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LUCOEX

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WP5: KBS-3V Emplacement tests in ONKALO (EMP)

DELIVERABLE (D5:03)
Memo on designing the gap filling tool

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CO	Confidential, only for partners of the LUCOEX project	

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EURATOM

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MEMO ON DESIGNING THE GAP FILLING TOOL

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2. Introduction

This document, D 5:03 Memo on designing the gap filling tool presents the process and development phases for designing the gap filling equipment and machines.

The development work in concern is carried out under the Work Package (WP) 5 "KBS-3V Emplacement tests in ONKALO (EMP)" in the FP7 EURATOM project LUCOEX – Large Underground Concept Experiments.

The document provides the framework for designing further and implementing Posiva's bentonite buffer gap filling methods and equipment in order to demonstrate the feasibility of the KBS-3V concept for that part. This document is connected to the LUCOEX WP5 Task 5.3 Quality assurance and problem handling. Posiva Oy acts as the WP5 Leader.
In Posiva's reference design the gap between the bentonite buffer blocks and the rock will be filled after buffer blocks installation. If something goes wrong, is it difficult to see where in 8 meter deep gap the problem is located.
In this work will be tested the filling of gap immediately after installation of each block. The benefit of this method is faster buffer installation process. Another gain is the certainty of gap filling. If there is a problem, it is seen immediately after gap filling.

This gap filling method can be used only in dry holes where the water protection is not needed.

The LUCOEX project will be implemented in collaboration with a consortium of international participants:
· SVENSK KÄRNBRÄNSLEHANTERING AB ("SKB") (Sweden)
· AGENCE NATIONALE POUR LA GESTION DES DECHETS RADIOACTIFS ("ANDRA") (France)
· NATIONALE GENOSSENSCHAFT FÜR DIE LAGERUNG RADIOAKTIVER ABFÄLLE ("Nagra") (Switzerland)

3. Objectives of the work

The main objective of the work was to design the equipment for filling the gap between the bentonite blocks and host rock with bentonite pellets.

Expected outputs of the work:

- Lay-out drawings
- Detailed drawings
- First prototype
- Full scale tests and reporting

4. Realised development activities and their schedule

The development work of buffer installation machine was started 25th May 2012 by a brainstorming workshop between Posiva and Insinööritoimisto Comatec Oy at Comatec's premises. The target of the workshop was to find new innovations for the installation of buffer blocks.

The main outcome of the workshop was the decision to develop the system where the buffer blocks will be transported from the manufacturer's storage to the disposal area inside of containers. The top part container operates as a gripper during the installation of blocks to the deposition hole.

As a fringe benefit the work gives new ideas for pellet filling. Inside the top part of container locates also the compartments for pellets. The container acts also as a filling tool so that the gap between the rock and buffer blocks could be filled after the assembly of each block, i.e. the filling tool could be

used together with the block emplacement equipment – not after all blocks have been emplaced, as it was planned earlier.

The basic concept of pellet filling method has developed further during the summer and autumn 2011. The work has included several project meetings with WP5 members and open project meetings where other LUCOEX partners could participate. Between the meetings calculations, comparisons, tests et cetera have been realised by WP5 project participants.

Picture 1. Planning meeting with Comatec.

An ideal gradient was sought by testing the first tool prototype with using three alternative pellet types: 8 and 10 mm pillow-shaped compressed pellets and 8mm cylindrical Cebogel pellets manufactured by extrusion. It was learnt that the needed gradient shall be at least 27 degrees.

The basic concept was ready in the end of autumn 2011.

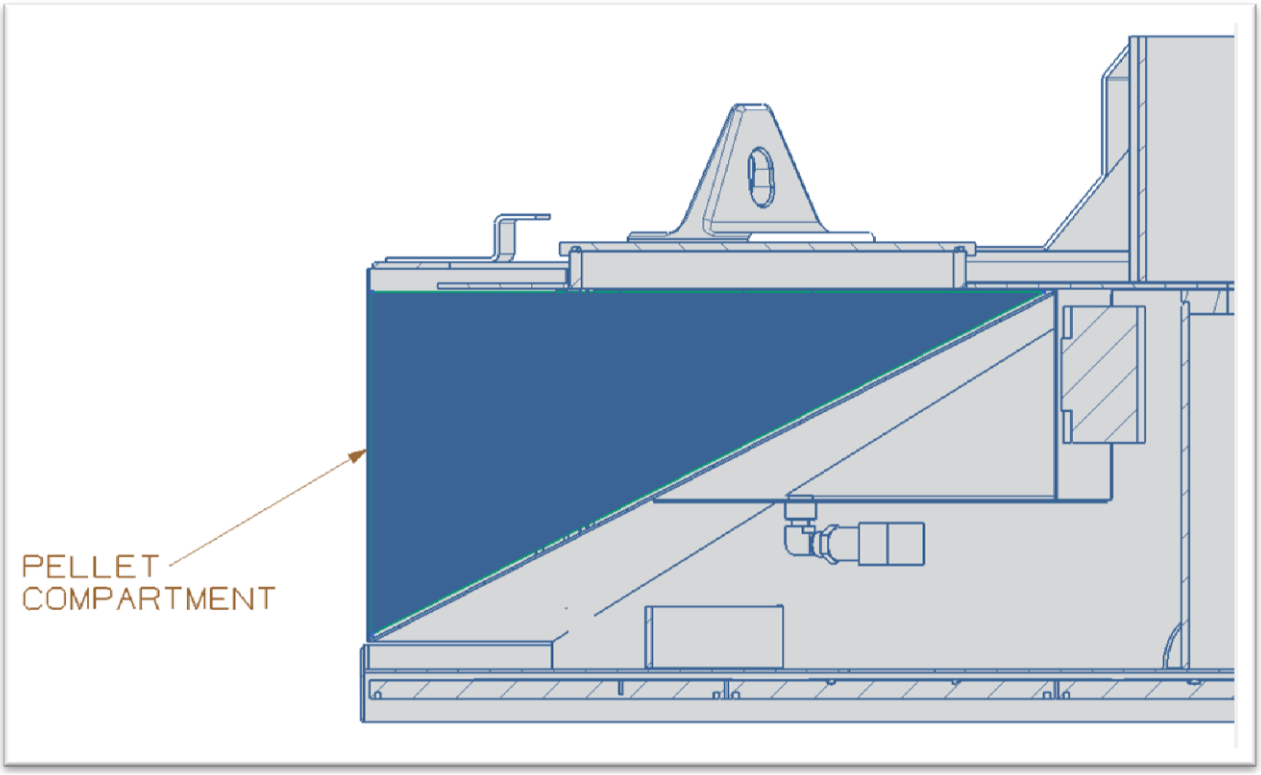
This is an alternative to dropping pellets to the gap after assembling all blocks first.

