Technical Realization of a Closure Concept for a Chamber-system in the Underground Richard Repository in the Czech Republic

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Introduction:

The Phare project CZ 632.02.04 "Realization of closure of a chamber in the Richard repository as input for establishing a safety case" is a follow up implementation phase of the Phare project, CZ 01.14.03 "Solution for closure of a chamber in the Richard repository".

Main objective of both projects is to propose and realize a disposal system in selected chambers of the Richard repository, which will eliminate burden from the past practices in waste management during the first phase of the Richard repository operation (1965 – 1980) and which will improve its overall long term safety.

This objective will be assured by realization of the concept of so called "hydraulic cage", which technical solution was developed by DBE TECHOLOGY within the Phare project CZ 01.14.03. The solution is described in the previous presentation "Hydraulic Cage Concept for Waste Chambers and its Technical Implementation for the Underground Richard Repository, Litoměřice, Czech Republic" (Bernt Haverkamp et all).

Realization of the hydraulic cage closure system is divided in 5 basic phases:

- Detailed realization design and technologic procedures development
- Preparatory work and clean up of the chambers
- Construction of the hydraulic cage and concrete structures for emplacement waste
- Removal, inspection, conditioning and relocation of "historical waste" into new chamber segments
- Backfilling of voids between waste packages – closure of the segments.

After the project completion RAWRA will launch a program on evaluation of a long term behavior of the backfill material and sealed waste packages, as an input for verification and validation of data necessary for the repository safety assessments.

Basic project information:

Project CZ 632.02.04:

Phare contractor:	EREBOS – podpovrchová výstavba spol. s r.o., M. Svatoňovice
Subcontractors:	TUBES spol. s r.o., Praha, (design)
	AGE, a.s. Praha (technical supervision)
	DBE TECHNOLOGY, GmbH, Germany (consultancy)
RAWRA contractor:	ALLDECO.CZ a.s. (waste treatment and relocation)

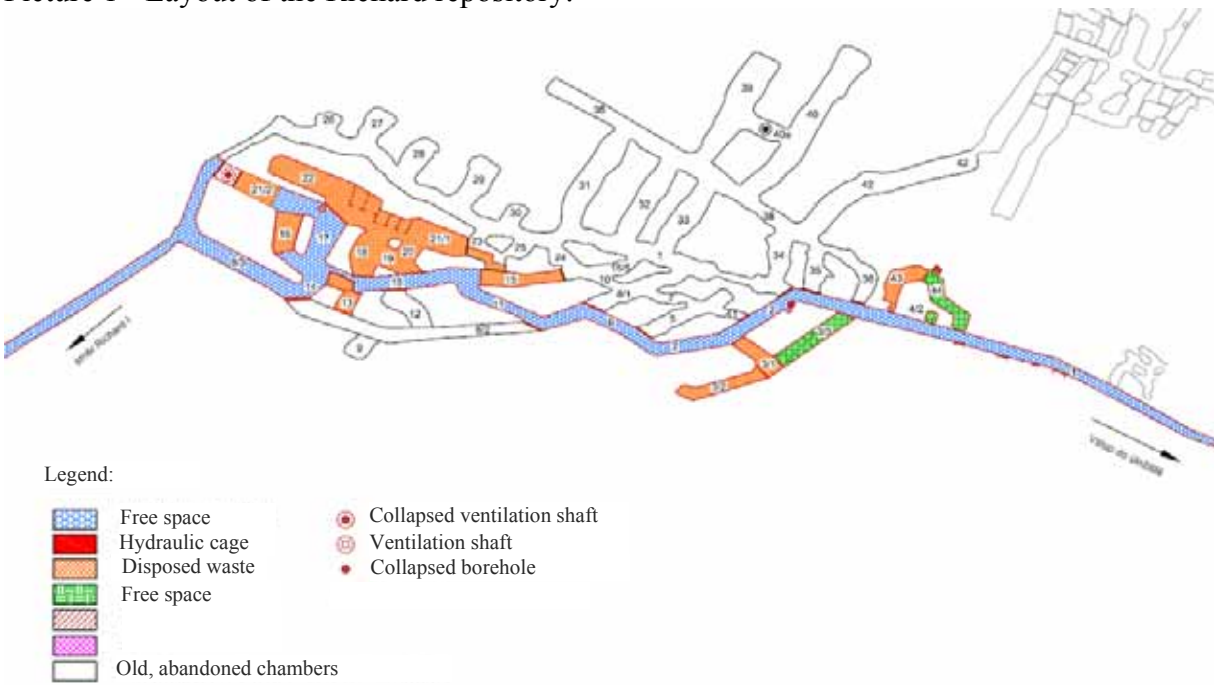
Time schedule:	Planed	Real
TOR approval	3Q. 2003	3Q. 2005
Contractor selection	1Q. 2004	July – Sept. 2005
Project start up	1Q. 2004	5. Dec. 2005
Project completion	3Q. 2005	June 2007
Disbursement period	Nov. 2005	Nov. 2007

