Aitemin

Association for Research and Industrial Development of Natural Resources

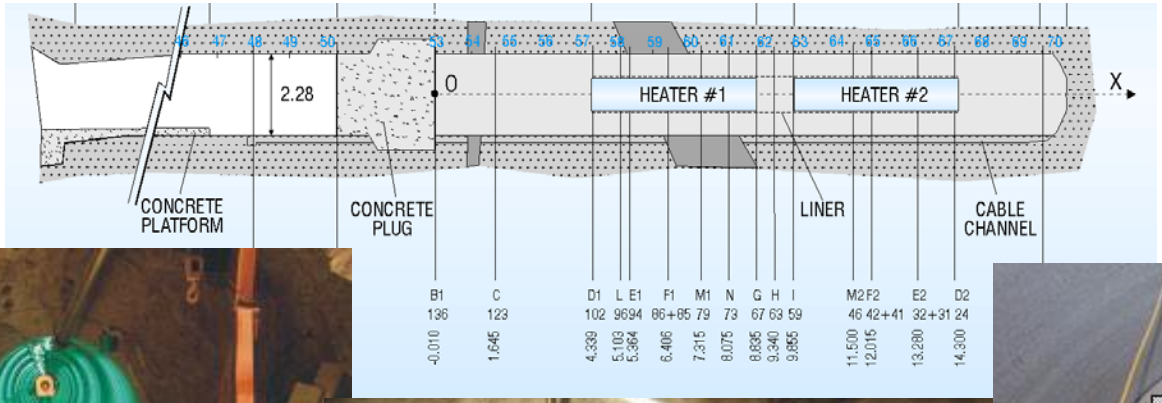
- **Technology Centre**
- **Private, non-for-profit character**
- **Established in 1977**

Technology fields related with WG2

Electronics and instrumentation	Control systems and data transmission
Information technologies	Advanced software development Computer Vision Virtual Reality simulators
Geotecnics and geophysics	Geotechnical instrumentation Georadar Electric tomography
Nuclear waste management	Site research and characterization Underground testing

Examples and references

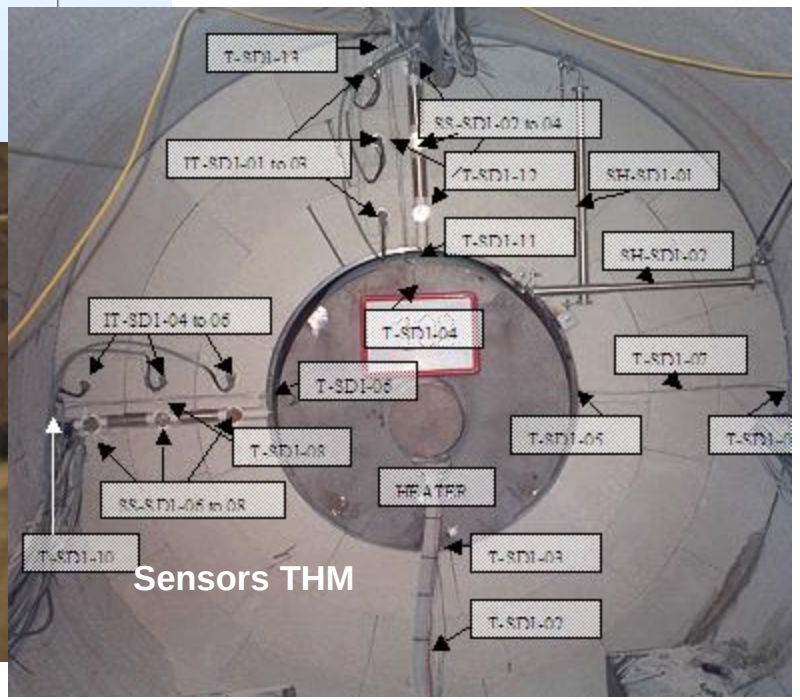
FEBEX (GTS) 1997-2015



Responsibilities:

Design, procurement (sensors, buffer, heaters, DAS), coordination & installation, operation, maintenance and reporting

