EUROPEAN COMMISSION

Community research

LUCOEX

(Contract Number:269905)

DELIVERABLE (D1.8)

Author: Christer Svemar

Date of issue of this report: **12/06/12**

Start date of project : 01/01/11 Duration : 48 Months

Project co-funded by the European Commission under the Seventh Euratom Framework Programme for Nuclear Research &Training Activities (2007-2011)		
Dissemination Level		
PU	Public	PU
RE	Restricted to a group specified by the partners of the [acronym] project	
CO	Confidential, only for partners of the [acronym] project	

EURATOM

Minutes of Project Progress Meeting – PPM 02

Time: 14 March, 2012
Location: Olkiluoto, Finland
Participants: Erik Thurner, SKB
Fredrik Johansson, SKB (Chair of meeting)
Magnus Kronberg, SKB
Christer Svemar, SKB (Secretary of meeting)
Jacques Morel, Andra
Frédéric Bumbieler, Andra
Tim Vietor, Nagra
Hanspeter Weber, Nagra
Sven Köhler, Nagra
Timo Äikäs, Posiva
Jukka-Pekka Salo, Posiva
Keijo Haapala, Posiva
Christophe Davies, European Commission

Distribution: Participants, LUCOEX Steering Committee, European Commission (Deliverable D1.8)

1 Welcome and introduction

Timo Äikäs welcomed the participants to Olkiluoto. He informed of the latest Olkiluoto news (presentation enclosed as Appendix 1), among other things:

- The third reactor OL3 is scheduled to start production in late 2013, while the initial plan had 2009 as starting year.
- The OL4 project started late December 2011.
- Posiva will submit its construction licence application late this year to Government.
- Yesterday (March 14th) the Minister of Labour and Economy urged Posiva's owners to create a working group together with Fennovoima with the objective to analyse the possibility to host

also Fennovoima's estimated volumes of spent nuclear fuel in the planned repository at Olkiluoto. The working group is expected to present its findings by the end of 2012.

2 Chair of PPM 02

Fredrik Johansson chaired the meeting.
Christer Svemar provides minutes of the meeting.

3 Agenda

The draft agenda was accepted as distributed prior to the meeting - Appendix 2.

4 European Commission presentation

Christophe Davies presented general information from the European Union on Euratom FP 7 and the future FP8 (2014-2020). The latter programme is launched under the name "HORIZON 2020".

The presentation is enclosed as Appendices 3a and 3b.

Christophe Davies specially mentioned:

- Three projects have been funded from the last call on "Management of radioactive waste – geological disposal": BELBAR on bentonite erosion, FIRST-NUCLIDES on instant release from high burn-up spent fuel, and SITEX on networking among regulatory bodies. In addition a cross-cutting activity - NEWLANCER – was supported with the objective to enhance the number of different NMS taking part in future Euratom FPs.
- In total 20 projects and activities have up till now (5 calls) been funded in FP7 "Geological disposal" and "Cross-cutting projects". The EC contribution amounts to approximately MEUR 44.3.
- A last call with deadline March 27 2012 is expecting two proposals: Plugs and Seals (one Collaborative project) and Secretariat of IGD-TP (one Coordination and Support Action). The budget of this call is MEUR 9 ± 10%.
- For the FP8 the Euratom budget is presently set to MEUR1788 (of which MEUR 355 is for fission, MEUR 710 for fusion and MEUR 724 for JRC – Joint Research Centre.)
- Number of supported projects is expected to decrease – from 40 to 30 – by shifting strategy from supporting specified projects to also support programmes or funding management of programmes. Joint programming is in this context judged to become prioritized.
- First call of FP8 will be launched early January 2014.
- Discussion is on-going on how to proceed in extending possibilities of supporting whole programmes in addition to supporting projects.

Christophe Davies also pointed out that two major events will take place in Luxemburg:

- International symposium and workshop on "Gas migration and generation" (FORGE project) on 5 to 7 February 2013.
- International conference and workshop on "Monitoring in geological disposal and radioactive waste" (MODERN project) on 19 to 21 March 2013.

5 Progress and plans - WP 1 and WP 6 (Coordinator)

Fredrik Johansson presented the status of WP 1 and WP6. The presentation is enclosed as Appendix 4. He especially mentioned:

- Time schedule
  - Nagra: A draft WP 2 Project plan has been distributed for comments. It is intended to be adjusted according to comments and to be finished before March 31.
  - Nagra: The Tunnelling Report is delayed, and construction work starts first next week. The work is judged to be completed with no further delay and end in July.
  - Andra: The tunnel excavation work is a few months late. It will be carried through in September-October instead of earlier intended February-March.
- Periodic report
  - Fredrik Johansson distributes instructions for the up-coming 18- month periodic reporting (due in June).
- Staff secondment
  - Andra and Nagra will issue their announcements soon.
- Website and Projectplace
  - Both have been established and are in operation.
- Scholarships
  - A wide distribution has been made but with discouraging result; no applicants have announced interest for the first event, the Olkiluoto workshop (tomorrow). All participants were asked to investigate ways of improving the response to the coming events.
- Risk list
  - Up-dates have been received from SKB and Andra. Posiva and Nagra will provide their inputs soon.
- Added Value
  - Five organizations – ONDRAF/NIRAS (Belgium), BfS (Germany), Javys (Slovakia), SERAW (Bulgaria) and Ministry of Economy (Poland) – have announced interest and an Activity Plan for dissemination activities with these organizations will be made. It will focus on a pre-judgment of added value to the organisations' respective RD&D programme, dissemination activities, and evaluation of the outcome.
  - Christer Svemar raised the question on confidentiality. He proposed Terms of Reference in compliance with the Grant Agreement and the Consortium Agreement. He will distribute a draft for participants' review.

6 Progress and plans - WP 2 (Nagra)

Hanspeter Weber presented the status of WP 2. The presentation is enclosed as Appendix 5. He specially mentioned:

- The activities are carried trough in accordance to the time plan with one exception. The excavation of the tunnel is delayed 9 months and starts first next week.
- Construction and installation are part of LUCOEX. Instrumentation is not and will consequently not be reported in EC Deliverables.
- Design lifetime is 20 years. Consequent redundancy of instrumentation will be considered.
- Aitemin designs and manufactures the heaters
- 50 m long tunnel excavation will soon start.
- The tunnel will host 3 "heaters" with dimensions simulating full-scale canisters, see drawing in Appendix 4. Each heater will get a thermal load of 1500 W from start.

- The buffer components will consist of bentonite blocks and bentonite pellets. The aim is to achieve a dry density of 1.4 Mg/m^3 in the saturated buffer.
- Fibre optics instruments will be used for measurement of temperature and extension.
- The emplacement activities will take a few months.

7 Progress and plans - WP 3 (Andra)

Frédéric Bumbieler presented objectives, activities and considerations of WP 3. The presentation is enclosed as Appendix 6.He specially mentioned:

- The activities are carried trough in accordance to the time plan for each activity, but critical activities have been delayed and the emplacement of the cell will be completed in November-December this year compared to May-June in the original plan.
- Aitemin designs and manufactures the heaters.
- They will be in operation during several years in the test.
- Strain gauges will be used for measurement of strain in the liner. Temperature, total pressure on the liner and clearance reduction between the liner and the cell wall will also be measured.

8 Progress and plans - WP 4 (SKB)

Magnus Kronberg presented the status of WP 4. The presentation is enclosed as Appendix 7. He especially mentioned:

- Preparations are carried through with an overall delay of a couple of months. Installation will be delayed with 5-6 months, and made early next year.
- Studies have recommended Ti instead of Fe as material for the Supercontainer shell, plugs and other supporting structures, but Fe will still be used in the MPT demonstration set-up as originally intended.
- The "Supercontainer" weighs 46 tonnes. It will be handled by the existing, specially constructed "Multipurpose vehicle" at Äspö, which has a payload capacity of 100 tonnes.
- The reference design – DAWE (Drainage Artificial Watering and air Evacuation) will be used in the MPT.
- A 400-day long test period will be carried out after installation.
- The natural rate of water inflow into the demonstration tunnel is approximately equivalent to the bentonite's sorption capacity.
- Wireless system for transmitting signals from instruments will be used in parallel with conventional wire bound transmission.
- The mould for compacting buffer blocks will be delivered in April as planned.
- One scholarship student is planned for autumn 2012, the task being to test-drive the deposition machine to try to identify problems generally avoided by the experienced operator.

9 Progress and plans - WP 5 (Posiva)

Keijo Haapala presented the status of WP 5. The presentation is enclosed as Appendix 8. He especially mentioned:

- Activities are carried through according to the time plan, except LOT 1 which has a time delay of 3 months now. This time delay will, however, not affect LUCOEX's overall time plan.
- A comprehensive study of methods for supplying buffer blocks to the installation position and for installation of them in the deposition hole has resulted in the selection of a two vehicle method instead of the earlier applied one vehicle method.

10 Mid-term Workshop

Fredrik Johansson informed of the planning status. A discussion and possible decision on the agenda was forwarded to the Steering Committee Meeting scheduled for tomorrow afternoon.

11 Next Project Progress Meeting - PPM 03

The next meeting will be held at Bure during the second part of Sept 2013. Andra will decide upon exact date after consultation with the other participants.

12 Decision making forwarded to Steering Committee Meeting

The following issues were forwarded to SC-03 for formal decisions:

- Confidentiality with respect to scholarships and organizations to be engaged in dissemination activities.
- Current delays and judgment of how they may affect the completion of planned activities within eh LUCOEX's 48 months.
- Guidance for compilation of 18 month periodic report.
- Staff secondment announcements.
- Meeting schedule for PPM 03.
- Scholarship announcements.
- Risk lists.
- Mid-term Workshop agenda.

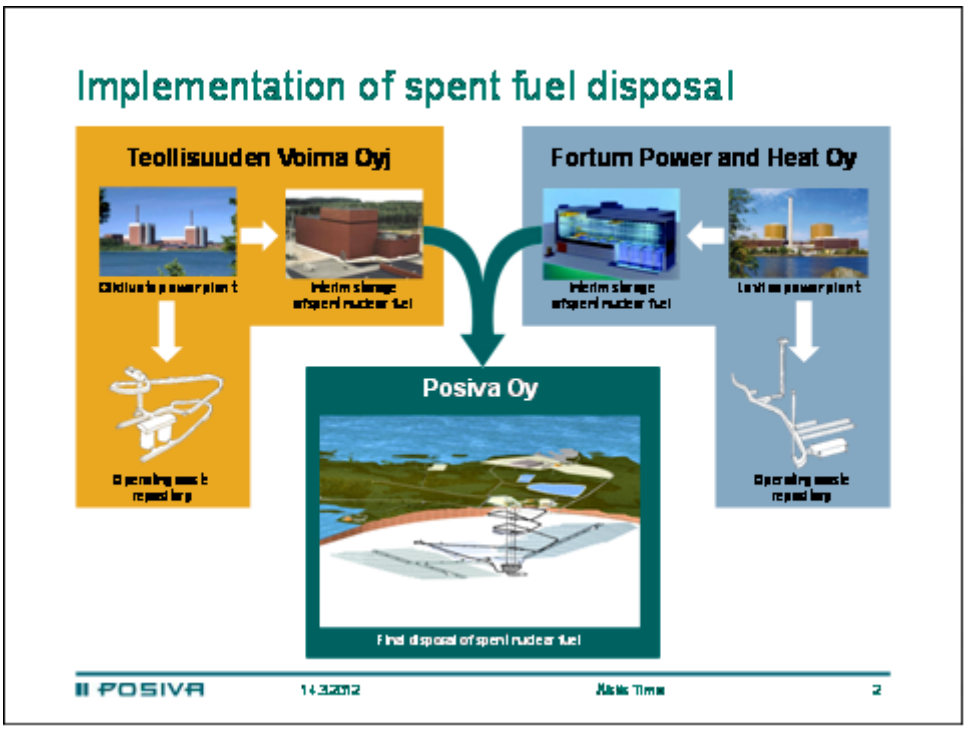
13 Onkalo visit.

Johanna Hansen and Paula Kosunen presented status and investigations of the Onkalo URCF (Underground Rock Characterisation Facility), see PowerPoint series in Appendix 9,

Visits were made to the drill core storage facility and the Onkalo underground parts.

Appendix 1


Final disposal repository for spent nuclear fuel ONKALO
Olkiluoto accommodation village
Raw water storage
Visitor Centre
Contractors area
Gas turbine plant
Interim storage facility for spent nuclear fuel
OL2
OL4
OL1
Power line
Ship lane
Main gate
OL3
Training Centre
Final repository for low- and medium-level waste


Implementation of spent fuel disposal
Teollisuuden Voima Oyj
Fortum Power and Heat Oy
Posiva Oy
Final disposal of spent nuclear fuel
POSIVA


Olkiluoto, Eurajoki


Plan for Disposal Facility for 2020
Office Building
ONKALO Entrance
Encapsulation Plant
Ventilation Building
POSIVA


Disposal facility above and under ground
POSIVA
14.3.2012
5

Appendix 2

LUCOEX Project Progress Meeting 02

13.1

13.2

13.3 **Time:** Wednesday March 14, 2012

13.4 **Place:** Posiva, Olkiluoto

Draft Programme

09.00 – 15.00 PPM 02 including lunch and coffee breaks

9.00–9.15	Welcome – introduction, with Coffee	Timo Äikäs
9.15- 9.45	EU news	Christophe Davies
9.45-10.30	Progress and plans WP1 and WP6 and project formalities	Fredrik Johansson
10.30–10.50	Coffee	
10.50-11.20	Progress and plans WP2	Hans-Peter Weber
11.20-11.50	Progress and plans WP3	Frédéric Bumbieler
12.00-13.00	Lunch	
13.00-13.30	Progress and plans WP4	Magnus Kronberg
13.30-14.00	Progress and plans WP5	Keijo Haapala
14.00-14.30	Summary and miscellaneous	
14-30–15.00	Safety instructions for ONKALO visit	
15.00-17.30	Onkalo visit	

- Group 1: ONKALO visit, Topias Siren, Kimmo Kemppainen
- Group 2: Onkalo research building: Paula, Johanna Hansen: ONKALO projects, experiences and results + Coffee/Tea.


EUROPEAN COMMISSION
Euratom research on radioactive waste management & Disposal
DG RTD (Research and Innovation)
Unit K4 – Nuclear Fission
Christophe Davies
BELBaR kick-off meeting, 07 March 2012


EUROPEAN COMMISSION
OVERVIEW
Euratom FP7 status in geological disposal
Euratom programme (2014-2018): Horizon 2020

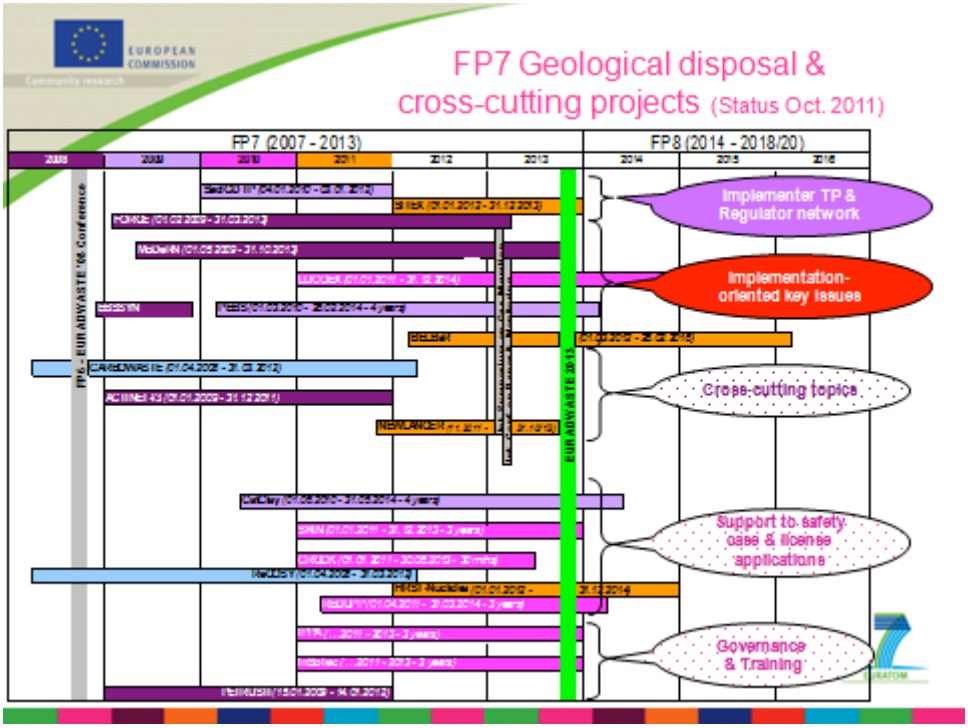
Funded projects in call FP7 - 2011

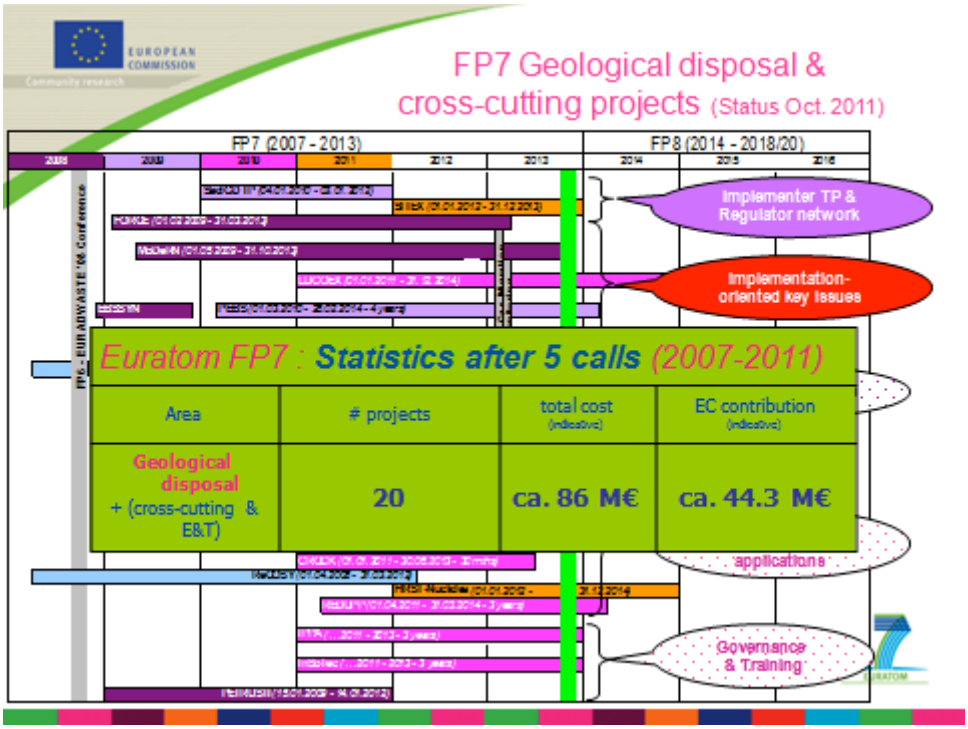
Management of radioactive waste – Geological Disposal

Project acronym and title	Key activities	Coordinator / no. partners	Start date & duration	Total cost / EU funding
BELBAR – Bentonite Erosion: Effects on the long-term performance of the engineered barrier and radionuclide Transport	To increase the knowledge of processes that controls clay colloid stability, generation and ability to transport radio-nuclides.	SKB (SE) 14 partners (6 countries + Russia)	March 2012 48 months	€5.6M / €2.6M R&D
FIRST-NUCLIDES – Fast / Instant Release of Safety Relevant Radionuclides from Spent Nuclear Fuel	To improve understanding of fast instant released radionuclides from disposed high burn-up UO2 spent fuel	KIT (DE) 10 partners (7 countries)	Jan. 2012 36 months	€4.7M / €2.5M R&D
SITEX – Sustainable network of Independent Technical Expertise for radioactive waste disposal (Support for regulatory functions)	Network regulatory bodies & TSOs for common understanding of the key safety elements to be presented in the safety case in discussion with waste management organisations	IRSN (FR) 15 partners (9 countries + Canada)	Jan. 2012 24 months	€1.34M / €0.95M Coordination

Support actions – Cross-cutting

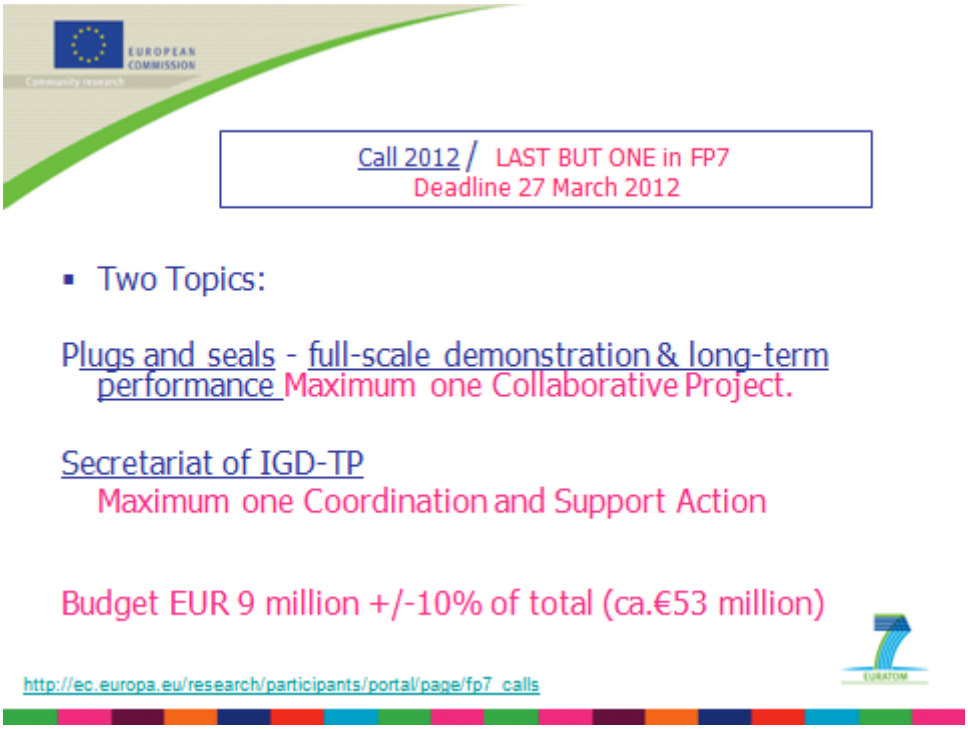
NEWLANCER – New MS Linking for an Advanced Cohesion in Euratom Research	To enhance NMS involvement in future Euratom FP and strenghten full NMS R&D potential and cohesion.	INR (RO) 15 partners (12 countries)	Nov. 2011 24 months	€0.94M / €0.9M Coordination