Budget:

Phare contract	- construction and backfilling	1 000 000 EUR
RAWRA co-financing	- relocation, conditioning waste	264 000 EUR
	- reconstruction of Richard cabling	151 000 EUR
	- reconstruction of drainage system	38 000 EUR

The project includes realization of reconstruction and closure of the chambers 8/2, 9 and 12. Historical waste will be removed from the chambers 22, 18 and 19. Debris from clean up of the chamber 8/2, 9 and 12 were removed into the chambers 4, 5, 7, 8/1 and 10. Situation is shown in the Picture 1 below.

Picture 1 - Layout of the Richard repository:



Realization activities

The contract on the Richard chamber closure realization, with the selected company EREBOS – podpovrchová výstavba, was signed on 9.11.2005. The contract does not include activities connected with handling, conditioning and disposal of the waste packages, before the chambers backfilling. These are provided by specialized company ALLDECO.CZ selected by RAWRA and contracted in May 2006 from the co-financing resources.

1st Phase

The project kick of meeting was held on 28 November 2005 and the project activities started on 5th of December.

First activities were focused namely on development of a detailed realization design of chambers reconstruction and preparation of all necessary documentation for licensing of planned actions. What concerns the project there are two main licensing authorities – the Czech Mining Office and the State Office for Nuclear Safety.

In parallel, EREBOS prepared its infrastructure for the project realization and training of the EREBOS personnel on emergency preparedness, radiation protection and other relevant internal instructions of RAWRA was held.

Special attention was focused also on preparation of the QA and QC plan, to achieve and ensure planed and/or required parameters of controlled materials and processes.

During the design development some changes of solution were proposed and consequently discussed with DBE Technology. The main changes are described below in the table 1.

