

LUCOEX NEWSLETTER TWO

Large Underground Concept Experiments

The Large Underground Concept Experiments "LUCOEX" project focuses on developing solutions for underground disposal of nuclear waste. The project was started in 2011 and it is implemented in collaboration with a consortium of Posiva (Finland), Svensk Kärnbränslehantering AB ("SKB") (Sweden), Agence nationale pour la gestion des déchets radioactifs ("ANDRA") (France) and Nationale Genossenschaft für die Lagerung radioaktiver Abfälle ("Nagra")(Switzerland). The project is partly financed by the European Union's EURATOM programme.

This is the second Newsletter for the LUCOEX project. It contains updates for all the ongoing experiments and plans for 2013.



Switzerland

Horizontal disposal of waste packages in Opalinus Clay formation

Nagra is responsible for Work Package 2, FE-Experiment "Full Scale Emplacement" Experiment in Opalinus Clay host rock at the Mont Terri rock laboratory in Switzerland.

This experiment aims at confirming the suitability of a repository concept by constructing an emplacement tunnel, manufacturing bentonite buffer units, manufacturing test equipment for waste and buffer emplacement and performs a full scale demonstration of the installation process.

Activities 2012

The main activity during 2012 was the excavation of the test tunnel at Mont Terri Rock Laboratory. The 50 metres long tunnel with a diameter of about 2.8 metres was successfully excavated from April to July 2012 within the planned time for the work.



Excavation of experiment tunnel with a pneumatic hammer

The development of manufacturing methods for bentonite blocks and pellets has started with laboratory and mock-up testing.

The design of the bentonite granulate emplacement machine has started with a conceptual study and the planning of the necessary pre-tests.

The tunnel support was made in accordance with the plans and consisted of steel anchors, steel ribs and/or low pH shotcrete. The shotcrete was applied in layers with steel net reinforcement.



Tunnel support made with steel nets and shotcrete

The advance rate was on average 1.0 up to 1.5 metres per day, the lower rate when steel ribs were used. After finishing the tunnel excavation in late summer 2012, the tunnel will be ventilated until the bentonite buffer emplacement in 2014. The instrumentation phase II with the instrumentation of the near field Opalinus Clay around the experiment tunnel has started with drilling of short boreholes.

Plans for year 2013

Further work will be done for the characterization of the bentonite buffer material and the development of the emplacement equipment, focusing on mock-up tests and detailed emplacement machine design.

Key deliveries during 2013 include:

- Production of 300 tons of granular bentonite
- Production of 50 tons of highly compacted bentonite blocks for tests
- Develop Granulate emplacement machine for full scale test with the bentonite granulate material.
- Install the near field instrumentation in the Opalinus Clay around the experiment tunnel (not part of LUCOEX).

As there will be quite many activities in parallel, it will be very important to plan in detail the further work and to coordinate the emplacement and the instrumentation work.

France

Horizontal disposal of waste packages in Callovo-Oxfordian Clay formation

Andra is responsible for the project's Work Package 3, ALC Full scale emplacement experiment, in Bure. This experiment aims to study the behaviour of a HLW cell under thermal loading by simulating the heat produced by waste packages.

The aim is both to demonstrate production and operation of a "HLW cell" and to understand the TM behaviour of the sleeve and the THM behaviour of the neighbouring rock.

Activities 2012

The design of sleeve and insert instrumentation has been completed, as well as the design and manufacture of the heaters that are to be used in the test.

