



Exchange Forum 4

Working Group 2 “Monitoring”

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High importance and urgency topics

1. Monitoring strategies and programmes for Performance Confirmation (including development of tools for decision making on monitored data)
2. Monitoring technologies and techniques (operational phase)
3. Guidelines for monitoring of environmental reference state

Medium importance and urgency topics

4. Monitoring of EBS during operations
5. Post-closure monitoring

- Objective: Performance Confirmation
- Focused to operational phase

Scope of a potential targeted R&D and demonstration project on monitoring:

- Sensing technologies
- Data transmission systems
- Long term power supply systems
- Durability of electronics, fibre optics and associated materials
- Influence of radiation

Starting point: “Call for ideas” exercise

- Carried out among MoDeRn partners
- Inputs from 7 parties received
- Completed on June 2013

OBJECTIVES:

- Identify specific areas related to repository monitoring in which further research is required, and have strong influence on:
 - Strategies
 - Repository design
 - Repository implementation plans
 - Communication strategies (present and future)
- Serve as starting point for the definition of the objectives and scope of a potential future collaborative project on repository monitoring

Areas to be considered

- A. Strategy aspects**
- B. Technology development**
- C. Practical implementation**
- D. Communication & stakeholder involvement**

A. Strategy

	Topic	Priority
1	Identification of monitoring requirements and critical parameters in relation with the safety case	H
2	Identification of triggered values and uncertainties. Development of response plans	H
3	Definition of the monitoring approaches for the different phases of the repository. Role of Pilots and URLs.	H

B. Technology development

	Topic	Priority
1	New sensors and sensing technologies	H
2	Wireless communication systems	H
3	Long term power supply methods	H
4	Assessment of durability and reliability of components and systems	H
5	Robotic inspection systems for non-backfilled areas	m
6	Data management methods (interpolation, fusion, storage..)	m

C. Practical implementation

	Topic	Priority
1	Development of specific monitoring concepts	H
2	Use of data from demonstrators and existing data sets for performance assessment modeling. Feedback to the safety case analysis and to repository design	H
3	Demonstration of integrated monitoring systems	H
4	Integration of monitoring in repository design	m

D. Communication & SH involvement

	Topic	Priority
1	Structured stakeholders engagement processes	H
2	Practical guidance on transparent information exchange	H
3	Calibrating expert and stakeholder expectations	H
4	New tools for communication of monitoring results	m

NOTE: to be integrated in all areas

- **Proposal on project scope and objectives to EC**
- **Building up a consortium of interested parties (Jan- Feb 2014)**
- **Parties proposing specific activities**
- **Identifying roles, WPs, and tasks**
- **Budgeting (medium size project ?)**
- **Proposal completed by June 2014**
- **Proposal submission in September 2014**
- **Project to start in April 2015**

- A. Strategy aspects**
- B. Technology development**
- C. Practical implementation**
- D. Communication & stakeholder involvement**

A. Strategy aspects

1. Establishing links and inter-comparison between monitoring plans, the rationale for these plans, and the safety cases, in order to identify **monitoring requirements**, including the analysis of test cases to identify critical and non-critical **parameters**
2. Definition of procedures for the **analysis of data** and management of potential **deviations** from the expected system evolution, including the consideration of **response plans**, and the analysis of implications on the **safety case** and on the repository design and construction (e.g **Identification of triggered values and uncertainties**)
3. Definition of monitoring approaches : analysis of the **staged implementation** of monitoring activities during the different repository phases, and the potential role of Underground Rock Laboratory (URL) **tests and pilot** facilities, to define the monitoring approaches during the whole lifecycle. **Feedback to repository design**

B. Technology Development (1)

1. Development and demonstration of **sensors and sensing techniques**, including geophysics, with particular emphasis on methodologies and systems that do not affect passive safety, and on those which can monitor parameters of key significance to the safety case (e.g. chemical parameters **& Fiber optics sensors**)
2. Further development and demonstration of **wireless** communication systems for short, medium, and long distance links through solid materials, including non-electric systems, to improve its range of applications and to optimise energy requirements
3. Research and demonstration on smart **power supply** systems for buried sensors and data transmission equipment, for very long operational periods
4. Development and demonstration of mobile and **robotic inspection systems** for non-backfilled areas (**visual and non destructive methods**)

B. Technology Development (2)

5. Assessment of the long-term behaviour and the **durability** of the different types of **materials and components** used in monitoring systems (sensing devices, electronics, cables, casings, etc), taking into account the expected operating conditions (e.g., temperature, chemical environment and radiation field).
6. Development of **quality assurance** methodologies that enable the quantitative assessment of the **long term performance** of monitoring **systems** and components.

These two previous points have been merged

7. Development of methodologies for the **management and interpretation of data** provided by the monitoring systems, taking into account sensor drift and reliability, and including topics such as redundancy, data filtering, data correlation and extrapolation, and data fusion, as well as the database storage and management.

C. Practical implementation

1. Development and **design of disposal specific monitoring concepts**, based on modelling of natural end engineered systems, and taking into account the spatial heterogeneity, the density and location of measurements, and trigger values for critical parameters and locations
2. Integration of monitoring requirements with repository concepts, in order to include them in the technical **design of repository** facilities for the different geological environments (crystalline rock, clay, rock salt)
3. Demonstration of **integrated monitoring systems** including coupling of new and advanced technologies with well-known technologies in realistic conditions, to solve specific technical issues.
4. Analysis of monitoring data from **demonstrators and existing data sets** to examine the implications of monitoring results to the **safety case**, including the potential feedback to performance assessment modelling. **Feedback to repository design.**

D. Communication & Stakeholder involvement

Research into **stakeholder expectations** of roles and relationships in relation with monitoring, and development of strategies for the **involvement of stakeholders** and independent organizations in the different phases of monitoring.

Research into **communication** processes and development of strategies and methodologies for the communication of monitoring results in an effective and acceptable way in order to contribute to confidence building.

The proposed work would contribute to the development and evaluation of:

- *Structured stakeholder engagement processes*
- *Practical guidance on transparent information exchanges*
- *A practical, learning-based approach to calibrating expert and stakeholder expectations of monitoring*
- *Development of new tools for communications of monitoring results*

Note : These activities have to be integrated in all areas (each main previous points)