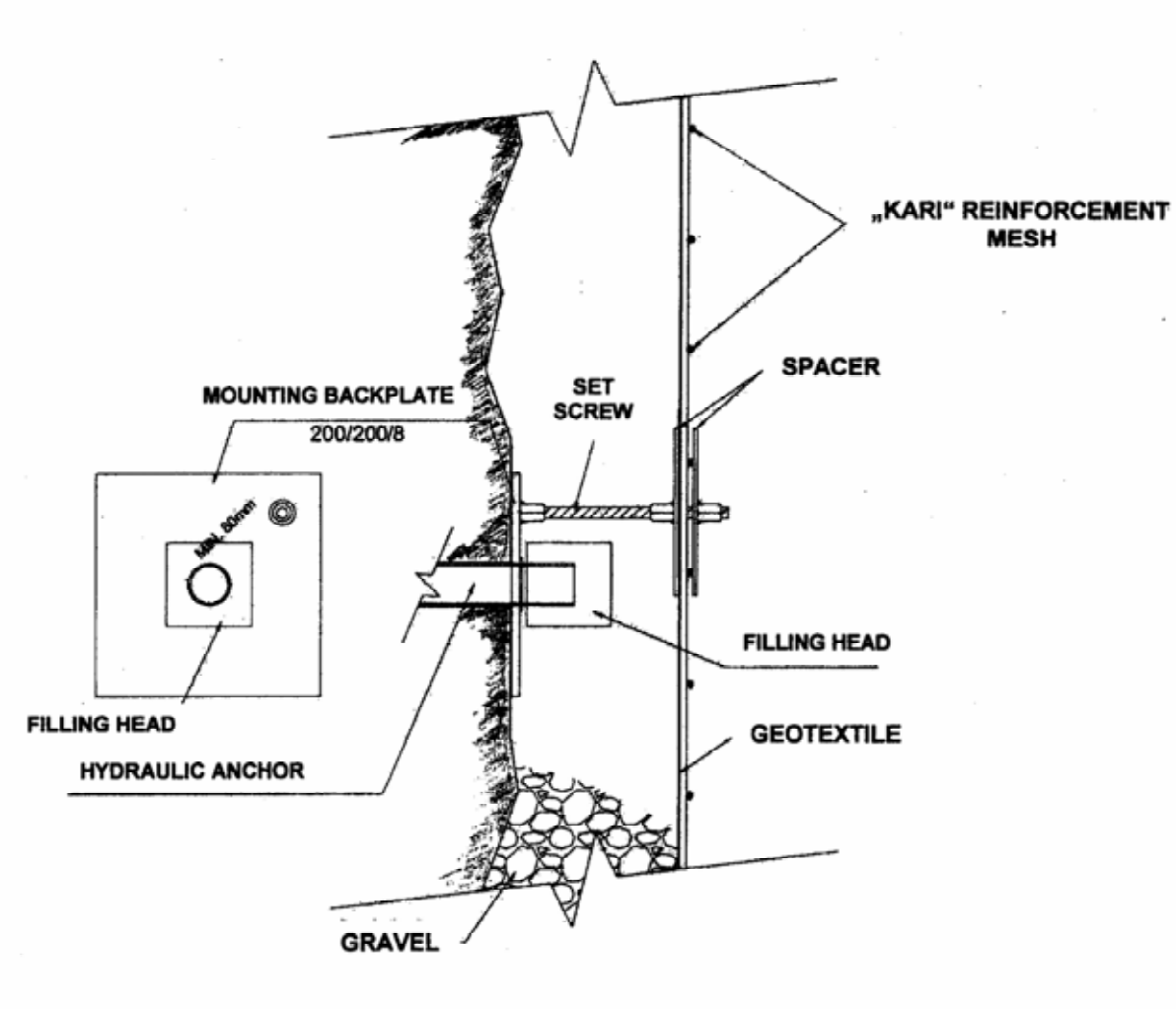
For construction of the hydraulic cage a unique system of the cage mounting on the chamber walls was developed. This system is very flexible and allows the cage construction without any limitation concerning the chamber walls shape – see Picture 2

To avoid random, uncontrolled formation of shrinking cracks during the concrete setting, a system of controlled shrinking joints is used. It includes inserting of a wooden conical lath into the floor or wall before its concreting in distance of some 6 - 8 m. After setting of the concrete the lath is removed and the gap is filled with a special expanding concrete. In the line of this dilatation joint will be created a gap between the waste packages minimally 10 cm wide, so the joint will be overlaid by pure concrete layer. The joint construction scheme is shown in the Picture 3.