FP7 Geological disposal &
cross-cutting projects (Status Oct. 2011)
FP7 (2007 - 2013)
FP8 (2014 - 2018/20)
Implementer TP & Regulator network
Implementation-oriented key issues
Euratom FP7 : Statistics after 5 calls (2007-2011)
Area
projects
total cost
EC contribution
Geological disposal + (cross-cutting & E&T)
20
ca. 86 M€
ca. 44.3 M€
applications
Governance & Training


International Symposium and workshop on
Gas generation and migration:
"Implications for the performance of geological repositories for radioactive waste disposal"
5 to 7 February 2013 - Luxembourg
EUROPEAN COMMISSION
website: www.FORGEproject.org/Luxembourg2013

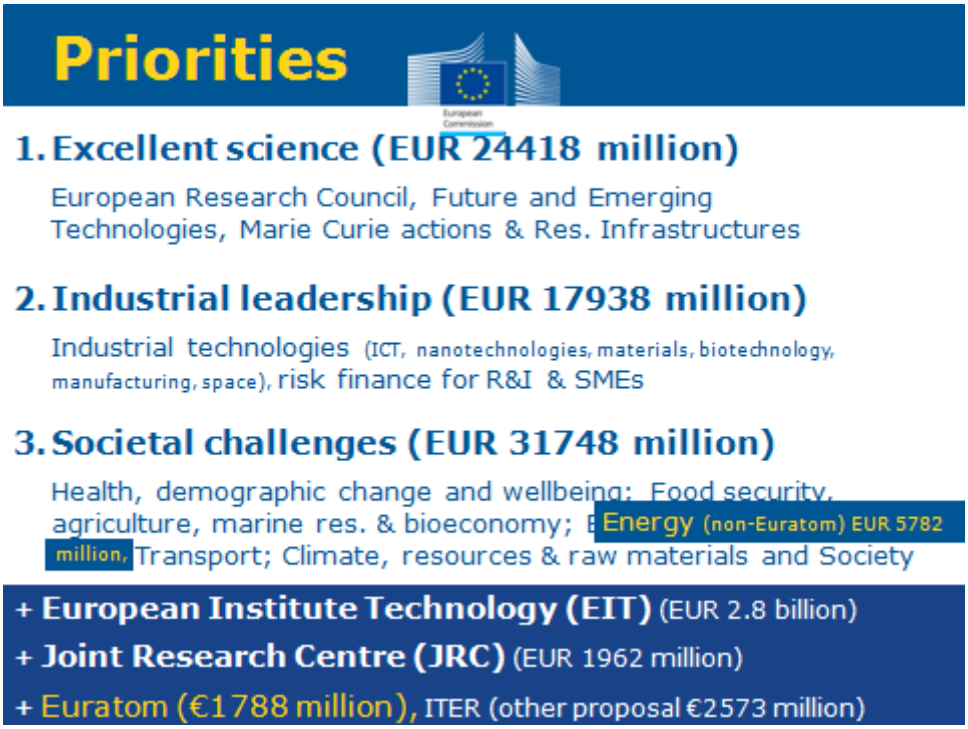

MODERN
International conference & workshop
Monitoring in Geological disposal of radioactive waste
Luxembourg, 19-21 March 2013
http://www.modern-fp7.eu/Monitoring-GDRW-2013/

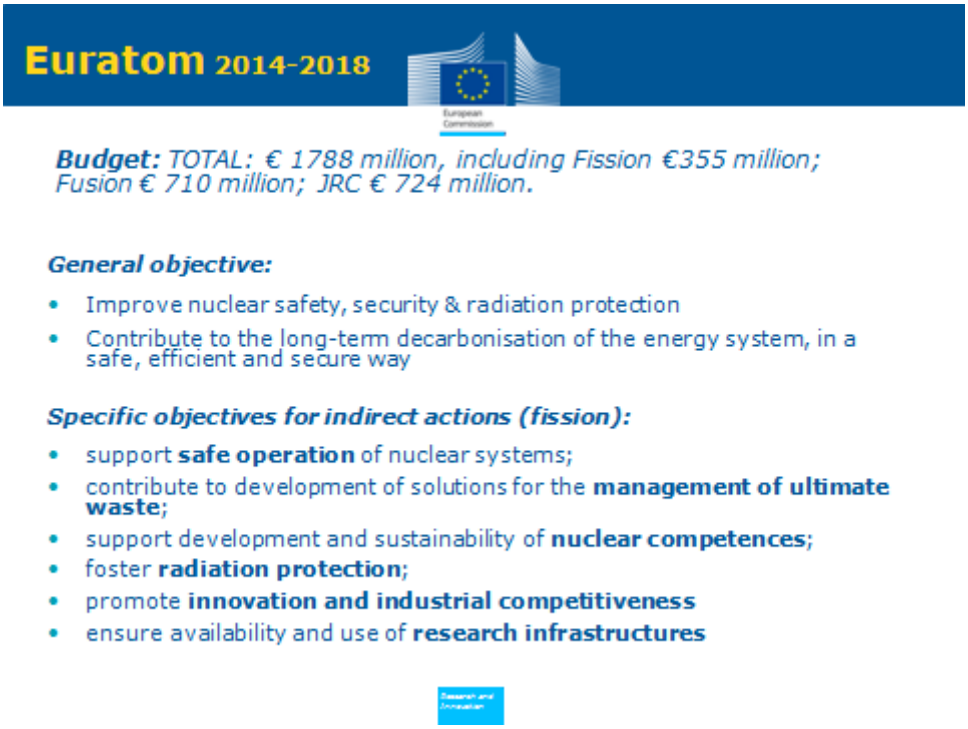

EUROPEAN COMMISSION
Call 2012 / LAST BUT ONE in FP7
Deadline 27 March 2012
Two Topics:
Plugs and seals - full-scale demonstration & long-term performance Maximum one Collaborative Project.
Secretariat of IGD-TP
Maximum one Coordination and Support Action
Budget EUR 9 million +/-10% of total (ca.€53 million)
http://ec.europa.eu/research/participants/portal/page/fp7_calls

Commission proposal for a 80 billion euro research and innovation funding programme (2014-2020)

A core part of Europe 2020, Innovation Union & European Research Area:

- **Responding to the economic crisis** to invest in future jobs and growth
- **Addressing people's concerns** about their livelihoods, safety and environment
- **Strengthening the EU's global position** in research, innovation and technology


Priorities
1. Excellent science (EUR 24418 million)
European Research Council, Future and Emerging Technologies, Marie Curie actions & Res. Infrastructures
2. Industrial leadership (EUR 17938 million)
Industrial technologies (ICT, nanotechnologies, materials, biotechnology, manufacturing, space), risk finance for R&I & SMEs
3. Societal challenges (EUR 31748 million)
Health, demographic change and wellbeing; Food security, agriculture, marine res. & bioeconomy; Energy (non-Euratom) EUR 5782 million, Transport; Climate, resources & raw materials and Society
+ European Institute Technology (EIT) (EUR 2.8 billion)
+ Joint Research Centre (JRC) (EUR 1962 million)
+ Euratom (€1788 million), ITER (other proposal €2573 million)


Euratom 2014-2018
Budget: TOTAL: € 1788 million, including Fission €355 million; Fusion € 710 million; JRC € 724 million.
General objective:
• Improve nuclear safety, security & radiation protection
• Contribute to the long-term decarbonisation of the energy system, in a safe, efficient and secure way
Specific objectives for indirect actions (fission):
• support safe operation of nuclear systems;
• contribute to development of solutions for the management of ultimate waste;
• support development and sustainability of nuclear competences;
• foster radiation protection;
• promote innovation and industrial competitiveness
• ensure availability and use of research infrastructures

Forms of Community support

- Specific instrument envisaged by the Rules for Participation

  Programme co-fund action - for supplementing calls or programmes funded by entities other than EU bodies managing research and innovation programmes

  See for example EMRP (emrponline.eu)

- Support for indirect actions instruments provided for by the New Financial Regulation
- .... Also complementary use of Structural Funds (relation with national Operational Programmes)

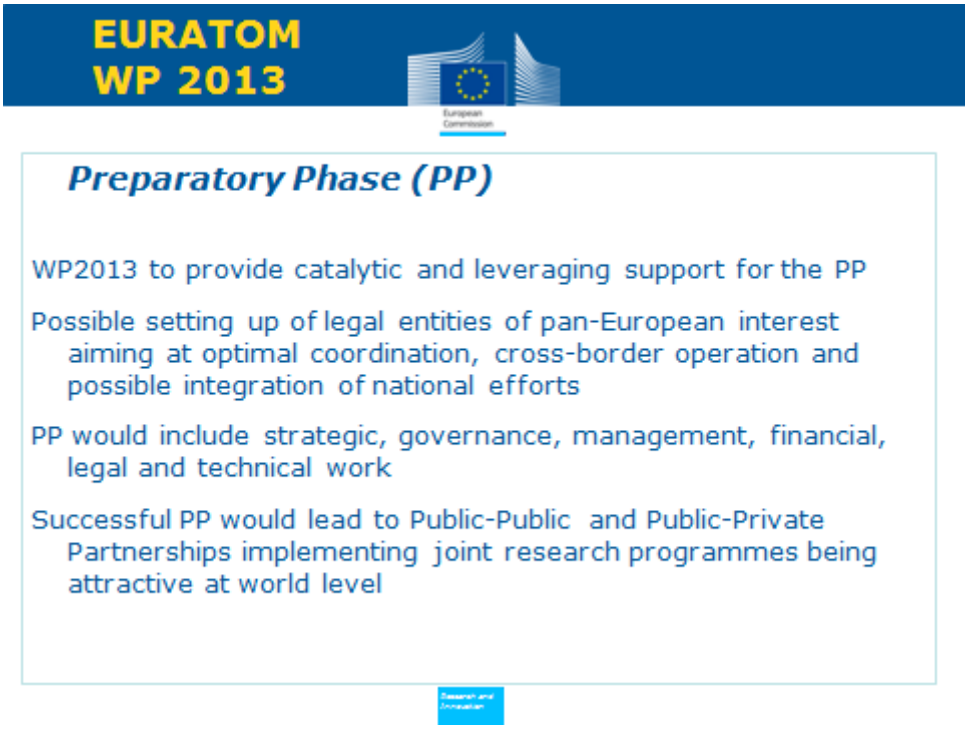
Work Programmes

- The essential element for implementing the actions
- Detailed objectives, associated funding
- Multi-annual approach & strategic orientations for the following years of implementation
- Links with the platforms' SRAs?
- Input from the symposium "Benefits and limitations of nuclear fission research for a low carbon economy fission research" to be organised in 2013

WP 2014 expected in summer 2013


Next steps
Ongoing: Parliament and Council negotiations on the basis of the Commission proposals
Ongoing: Parliament and Council negotiations on EU budget 2014-2020 (including overall budget for Horizon 2020)
Mid 2012: Final calls under 7th Framework Programme for research to bridge gap towards Horizon 2020
Mid 2013: Adoption of legislative acts by Parliament and Council on Horizon 2020
1/1/2014: Horizon 2020 starts, launch of first calls


EURATOM
WP 2013
The EURATOM programme for 2013 is meant to support a Preparatory Phase of 2014-2018
Expected Call publication : Summer 2012 ?
Target call deadline : Fourth quarter 2012
Evaluation of proposals : early 2013
Contracts signed and payments made in 2012


EURATOM
WP 2013
Preparatory Phase (PP)
WP2013 to provide catalytic and leveraging support for the PP
Possible setting up of legal entities of pan-European interest aiming at optimal coordination, cross-border operation and possible integration of national efforts
PP would include strategic, governance, management, financial, legal and technical work
Successful PP would lead to Public-Public and Public-Private Partnerships implementing joint research programmes being attractive at world level


WP1 and WP6
Fredrik Johansson


Summary of activities 2011
• Handling of deliveries and meetings (4 SCM).
• Documents and reports
– Project plan,
– Project risk list
– Communication plan
– Staff secondment plan
– Scholarship plan,
– Scholarship terms of reference
– Expert group terms of reference.
• Internal and external website

Expert group formed

- **Internal Experts**
- Chair: Jean Michel Bosgiraud (Andra)
- Thomas Fries (Nagra)
- Stig Pettersson (SKB)
- Jere Lahdenperä (Posiva)

External experts

Alan Hooper

Wilhelm Bollingerfehr (DBE)

Geert Volckaert (SCK-CEN)

Lumir Nachmilner

- Start-up meeting in March.

European added value

- Poland, Ministry of Economy
- Bulgaria, State enterprise radioactive waste
- Slovakia, Javyz
- Belgium, Ondraf Niras
- German, Federal office for radiation protection

Nextcoming deliveries

• Workplan	Nagra	01/06/2011
• Report on construction of the emplacement tunnel	Nagra	01/03/2012
• Report of the digging and emplacement of the cell	Andra	01/06/2012
• Report on manufacturing of distance blocks	SKB	01/04/2012
• Periodic report to be submitted to the Commission	SKB	01/06/2012

Staff Secondment

Activity	Preliminary session	Duration	Detailed announcement expected
Supercontainer and distance block installation	September 2012	1-2 weeks	May 2012

1.1 Andra

Activity	Preliminary session	Duration	Detailed announcement expected
Full scale excavation	February 2012	1-3 weeks	October 2011
Emplacement of heaters	July 2012	1-3 weeks	October 2011

1.2 Nagra

Activity	Preliminary session	Duration	Detailed announcement expected
Tunnel excavation	Early 2012	1-2 weeks	October 2011
Buffer installation	Mid 2013	1-4 weeks	February 2013

1.3 Posiva

Activity	Preliminary session	Duration	Detailed announcement expected
Block installation and gap filling testing in ONKALO with concrete blocks	December 2012	1 month	October 2012
Equipments for quality control, testing in ONKALO with concrete blocks	March 2013	1 month	February 2013
Block installation and gap filling testing in ONKALO with bentonite blocks	June 2013	1 months	April 2013
Equipments for quality control, testing in ONKALO with bentonite blocks	August 2013	1 month	June 2013

Meeting schedule

From SCM02

- **The meeting schedule for PPM and SCM is:**
  - **PPM 02: March 2012 at Olkiluoto, Finland. Theme: Tunnel and disposal cell excavation.**
  - **PPM 03: September 2012 at Bure, France. Theme: Instruments and instrumentation.**
  - **PPM 04: June 2013 at Mont Terri, Switzerland. Theme: Bentonite block and pellets production and emplacement.**
  - **PPM 05: April 2014 at Äspö, Sweden.**
- **Mid-term and Large Workshops are scheduled for:**
  - **Mid-term one-day WS: October 25-26, 2012 in Montpellier.**
  - **Large two-day WS: April 2014 at Äspö in conjunction with PPM and SCM.**

Web site

- Projectplace
  - All project documents
  - Possibilities to communicate
- www.lucoex.eu
  - General information
  - Application for scholarship
  - Deliveries (public)
  - News

Scholarships

- How do we get applicants?

Risk list 2011

ID	Risk Description of the risk and its' potential consequence.	Risk analyse			Preventive action	Responsible person (within Lucoex)	Deadline for preventive action.	Status (will be yellow if deadline in danger and red if deadline missed)	Risk identified/ updated Date for entry of risk and latest update.
		P	C	R	Description of the preventive action which is planned to diminish the probability of the risk or mitigate its' consequence.				
Negra 1	Original time schedule for WP 2 too optimistic.	4	4	16	Walk through of time schedule. Identifying uncertainties.	WP2 and task leaders	2011-07-01		2011-05-01
Posiva 2	Changes in requirements or data basis in a late stage of work -> Delays in activities	4	4	16	Careful monitoring and early reactions to any indications of changes.	WP5 leader			2011-05-01
Posiva 4	Technical challenges in developing technologies -> Needed solutions not identified or no ability to realize them.	4	4	16	Cooperation to solve challenging technological problems.	WP5 leader			2011-05-01

FE: Full-Scale Emplacement Experiment at Mont Terri
Status and Outlook

Hanspeter Weber et al.

14th of March 2012

Content of this Presentation

- Organisation – involved Nagra staff
- Experimental aims
- Location, plans / (3D) Sketches
- Scoping calculations, modeling-
- Observation boreholes
- (Excavation 50 m long Test Tunnel) → see Pres. Sven Köhler
- Granular Bentonite - production and emplacement
- Pedestrial Bentonite Blocks - production
- Time plan

Introduction Project FE / Lucoex

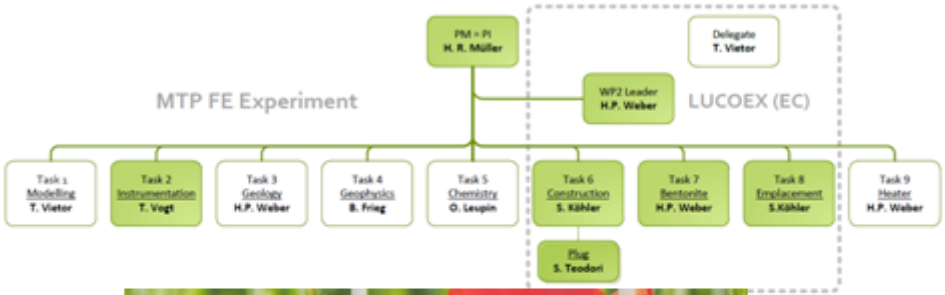
- FE = Full-scale Emplacement Experiment at Mont Terri
  - Principle Investigator: Herwig Müller (NAGRA)
  - Partners in Phase 17:
    - ANDRA
    - CHEVRON

Mont Terri Project

- LUCOEX = Large Underground Concept Experiments
  - EC funded project (EURATOM, 7th Framework Programme)
  - Partners:
    - SKB
    - ANDRA
    - POSIVA
    - NAGRA

9 March 14, 2012 LUCOEX WP9 (Web) nagra.

Nagra's Project Team



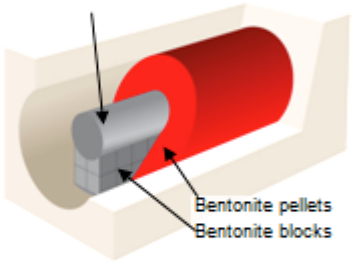
4 March 14, 2012 LUCOEX WP9 (Web) nagra.

