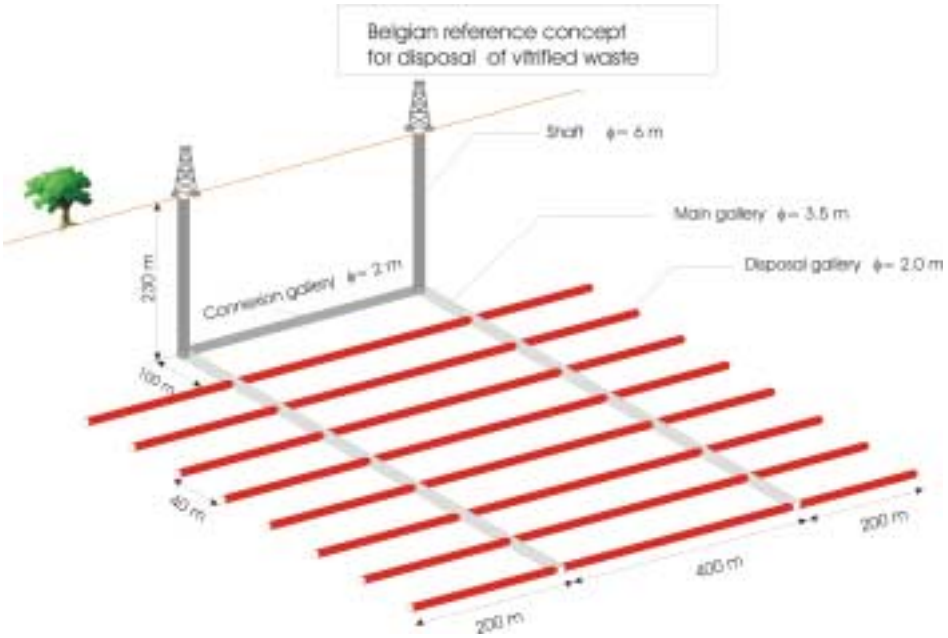

***Figure 4-1**:* *General view of the deep disposal facility for vitrified waste (reference repository design).*

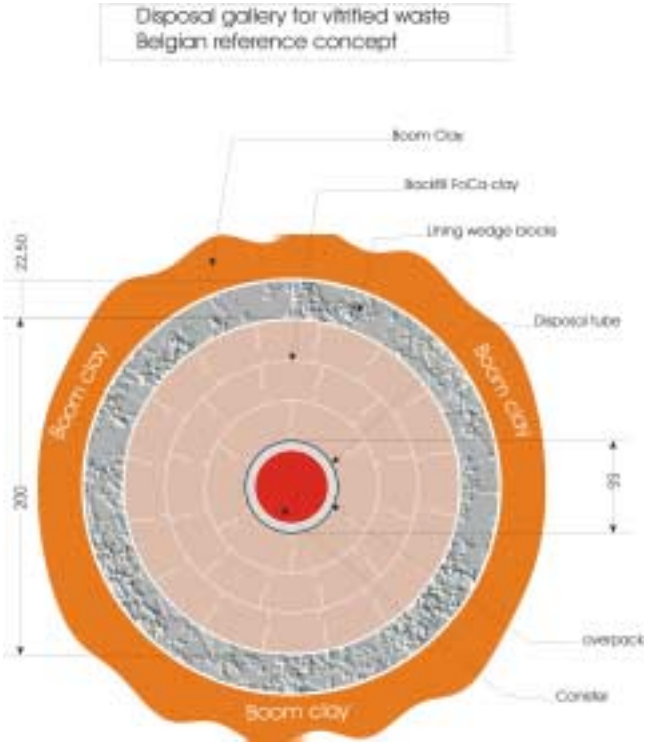

***Figure 4-2**:* *Section through a disposal gallery for vitrified waste (reference repository design).*

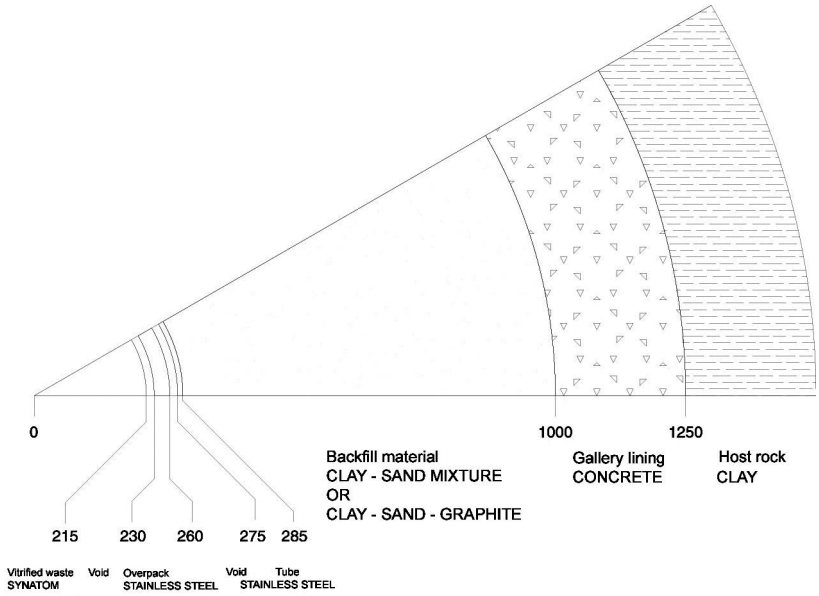

***Figure 4-3**:* *Configuration for the calculation of maximum temperatures around a disposal gallery.*

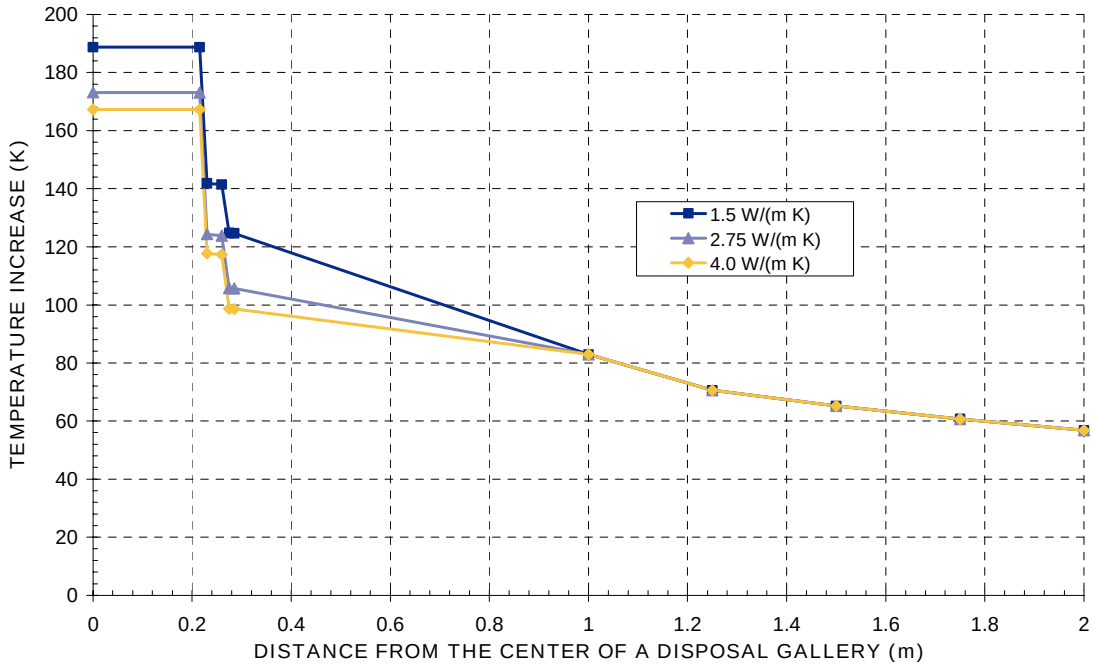