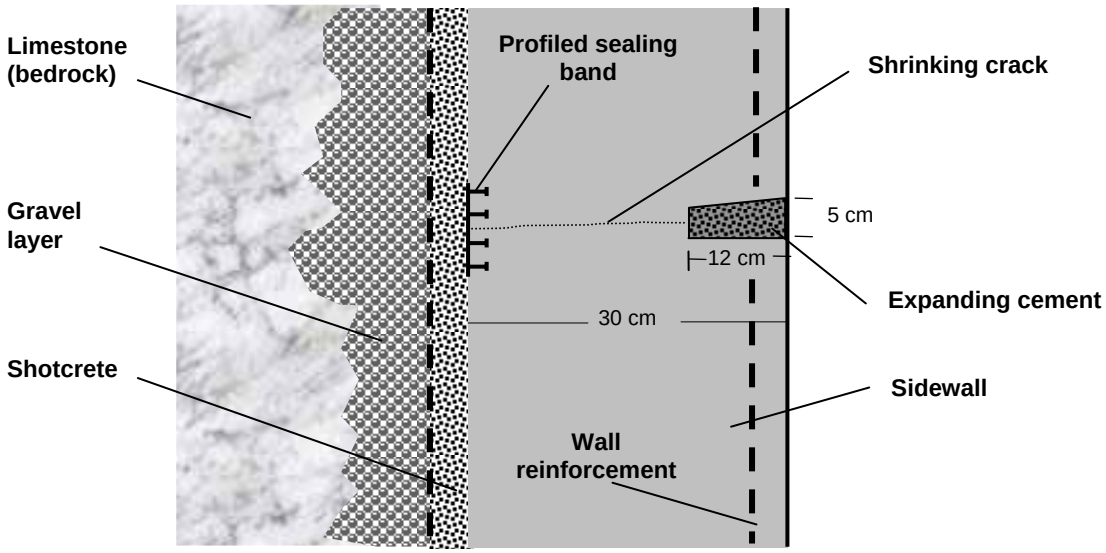
Table 1: Changes in the realization design in comparison with proposed technical solution.

	Technical solution according to 2005 closure plan (DBE Technology)	**Changed technical implementation according agreement of RAWRA, EREBOS and TUBES**
1	Fixing of the wire gauze to steel KARI – mesh to separate gravel layer from shotcrete	Wire gauze replaced by geotextile
2	Construction of concrete pillars for controlled drum stacking; Backfilling of 40 cm space between walls and RAW with backfilling concrete during closure of chamber segment	Construction of concrete side walls prior to drum stacking as advanced part of the later backfilling with shrinking joints (6-8 m apart) 50 mm cover to reinforcement of the walls (KARI-mesh 6,3/100/6,3/100)
3	Application of 10 cm layer of shotcrete (SB C 20/25) to separate gravel layer with wire gauze/geotextile from inner chamber.	Application of 5 cm layer of shotcrete (SB C 20/25 X0)
4	Roadway construction as 40 cm reinforced concrete layer (40 cm, C30/37)	Realization without reinforcement but in two subsequent concreting processes within 1-2 days.
5	Chronological separation between disposal of compacted 50-l drums waste and disposal of 200-l drums	Concurrent disposal of different kind of waste
6	Backfilling of voids between compacted 50-l drums within containers in advance to disposal or alternatively in compartments within chamber segment Backfilling of remaining voids during closure of chamber segment	Backfilling of voids between drums: (mainly 50-l drums) stepwise, backfilling of remaining voids between different waste packages and free space (40 cm) towards ceiling and upper walls for complete chamber segment after disposal during closure of chamber segment

Picture 2: Hydraulic cage mounting on the chamber wall



Picture 3: Controlled concrete wall shrinking joint



2nd Phase

The full-scale activities concerning the chambers reconstruction started on 2 January 2006. Firstly, the chambers 4, 5, 7, 8/1 and 10 were prepared and stabilized for accepting debris from the reconstructed chambers. During the clean up, more than 600 m^3 of debris rock was removed from the chambers 8/2, 9 and 12 and disposed in the above mentioned chambers. This phase was completed in first decade of March. Anchors used for fixing ceilings were the same as for mounting the hydraulic Cage.