Experimental Aims

- LUCOEX aim:
  The demonstration of emplacement techniques under repository conditions.
  For NAGRA: Simulation of horizontal canister and buffer emplacement.
- FE aim:
  The investigation of repository induced, thermo-hydro-mechanical (THM) coupled effects on the host rock.
- The experiment will be
  - Full-scale
  - Heated up to 130°
  - Not artificially saturated
  - Long-term (approx. 20 years)

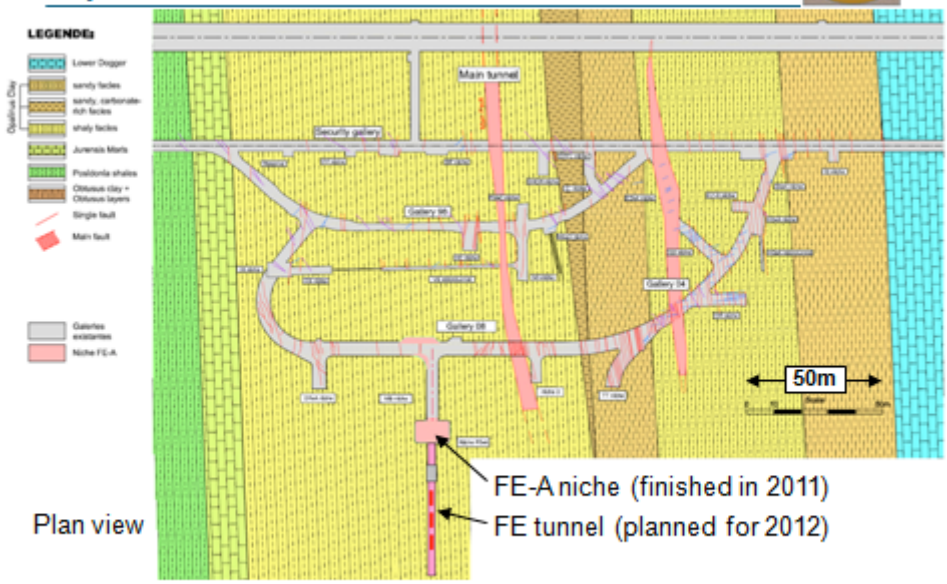
NAGRA's HLW emplacement concept

in 'Reality': Canister
for FE: Heater



6 March 14, 2012 LUCOEX WP5 (Web) nagra.

Experiment Location at Mont Terri

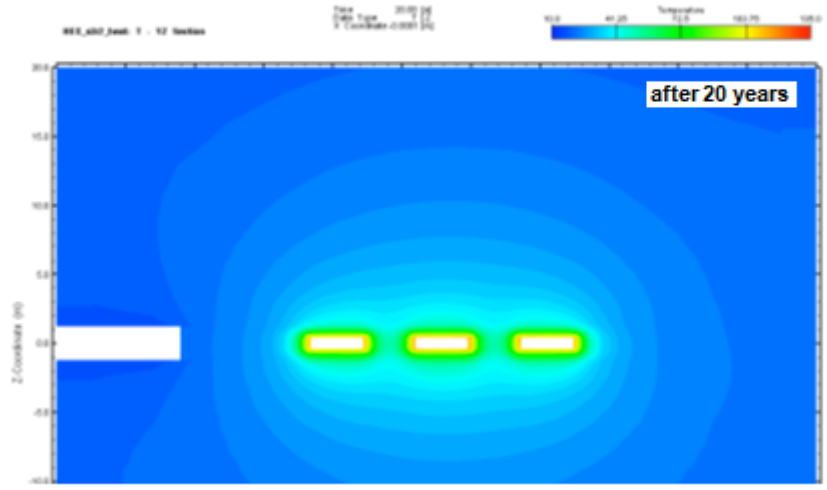


Plan view

6 March 14, 2012 LUCOEX WP5 (Web) nagra.

FE-Experiment, Scoping calculations

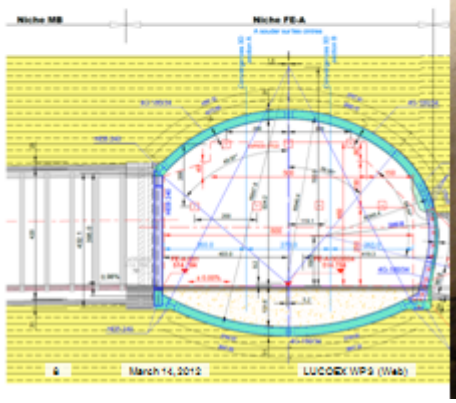
Example from TH-modeling with the multiphase flow simulator TOUGH2
- Temperature after 20 years (longitudinal section)



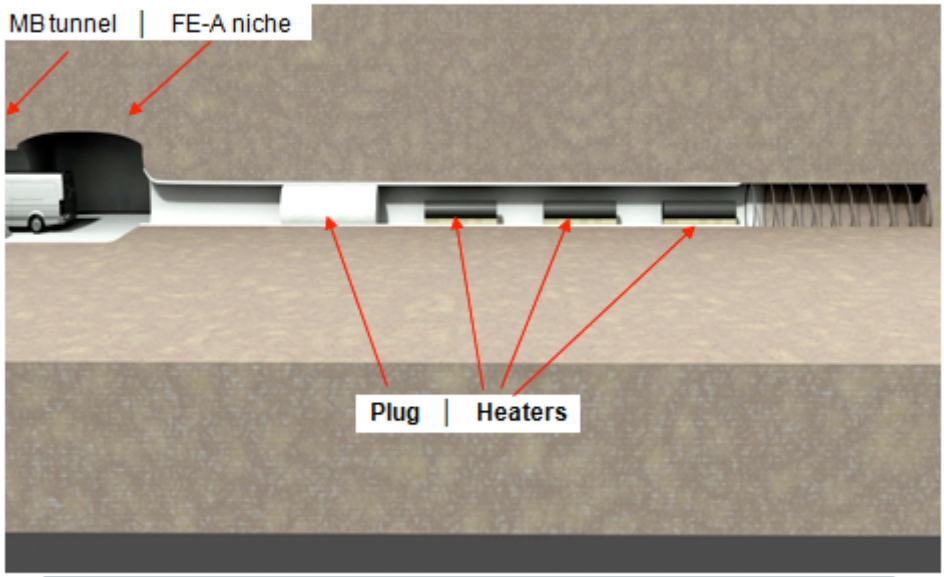
nagra.

Niche Construction

- FE-A (start) niche
- height: approx. 5m, length: approx. 8m, width: approx. 10m)
  - finished in June 2011
  - needed für instrumentation, tunneling and emplacement



Experimental Design



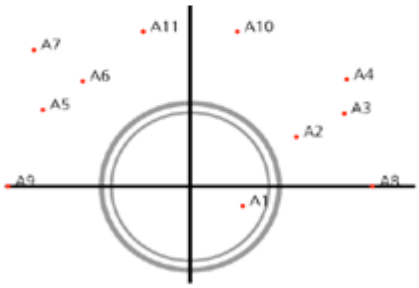
9 March 14, 2012 LUCOEX WP9 (Web) nagra

Boreholes for Instrumentation – Phase 1

What do we want to measure?	Instrumentation		
	Phase 1	Phase 2	Phase 3
	Rock		Buffer
	Far-field	Near-field	
Temperature	X	X	X
Saturation	-	X	X
Pressures	X	X	-
Deformation	X	X	-

Bohrung	Länge [m]	Durch-messer [mm]	Kerndurch-messer [mm]	Azimuth [°]	Neigung (aufwärts gerichtet) [°]
BFE-A8	13.13	76	61	242.10	-5.00
BFE-A9	13.10	76	61	242.10	-5.00
BFE-A10	46.43	131	117	242.10	0.38
BFE-A11	46.45	131	117	242.10	0.38

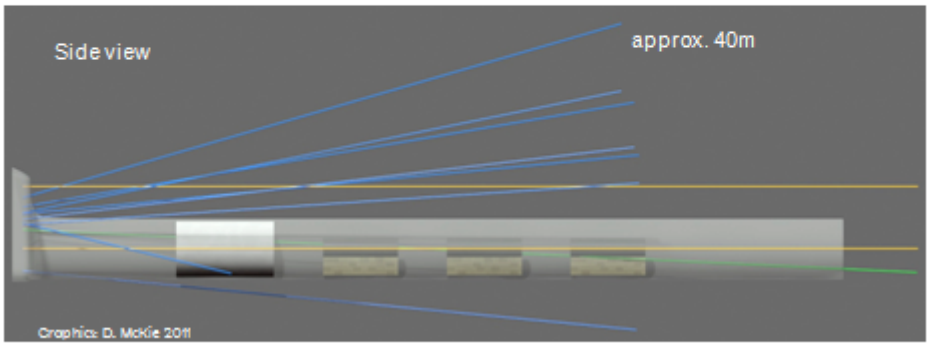
Instrumentation Phase 1: approx. no. of sensors
5 climate
8 packer systems
38 temperature
38 pore pressure
38 packer ("total") press.
2 horizontal inclinometers
40 temperature
80 deformation points



10 March 14, 2012 LUCOEX WP9 (Web) nagra

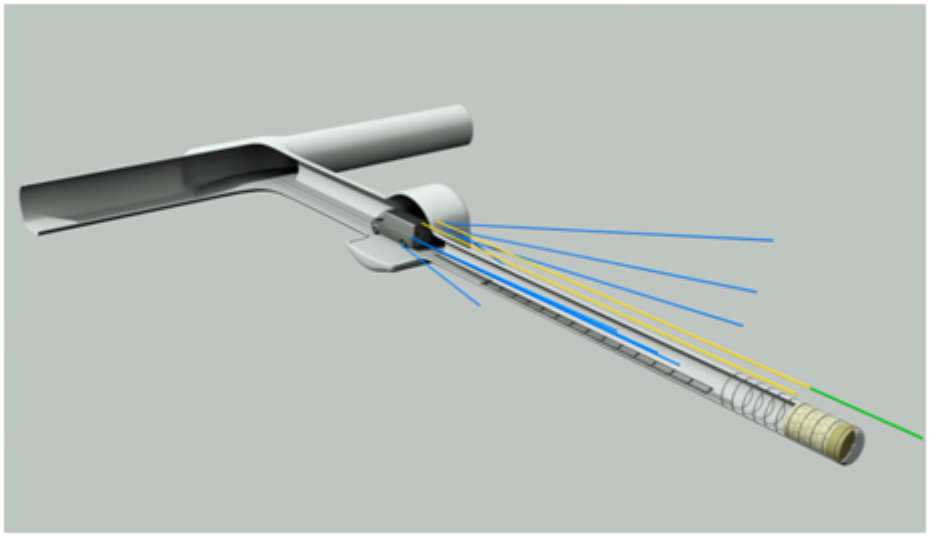
FE-Experiment, Instrumentation (Phase 1)

- Instrumentation of the host rock (far-field)
  - Hydraulic (multi) packer systems (pressures + Temp.) [in blue]
  - Horizontal inclinometers (deformation + Temp.) [in orange]
  - Explorational borehole extension [in green]
  - Distributed fiber optical sensing (Temp.)

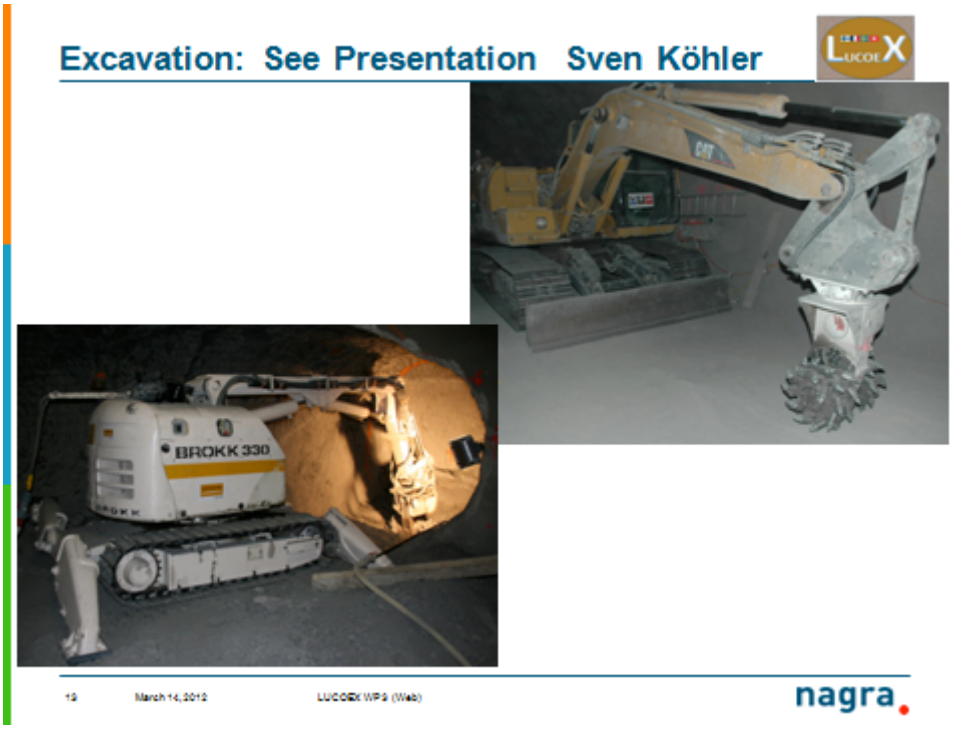


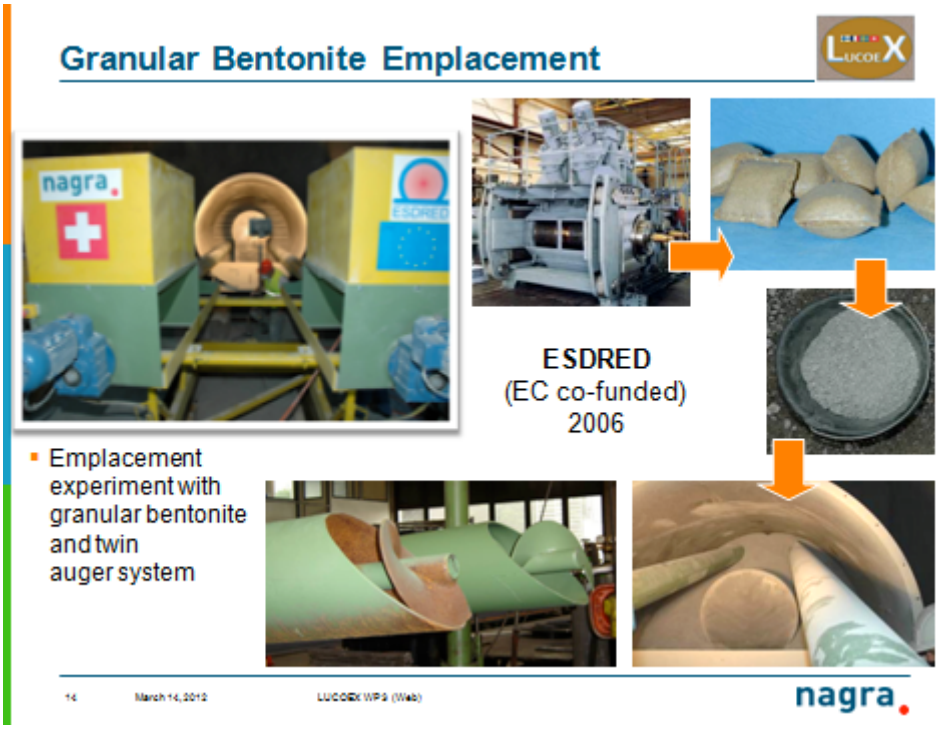
11 March 14, 2012 LUCOEX WP9 (Web) nagra.

FE-Experiment, Instrumentation (Phase 1)



12 March 14, 2012 LUCOEX WP9 (Web) nagra.


Excavation: See Presentation Sven Köhler
BROKK 330
19 March 14, 2012 LUCOEX WP9 (Web)
nagra.


Granular Bentonite Emplacement
nagra.
ESDRED
(EC co-funded)
2006
Emplacement experiment with granular bentonite and twin auger system
14 March 14, 2012 LUCOEX WP9 (Web)
nagra.

Fine Granular
Industrial Sodium Bentonite

MX 80

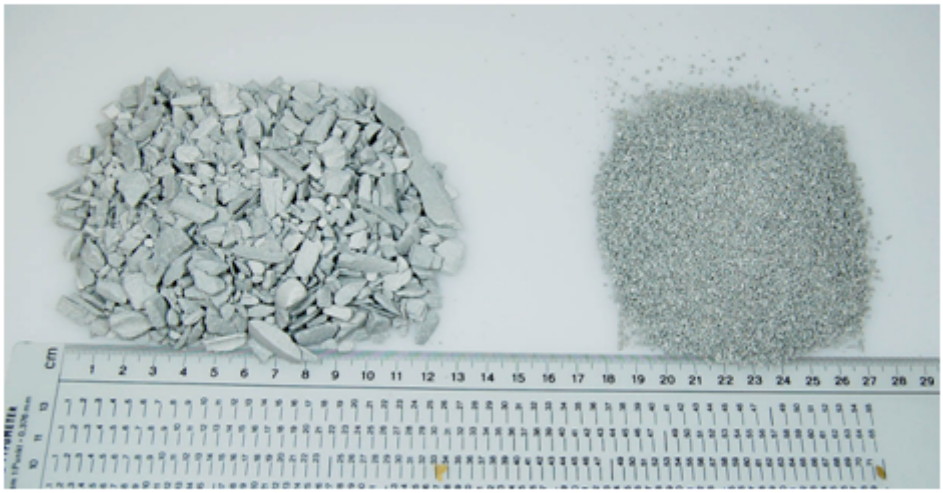
General Description	Fine granular Sodium Bentonite with an average particle size ranging between 16 and 200 mesh.
Functional Use	Multi-purpose product noted for rapid dispersion in water. Employed in a wide variety of industrial applications.
Purity	Hydrous aluminium silicate comprised principally of the clay mineral Montmorillonite. Montmorillonite content 90% minimum. Contains small portions of feldspar, biotite, selenite, etc.
Chemical Composition	Typical Analysis (moisture free)

SiO_2	63.02%	MgO	2.67%
Al_2O_3	21.08%	Na_2O	2.57%
Fe_2O_3	3.25%	CaO	0.65%
FeO	0.35%	H_2O	5.64%
Trace	0.72%		

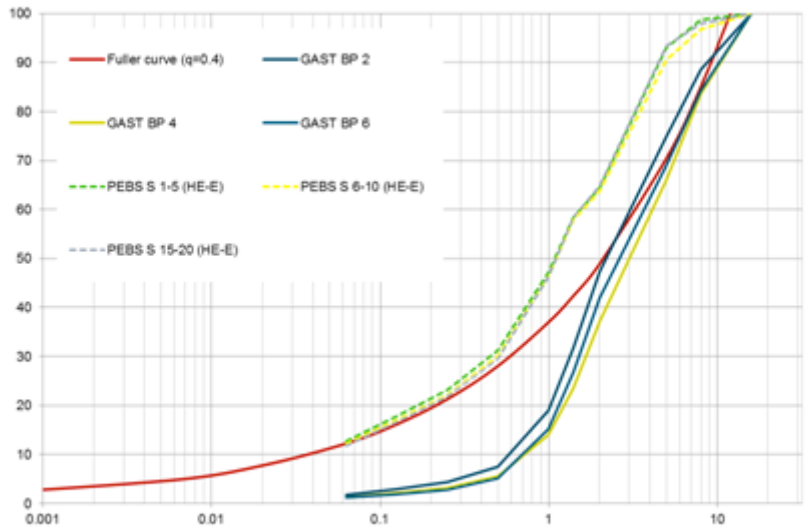
Chemical Formula	A tri-layer expanding mineral structure of approximately: $(Al, Fe_{0.67}, Mg_{0.33})\ Si_4O_{10}\ (OH_2)\ Na^1Ca^{2+}_{0.33}$
Moisture Content	Maximum 12% as shipped.
Dry Particle Size	Maximum 10% retained on 18 mesh (850 microns) Maximum 15% passing 200 mesh (75 microns)
pH	5% solids dispersion 8.5 to 10.5
Viscosity	1 part bentonite to 15 parts deionized water (6.25% solids) dispersed on high-speed mixer. Fann viscometer , 8cps. minimum
Packaging	Multi – wall paper bags, (25 kg), big-bags or bulk.

Grain sizes granulates-bimodale distribution

Martin Holl **Rettenmaier & Söhne**
Holzmühle 1 **73494 Rosenberg** **Germany**

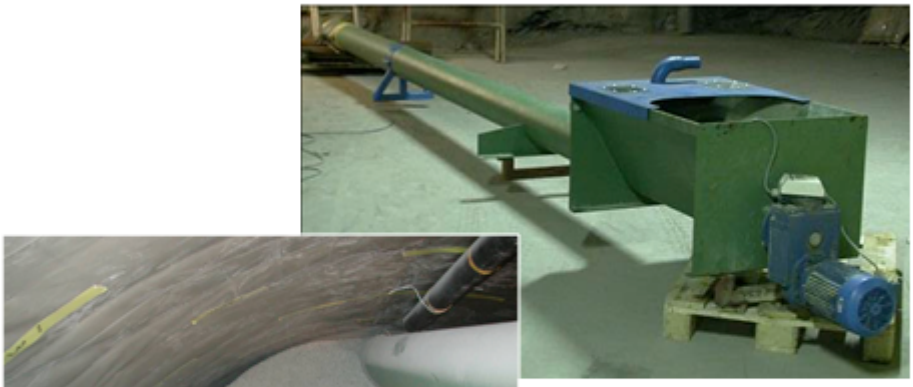


Grain size distribution bentonite granulate



17 March 14, 2012 LUCOEX WP9 (Web) nagra.

Emplacement with 1-Auger-System (EB); 2002



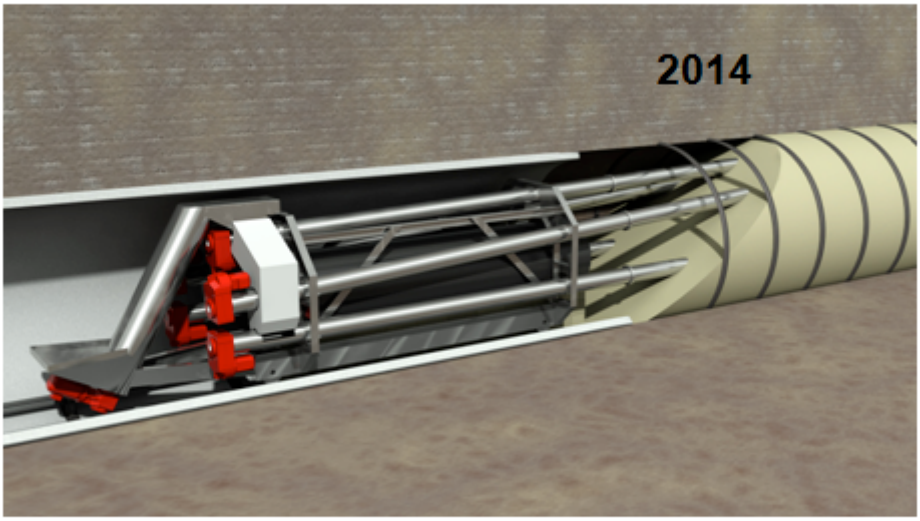
19 March 14, 2012 LUCOEX WP9 (Web) nagra.

Emplacement with 2-Auger-System (ESDRED)

2006

19 March 14, 2012 LUCOEX WP 9 (Web) nagra.

Emplacement with 5-Auger-System (LUCOEX)



20 March 14, 2012 LUCOEX WP 9 (Web) nagra.

Block

LAVIOSA MPC
Zone Portuaire
62, Route du
Hazay
78520 Limay
FRANCE
Serge Resnikow

Bony S.A.
St. Etienne (F)

21

nagra.

