

# LUCOEX

## Conference and Workshop - Summary and Conclusion - *Observations of Sc. Rapporteurs*

**Full-scale demonstration tests  
in technology development of repositories  
for disposal of radioactive waste**



# Session 1: National Programmes of DGD

## News from EC: Climate Change and Energy Policy, HORIZON 2020

- message: EC continuously did and will support national programmes on geological disposal by providing budgets for RD&D; IGD-TP has a key role to play in the evolution of EC policy!

## 4 Presentations on the status of National Programmes of DGD

- **in Sweden**; given by Magnus Westerlind, SKB: *messages*:
  - flexibility of licensing process with regard to conceptual modifications is an issue in Sweden; appropriate timing required
  - remaining challenges are the license and the industrialization of the Programme
- **in Finland**; given by Petteri Vuorio, Posiva: *messages*:
  - RD&D plan required (STUK) for demonstration tests (sealing, transport and emplacement machineries, etc.)
  - Waste package transport via shaft instead of ramp (safety reasons: encapsulation facilities directly positioned above repository mine)

# Session 1: National Programmes of DGD

- **in France**, given by Jean-Michel Bosgiraud, Andra: *messages*
  - Waste transport and handling demonstration tests only done on surface facilities; repetition under real repository conditions required
  - Industrial pilot phase (2025) of uppermost importance
  - Details in RD&D programme missing; e.g. proof of integrity of vaults construction over 100 years
- **in Switzerland**, given by Tim Vietor, Nagra: *messages*
  - strong driver of site selection and implementation process required to keep programme on track
  - Stakeholder engagement may have impact on decision of single repositories for ILW and HLW or a combined repository for both waste categories

## Session 2: Full Scale Tests (1)

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### 12 presentations describing LUCOEX, DOPAS, and MODERN programmes

#### Backfilling & sealing

- Technology demonstration, both equipment and procedures
- Optimisation of material composition
- Bentonite sensitive to humidity
- Swelling slower than anticipated
- Investigation of emplacement procedures => design changes
- Selection and perfecting of excavation tools and methods achieved
- Manufacturing large components found feasible
- Design bases for plugs/seals developed – approach and methodology applicable to other repository elements
- Feasibility of full scale sealing demonstrated

## Session 2: Full Scale Tests (2)

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### **Instrumentation and monitoring issues**

- Sensor longevity some decades, improves based on gained experience
- Specific materials and designs needed for better performance of sensors (temperature, corrosion)
- Wireless transmission and fibre optic cables – promising solutions but need more development
- Monitoring approaches – see MODERN 2020

### **Heating**

- Performance of the system satisfactory
- THM response to heating under control

### **Modelling**

- Results mostly consistent with measurements

## Session 2: Full Scale Tests (3)

### Highlights

- Experience provides bases for optimisation of technologies
- In situ tests are expensive but needed to recognize weaknesses
- DOPAS & LUCOEX experiments are complementary, their results are shared, links to MODERN, FEBEX
- Results of experiments satisfactory, challenges provide a shopping list for future activities
- Thorough planning – a key to successful implementation of experiments (incl. management manual and risk resolution)
- Need for keeping know-how and continuity of the staff, and assigning responsibilities
- All large scale experiments faced some delays – their analysis (reasons) would help in planning future experiments and DGR construction

## Session 3 : Excavation of Tunnels and Drifts

### 4 presentations on experiences gained during excavation work in the URLs Mt Terri, Bure and ÄSPÖ and on wire sawing

- FE tunnel excavation: Mont Terri:
- drilling of horizontal 300m boreholes, Äspä: HRL...
- excavation in Bure, transferable to Cigéo:
- wire sawing, Äspö HRL

#### messages:

- careful analysis of geological environment at the site needed to avoid surprises (faulted areas, anisotropic behaviour)
- horizontal drilling of 300m boreholes in crystalline rock requires detailed preparation and stepwise approach (small diameter and short distances to large diameter and long distances)
- excavation of different types of openings by appropriate technical means is state of the art: e.g. TBM for large drifts/tunnels; microTBM for emplacement cells; one challenge is the opening of liners after long time
- for excavating tunnels in crystalline rock wire sawing was explained as the cost saving alternative (enables parallel working in various tunnels in the mine at the same time)

# — Session 4: Production of Bentonite Blocks/ Granulates

## Manufacturing issues

- Bentonite blocks sensitive to humidity – equilibrium relative humidity concept
- Controlled environment needed while producing blocks – differs for different experiments
- Experimental equipment does not produce standard quality blocks
- Bentonite humidity – the main factor influencing quality of blocks

## Lessons learnt

- QA measures vital for the block quality, must be set as a part of the technology development
- Industrial production of blocks will result in standardisation of their quality
- Each type of product requires specific manufacturing conditions
- Pellets/granulate production is less challenging



# Poster Session

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- **some 30 posters** : shown in a dedicated poster session
- providing complementary information and details extending the messages given by the conference presentations (national programmes, LUCOEX, DOPAS)
  