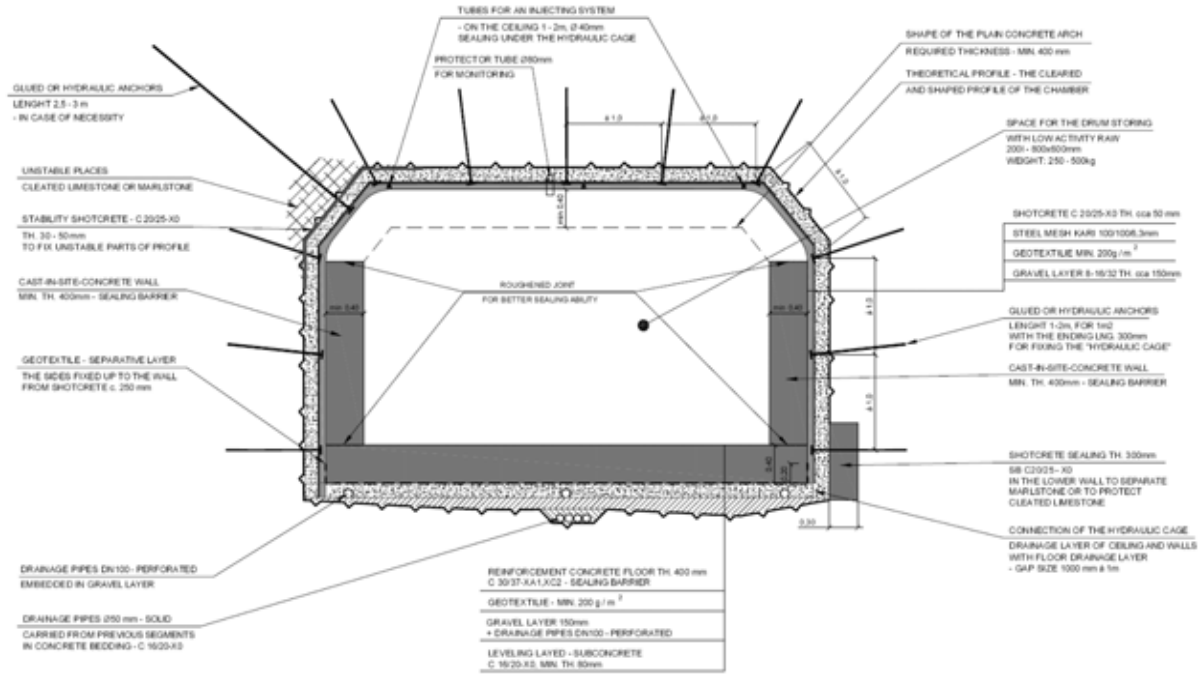
Picture 4: Chamber 8/2 before clean-up

Picture 5: Chamber 8/2 after clean-up

3rd Phase

This Phase includes construction of hydraulic cage, supporting frames, floor with drainage system and concrete walls as shown in the Picture 6. It started in second decade of March, hydraulic cage on walls and ceiling was completed in June, in July were completed and cleaned up 3 segments for accepting waste.

Picture 6: Cross-section of the disposal chamber



Quality control of used concrete during the construction work confirmed its compliance with the requirements from the technical specifications prepared by DBE TECHNOLOGY.