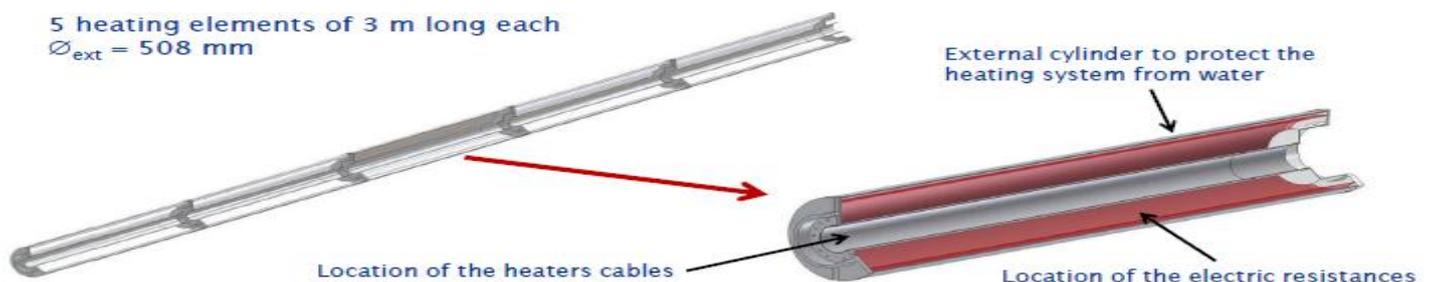
A test of the heater installation procedure was carried out in July 2012 in Toledo by Aitemin (subcontractor in charge of heaters), using a test bench simulating the cell with the instrumented sleeve (as the heaters will be installed inside the cell once the sleeve is already equipped with all sensors). The heating regulation system has also been tested, as well as electromagnetic compatibility between heaters and sleeve instrumentation. All component tests have been carried out successfully and the components are thereby validated for the in-situ installation.

The 25 m long cell has been excavated from 23 to 31st October 2012. It is composed of two main sections:

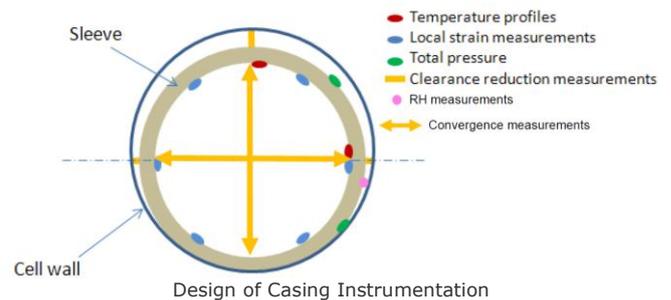
First we have a 6 m long cell head (791 mm diameter) and equipped with a 21 mm thick steel sleeve insert (767 mm external diameter).

Secondly we have a 19 m long "usable" part where the heaters will be installed. This was excavated with a 750 mm diameter and equipped with a 20 mm steel sleeve (700 mm external diameter). The base plate has been installed at the base of the usable part by human intervention inside the cell.

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



A part of the instrumentation (strain gages) was preliminary mounted on the sleeve prior to the excavation. The rest of the sleeve instrumentation (cell wall/sleeve clearance reduction sensors, sleeve convergence sensors, total pressure sensors, temperature and humidity sensors) as well as cables connections has been carried out by human intervention inside the cell after excavation, during November and December 2012.



The last peripheral boreholes, for temperature and pore pressure measurements parallel to the cell head, have been drilled and equipped.

Plans for year 2013

Activities in 2013 include the installation of the heaters in the cell and finalization of the instrumentation of the cell.

Main heating phase will start in March after a short heating test in February. Cell's sleeve and neighbouring host rock behaviour will be monitored through the instrumentation in the cell, in the access drift and in peripheral boreholes. It's expected to reach more than 60°C on the sleeve in the heated usable part by the end of 2013, thus given already at that time important data on the cell behaviour (evolution of thermo-mechanical loading of the sleeve, thermal dilation of the sleeve and sliding in the insert), and on THM impact on host rock. The experiment will then continue to reach 90°C on the sleeve by the end of the project.

Sweden

Horizontal disposal of waste packages in crystalline hard rock

SKB is responsible for the project's Work Package 4, Multi-Purpose Test (MPT) which is planned to be carried out at the Äspö HRL during 2011-2014.

The test is basically a short term, non-heated installation of the reference design for KBS-3H, DAWE, including the main KBS-3H components, see Figure below. The test will be carried out in the 95 m long / 1.85 m diameter drift at the -220 m level of the Äspö HRL.

The aim is both to verify the ability to manufacture full scale components and test the interaction between the system components in full scale to obtain an initial verification of design implementation and component function.