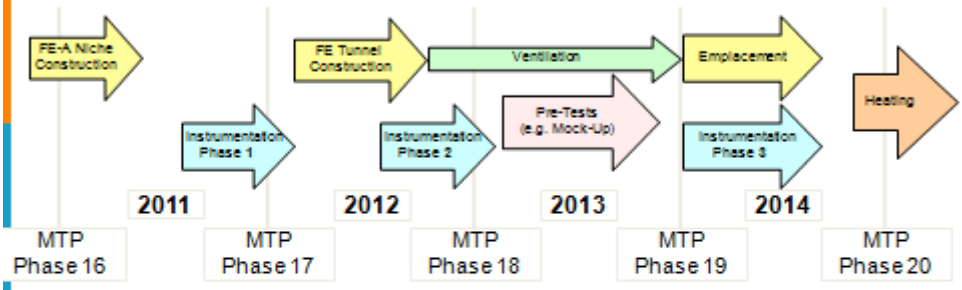
Bentonite Block Production 2011

Alpha
Ceramics
Aachen (D)

22 March 14, 2012 LUCOEX WP3 (Web)

nagra.

FE/LUCOEX-Experiment, Time Frame



- Instrumentation will be realized in 3 phases
  - Phase 1: Instrumentation of host rock (far-field)
  - Phase 2: Instrumentation of host rock (near-field)
  - Phase 3: Instrumentation of buffer / canisters
- The duration of heating resp. monitoring depends on the "speed" of saturation and hence will last approx. 15 to 20 years

Acknowledgment:
- Experimental Partners: ANDRA, CHEVRON, SKB, POSIVA
- Mont Terri Consortium: P. Bossart, Ch. Nussbaum, D. Jäggi, Th. Theurillat, etc.
- Project Team: P. Blümling[†], H.P. Weber, T. Vietor, P. Marschall, S. Köhler, T. Vogt, etc.
- Contractors: Swisstopo, CTSM, GGT, Flotron, Schützeichel, Geotest, Solexperts, Soldata, etc.
- Modeling Teams: UPC, Intera, Pöyry, GRS, LBNL , BGR

thank you for your attention

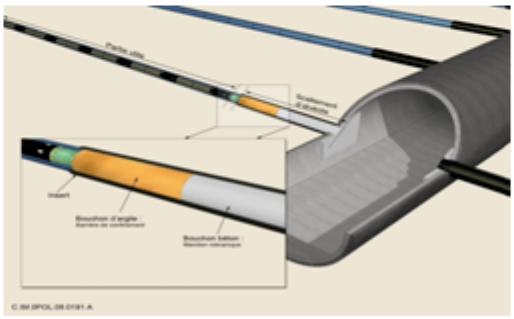
nagra.

WP3 - Full scale emplacement experiment (ALC Phase 3 experimentation)

LUCOEX Progress meeting 2
Olkiluoto

Objectives of the Phase 3 HLW cell experiment

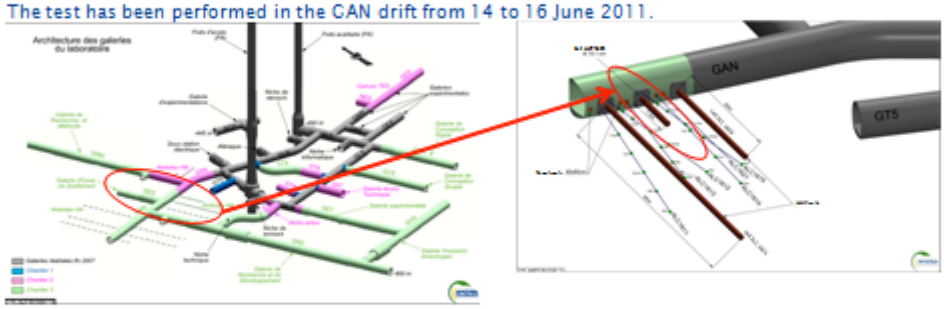
- test the technical feasibility of a cell construction, including useful & head part and different equipments into the cell (end steel plate and shield steel plug),
- verify the suitable working of the head insert to absorb the thermal dilation of the casing,
- provide data on the casing behaviour under thermal loading,
- verify the design of the cell head to limit thermal gradients on the drift wall,
- study the THM behaviour of the interface between rock and casing and of the surrounding rock (not included in LUCOEX).



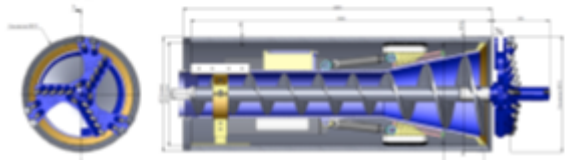
Preliminary test of the head part feasibility (1)

Objective : demonstrate the feasibility of driving in a metal cell-head insert over a length of 10 m with a reduced initial annular space

The test has been performed in the CAN drift from 14 to 16 June 2011.



The drilling machine ($\varnothing_{excavation}$ = 791 mm)



Characteristics of each sleeve section

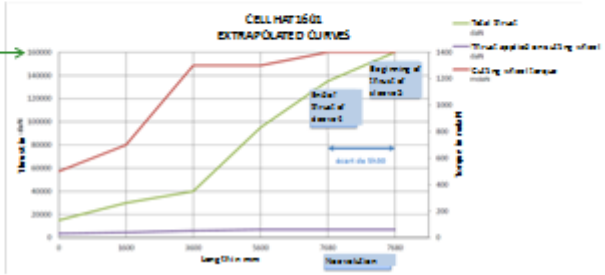
material	Non alloy steel S235
Outside diameter	775 mm (annular space = 8 mm)
thickness	35 mm
Useful length	2 m

5 © Andra

Preliminary test of the head part feasibility (2)

The drilling has been stopped after 7,5 m (4 sleeve sections) due to the jamming of the insert in the rock

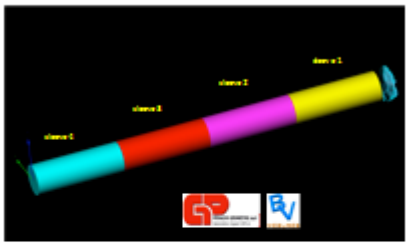
Thrust limit of the drilling bench →

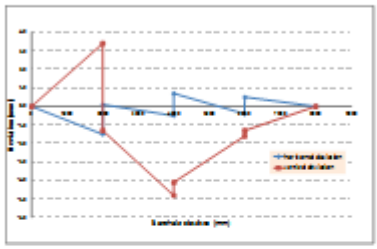


4 © Andra

Preliminary test of the head part feasibility (3)

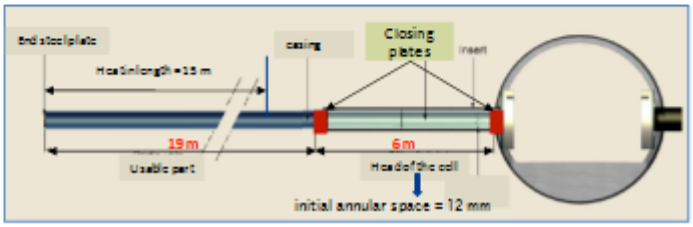
Geometry of HAT1601 insert (3D scan performed 3 weeks after the excavation)



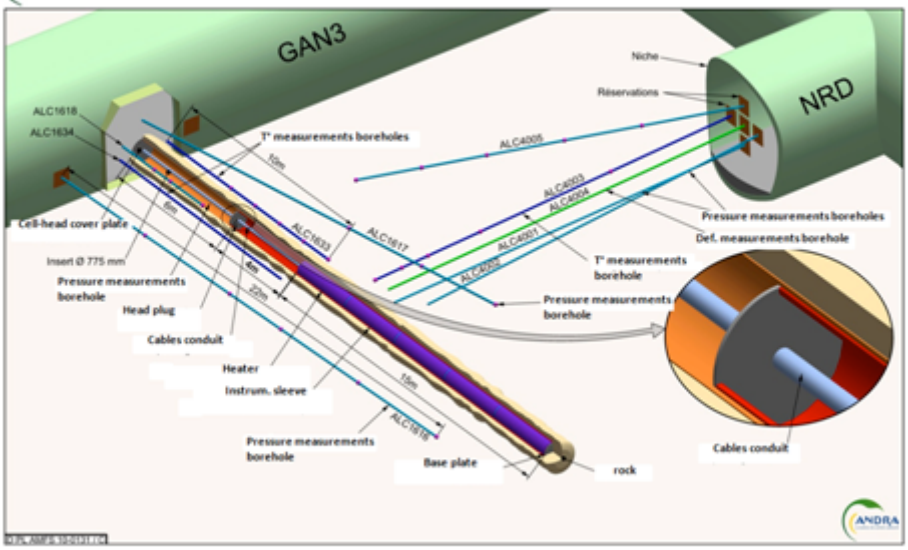


Incline of the cell = +0,63°, overall horizontal deviation < 10 cm

Impact of this preliminary test on the design of the cell that will be excavated in the Phase 3 of the "HLW cells" program :

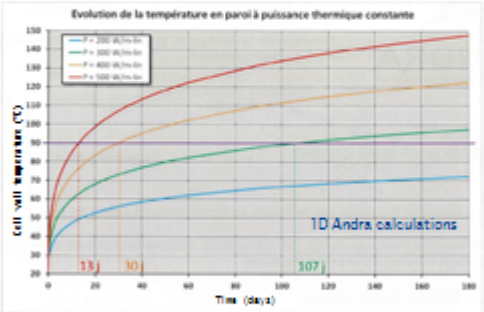


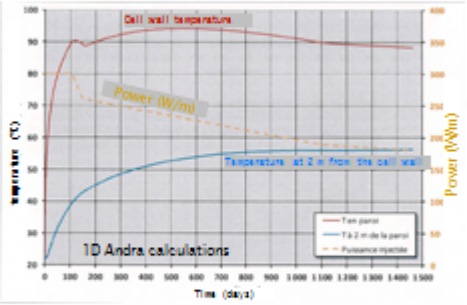
Overview of the experimental set-up for phase 3 of the "HLW cells" Program Unit



Definition of the thermal load

- To be representative of the waste packages, a constant rated power has to be applied from the beginning of the heating
- The thermal peak has to be reached in a reasonable time (< 1 or 2 years)

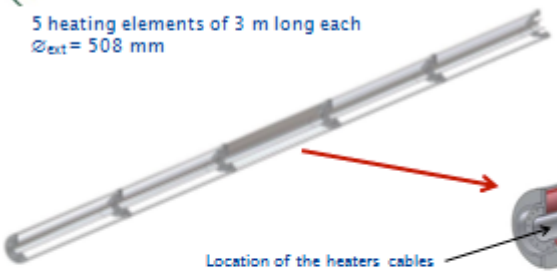


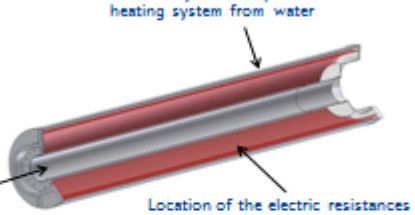


For comparison, the mean thermal power of HA0 waste packages at the moment of their storage (2025) will be approximately 100 W/m → thermal peak after 25 years

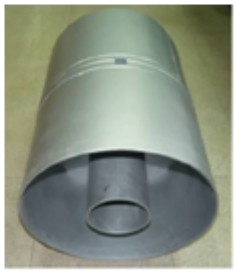
Design of the heaters (performed by Aitemin)

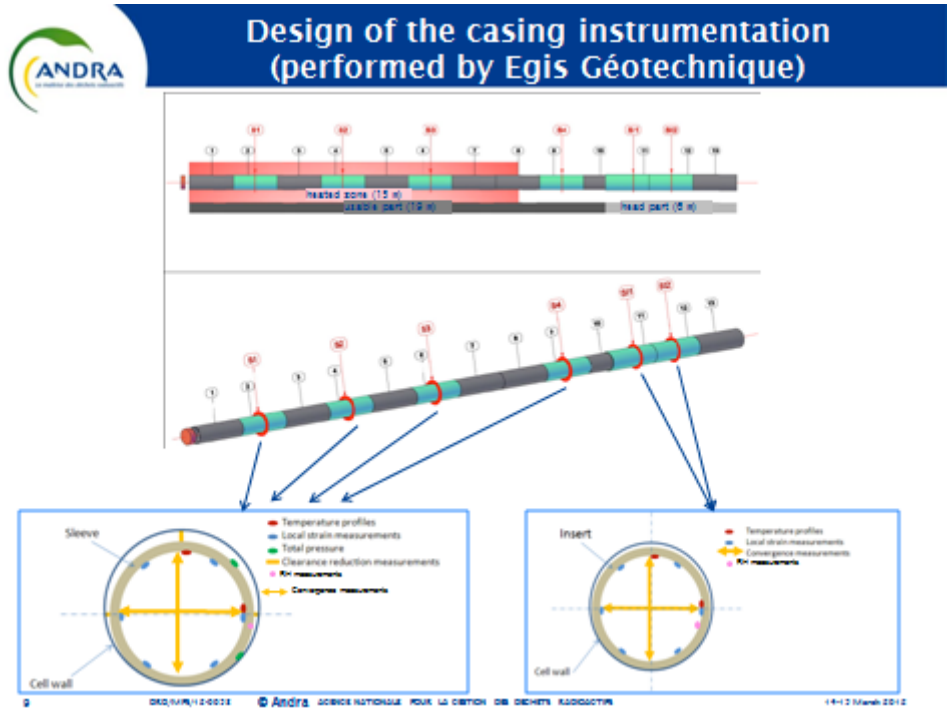
5 heating elements of 3 m long each
$\varnothing_{ext}$ = 508 mm

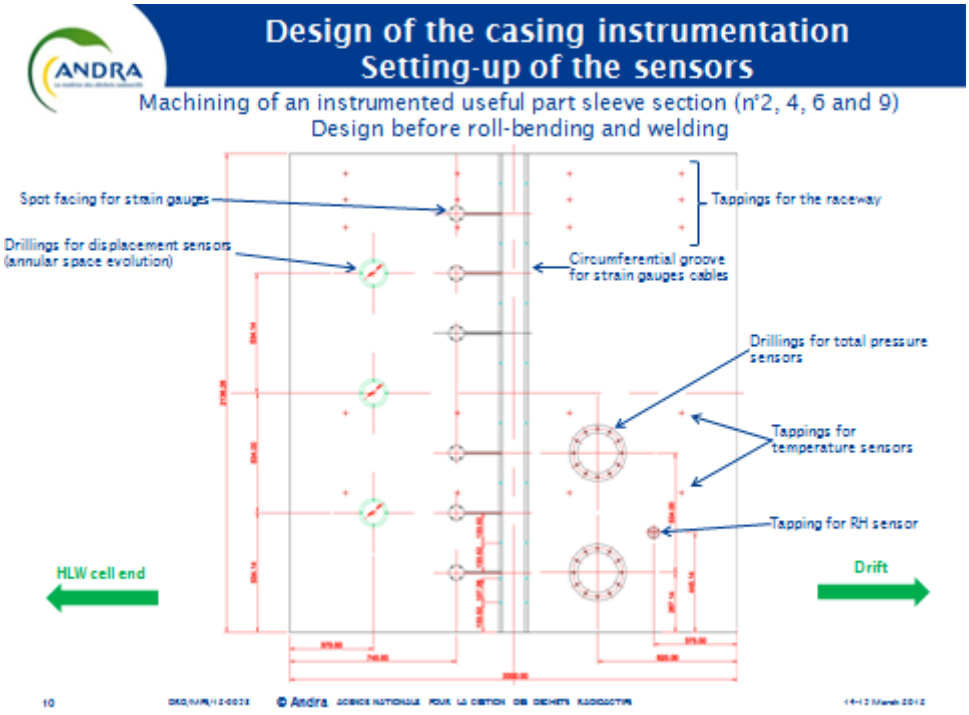




Heater prototype



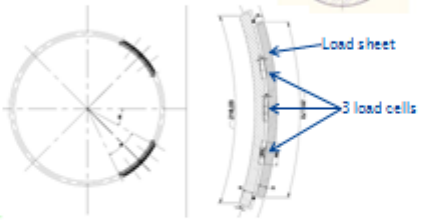

Design of the casing instrumentation
(performed by Egis Géotechnique)
Sleeve
Insert
Cell wall
Temperature profiles
Local strain measurements
Total pressure
Clearance reduction measurements
Convergence measurements


Design of the casing instrumentation
Setting-up of the sensors
Machining of an instrumented useful part sleeve section (n°2, 4, 6 and 9)
Design before roll-bending and welding
Spot facing for strain gauges
Drillings for displacement sensors
(annular space evolution)
Tappings for the raceway
Circumferential groove
for strain gauges cables
Drillings for total pressure
sensors
Tappings for
temperature sensors
Tapping for RH sensor
HLW cell end
Drift

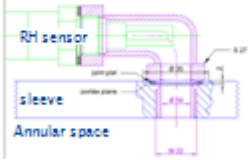
Design of the casing instrumentation Sensors technology

- Local strain measurements : strain gauges stuck on a metallic foil, itself welded on the sleeve

- Total pressure measurements



- RH measurements

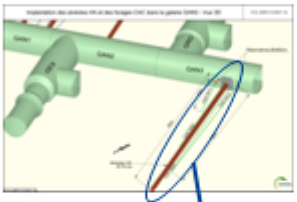


- Temperature measurements : PT100
- Convergence measurements : classical potentiometric displacement sensor
- Annular space evolution : not defined yet

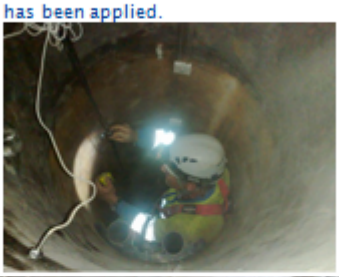
11 © Andra

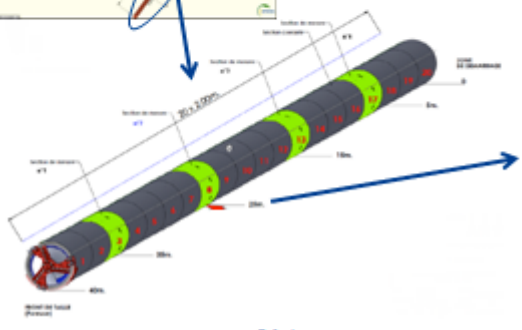
Examples of similar measurement results

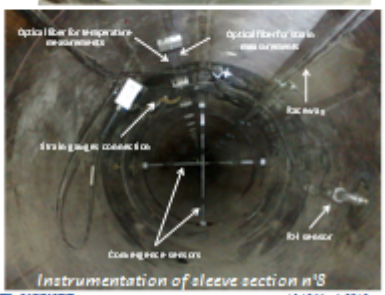
Within the framework of Phase 2 « HLW Cells » Program Unit, a 40 m long cell has been drilled in the CAN drift in october 2011. The sleeve has been equipped with several sensors to estimate the mechanical load of the rock. No thermal load has been applied.