Data adquisition and control



Sensors THM

Planning and Design | Set-up | 1st Operational Phase | 2nd Operational Phase

94 95 96 97 98 99 00 01 02 03 04 05 06 07

FEBEX
Jan 1996 – Jun 1999

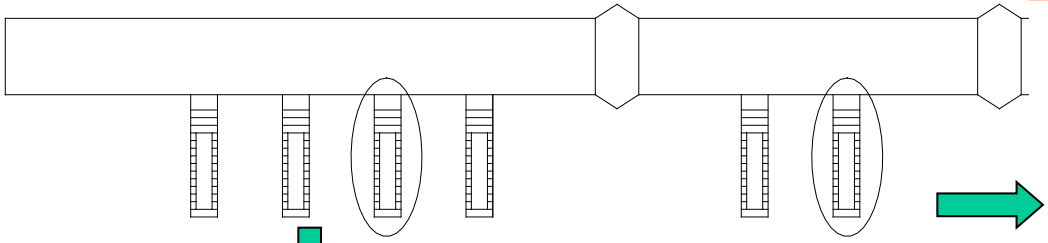
FEBEX II
Aug 2000 – Dec 2004

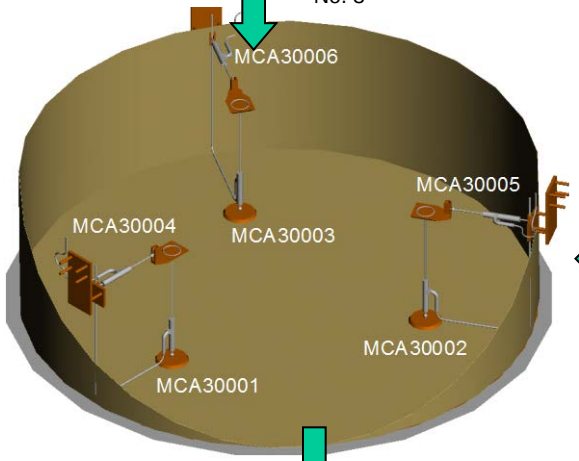
NF-PRO (WP 3.3)
Jan 2005 – Dec 2007

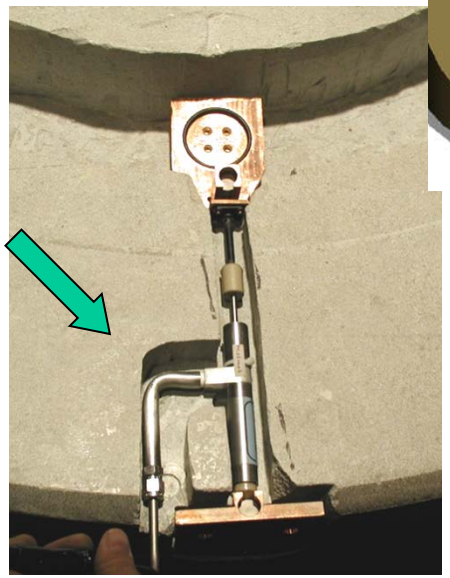
Consortium: SKB, POSIVA, NAGRA & CIEMAT
2008-2015

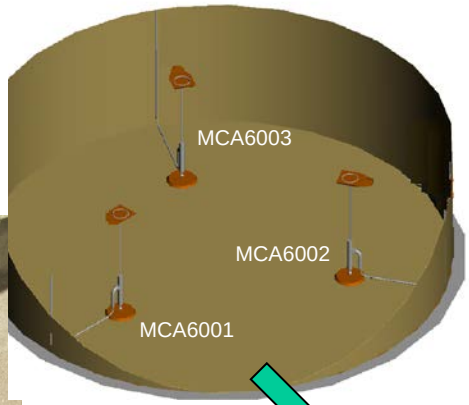
IGD-TP EF4 / Working Group Monitoring (WG2)

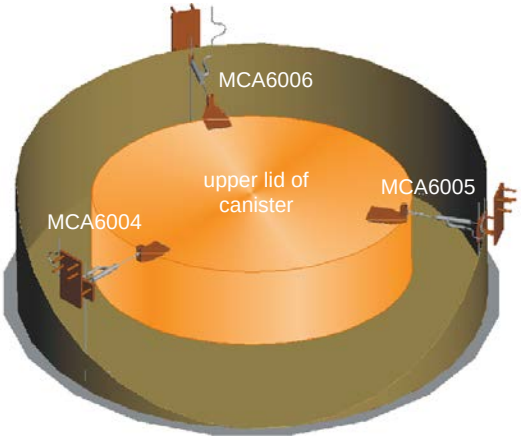
Prototype Repository (Äspö URL) 2002-2011