5. Results

The result of the development work for pellet filling is the gap filling tool that is attached to the upper part of the vacuum gripper used for block emplacement. The tool is composed of 6 pellet compartments that will be filled with a predesigned amount of pellets when the bentonite blocks are

sent out from the storage facility. The pellets will slide out from the compartments by gravity. The tool design includes an option for assembling vibrators under compartments to assist the pellet flowing out from compartment.

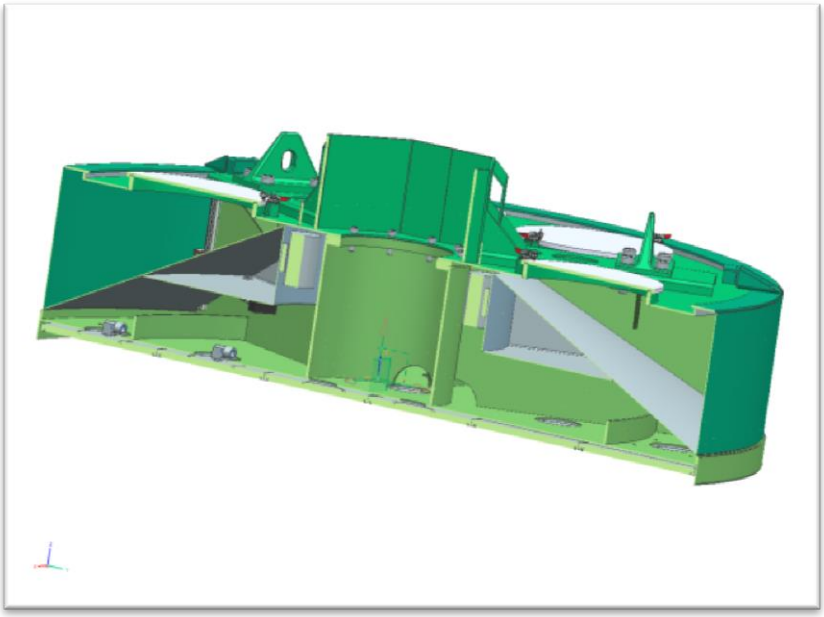
By assembling pellets in connection to every individual block emplacement the filling quality and the pellet flow into the gap can be assured. This solution cannot be used together with water protection.



Picture 2. Design of a pellet compartment

Picture 3. Test compartment

Picture 4. Test compartment with pellets



Picture 5. Design for the gripper which includes gap filling compartments.

6. Problem situations faced and how they were solved

During the work, the following problem situations and challenges were faced:

- The width of the gap between the buffer block and host rock may vary around the block so uniform filling of the gap with pellets may be challenging.

→ Solution: The six compartments of the gripper can be filled with different quantities of pellets, which makes the filling of the gap more uniform. As a preparatory work the volume and form of the disposal hole shall be defined by laser-scanning before the installation. This information will be used to define the optimal centre axis point of buffer stack and the volume of gap in different sectors around the buffer. This information will be used to define the amount of pellets to different compartments.

- Pellets must not end up on top of a buffer block in any situation

→ Solution: The gap will not be filled completely, the space a few centimeters below a block's top will be left empty.

- The hatch releasing the pellets from the compartment had to be designed so that the entire gap around the block would be filled simultaneously.

→ Solution: The entire edge will be lifted up simultaneously.

- It has to be safeguarded that every single pellet will fall into the gap.

→ Solution: Realising tests and if needed, adding vibrators to the structure. In the tool structure there is a provision for vibrators.

- If water protection is used in the hole, this gap filling method cannot be used.

→ Solution for such situation: The gripper can be used without pellets filling. All blocks will be emplaced first and the entire gap will be filled at once with another tool after the water protection system has been removed from the hole.

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7. Evaluation of the work / process

In comparison with the current solution, the initial designs of the gap filling tool were more complicated. The tool developed is simple and no problems have occurred in integrating it into the block emplacement tool. Before the manufacturing of complete gripper the gap filling tool could have been tested separately as an own entity but this was not possible in the schedule that had to be followed.

8. Next steps / work phases

The next step in the tool development work is testing the equipment and implementing possible changes and corrections. With regard to the alternatives tested, the tool did not function with cylinder shaped pellets manufactured by extrusion. However, that did not cause problems, as these pellets will not be used in the gap filling according to the current plans.