Human intervention inside the casing to install the sensors (except strain gauges) and connect them to the data acquisition system

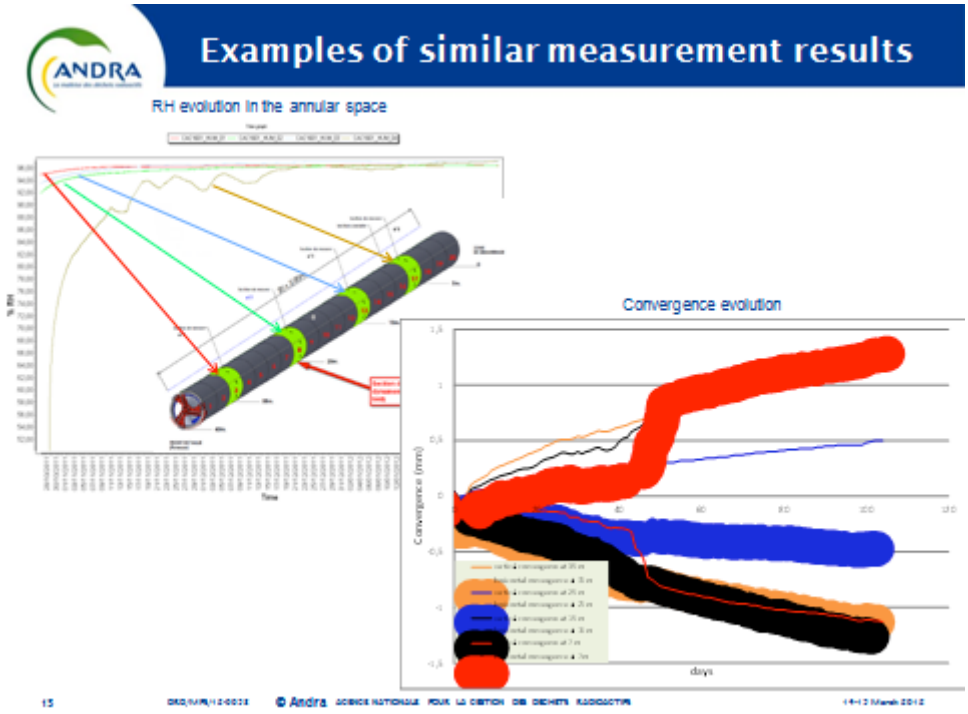


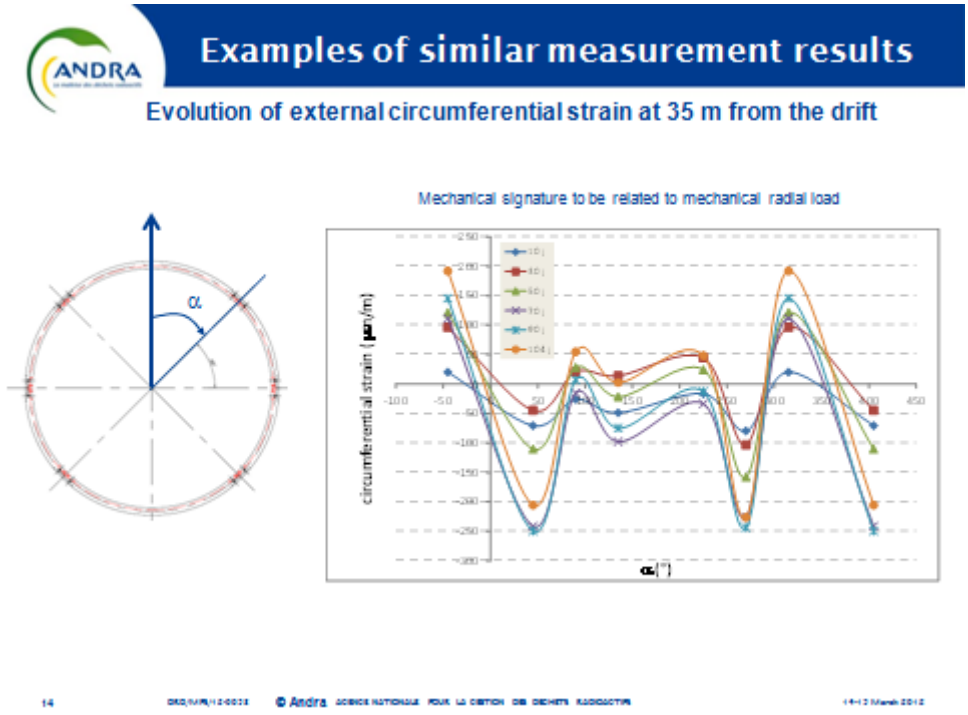




Instrumentation of sleeve section n°8

12 © Andra

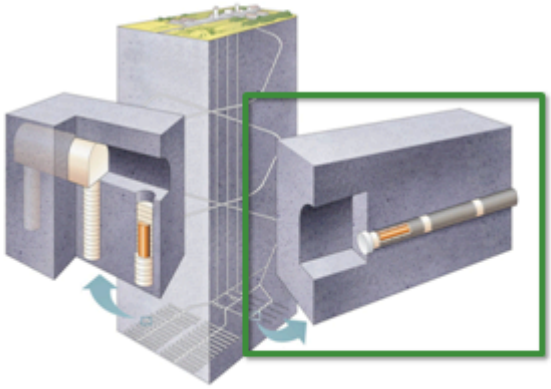

Examples of similar measurement results
RH evolution in the annular space
Convergence evolution
Convergence (mm)
days


Examples of similar measurement results
Evolution of external circumferential strain at 35 m from the drift
Mechanical signature to be related to mechanical radial load
α
circumferential strain (µm/m)


Current status of the project
Design of the experimentation
Design of the heaters → end of march 2012,
Design of the sleeve instrumentation → end of march 2012,
Qualification phase
Qualification of the heaters → June 2012,
Thermo-mechanical qualification of the sleeve instrumentation : from April to July 2012 in Seyssins (France)
Qualification of the electromagnetic compatibility between heaters and sensors : May 2012 in Toledo (Spain)
Machining and instrumentation of the sleeve and insert elements : from July to September 2012
Excavation of the cell : October 2012
Finalisation of the instrumentation of the sleeve and insert : October/November 2012
Heaters installation : November/December 2012
Deliverables : Installation report in January 2013

LucoeX Work Package 4, Multi Purpose Test

LUCOEX Project Progress Meeting 02
March 14th -15th , 2012
Magnus Kronberg



Contents

- **MPT, short recap**
  - *Background*
  - *Objectives*
- **Status and plans**
  - *Established organisation*
    - *Steering documents*
  - *Status and plans*
    - *Instrumentation and preparation*
    - *Buffer and filling components*
    - *Machine development work*
- **Time schedule**

Contents

- **MPT, short recap**
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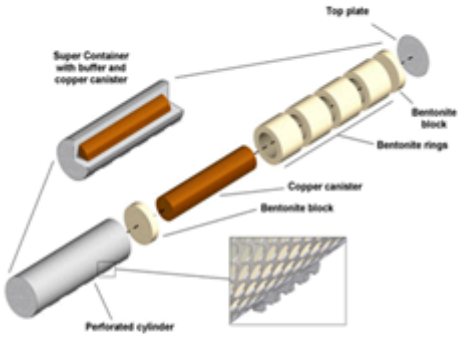
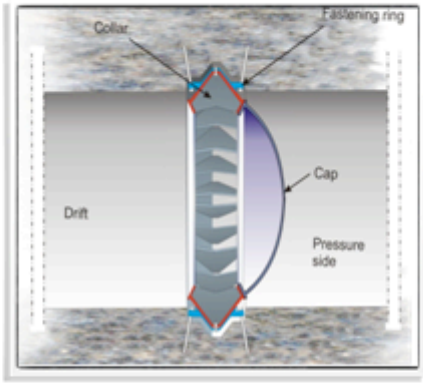
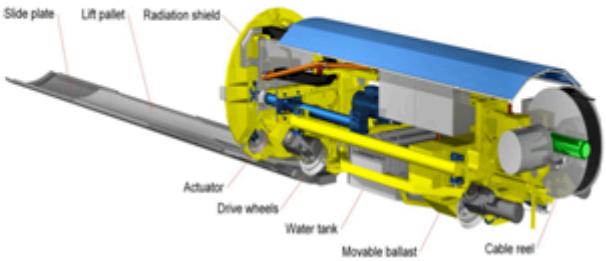
KBS-3H key components in the design

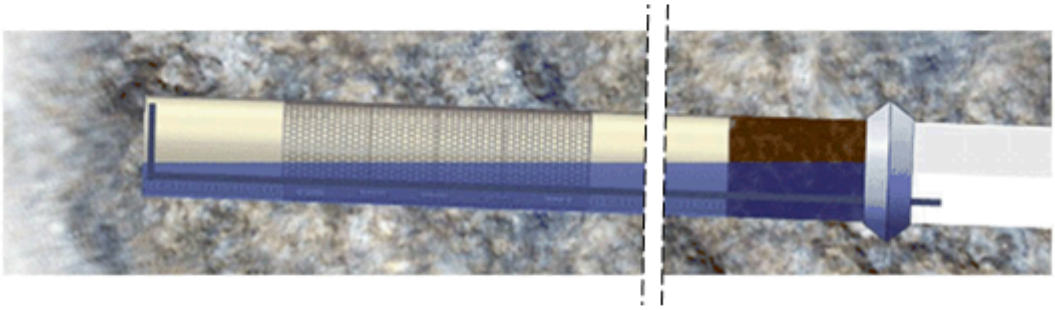






The development and demonstration of the deposition machine was included in ESDRED

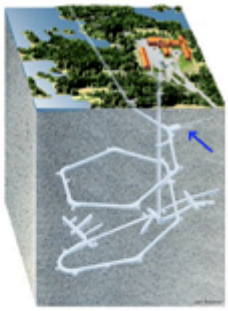
KBS-3H reference design: DAWE (Drainage, Artificial Watering and air Evacuation)



Schematic illustration of DAWE, in the repository case the sections will be ~150 m long with multiple canisters and distance blocks.

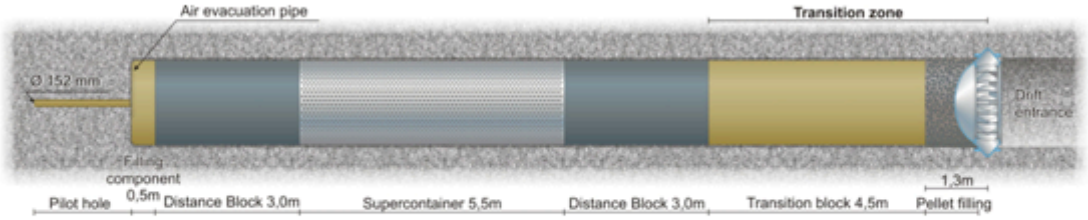
Multi Purpose Test, background

- Äspö HRL, KBS-3H test site at the -220 m level
  - Deposition drift DA1619A02, 95 m long
  - Deposition equipment is located at the site



Multi Purpose Test, objectives

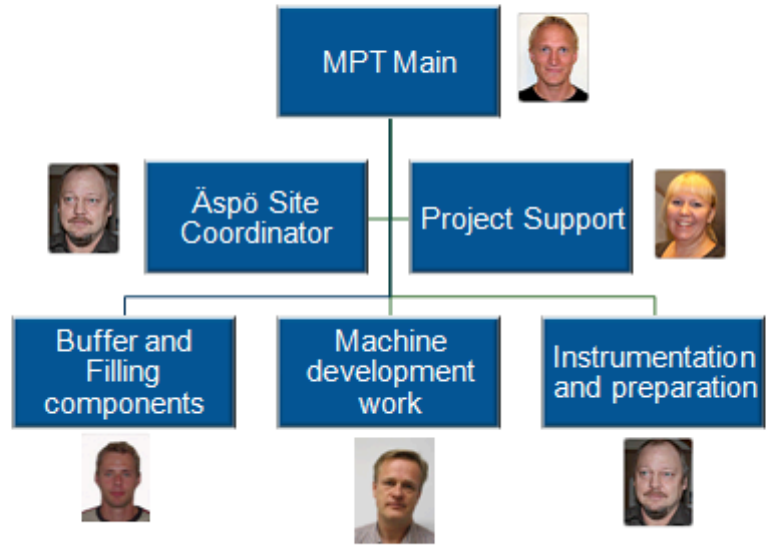
- Test the system components in full scale and in combination with each other to obtain an initial verification of design implementation and component function
- This includes the ability to manufacture full scale components, carry out installation (according to DAWE) and monitor the initial system state of the MPT and its subsequent evolution



Contents

- MPT, short recap
  - *Background*
  - *Objectives*
- **Status and plans**
  - *Established organisation*
    - *Steering documents*
  - *Status and plans*
    - *Instrumentation and preparation*
    - *Buffer and filling components*
    - *Machine development work*
- Time schedule

Multi Purpose Test, established organisation

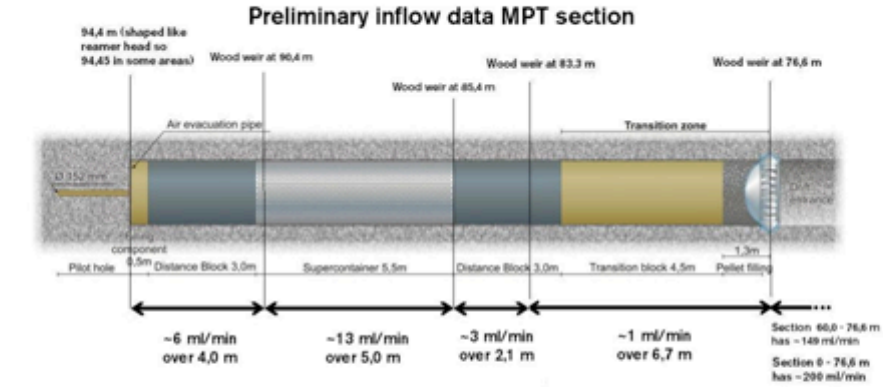


Multi Purpose Test, steering documents

- KBS-3H Multi Purpose Test, LucoeX WP4, Work Plan
  SKBdoc ID 1289289
  - Sub Work Plan MPT Instrumentation and Preparation,
    SKBdoc ID 1318412
  - Sub Work Plan MPT Buffer and filling components
    SKBdoc ID 1318470
  - Sub Work Plan for the KBS-3H Machine development work *SKBdoc ID 1294077*

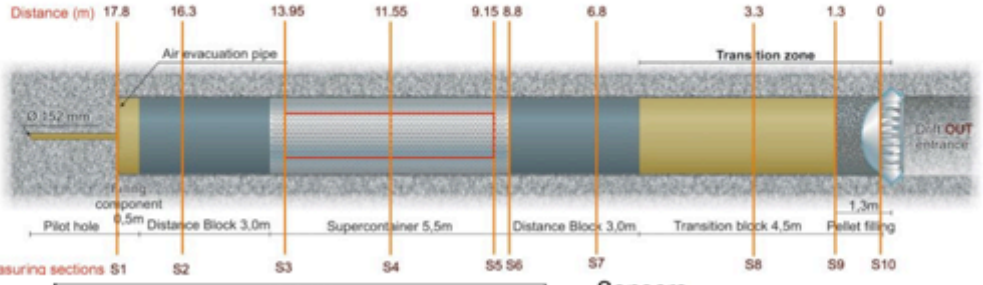
- *Documents and WP4 folders will be copied to the project place during March (April)*

MPT, Instrumentation and Preparation, status



Scoping calculations indicate that the inflow is about the same as what the buffer can absorb. Given the large quantity of water which is artificially added into the system following the installation (according to DAWE) further wetting is not assessed as being beneficial and the test will be left to saturate naturally during the test period.

An Instrumentation plan has been developed



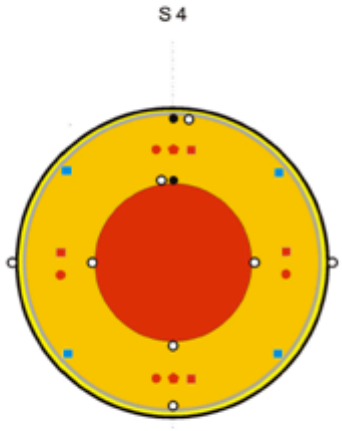
	SECTIONS										
Sensors	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	OUT	TOT
TP rock/plug	5	4		2			4	4	4	5		28
TP buffer				6	4	5						15
PP rock	1	4					4		12			21
PP buffer		4		4	5		4			7		24
WC		6		4	5		6	7	6			34
WP		6		4	5		6	6	6			33
WF	1	2		2	2		2	2	2			13
DS					4	4						8
DB									2			2
DC											3	3
IS				2								2
IB		1					1		2			4
SG supercontainer			12	16	12							40
SG cap											20	20
FM											1	1
GP					1	1				1		3
Wireless	0	6	0	0	6	0	6	6	6	6		36
Wired	7	21	12	40	32	10	21	13	28	7	24	215
Total	7	27	12	40	38	10	27	19	34	13	24	251

S1: 1 pore pressure will be installed at the pilot hole
S9: 3 pore pressure transducers will be installed in each core

Sensors

TP Total pressure
PP Pore pressure
WC Water content capacitive
WP Water content psycrometric
WF Water content volumetric
DS Displacement supercontainer
DB Displacement bentonite
IS Inclinometer supercontainer
IB Inclinometer bentonite
GP Gas pressure
SG Strain gauge
FM Flowmeter
DC Displacement collar

MPT, Instrumentation plan, detailed example



Sensors

- TP Total pressure
- PP Pore pressure
- WC Water content capacitive
- WP Water content psycrometric
- WF Water content volumetric
- DS Displacement supercontainer
- DB Displacement bentonite
- IS Inclinometer supercontainer
- IB Inclinometer bentonite
- GP Gas pressure

MPT, Instrumentation and Preparation

Status

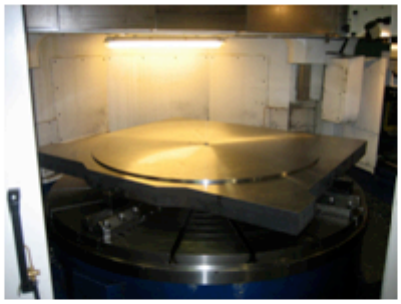
- The Instrumentation Plan review and update process is currently being finalized and an updated cost assessment has been initiated.
- Tenders for manufacturing of the plug have been obtained and evaluated, the purchase is currently in its final stage.
- Contractor for the sawing of the plug and cable notches have been selected.

Plans

- Production of drawings for the measurement system will start when the number of sensors and contractor have been decided, followed by purchasing of measurement system, sensors, data loggers, computers etc.
- Scanning and an updated geological mapping is being planned

MPT, Buffer and filling components

- **Status**
  - A Buffer Mould has been ordered from Herrströms Mekaniska, expected delivery is April 30, 2012.




  - Bentonite (MX-80) has been ordered and delivered

MPT, Buffer and filling components

- **Planned work**
  - Acceptance test of the bentonite
  - Compaction test to establish the correct process parameters for the specific material.
  - Mixing of the bentonite with water to attain the required moisture content, prior to pressing of the blocks.
  - A few test blocks will be cut and samples extracted to check the quality of the blocks.
  - Machining of the blocks is planned to be carried out in Finland

MPT, KBS-3H Machine development work

- **Status**
  - Flaws in the software structure have been surveyed
  - Bus loads, sensor interfaces and control interfaces have been examined.
  - Software corrections programmed
  - Wear in the sliding plate noted. Likely reason for the jamming problems noted when driving the palette underneath the Supercontainer.
  - New cushions and new sensors systems will be mounted in the palette.

MPT, KBS-3H Machine development work

- **Planned work**
  - When the mechanical updates are ready the control system testing will continue (structural corrections and development of new control methods).
  - Upon sufficiently stable control the machine performance will be evaluated in repetitive tests (Supercontainer and Distance block dummies followed by bentonite distance blocks).
  - 2-week training possibility for Post-doc/student planned for autumn 2012, operating the deposition machine with the objective to identify difficulties generally avoided by the regular operator due to experience of specific situations

MPT, KBS-3H Machine development work

- **Planned work**
  - Transport of the Supercontainer dummy to ground surface will provide knowledge of the overall transportation process with SKBs new MPV(Multi Purpose Vehicle)
  - Detailed planning of Supercontainer and Distance Block assembly with sensors will be initiated as soon as the instrumentation design is locked
  - Detailed planning of MPT installation and control procedure will be initiated before summer.

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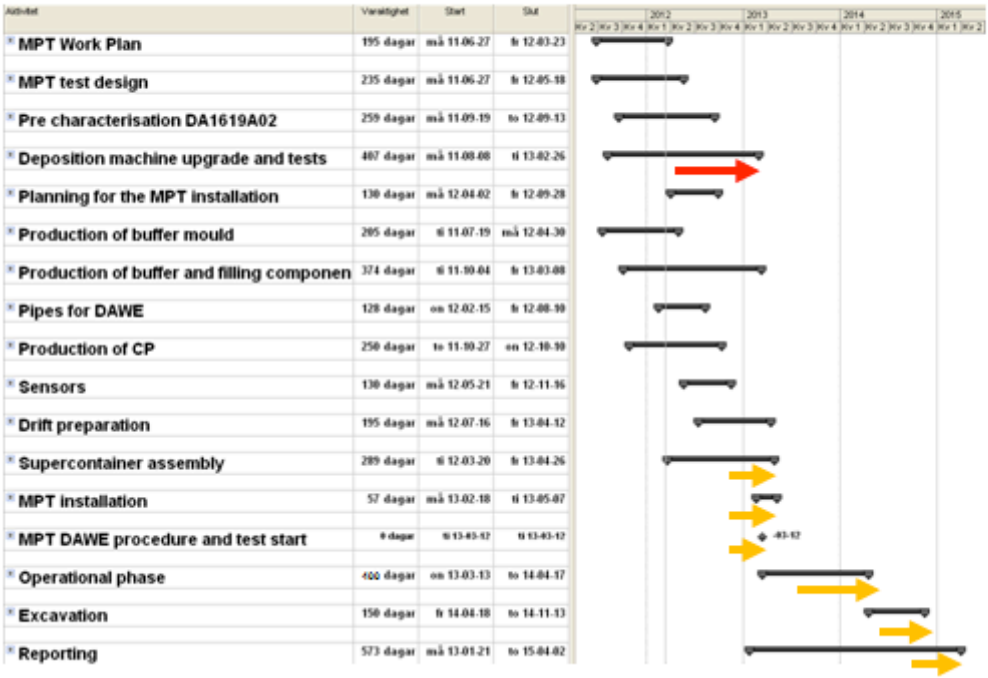
    - *Buffer and filling components*
    - *Machine development work*
- **Time schedule**

Multi Purpose Test, time schedule, delays

- Work with the deposition machine is delayed due to key recourses (control system expertise) required within a prioritized SKB project.
- There is an ongoing expansion of Äspö HRL and the blast cycle affects the KBS-3H test site from 14:00 most days throughout 2012.

As a result installation will not be possible during 2012 but will rather be carried out in the beginning of 2013. The consequences for the KBS-3H and LucoeX project is currently being evaluated and will be addressed asap.

