification of Key Topics for the SRA started with inputs from participating WMOs using individual host-rock specific safety cases and associated RD&D programs. For those organizations yet to decide on host rock geology, their generic RD&D programs were used.

The SRA was published in July 2011[5]. The strategy for the joint RD&D interest was organized in seven Key Topics comprising of a total of 37 individual Topics. The majority of the Topics concentrate on the "Technical feasibility and long-term performance of repository components" reflecting the maturity of the repository development in the waste management programs closest to licensing. Additionally Cross-Cutting Activities (CC) and Waste Management program specific activities (WMS) are also identified.

The seven Key topics are presented in figure1:

Fig.1. the 7 Key Topics

The Deployment Plan

The Deployment Plan (DP) [6] was published in June 2012. It addresses the Joint Activities that were

derived from the SRA's Topics and which are currently active or will start during the period 2011-2016. The key information in the DP consists of the first Master Deployment Plan (2011-2016) presented in a timetable and decision-making forms and Joint activities outline. This Master Deployment Plan is updated annually according to decisions made by the IGD-TP's Executive Group.

The review of the 37 Topics listed in the IGD-TP's SRA made it possible to identify 16 different types of Joint Activities that should be used to help the deployment of the SRA Topics, and more specifically to supply those tasked with the management of a given Topic (or Joint Activity) with guidelines to assist them in their task.

The 16 Joint Activities are presented in TABLE I:

TABLE I. Joint activities

Joint Activity Number	**Joint Activity Title and related SRA Key Topic or cross-cutting activities**
1	Waste form and their behavior [2]
2	Full scale demonstration of plugging and sealing [2]
3	Waste form and their behavior C14 [2]
4	Monitoring the Environmental Reference State [6]
5	Safety of construction and operations [5]
6	Confidence increase in safety assessment codes (concept, definition of scenarios and computer codes). Materials interactions: especially cement and clay based interactions [1] and [3]
7	Monitoring Program [6]
8	"Benchmarking" for confidence in Long Term Safety in Safety Cases [1]
9	Efficient peer review and related QA processes [1]
10	Long-term stability of bentonite in crystalline environments [3]
11	Various topics belonging to different categories. Topics concern the governance of the decision making and various topics related to the technical feasibility of repository components [7] and [3]
12	Adaptation and optimization of the repository [4]
13	Communicating results from RD&D [CC1, CC4]
14	Competence Maintenance, Education and Training [CC2]
15	Nuclear Knowledge management [CC3]
16	Waste Management Organization - Information Exchange Platform

Associated with the timetable, the Joint Activity outlines presents the framework in which technical projects could be developed. For the period 2012-2015 it is planned to upgrade the Master Deployment Plan and the Joint Activity outlines at the end of each year, taking into account Exchange Forum discussions and outcomes.

Since the DP depends on the strategy defined in the IGD-TP's SRA, when a new SRA is produced, the Deployment Plan document also needs to be updated. A new working group is then chosen by the EG to carry out the update of the SRA and the corresponding DP.

The next revision of the SRA may start early 2014 to be published at the end 2015.

SPECIFIC INVOLVEMENT OF LESS ADVANCED PROGRAMMES

T The above mentioned Joint Activities are of interest for all disposal programs irrespective of their current level of development. Furthermore, IGD-TP addresses the needs of less advanced programs.

In particular, a specific initiative has recently been launched to identify on the one hand key open (but not always easily accessible) documentation that could be used as state-of-the-art or best practices ("knowledge mapping") and, on the other hand, areas of technical transfer through agreements between more and less advanced programs.

In the EC SecIGD2 Project, supporting the Secretariat's work, two work packages are of specifically targeted at for these less advanced programs.

The first one is "Support for networking, structuring and developing RD&D competences in countries with less advanced geological disposal programs" This work package is specifically set up to help the RD&D in countries with less advanced programs in order to meet the requirements of the European "Waste Directive". Its intention is mainly to provide support and learning opportunities for the personnel from such Member States and at the same time support in the organization of Information Exchange Forums where expert knowledge is shared. In addition, public events are planned to present RD&D strategies and capabilities which could then be adapted and used by Member States.

The second work package is called "Support for the development, implementation and coordination of Competence Maintenance, Education and Training (CMET) activities in geological disposal in Europe". This activity aims to support the development and implementation of end-user needs-based of competence maintenance, education and training activities in the field of radioactive waste management and geological disposal.

More specifically, SecIGD2 assists the CMET working group, (which was launched in June 2012), in achieving its goals. The overall goal of this working group is to promote European cooperation in this cross-cutting area in support of the IGD-TP Vision and its activities is divided into four main objectives which are to (i) Identify and share the needs in knowledge, skills and competences (KSC) of the geological disposal community; (ii) Develop quality assurance of training for professionals in the field of nuclear waste management and especially geological disposal by means of common criteria and voluntary accreditation; (iii) To compile Develop the content of training needed for the implementation of IGD-TP's Strategic Research Agenda, and to (iv) Ensure indirectly that providers and new personnel will be available in the near future.

In addition, the evolving nature of the SRA allows the inclusion of any new initiatives aimed towards addressing the above needs.

ROLE OF IGD-TP IN THE FUTURE FOR THE EURATOM PROGRAMMES

The SRA should continue to be used as a basis for the EURATOM programs as it provides a vehicle to emphasize RD&D and networking activities that are important for establishing safety cases and fostering disposal implementation. It also ensures a balance between fundamental science, implementation-driven R&D and technological demonstration.

