



EUROPEAN
COMMISSION

European
Research Area

PROJECT PRESENTATION (PP)

Monitoring Developments for safe Repository operation and staged closure MoDeRn



Contract (grant agreement) number: 232598

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Date of issue of this report: 27/01/2010



Nature, scope and potential impact of the MoDeRn project

Spent nuclear fuel and long-lived radioactive waste must be contained and isolated for very long periods, and current schemes for its long-term management involve disposal in deep geologic repositories. The successful implementation of a repository programme for radioactive waste relies on both the technical aspects of a sound safety strategy and scientific and engineering excellence as well as on societal aspects such as stakeholder acceptance and confidence. Monitoring is considered key in serving both ends. It underpins the technical safety strategy and quality of the engineering, and can be an important tool for public communication, contributing to public understanding of and confidence in repository behaviour.

The main goal of MoDeRn (**M**onitoring **D**evelopments for safe **R**epository operation and staged closure), a four year Collaborative Project funded under the 7th Framework Program for Nuclear Research and Training (EURATOM) is to establish a roadmap for developing and implementing various monitoring activities for deep geological repositories. This 'reference framework' will draw on experiences and lessons learned from waste-management programmes in different countries and will integrate new information from various stakeholder-engagement activities. It will cover all stages of the disposal process, and will suggest ways of integrating monitoring results in the decision-making process.

To achieve this, MoDeRn is reviewing broadly accepted monitoring objectives and elaborating them to better reflect the actual implementation of disposal monitoring activities. The project also aims to verify whether these objectives are likely to address both expert and non-expert stakeholder expectations. To this end, MoDeRn project partners seek to better understand repository monitoring activities and technologies and to provide recommendations for stakeholder-engagement activities.

As a core part of its proposed activities, MoDeRn will provide a clear description of monitoring objectives and strategies, taking into account a variety of physical and societal contexts, available monitoring technology, and feedback from both expert and non-expert stakeholder interactions. In relation to this, the project has defined the technical requirements of monitoring activities and has begun to assess the latest relevant technology. A technical workshop involving other monitoring Research and Technology Development (RTD) projects was hosted to identify RTD techniques that enhance our ability to monitor deep geological repositories. In particular, innovative monitoring approaches specific to repository design requirements are being tested within underground research laboratories. In addition, a case study was initiated to illustrate the process of mapping objectives and strategies onto the processes and parameters that need to be monitored in a given context, with a further aim to illustrate the potential design of corresponding monitoring systems and possible approaches to prevent and detect measurement errors. The case study will also show how unexpected repository evolutions may be handled.

Interaction with stakeholders is at the heart of the MoDeRn project. Workshops and conferences will provide opportunities to report and discuss results with the research community, experts (e.g. from technical safety organisations) and non-experts (e.g. from civil society) and to collect feedback. A **website** (www.modern-fp7.eu) will provide updated information about progress (e.g. via project Deliverables) and events (e.g. workshops) as well as access to relevant publications.

Collectively, these activities will form the basis for a 'roadmap for repository monitoring' and may have a significant societal impact. The project also aims to propose an approach to enhancing confidence in the disposal process by describing feasible monitoring activities, highlighting remaining technological obstacles, illustrating the possible uses of monitoring results and suggesting ways to involve stakeholders in the process of identifying monitoring objectives. The resulting 'roadmap' will then enable radioactive waste management organisations in Europe and beyond to further progress towards implementing deep geological repositories that are safe and acceptable for all.

MoDeRn project partners (in Table 1 below) committed to providing these expected results represent organisations responsible for radioactive waste management in the EU, Switzerland, the US and Japan as well as organisations having relevant monitoring expertise. Other partners offer substantial experience in researching how people interact with technology and finding ways to engage all stakeholders (e.g. civil society, experts, technical safety organisations, industry) in highly technical issues.

Table 1.1: List of MoDeRn Project Partners

Partner number	Partner full name	Short name	Country code (2-letter ISO code)
1	Agence nationale pour la gestion des déchets radioactifs	Andra	FR
2	Asociación para la Investigación y el Desarrollo Industrial de los Recursos Naturales	Aitemin	ES
3	DBE Technology GmbH	DBE TEC	DE
4	Empresa Nacional de Residuos Radioactivos S.A.	Enresa	ES
5	European Underground Research Infrastructure for Disposal of Nuclear Waste in Clay Environments	Euridice	BE
6	Nationale Genossenschaft für die Lagerung radioaktiver Abfälle	Nagra	CH
7	Nuclear Decommissioning Authority	NDA	UK
8	Nuclear Research and Consultancy Group v.o.f.	NRG	NL
9	Posiva Oy	Posiva	FI
10	Radioactive Waste Repository Authority	RAWRA	CZ
11	Radioactive Waste Management Funding and Research Center	RWMC	JP
12	Sandia National Laboratories	Sandia	US
13	Universiteit Antwerpen	UA	BE
14	University of East Anglia	UEA	UK
15	University of Gothenburg	UGOT	SE
16	Galson Sciences Ltd.	GSL	UK
17	Eidgenössische Technische Hochschule Zürich	ETH Zurich	CH
18	Svensk Kärnbränslehantering AB	SKB	SE

Current status on work performed and main results obtained during the first period

The project objectives are achieved through a comprehensive and coherent program of research structured along five interrelated RTD and demonstration work packages.