Multi Purpose Test, time schedule



FP7-Fission

LUCOEX

Large Underground Concept EXperiments
2011 - 2014
Project Progress Meeting
14 - 15.3.2012
EURAJOKI

Work Package 5, Progress and plans

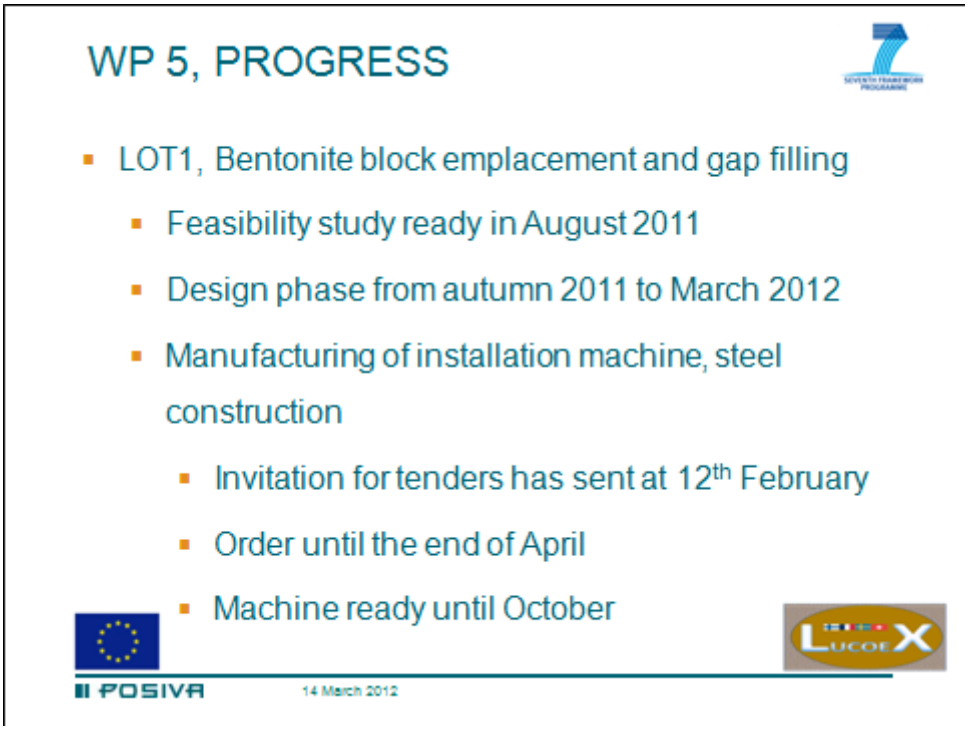
Keijo Haapala

POSIVA

WP 5, GENERAL

- LUCOEX tasks:
  - 5.1. Detailed WP planning
  - 5.2. Demonstration of buffer components emplacement
  - 5.3. Quality assurance and problem handling
  - 5.4. Final reporting of WP5
  - 5.5. Integration
- Tasks 5.2 and 5.3 has devided in 3 LOTs:
  - LOT 1: Bentonite block emplacement and gap filling
  - LOT 2: Equipments for quality control
  - LOT 3: Problem handling equipment

POSIVA 14 March 2012


WP 5, PROGRESS
LOT1, Bentonite block emplacement and gap filling
Feasibility study ready in August 2011
Design phase from autumn 2011 to March 2012
Manufacturing of installation machine, steel construction
Invitation for tenders has sent at 12th February
Order until the end of April
Machine ready until October
POSIVA
14 March 2012


WP 5, PROGRESS
LOT2, Equipments for quality control
Feasibility study ready in November 2011
Design phase from November 2011 to May 2012
Manufacturing of equipments; from summer to autumn 2012
POSIVA
14 March 2012

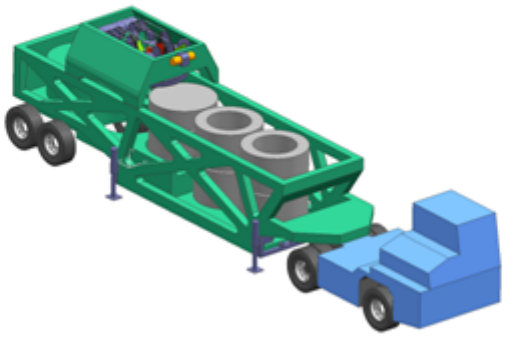
WP 5, PROGRESS

- LOT3, Problem handling equipments
  - Work will be started in June 2012
  - Currently we are waiting new ideas

POSIVA 14 March 2012

LOT 1, STARTING POINT

- One vehicle with full bentonite set and lifter, "Full Set Combined Vehicle"
- Plain bentonite blocks brought to the tunnel



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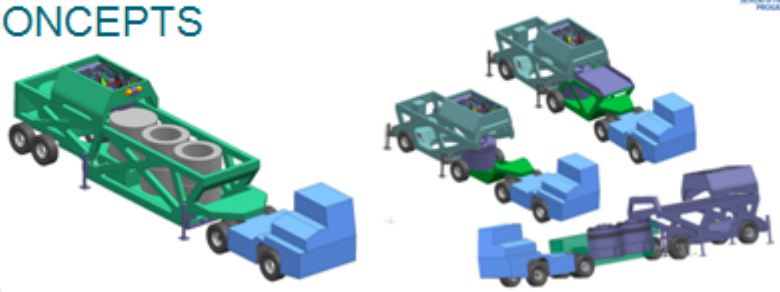
LOT 1, EXAMINED VECHICLE CONCEPTS



- One logistic selection
  - Many blocks at the same time to the deposition hole or
  - blocks brought during the installation procedure
- Five different vehicle types examined further
  - Full Set Combined Vehicle = FSCV
  - Four different kind of "split vehicles"

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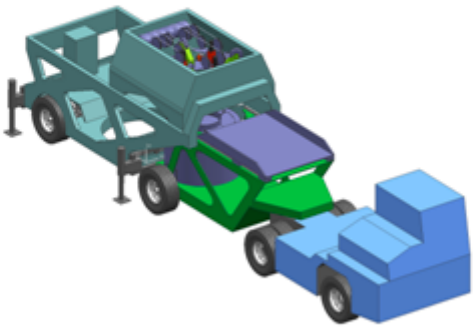
LOT 1, CHOSEN CONCEPT

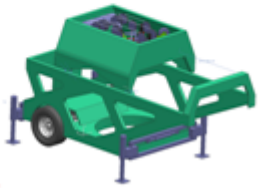
- Two vehicles, installation machine and transfer shuttle
- Transfer suffle is travelling between driving tunnel and deposition hole bringing blocks for installation machine.

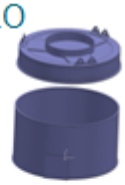


POSIVA 14 March 2012

LOT 1, CHOSEN CONCEPT

- Dimensions of the blocks
  - Diameter 1,65 M
  - Height 0,5 M – 0,96 M
- Transportation of buffer blocks to ONKALO inside the container

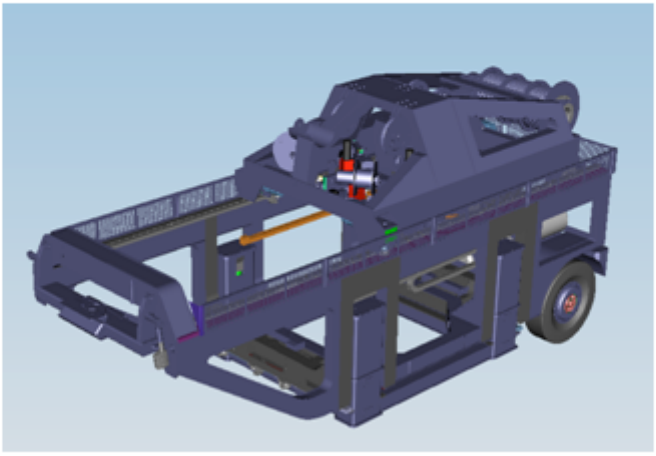




POSIVA 14 March 2012

LOT 1, CHOSEN CONCEPT

- Installation machine



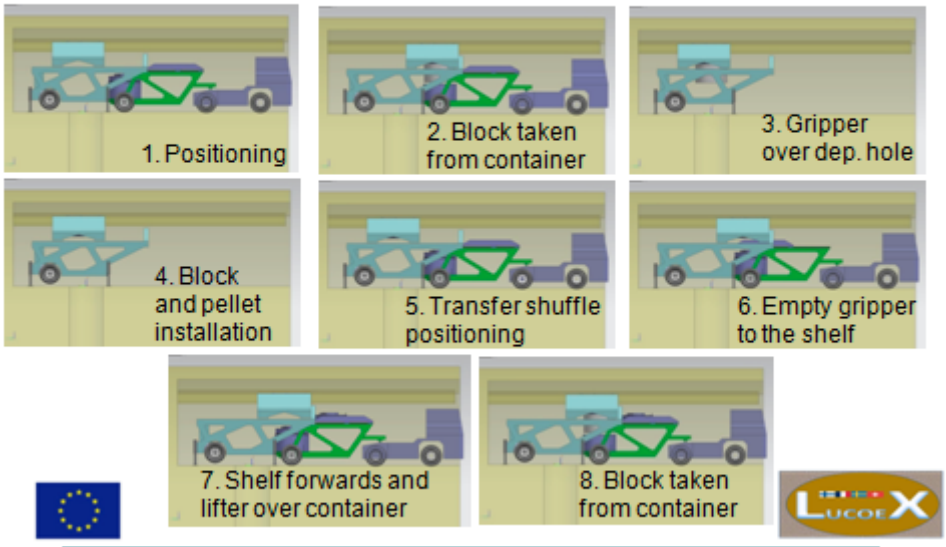
POSIVA 14 March 2012

LOT 1, CHOSEN CONCEPT

- Installation machine

POSIVA 14 March 2012

BUFFER INSTALLATION SEQUENCE



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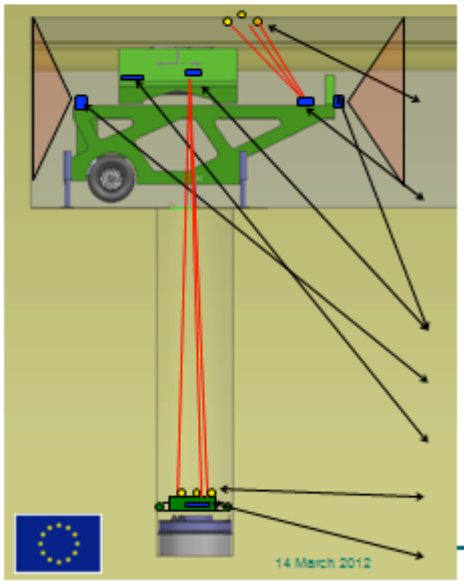
LOT2 : 3D Coordinate System with a Laser Tracker



1. 3 reference points (equipped with prisms) to connect equipment's local coordinate system to tunnel's coordinate system.
2. Laser tracker to locate the reference point with accuracy of 0.1mm.
3. Xy Inclinometer to level the frame within ± 0.2 degrees
4. 3 reference points (with prisms) to get the position of the gripper within accurracy of ± 1 mm
5. Precise xy inclinometer to level the gripper within accuracy of 0.01 degrees

LUCOEX milestones

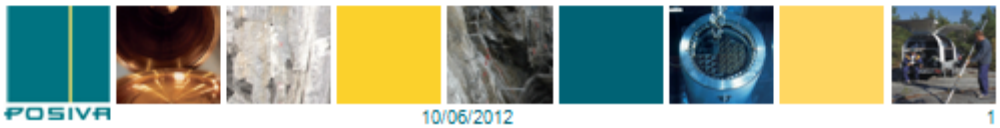
LOT1:		
MS 1 Feasibility studies ready	30.08.2011	OK
MS 2 Design of method and related equipment ready	23.12.2011	Delayed, ready by mid march
MS 3 Indoor testing ready	27.07.2012	Will be delayed
MS 4 Testing in Onkalo with concrete blocks ready	21.12.2012	
MS 5 Testing in Onkalo with bentonite blocks ready	20.05.2013	
MS 6 Installation report ready	26.09.2013	
MS 7 Final report / LOTs 1-3 ready	25.03.2014	
LOT2:		
MS 1 Feasibility studies ready	16.11.2011	OK
MS 2 Design of method and related equipment ready	15.02.2011	Delayed, was waiting
MS 3 Indoor testing ready	14.12.2012	Critical
MS 4 Testing in Onkalo with concrete blocks ready	15.04.2013	
MS 5 Testing in Onkalo with bentonite blocks ready	07.10.2013	
MS 6 Quality assurance method report ready	05.11.2013	
LOT3:		
MS 1 Feasibility studies ready	03.10.2012	
MS 2 Design of method and related equipment ready	04.12.2012	
MS 3 Indoor testing ready	07.10.2013	
MS 4 Testing in Onkalo ready	17.01.2014	
MS 5 Problem handling report ready	25.02.2014	

POSIVA 14 March 2012

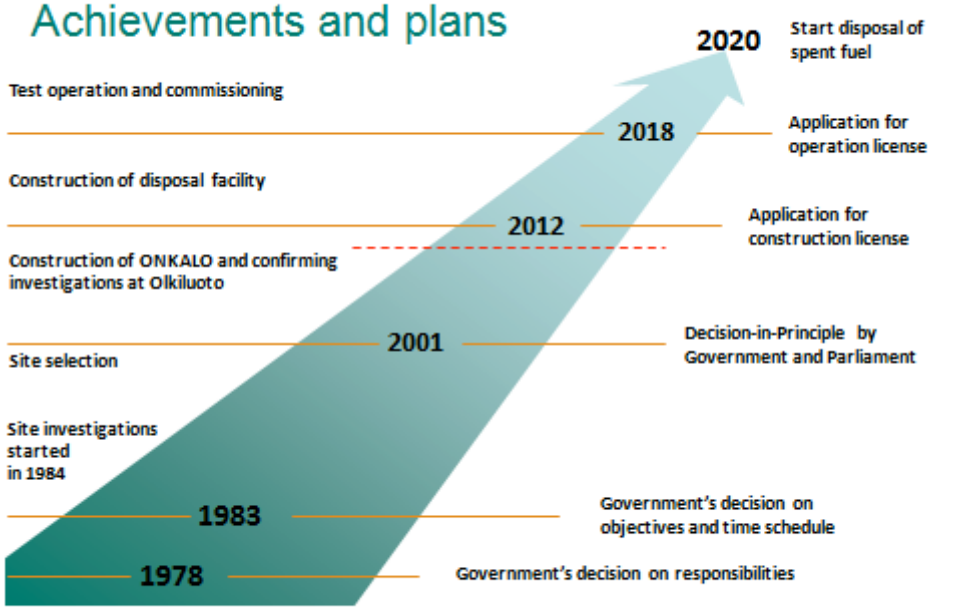
ONKALO URCF

Status and investigations

Johanna Hansen/Paula Kosunen



Achievements and plans



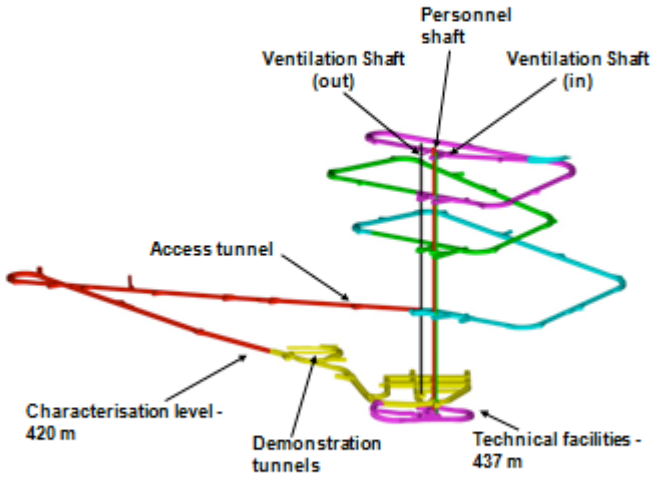
ONKALO layout and technical information

TECHNICAL INFORMATION

- Excavation volume 365,000 m³
- Access tunnel
  - Length 5 km
  - Inclination 1:10
  - Size 5.5 x 6.3 m
- Total length of tunnels and shafts 9,5 km
- Shafts 3.5, 4.5 & 3,5 m

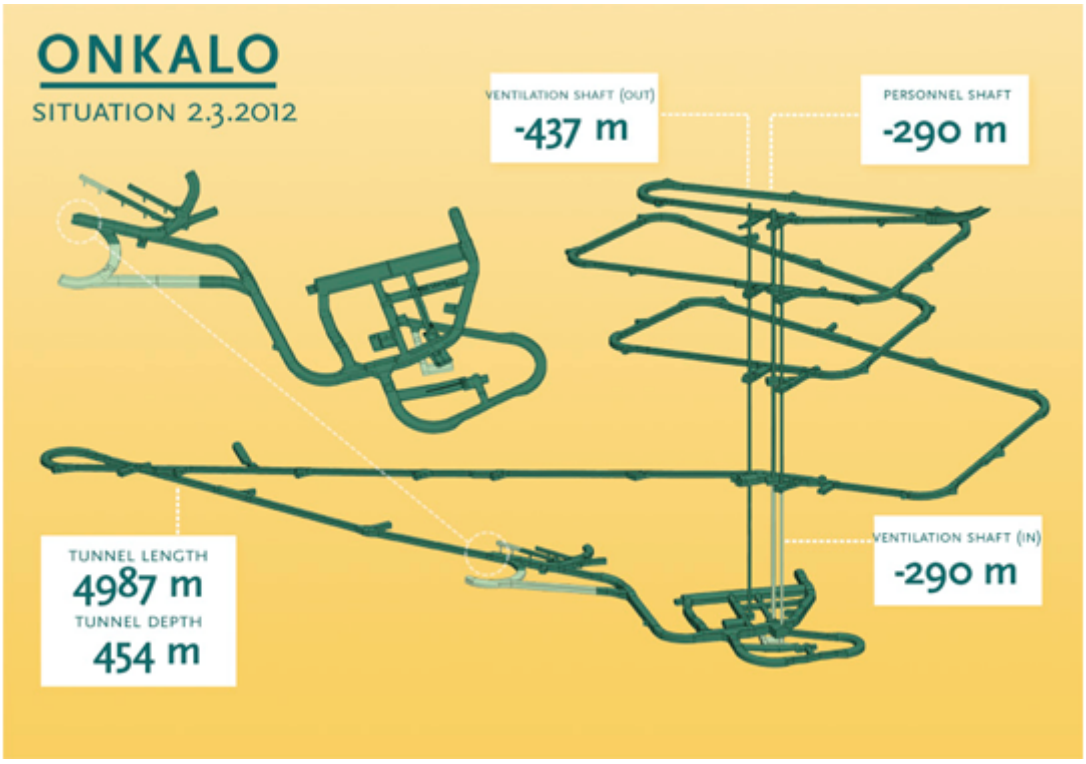
TIME-TABLE

- Start summer at 2004
- Research depth at 2010
- excavation complete at 2011

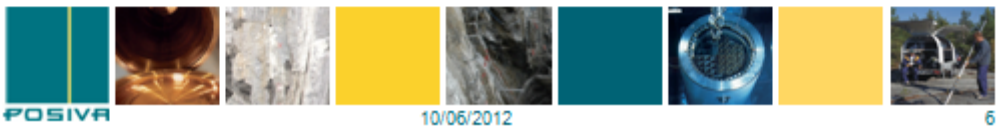


Aims and objectives of ONKALO

- Provide an opportunity for Posiva to learn and develop competences
  - Human performance and safety culture
  - Competences required for nuclear facility
  - Methods and means to construct and supervise related acitivities
- Contribute to the application for Construction License (CLA)
  - Assess that previous conclusions of the site and its properties hold good
  - Enable the acquisition of detailed characterisation information for design and performance assessment
  - Produce evidence that safety critical functions can be managed and controlled during construction
  - Provide assessment that excavation can be executed, managed and quality assured to a sufficient level
- Contribute to the application for Operation License (OLA)
  - Provide a possibility to test and demonstrate repository systems for their intended use (inc. separate licensing)
  - Make possible a full system test to assess "initial state" (prototype)
  - Make possible long-term tests and observations (if needed)



Investigations at ONKALO



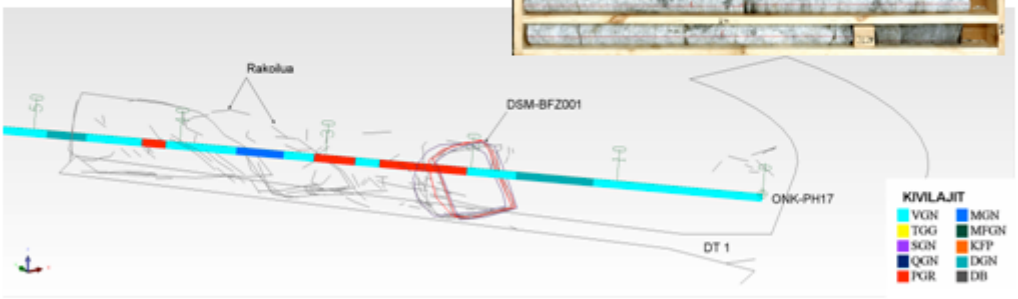
10/06/2012 6

Investigations carried out in parallel with excavation



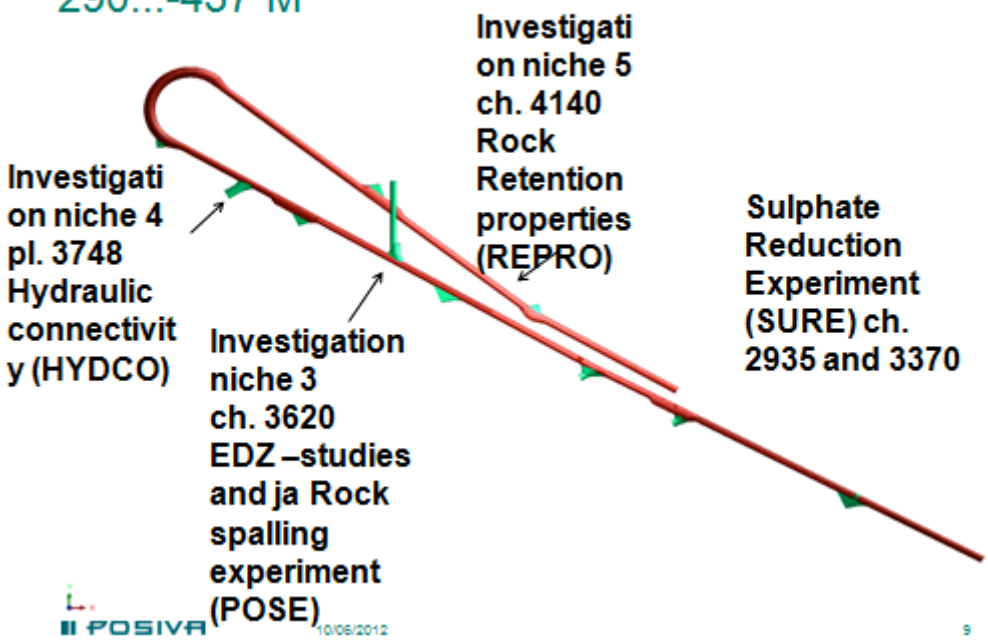

POSIVA 10/06/2012 7

Demonstration tunnel 1 in -420 level ONKALO pilot hole

POSIVA 10/06/2012 8

INVESTIGATIONS IN ONKALO AT DEPTH -290...-437 M



SURE

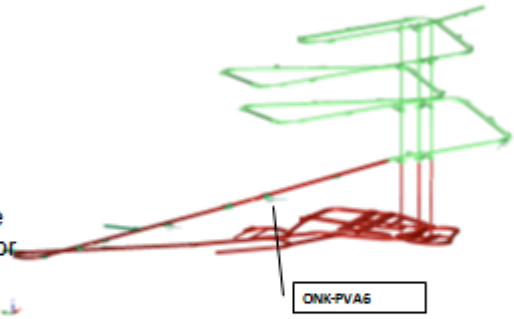
Sulphate reduction experiment: investigation plan for the 1st phase