Activities 2012

Detailed drawings for the test have been developed and the test preparation work has subsequently been carried out according to these, including sawing of cable and plug notches and drilling of holes for sensors.



Instrumentation drilling of sensor holes, the sawed out cable notches can be seen on the drift sides

Sectioned inflow measurements have been carried out throughout the drift.

A steel Compartment plug has been manufactured and its fastening ring has been casted into the plug notch. In parallel with this we have also done the first test manufacturing of buffer blocks, including test of the new buffer mould. The test blocks have also been machined to the KBS-3H reference design size and will be used to do a test assembly of a distance block.

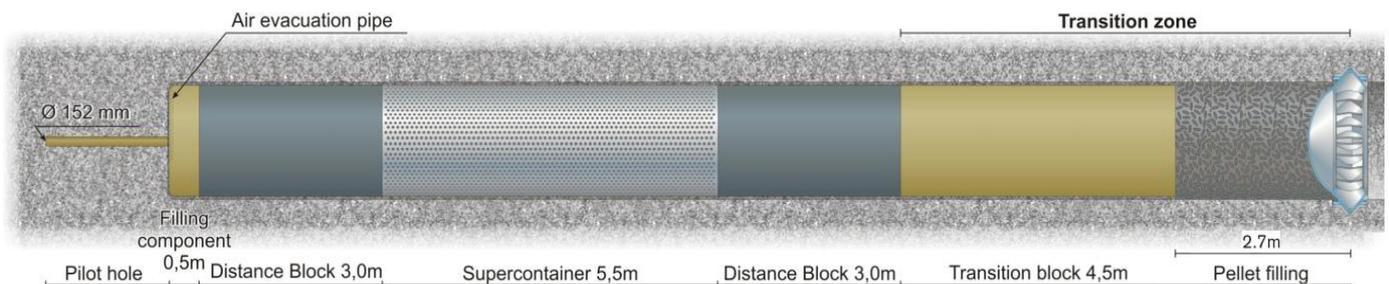
The deposition machine has been further developed to include better error recovery and extensions for automation. Remaining key challenge is the balancing of the deposition machine which has remained problematic during 2012. This has prompted an extra month of test-driving in 2013 to ensure balance and system reliability.

Planning for component assembly and development of necessary equipment has been carried out.

Plans for year 2013

Key activities during 2013 include:

- The laser scanning of the drift
- Further preparations and installation of sensors and support system will be done.
- Manufacturing of the MPT blocks
- A full test assembly will be done early 2013. This will provide basis for the final planning of the actual MPT assembly and installation.
- The risk and safety validation of the deposition machine will be finalised and final reporting of the soft- and hardware updates will be carried out.
- After installation of Sensors inside the drift and in the components we will install and initiate the Multi-Purpose-Test. This will be followed by a 400 day long monitoring period.



Schematic illustration of the MPT layout, the pellets filling section length has been increased from 1.3 m to 2.7 m to allow for instrumentation.

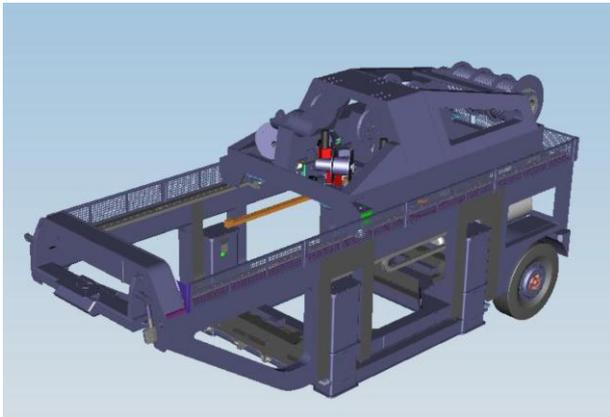
Finland

Vertical disposal of waste packages in crystalline hard rock

POSIVA is responsible for Work Package 5 where we are focusing on vertical deposition in crystalline rock. The focus is the development of necessary machinery and quality control programs including problem handling to create a stable proof of concept.