- **messages:**
  - Full Scale Experiments needed to fully understand material behaviour (in particular bentonite),
  - Full Scale Experiments needed to fully understand repository processes (construction and QA measures under repository like conditions)
  - Full Scale Experiments needed to fully understand the reliable and safe operation of transport and emplacement technique

# Panel Discussion

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**Introduction:** Ann Caroline Wiberg: Utilization of LUCOEX-results for others:

**message:** results are valuable back-bones for the evolution of country specific waste management programmes

## **4 Presentations from 4 organizations on their programmes and plans related to large/full scale tests**

- Surao, Czech Republic (Vitezslav Duda); PURAM, Hungary (Kalman Benedek); INR, Romania (Marius Jordache); RWM , UK (Robert MacLaverty)

**messages:**

- international cooperation is a key facet in research strategy
- URL Research can help to achieve progress in national WM programme
- strong wish to benefit from achievements in particular EU funded RD&D projects
- interested in information exchange / cooperation / participation in future RD&D-actions

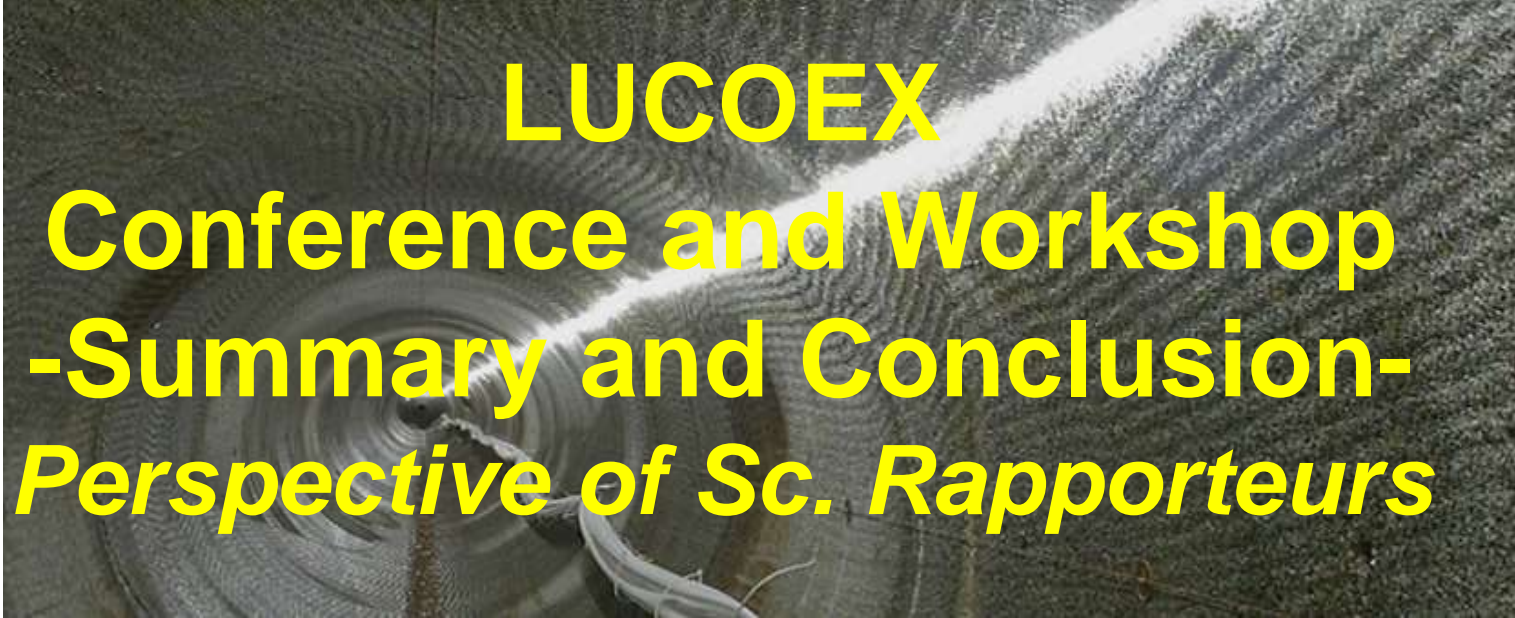
## 5 Panelist were discussing pros and cons of Full Scale Tests in URLs

### messages:

- reasons (**pros**) for performing/ participating in large/full scale tests:
  - **cost saving:** access to documented data (open platforms), participation in existing URLs instead of constructing own facilities (large or small size), conformation laboratories vs generic laboratories?
  - **confidence building:** people can get into contact to repository components prior to repository construction and operation, proper scientific work
  - **staff training** (security issues, mastering of procedure, knowledge transfer)
  - **development of quality management system** for repository construction and operation/closure
  - **Operational Safety:** FS-Tests provide real data on reliability and safety of repository components and techniques ), avoiding surprises and malfunction in real repository construction /operation (early involvement of safety authorities)
- few **cons** identified : early investments, share of financial burden, with time technologies might be state of the art an could be bought on market

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**LUCOEX**  
**Conference and Workshop**  
**-Summary and Conclusion-**  
***Perspective of Sc. Rapporteurs***

***Thank you for your Attention!***  
***Danke für Ihre Aufmerksamkeit!***  
***Děkujeme za vaši pozornost!***