Table 2: Parameters of concrete used for the walls and floor construction

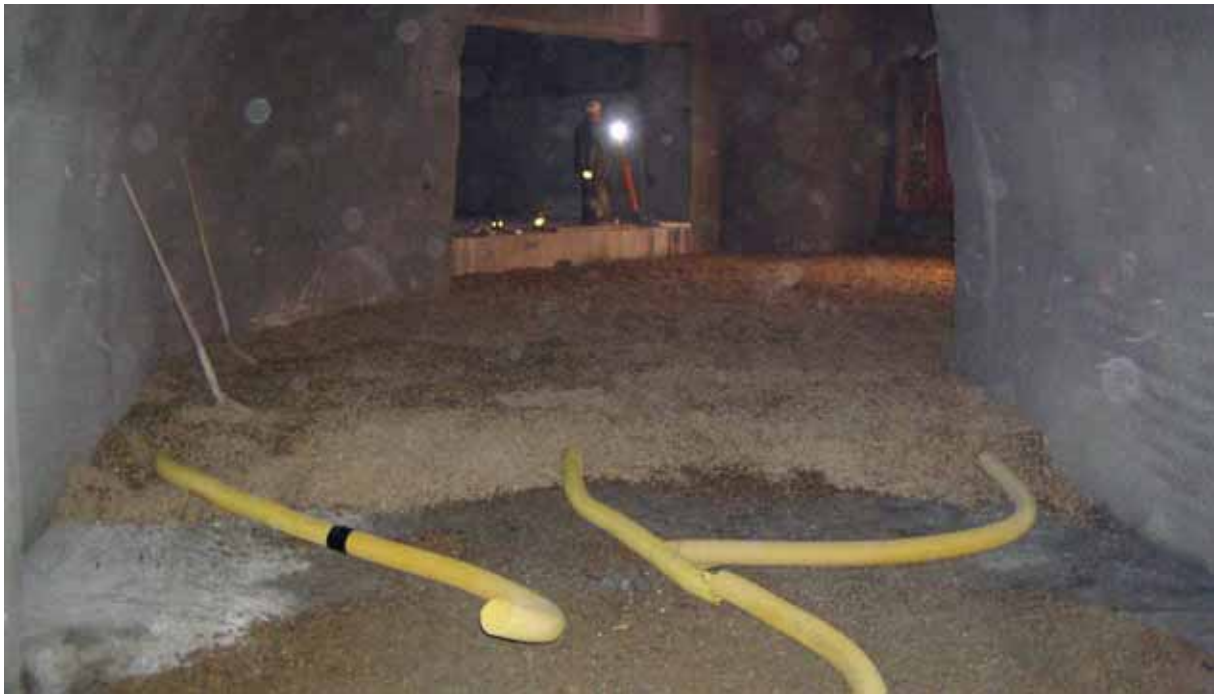
Parameter	Required	Achieved
Compressive strength	30 MPa	35 – 50 MPa
Content of cement	300 Kg/ m^3	400 Kg/ m^3
Water penetration depth	75 mm	16 mm
Temperature during concrete setting	Max. 60°C	Max. 32°C

Up today remains realize construction of floor and walls in the last chamber segment; this will be completed within next two weeks.

Following pictures illustrate the work realized:

Picture 7, 7a: Details of the hydraulic cage

Picture 8: Construction of bottom drainage system



Picture 9: Formwork for the wall concreting

Picture 10: Completed part of the chamber 8/2

4th Phase

For inspection and compaction of waste packages ALLDECO.CZ erected a separate working place. It is situated in the chamber 17 next to the chamber 22, from which the historical waste will be removed. In this place are installed a hydraulic compactor for compacting the 50 liter barrels, electronic weight and radiation control equipment. The compactor has filtrated exhaust (with high efficiency HEPA filter) connected to the main ventilation system. Each waste package is measured on gamma exposure rate and neutron flux and each barrel content is visually controlled by opening a lid. Depending on results of waste content checking, the shift foreman takes a decision on compaction or other treatment of the waste package. Up to now approximately 300 of historical waste packages were inspected and treated. Some of the packages are in a very bad condition – heavily corroded. These barrels are inserted into plastic bags and consequently into new 100 l barrels. Void space will be backfilled by concrete "in situ".

Following pictures illustrate the historical waste handling.