Activities 2012

During 2012, the Finnish engineering office Insinööritoimisto Comatec Oy has completed the design of the steel construction and automation system for the buffer installation machine.



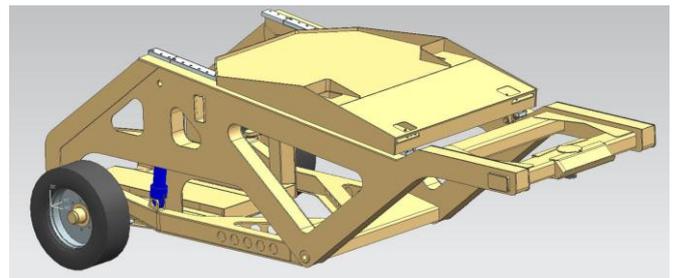
Posiva buffer handling machine

Konepaja Laaksonen Oy was chosen in a tendering process to manufacture the steel construction for the buffer and pellet installation machine. The work started in July and was completed by the end of 2012 when all steel components had been manufactured and painted. The next step was the assembly which was started in November and will be completed by the end of January 2013.

At the same time as assembly is being done, Elmont Oy has been chosen to realize the needed electrical work and automation component installations.

In parallel to these efforts we have also been working on the design of quality control equipment and problem handling tools. Possible solutions for these have been identified and the basic design for the respective equipment has been formulated.

The final part of WP5 is focused on the design of the transportation shuttle required for taking the buffer blocks from the central tunnel to the installation machine.



Posiva Transportation Machine

With the basic design done for both the transportation machine and the quality control equipment and problem handling tools we have prepared the necessary documents for the respective tendering process.

Plans for year 2013

LUCOEX WP5 main activities in 2013 will be the installation of electricity and automation equipment into the installation machine and the manufacturing of the transportation shuttle.

Demonstrations of the buffer installation with full scale blocks and pellets will be started in the spring in three phases, together with demonstrating the quality control equipment. If possible, also the demonstration of problem handling tools will be connected to the demonstrations.

Key deliveries during 2013 include:

- Complete installation work on the buffer handling machine.
- Manufacture the transportation machine.
- Manufacture the necessary blocks and pellet for the trials (not included in the Lucoex project)
- Conduct above-ground-tests of the buffer transportation and Buffer handling machines
- Conduct underground demonstration of the developed buffer handling and buffer transportation machines in Onkalo in Olkiluoto.

Project Management

Work package 1 and Work package 6

Project management, integrated planning, communication and dissemination for the LUCOEX project is management through work package 1 and work package 6. Both of these work packages are managed by SKB but supported by all participants.

Activities 2012

Work Package 1 has during 2012 supported the demonstration projects in technical issues while Work Package 6 has handled administrative matters.

The WP1 activities for integrated planning and dissemination of results include two Project Progress Meetings and three workshops – all activities with the goal to share experiences between the different participating countries and between the project and the public. The largest of the workshops was the Mid-term workshop held in Montpellier in conjunction with the international conference on "Clays in Natural and Engineered Barriers for Radioactive Waste Confinement". That workshop attracted interested parties from eleven different countries covering Europe, North America and Asia.

An important part of the dissemination is the Expert Group which has held two meetings, a first organizational one and a second focused on a technical review of the work packages and open discussions.

As part of the management of the project we have held two Steering Committee meetings in conjunction with the Project Progress Meetings where we worked actively with the updated planning of the project and the management of the projects risk list.

The WP 6 activities have accomplished up-dating of the public web portal as well as the web site for project-internal communication and information. Further support has been to review and submit Deliverables produced during the period.

Plans for year 2013

Key activities for WP1 and WP6 include:

- A next Project Progress Meeting, combined with a technical workshop, is planned to be held in Switzerland in September 2013.
- Two scholarships are planned to be awarded for participation at this workshop.
- Update and redesign of the webpage to ensure a long term stable operation even after the closure of the project.

Additional information

Further information regarding the project is always available on our website. If you have any questions or great ideas you are always welcome to contact the project coordinator Jan Gugala or the chair of the steering committee Erik Thurner.

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