- The aims of the experiment are:
  - to demonstrate microbial reduction of sulphate with ANME
  - to determine case-specific (i.e. variable concentrations) reduction rates
  - to determine renewal rates of energy sources for sulphate reduction
- Two drillholes will be drilled: one for the sulphate rich watertype and the other for methane rich watertype (ONK-PVA6)
- Investigations contain following stages:

  1) Drillings and baseline characterization of the investigation drillholes in 2009-2010

  2) Microbiological studies in SO_4 and CH_4 rich water types in 2010

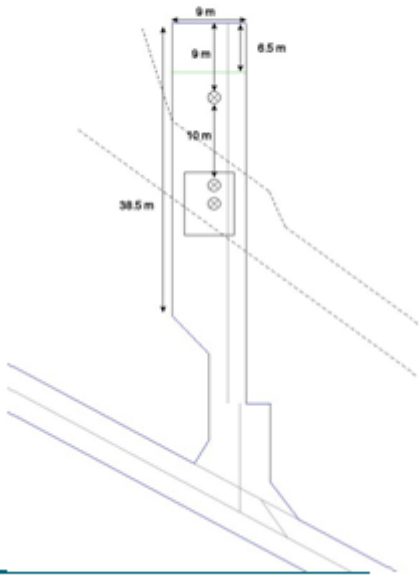
  3) Influence of flow changes to sulphate reduction rate in 2011



POSE

Posiva's Olkiluoto Spalling Experiment, phase 1

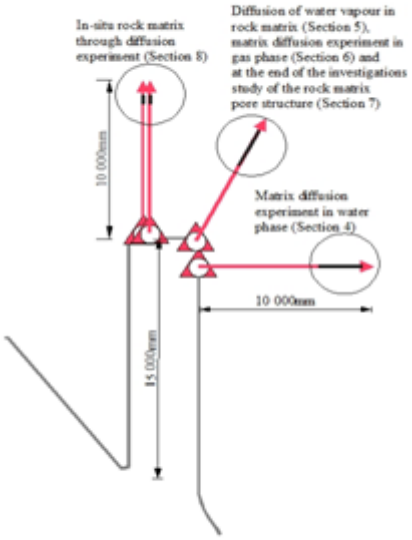
- Objectives:
  - To establish the *in situ* spalling strength of Olkiluoto migmatitic gneiss
  - To establish the state of *in situ* stress at the -345 m depth level
  - To act as a Prediction-Outcome (P-O) exercise
- The boring of the disposal holes is done in summer 2010
- The experimental work should be ready by the end of 2010



REPRO

Rock Matrix Retention Properties

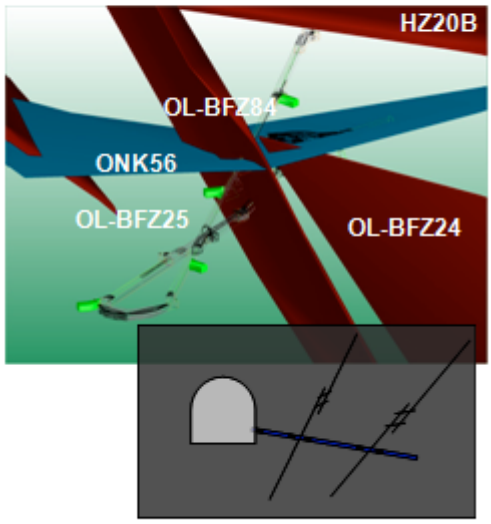
- Objectives:
  - to investigate rock matrix retention properties (porosity and diffusivity of rock matrix pores) under in situ conditions
  - to demonstrate that the assumptions made in the safety case are in line with the site evidence.
- Experiments are focused on the rock mass which presents conditions in the repository near field (ch. 4140), because most of the retention along potential release paths takes place in the vicinity of the deposition holes.
- Three different experiment types are applied:
  - tracer experiments in the water phase,
  - diffusive gas transport in the rock matrix
  - electrical method for logging of the rock matrix pore structure.



HYDCO

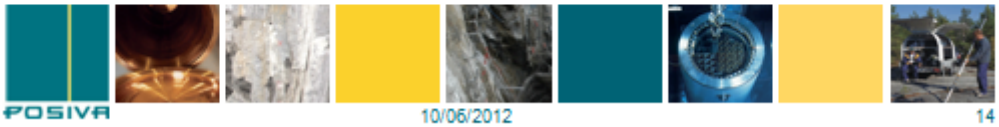
Hydraulic characterization of the rock mass and geochemical characterization of poorly conductive fractures

- The primary objective is to investigate groundwater flow pattern in poorly conductive ($T < 10^{-7}$ m²/s) fractures in the rock mass representative to that to be surrounding deposition holes and tunnels.
- The goal is to investigate
  - the geometry, connectivity, geochemical properties, heterogeneity and transport properties in poorly conductive fractures (T<10-7 m2/s) (the hydraulic coupling of the transport, i.e., the transport resistance)
  - influences of open drillholes to connectivity
  - geochemical characterization of poorly conductive fractures
- Experimental work will be finised by the end of 2010



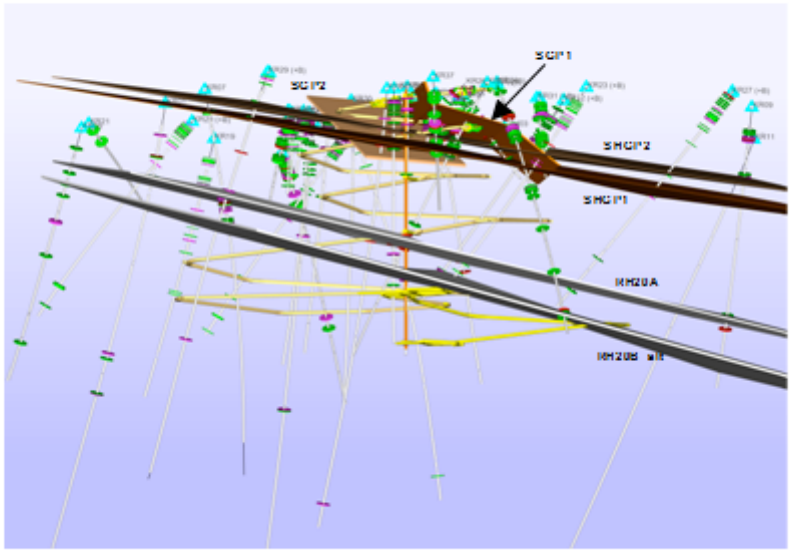
POSIVA 10/06/2012 13

Underground construction related activities



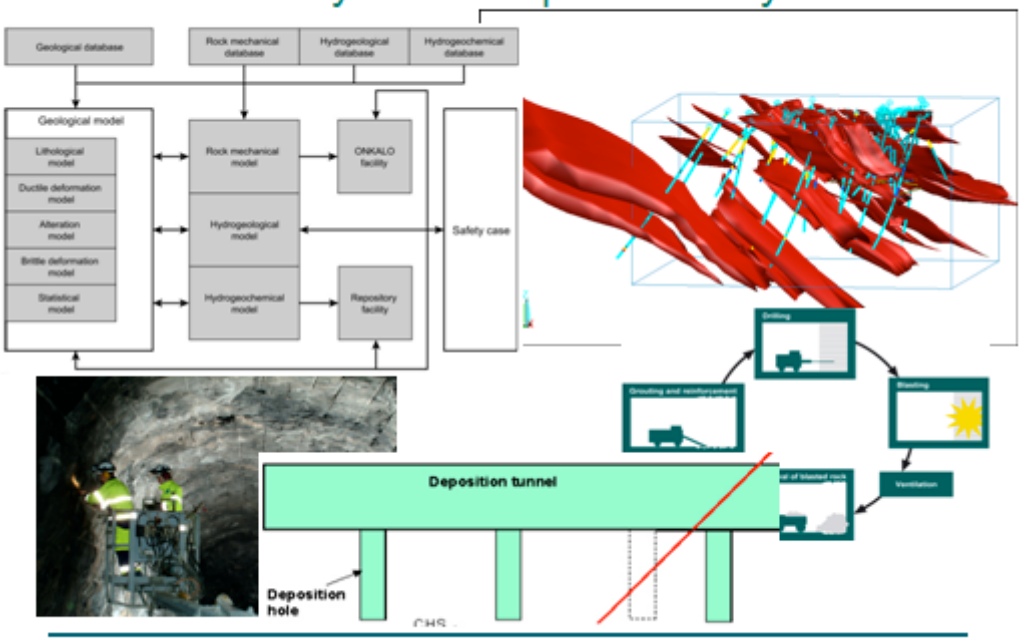
POSIVA 10/06/2012 14

The main structures in Olkiluoto



POSIVA 10/06/2012 15

Construction cycle for disposal facility



POSIVA 10/06/2012 16

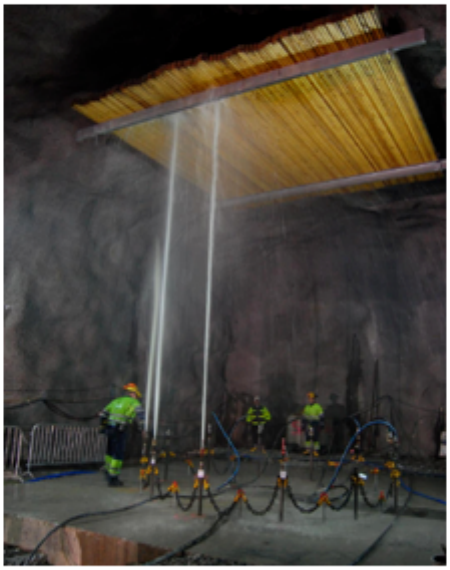
Reinforcement

POSIVA 10/06/2012 17

Grouting with silica in D2

POSIVA 10/06/2012 18

Grouting of personnel and ventilation shafts ongoing



POSIVA 10/06/2012 19

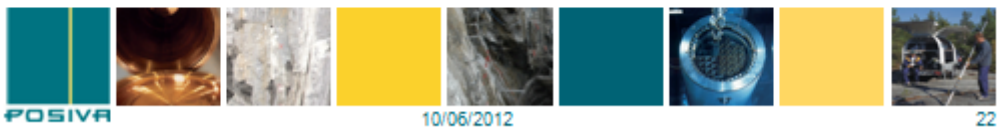
Demonstration tunnel

POSIVA 10/06/2012 20

Making tunnel floor even by mechanical method

POSIVA 10/06/2012 21

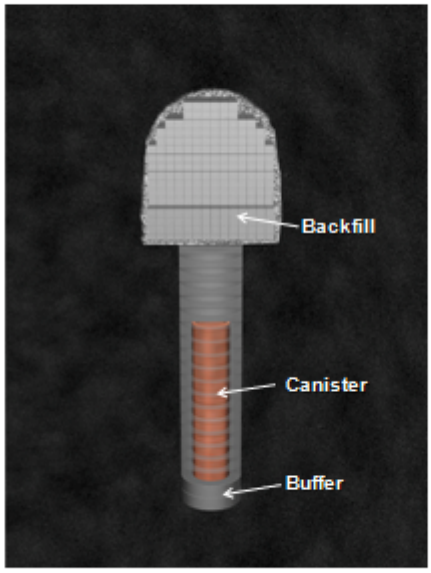
Toward the EBS demonstrations



POSIVA 10/06/2012 22

Steps for development and design of KBS-3 system and considered in testing and demonstration at ONKALO

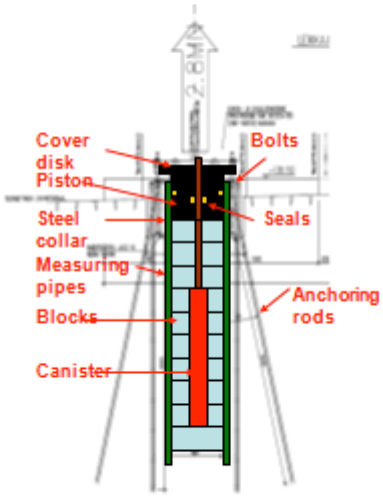
SAFETY REQUIREMENTS
↓
DESIGN BASIS
↓
FUNCTIONAL REQUIREMENTS
↓
SPECIFICATIONS
↓
TECHNICAL SOLUTIONS
↓
PERFORMANCE ASSESSEMENT
↓
SAFETY CASE
↓
LICENSE APPLICATION



POSIVA 10/06/2012 23

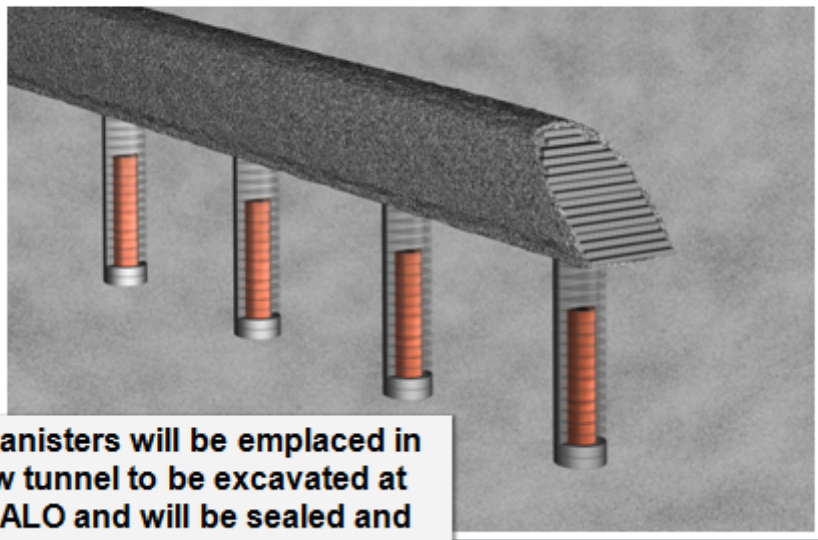
Buffer bentonite demonstration test

- Objectives:
  - develop instrumentation of a test set up
  - test alternative buffer design
- Location:
  - Demonstration niche TU1 (tc1470)



POSIVA 10/06/2012 25

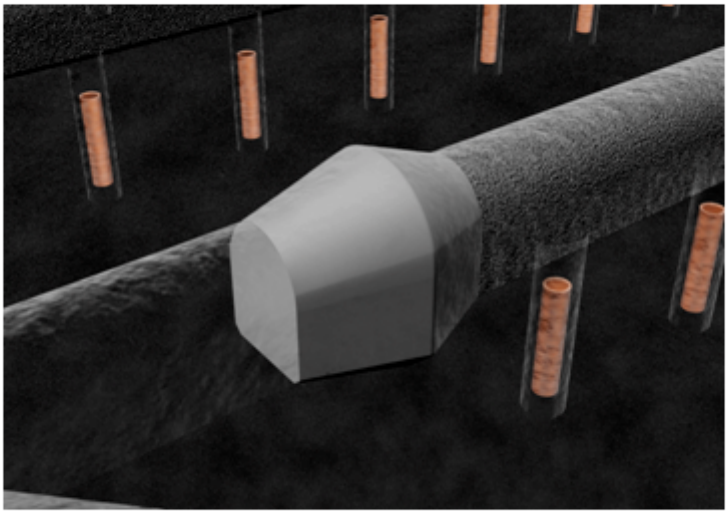
Future: preparing for prototype at ONKALO



4-5 canisters will be emplaced in a new tunnel to be excavated at ONKALO and will be sealed and plugged for monitoring

27

which includes plug too

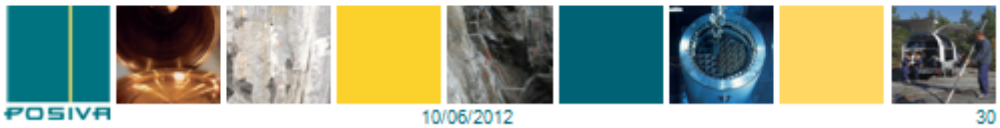


Prototype at ONKALO –preliminary plans

- Implementation at -420 m, ”demonstration area”
- A new tunnel will be excavated
  - Investigation, design and excavation shall be made based on “final” instructions and method descriptions
- More detailed plan and cost estimation during 2012
  - In conjunction of YJH 2012 -programme
- Tests on equipment in current demonstration tunnels at ONKALO
  - Acquisition of knowledge and experiences for elimination of deficiences and uncertainties
  - Tunnels will be used also at later date as a place for equipment testing and validation

RSC methodology

Paula Kosunen



POSIVA 10/06/2012 30

RSC

The Rock Suitability Criteria (RSC) programme 2007-2009

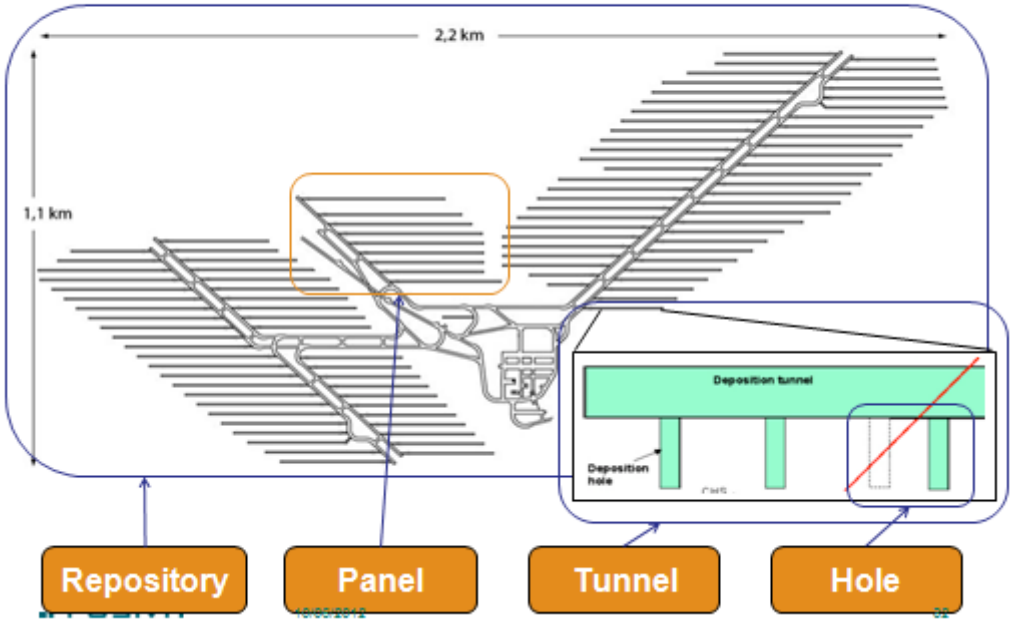
- Evaluation of the natural properties of the host rock for the purpose of locating suitable rock volumes for the repository -> avoidance of such features of the host rock that might endanger the proper functioning of the engineered barrier system (canister – buffer – backfill) or the function of the host rock as a natural barrier
- Definition of the target properties of the host rock, related to chemical composition of the groundwater, groundwater flow, groundwater transport properties and thermomechanical stability.
- Development and testing of the criteria -> tentative criteria by 2009
- Posiva Working Report 2009-29

The RSC-process ("Rock Suitability Classification") 2010 ->

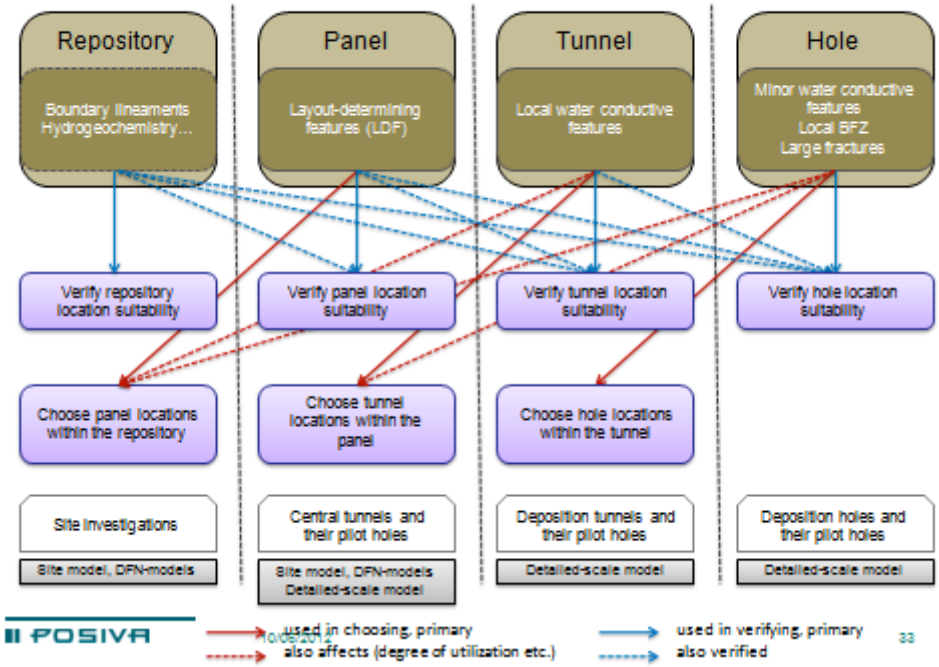
- Testing and evaluation of the rock suitability criteria, criteria update
- Application of the criteria -> RSC implementation process
- Integration of RSC into the repository design and construction
- RSC demonstration