Inspection of the waste packages content

Compacted 50 liter drum

Waste drums in the chamber 22

Corroded drums

Compacted waste in the transporting containers

5th Phase

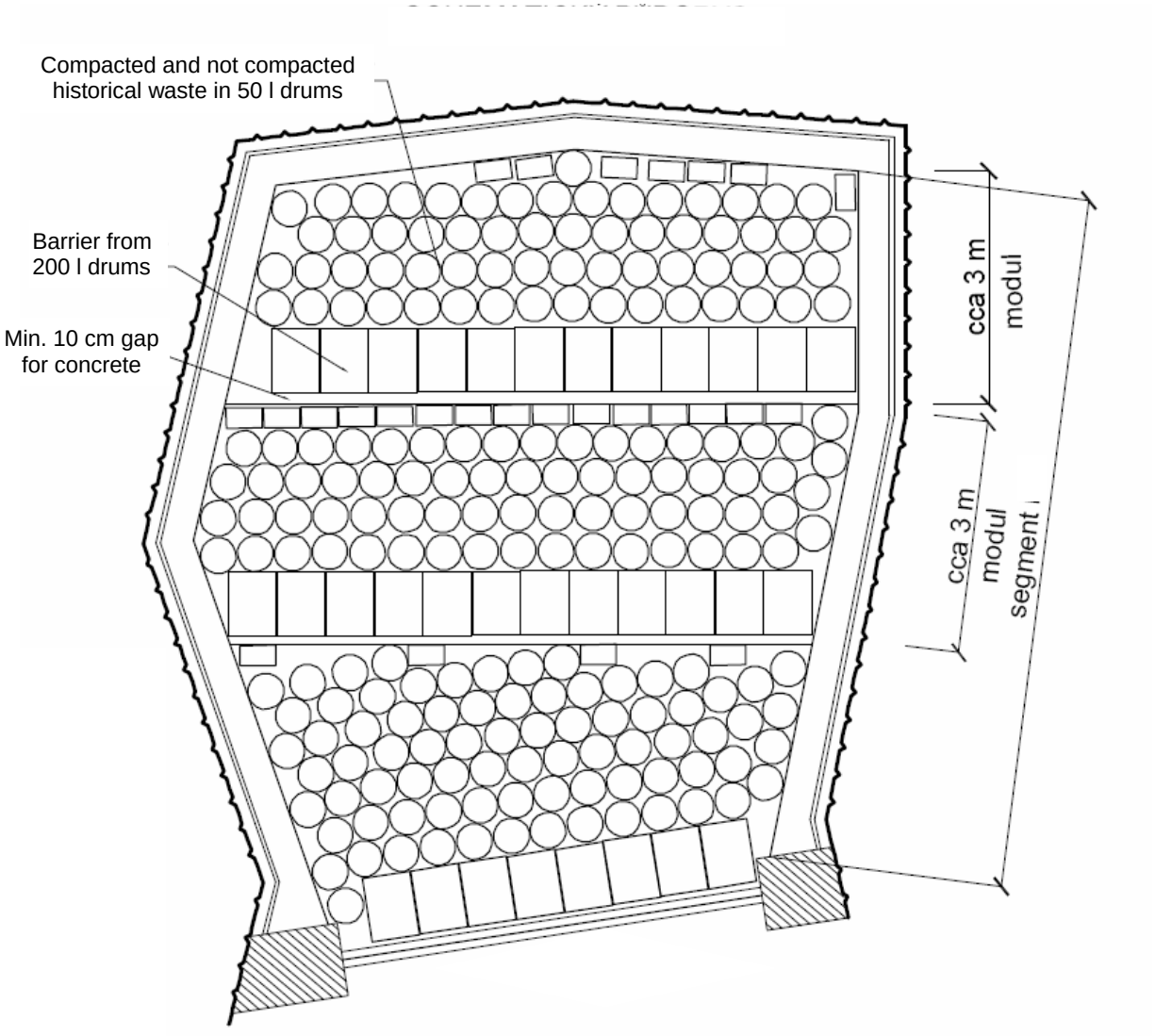
After evaluation of various proposals and concepts of emplacement and backfilling of the waste packages was agreed the following concept. This concept we consider as an optimized solution from radiation protection, as well as from the backfilling technology point of view.