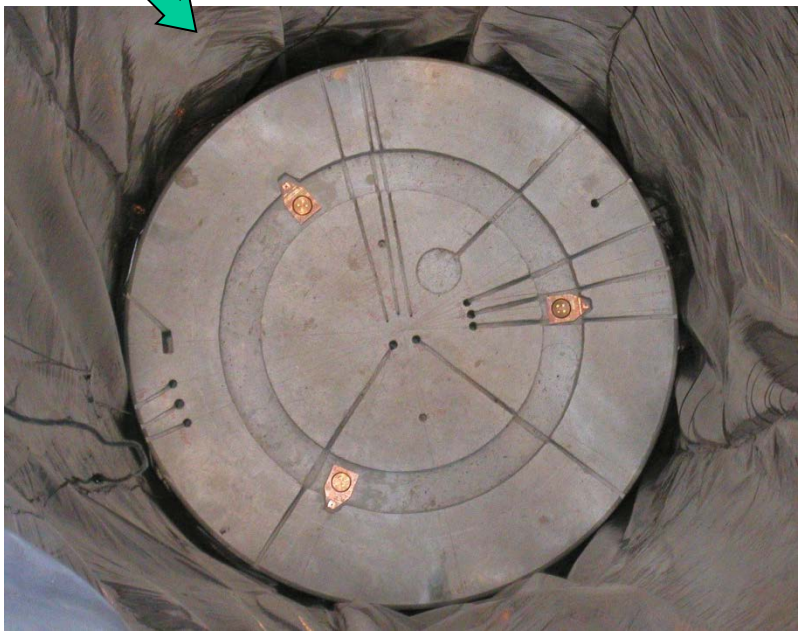












Responsibilities:

FO extensometers: design, procurement, installation and reporting

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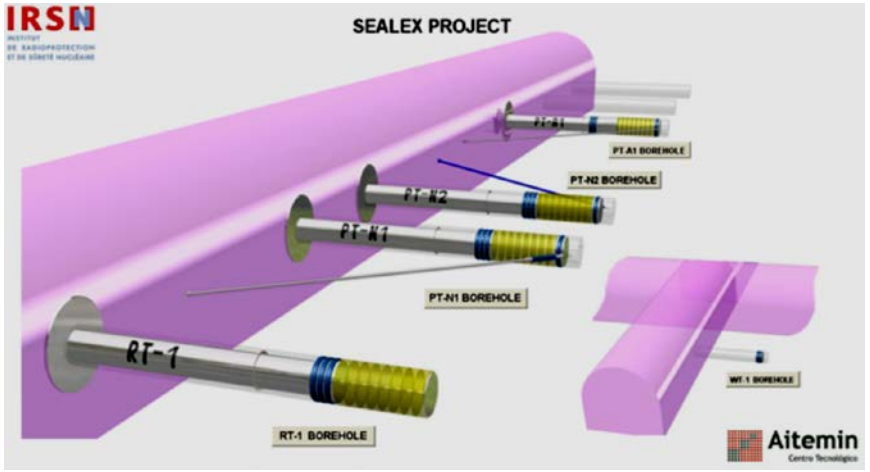
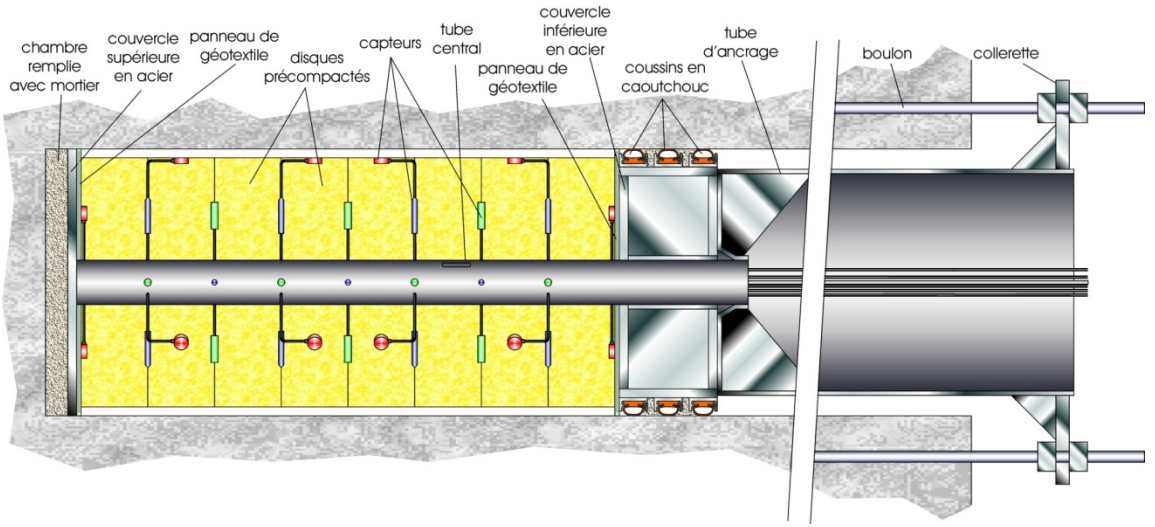
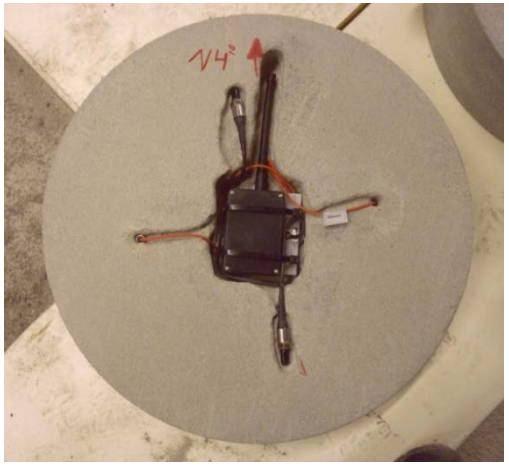
SEALEX (Tournemire URL) 2010-2015





Responsibilities:

Design, procurement (all components except bentonite and including DAS) installation, operation and reporting



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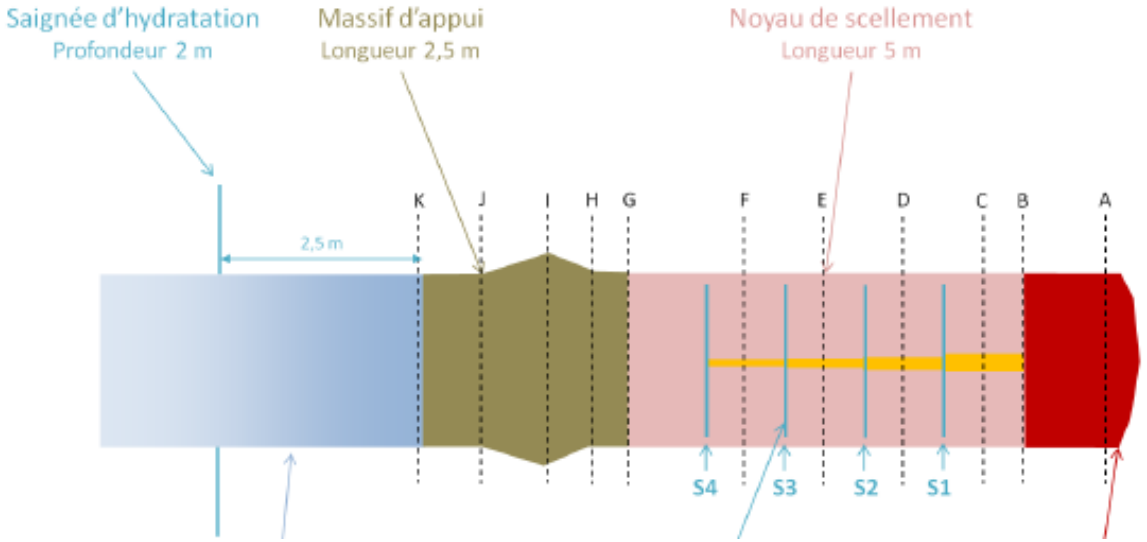
NSC (BURE URL) 2011-2015