The need for disposal related RD&D will last for a long period of time, to ensure appropriate conception and assessment of future repositories, establishment and evaluation of related safety cases, as well as adaptive implementation and optimization of the operation of repositories.

IGD-TP may play also a key role for the EC's wish for increasing the number and nature of stakeholders involved in RD&D joint programming at the European scale. The first goal should be the greater involvement of new Member States with less advanced programs. They could benefit from the experience gained and could build their own program in a consistent European policy framework. Thus, in order to benefit from the evolution of SRA priorities, the Waste Management Organizations of these new Member States are strongly encouraged to join the Executive Group which is the main decision and governance body of IGD-TP.

Since its inception IGD-TP has been encouraged to network strongly with other TPs such as MELODI, SNE-TP or NUGENIA. For instance, development in new nuclear fuels should imply changes in the waste forms that will need to be disposed of in geological repositories. Indeed, the confirmation that this waste will be compatible with the current engineered barrier systems and host rocks may require intensive R&D over long timescales. In line with its vision, the issue for IGD-TP is primarily changes to be expected in the coming two decades (e.g. higher burn-ups, change of cladding materials, use of fuel form other than UO2, increased separation and recycling, change in the reprocessing end-product, Gen III reactors…).

Finally, in the forthcoming years, progress could be achieved through more cooperation and harmonization with other actors such as Technical Support Organizations (TSOs) in areas of R&D of common interest. In this way, the EU project SITEX interacts strongly with IGD-TP.

Nevertheless, any common grounds for discussion should clearly and strictly be defined in order to avoid any problem between the regulators and the implementers, specifically during the licensing phase of facilities. Thus, any planned dialogue structure should retain the specificities of the WMO needs and the "Vision 2025" on one hand, and guarantee the independence of the regulators and TSOs on the other.

IGD-TP should therefore keep on contributing to a sound, broadly shared, societally accepted and transparent scientific and technological basis for geological disposal.

MAIN ACHIEVEMENTS TO DATE

In line with the SRA Key Topics and the DP, IGD-TP has currently set up 12 out of 16 working groups related to Joint Activities. Five of them have convened at least once in the first half of 2013.

In addition, 7 EU projects, launched after the IGD-TP creation, are followed up by members and their progress and outcomes are reported three times a year in Executive Group meetings. Three groups are actively preparing proposals which will be ready for the future first H2020 call.

We expect to launch in the forthcoming years a minimum of two EU technical projects per year and at least one internal project.

Internally, we had strengthened our organization thanks to a secretariat supported by an EC Grant and its main actions are dedicated to the:

- Involvement of new stakeholders by the mean of an internal working group linked with the EU project InSoTec, whose leaders are invited to present their work in our Exchange Forum,
- Networking with other TPs to stimulate new ideas that could complement the SRA in view of the disposal of new waste types,
- Collaboration with other European projects such as SITEX, to define new grounds for interacting with the regulatory bodies, including TSOs.

The platform is also engaged in support for the Competence Maintenance, Education and Training group whose aim is to establish a coherent framework of training schemes aiming at preparing the shortage in engineers and researchers in the field of geological disposal that may occur in the future.

Finally, the platform is engaged in a process of dissemination of the IGD-TP activities and achievements. This has led to the development of a new website (www.igdtp.eu), an increasing participation to conferences organized to address, in particular, the needs and projects of the New Member States and the cooperation with EU.

The IGD-TP is organizing an international conference on geological disposal in June 24-26, 2014 in Manchester which will focus on themes based on the topics in the SRA, raised in the IGD-TP Exchange Forums and the perceived needs raised by the less advanced programs.

CONCLUSIONS: CHALLENGES IN RD&D

The avenues for the development of possible studies for the coming decades include: i) the improvement of excavation and sealing techniques, ii) hydro-geochemical and gas experiments focused on the global observation of disturbances of confinement properties in connection with repository materials, iii) the development of robust monitoring devices for long-term surveillance of the geological media and the surface environment, and iv) opinion building for the public.

For all the geological disposal concepts, the design, construction and performances of seals are the subjects of special purpose in-depth studies. The sealing materials (swelling bentonite clays in compact blocks or granular backfills) are artificially saturated because of the very low production of water in argillaceous formations. However, sealing experiments with natural saturation and with measurement devices to monitor over several decades are planned.

Hydro-geochemical and gas experiments cover a large range of topics such as i) characterization of pore water and its thermal, oxidizing, bacterial perturbations, ii) characterization of interactions between water/rock and repository materials, iii) continued study of the radionuclide diffusion mechanisms, iv) study programs into the consequences of rock saturation and de-saturation, and v) study programs into the generation of gases from packages and their migration through the rock and sealing devices.

The development of strategies and techniques for repository surveillance, called monitoring, addresses the need to ensure that the engineering works have the expected quality and long-term performance. In addition, these strategies must provide input for decision-making about the operation of a repository, i.e. to decide on the transition from one operating phase to the next and to the final closure or a potential decision to retrieve waste packages.

Information and communication policy of implementers, safety authorities and regulators should be also developed to share the experiences, success or drawbacks to limit the risk of reject of the project by the public and allow their involvement at various level of decision.

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