The **first work package** aims to provide guidance to advance the development of monitoring high-level principles forward to a level of detail for monitoring objectives and strategies that appear viable and can be readily linked to monitoring implementation in the different national programmes across all phases of the repository development.

Work has progressed, first (Task 1.1) by providing an overview of the various national contexts that would condition choices on repository monitoring and by summarizing key commonalities and differences, as well as the status of existing developments – production of a “National context” summary report with country annexes. In parallel to this, (Task 1.2) first developments of monitoring objectives and a first attempt to structure the approach of developing a monitoring programme were provided – production of a first version “Objectives and Strategies” report with country annexes. National stakeholder engagement experiments (Task 1.4) were prepared by providing a thorough analysis of the understanding and aims of the scientific and technical community on what monitoring may and should contribute to geological disposal (Task 1.3) – partial production of an “Understanding the Experts” report.

The **second work package** aims to provide a realistic assessment of the specific technical requirements for needed monitoring equipment, an overview of the state-of-the-art in monitoring approaches and technologies available and potentially useful for repository monitoring, highlighting those remaining technological shortcomings that may still represent an obstacle in meeting monitoring objectives as described under WP1, and improving on what is currently available by conducting several focused RTDs.

Work has progressed (Task 2.1) by providing a first description of technical requirements which will likely need to be addressed when developing, selecting and implementing monitoring technologies suitable to be used for the geologic disposal of radioactive waste – production of a “Technical requirements” report (Deliverable 2.1.1). It then proceeded (Task 2.2) by organizing and reporting on a workshop on monitoring technologies – hosting the “monitoring RTD workshop” and production of the corresponding workshop report (Deliverable 2.2.1) and by presenting an initial overview of available project knowledge in monitoring technologies state-of-the-art in the production of a first draft “State-of-the-art monitoring technologies” report. In parallel, (Task 2.3) several focused monitoring technology RTDs aimed at enhancing the available toolbox for repository monitoring were initiated and a draft intermediate progress report was prepared on:

- Wireless network techniques and adequate power sources,
- Wireless through-rock transmission,
- Geophysical monitoring techniques,
- Fibre optic sensors.

The **third work package** aims to develop in-situ demonstration of innovative monitoring techniques and provide a description of innovative monitoring approaches specifically responding to some of the design requirements of a repository.

Work has progressed (Task 3.1) by developing plans for the proposed demonstration programmes – production of a “Demonstrator monitoring programmes” report (Deliverable 3.1.1) and through initial installation and begin of the four corresponding monitoring experiments (Tasks 3.2 – 3.5):

- Testing and Evaluation of Monitoring Systems (TEM) to be undertaken at the Grimsel Test Site (GTS) Underground Rock Laboratory (URL) in Switzerland,
- Application of wireless data transmission monitoring technology in the GTS URL,
- Monitoring of the PRACLAY large-scale heating experiment in the HADES URL in Belgium, using micro seismic and fibre-optic based sensing techniques. In addition,

wireless techniques for the transmission of data from HADES to the surface will be tested,

- Integrated internal monitoring of inside of a disposal cell demonstrator, on its liner and its near-field in the Bure URL in France.

The **fourth work package**, consisting of a case study activity, aims at tackling all relevant monitoring aspects by considering a system design based on different monitoring concepts and adapted to different specific host rocks and engineered barriers. The cases to be studied in this work package should take the main objective and sub-objectives defined in work package 1 as a starting level and then address the sub-objectives to link them to monitoring relevant physical processes to the point of parameters actually be monitored by corresponding measurement systems.

Work has progressed (Task 4.1) by defining the cases to be studied as focused on the three most commonly considered host rocks – i.e. salt, clay and granite, as well as three different disposal concepts (the German, French, Finnish concepts), in order to cover the most relevant monitoring issues for final repositories of high-level heat generating radioactive waste. An initial draft developing possible monitoring processes and parameters for all three cases (Task 4.2) was developed as a basis for further discussions.

The **fifth work package**, aims at providing key dissemination activities towards the general public, stakeholders interested in certain technical/scientific aspects of repository monitoring. Work has progressed (Task 5.1) by designing a project website for communication of project internal and general public information – production and restricted/public access to the project website; (Task 5.2) by providing an initial project presentation and a communication action plan; (Task5.3) by planning and initial preparation for an expert stakeholder workshop to interact with a broader community expert in repository developments – production of a workshop brief; (Task 5.4) by developing first plans for an international repository monitoring conference.

A **final work package** will consolidate results from the previous work packages and provide a shared international view on how monitoring may be conducted at the various phases of the disposal process. This activity will start during the last period of the project.

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Project information

Project Website : www.modern-fp7.eu

Project type (funding instrument): Collaborative project – Medium-scale focused research project

Project start date: 01/05/2009

Duration: 48 months

Total budget: EUR 5 111 484

EC contribution: EUR 2 800 000

Picture of MoDeRn partners, at the First MoDeRn Workshop, 23-24 June 2009, Le Plessis-Robinson (France)