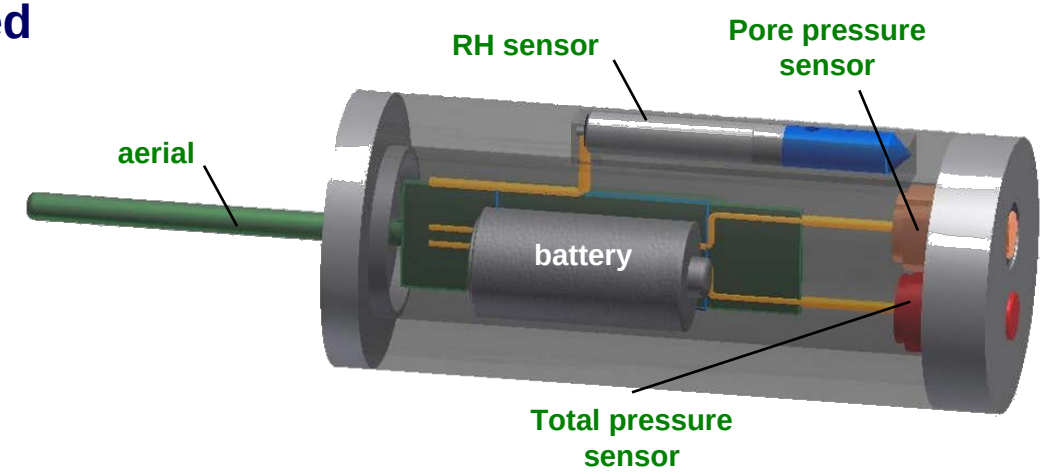
Responsibilities:

Design of instrumentation (types and layout), RH sensors and Hydration mats, procurement and installation, reporting and operation

IGD-TP EF4 / Working Group Monitoring (WG2)

MoDeRn (FP7 Euratom) 2009-2013

- **High Frequency Wireless (HFW) based sensing units:**
  - Wireless node: aerial, radio transceiver and battery pack
  - Four sensors: pore pressure, total pressure, humidity and temperature
- **Compact, high-pressure resistant all-in-one design (190 x Ø75 mm)**



Demonstrator at GTS

IGD-TP EF4 / Working Group Monitoring (WG2)

Key messages from MoDeRn project

- Main role of monitoring programs:
  - **Support confidence building**
  - **Support decision making process**

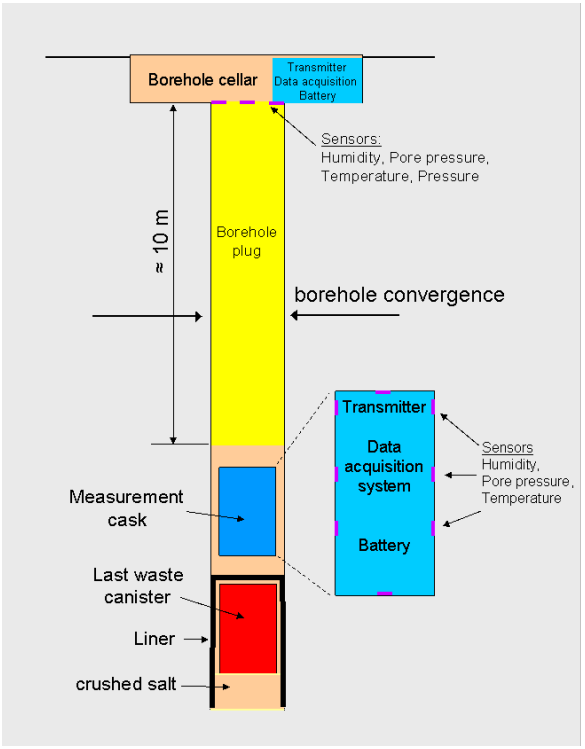
- MoDeRn project represents a significant step forward but it is recognized that monitoring the repository remains a significant challenge, in particular due to the limitations with regard the longevity and reliability of required equipment.