Backfilling will be held in modules that will be wide approximately 3 meters. From 200 l waste drums will be stepwise created a barrier supporting the pile of compacted and not compacted 50 l waste packages, up to the height of the concrete wall. Then will be erected a formwork and the waste pile will be backfilled with concrete. On the top of the backfilled waste will be inserted waste packages in that manner that a void space between the hydraulic cage and waste packages will be minimally 30 cm, to ensure sufficient isolating concrete layer. After stepwise backfilling of the modules, whole segment with remaining not backfilled upper layer of waste packages will be backfilled together at once, so a compact concrete "head" will be created.

Backfilling of the waste packages does not started yet, but we expect that it will start in the end of September, after receiving the license from the Mining Office. During that period a system of monitoring of backfilling process will be realized. EREBOS will run tests of concreting technology (mixing, pumping) using variable concrete mixtures, to ensure optimized parameters of the concrete.

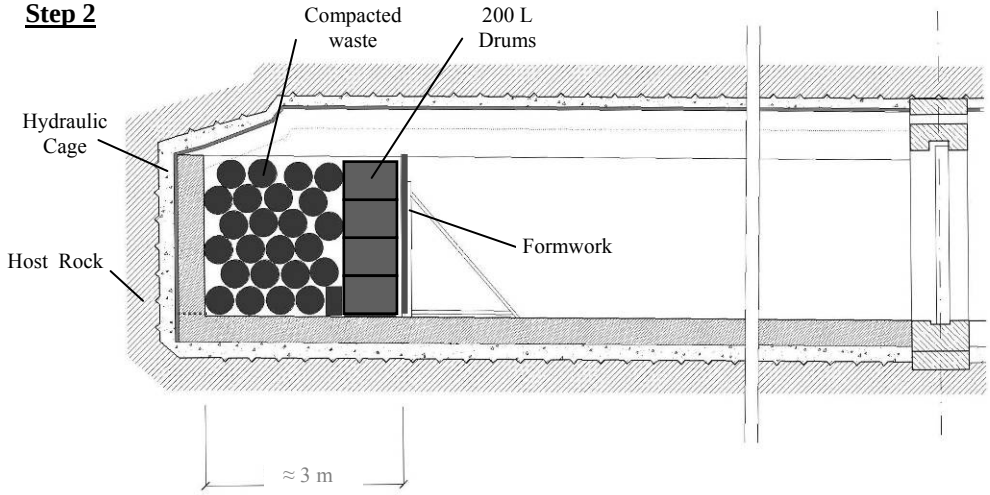
The proposed system of waste emplacement and backfilling is visible from the following pictures.

Layout of the chamber 9 filled with the waste packages

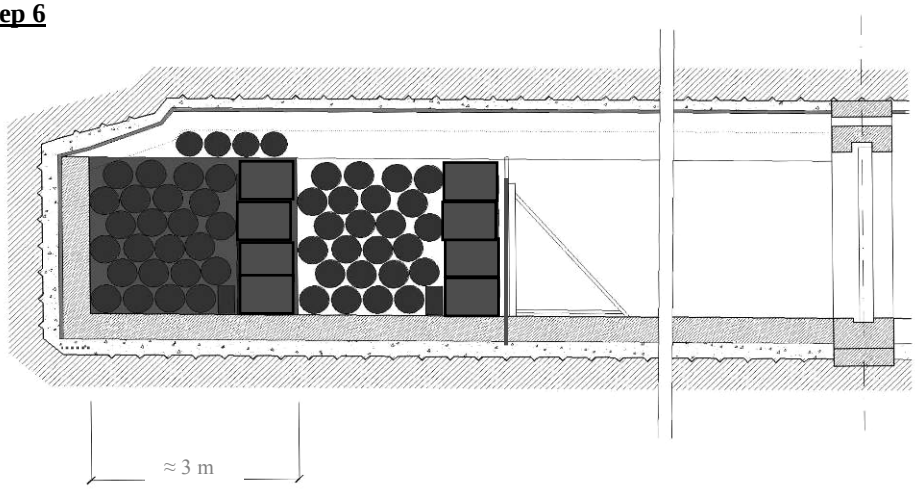


Sequencing of the waste emplacement and backfilling

Step 2



Step 6



Final step