POSIVA 10/06/2012 31

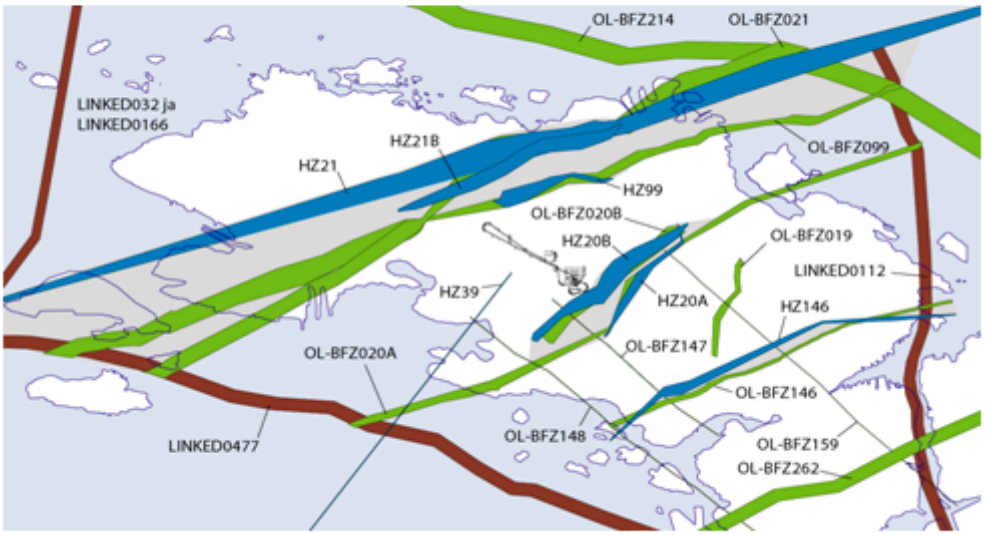
The scales of Rock Suitability Classification



The basic principle of host rock suitability assessment

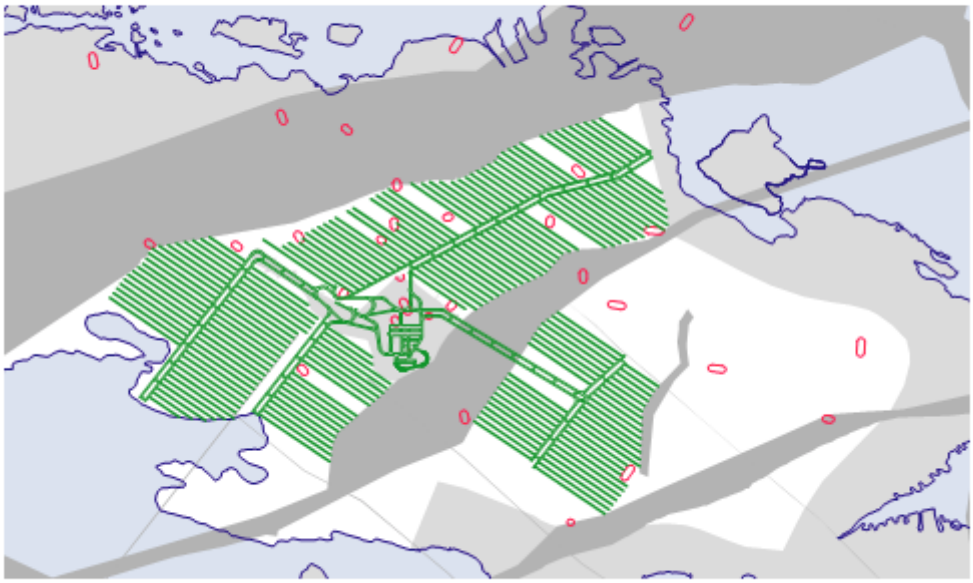


Layout determining features of Olkiluoto



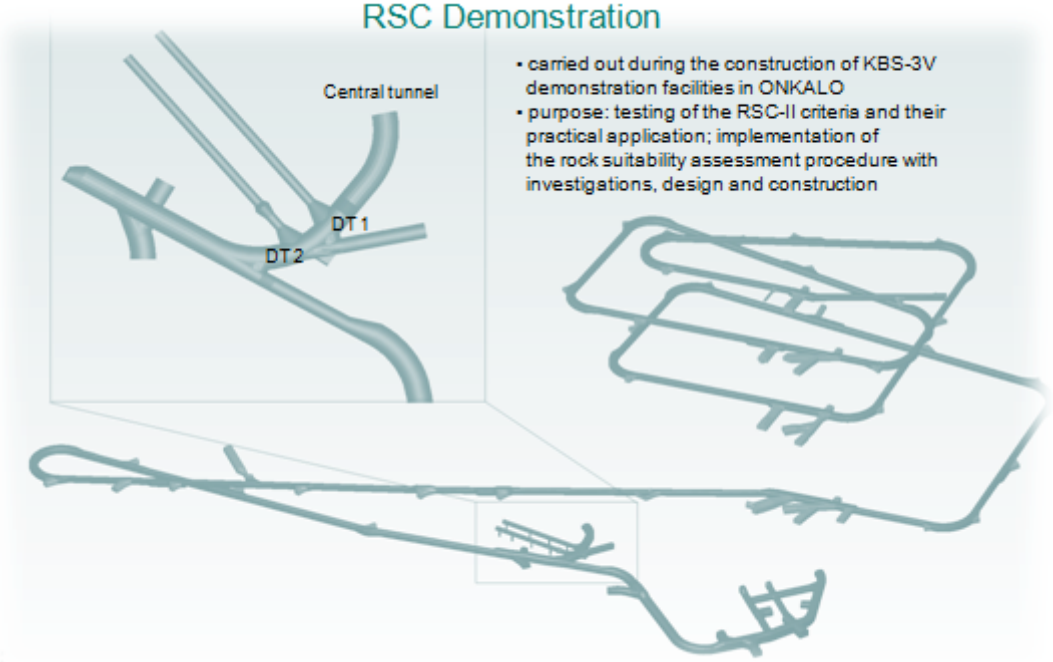
POSIVA 10/06/2012 34

9000tU layout



POSIVA 10/06/2012 35

RSC Demonstration



- carried out during the construction of KBS-3V demonstration facilities in ONKALO
- purpose: testing of the RSC-II criteria and their practical application; implementation of the rock suitability assessment procedure with investigations, design and construction

POSIVA 10/06/2012 36

Preliminary RSC suitability assessment

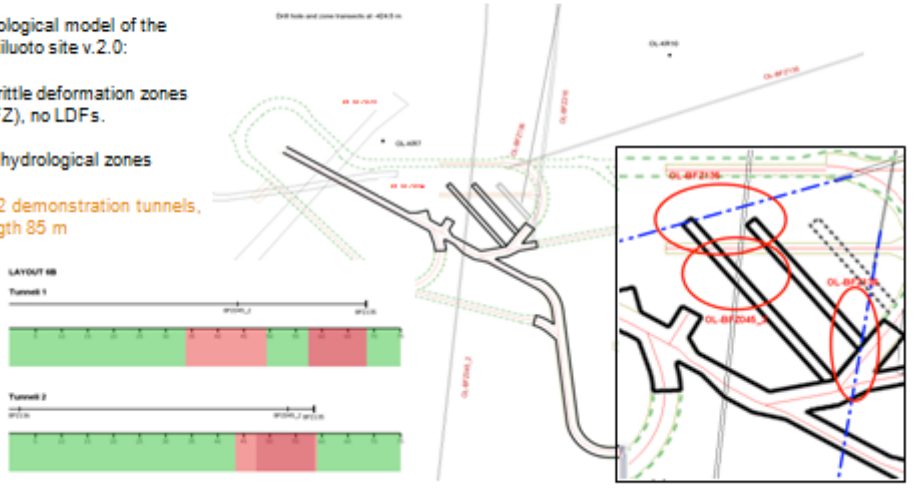
- June 2010: rough, preliminary evaluation of the rock suitability in the demonstration area to estimate the needed length for the demonstration tunnels
- based on the preliminary RSC-I criteria (WR2009-29, Hellä et al.)

Geological model of the Olkiluoto site v.2.0:

6 brittle deformation zones (BFZ), no LDFs.

No hydrological zones

=> 2 demonstration tunnels, length 85 m



POSIVA 10/06/2012 37

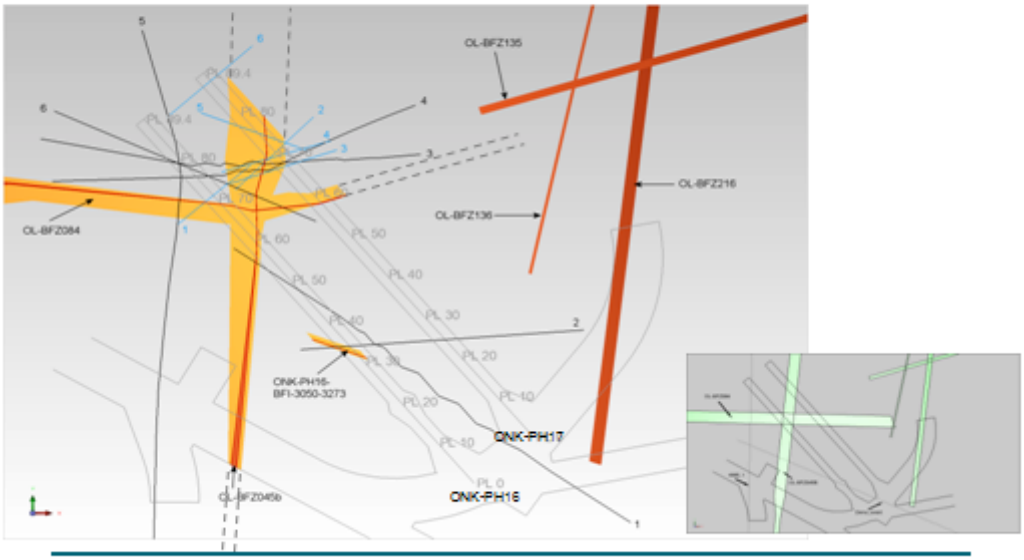
Demo-area detailed-scale model vs.1

September 2010, after investigations in the ONKALO access tunnel and in part of the demo-area central tunnel.

POSIVA 10/06/2012 38

Demo-area detailed-scale model vs.2

Model update in November 2010, after drilling of and investigations in pilot holes ONK-PH16 and ONK-PH17.

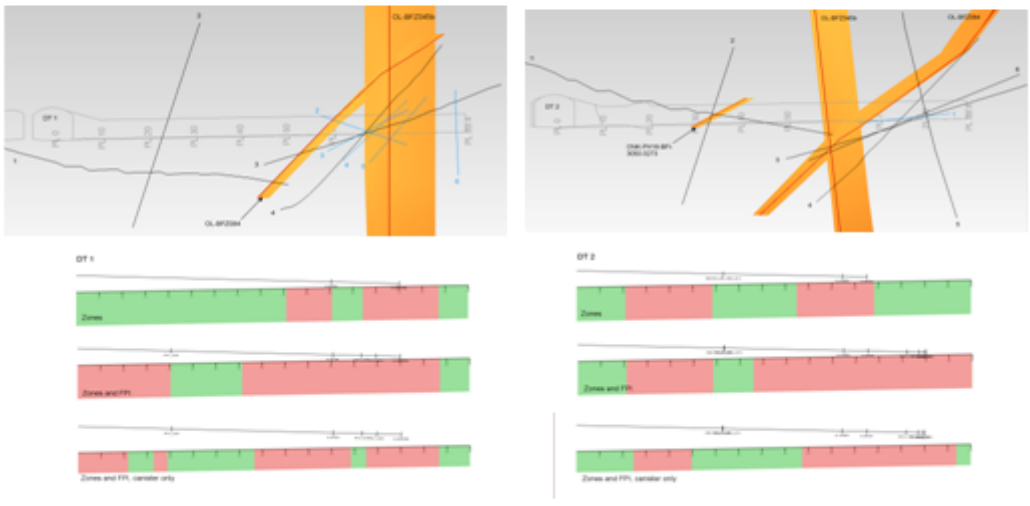


POSIVA 10/06/2012 39

RSC suitability assessment

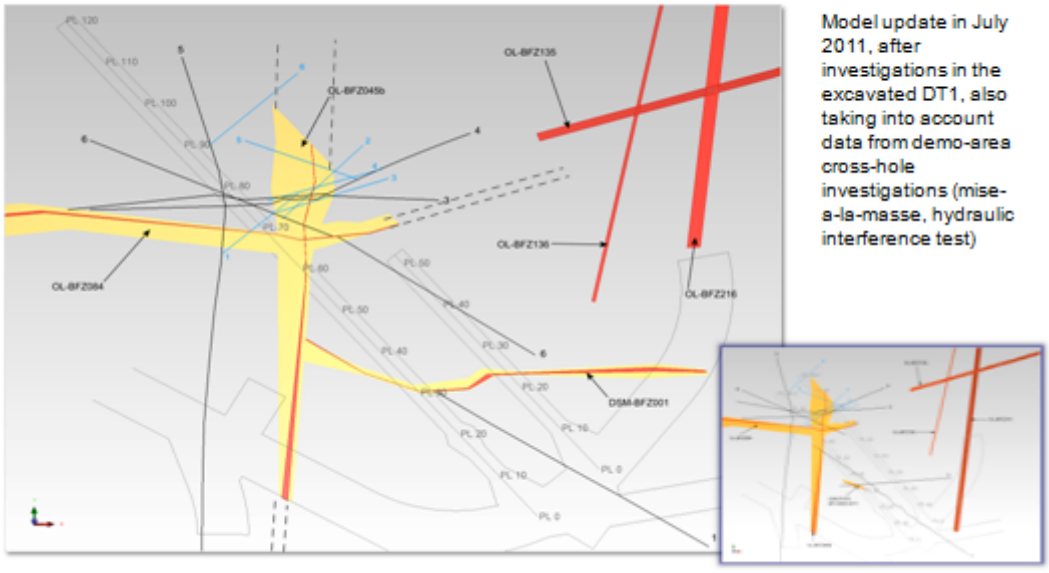
• End of December 2010, based on updated RSC-criteria, including a criterion for maximum fracture-specific inflow; effect of the large fractures estimated also by using the FPI-criterion suggested by Munier (2010)

=> Decision on tunnel excavation: DT1 shortened to 52 m, DT2 to be made respectively longer



POSIVA 10/06/2012 40

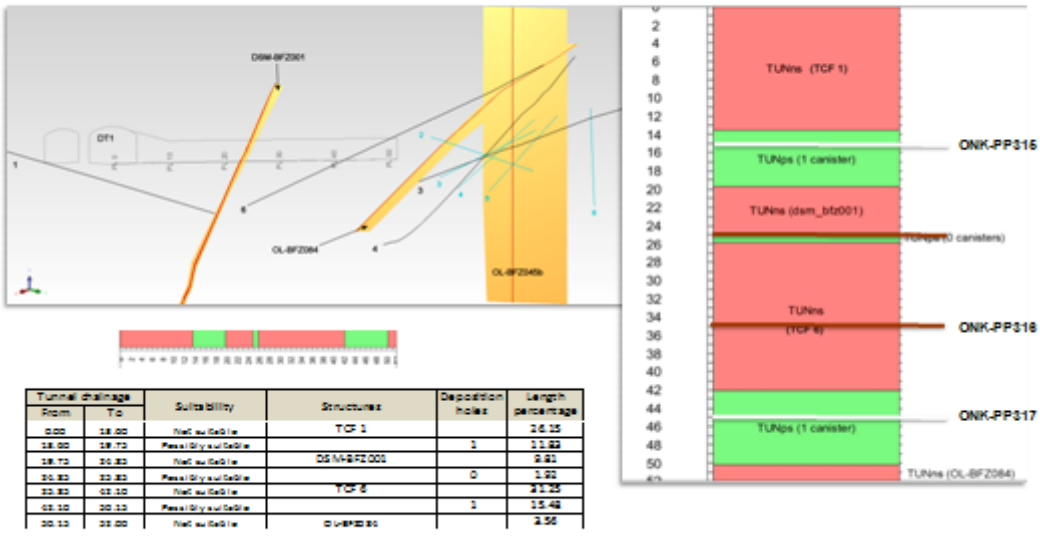
Demo-area detailed-scale model vs.3



Model update in July 2011, after investigations in the excavated DT1, also taking into account data from demo-area cross-hole investigations (mise-a-la-masse, hydraulic interference test)

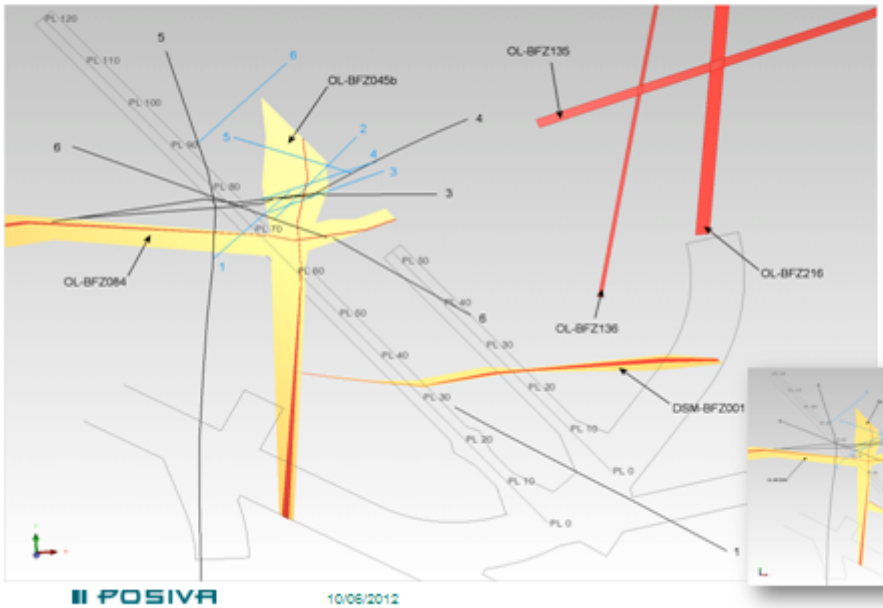
POSIVA 10/06/2012 41

RSC suitability assessment (DT 1)

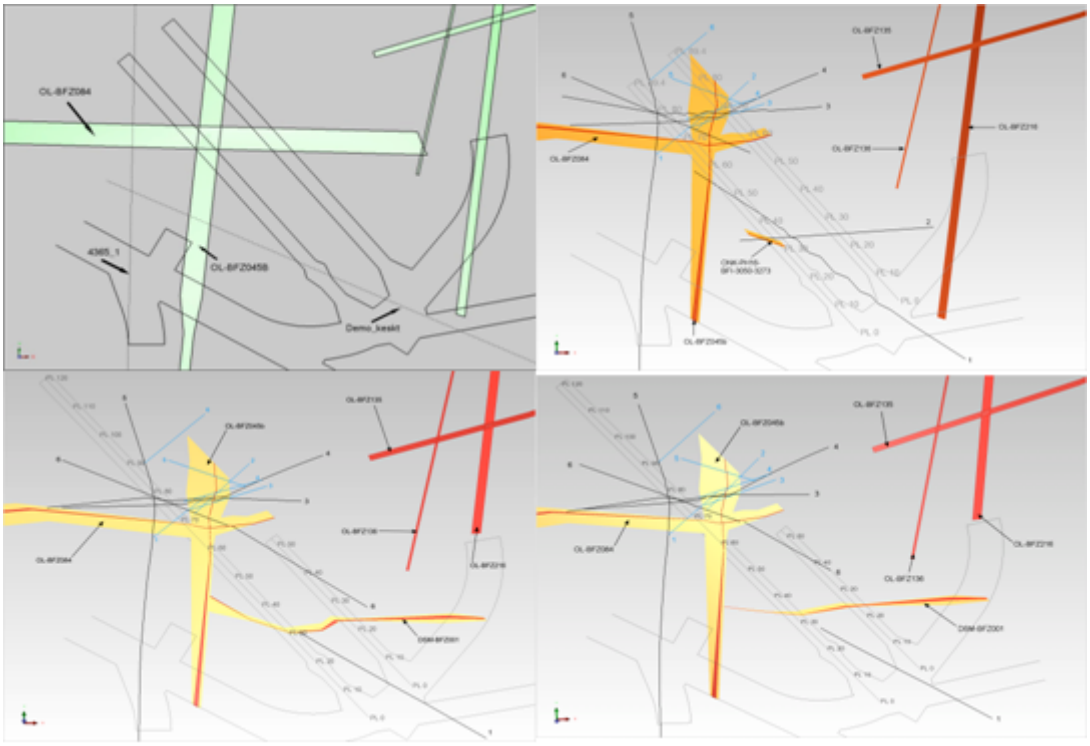


Tunnel chainage		Suitability	Structures	Deposition holes	Length percentage
From	To				
0.00	18.00	[illegible]	TCF 1		26.15
18.00	18.72	[illegible]		1	11.83
18.72	20.83	[illegible]	DSM-BFZ001		2.81
20.83	33.83	[illegible]		0	1.92
33.83	43.10	[illegible]	TCF 6		21.25
43.10	50.13	[illegible]		1	15.48
50.13	53.00	[illegible]	[illegible]		2.56

Demo-area detailed-scale model vs.4



Model update in October 2011, after deposition hole pilot hole investigations (DT1); also taking into account data from DT2 (tunnel and probe hole data).



Expansion of the detailed scale model

- plans to
  - expand the DSM to cover the technical facilities in ONKALO and, eventually, the first deposition panel
  - include lithology and ductile deformation