- Monitoring can only be conducted in selected locations and on specific components.

- Monitoring programs must no reduce the overall level of safety of the passive barrier system: systems based on wireless data transmission are a good option.

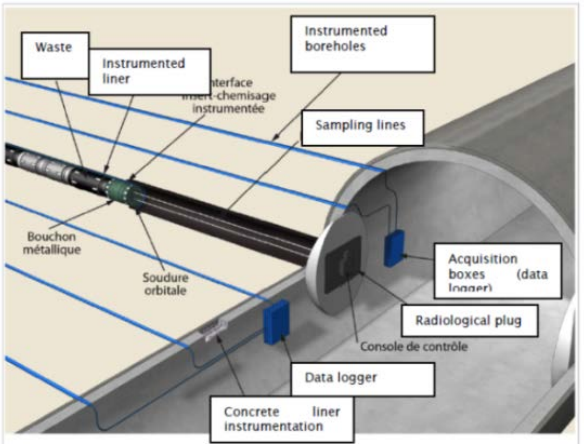
MoDeRn Case Studies Final Report

Measuring canister for borehole



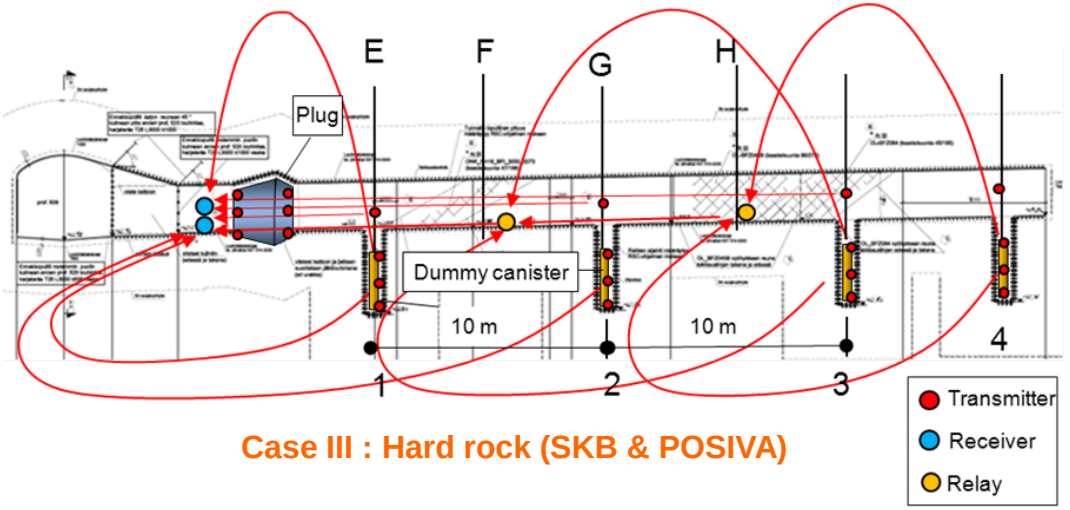
Case I: Rock salt (DBE TEC)

Withness structure



Case II: Argillaceous rock (ANDRA)

Near-field monitoring scheme



Case III : Hard rock (SKB & POSIVA)

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Proposals for future research

- Improvement of short range wireless transmission systems for repository monitoring:
  - **Power management: consumption reduction, new batteries, effective use of energy harvesting, etc**
  - **Compatibility with more sensor technologies**
  - **Signal hopping between nodes to cover longer distances**
  - **Units enduration: temperature, pressure, chemical attack, radiation, ageing,..**
  - **Size reduction (both wireless and sensors) to minimise the EBS system perturbation**
- Combination of short and long range wireless transmission systems applied to minitoring systems to reach the surface facilities without cabling: systems integration.
- Improvement and testing of the endurability of monitoring system components intended for future repository use under the expected conditions.
- Further demonstration of monitoring systems for repository, in particular those based on wireless data transmission systems.
- Improvement of monitoring data interpretation: correlation, data fusion, expert systems,..
- Development of new monitoring approaches in function of the staged implementation of the repository

IGD-TP EF4 / Working Group Monitoring (WG2)