***Figure 4-4**:* *Maximum temperatures around a disposal gallery – temperature profile as a function of thermal conductivity of backfill material.*

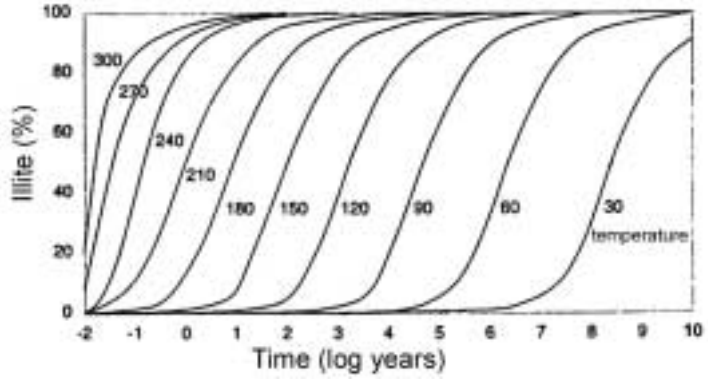

***Figure 4-5**:* *Rate of transformation from smectite to illite.*

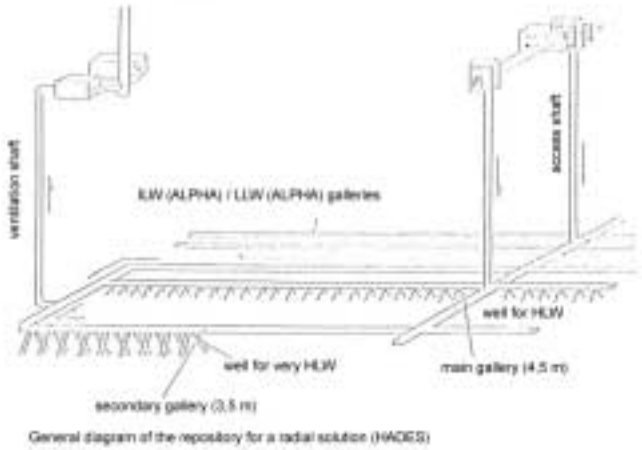

***Figure 4-6**:* *The HADES design – SAFIR (1989).*

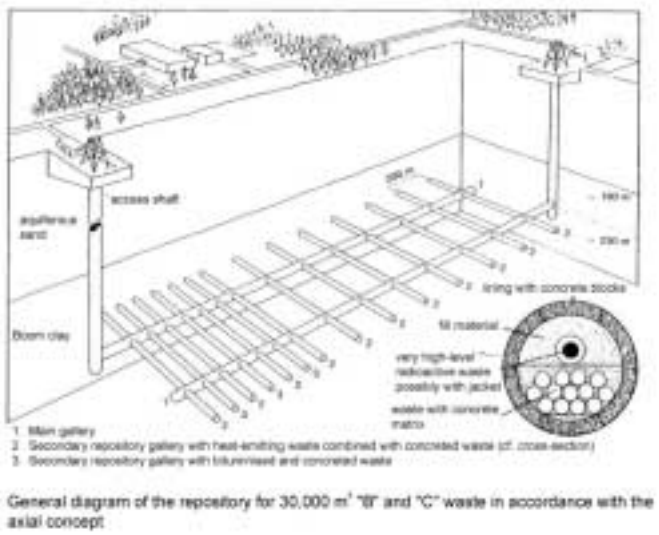

***Figure 4-7**:* *The Belgian design– SAFIR (1989).*

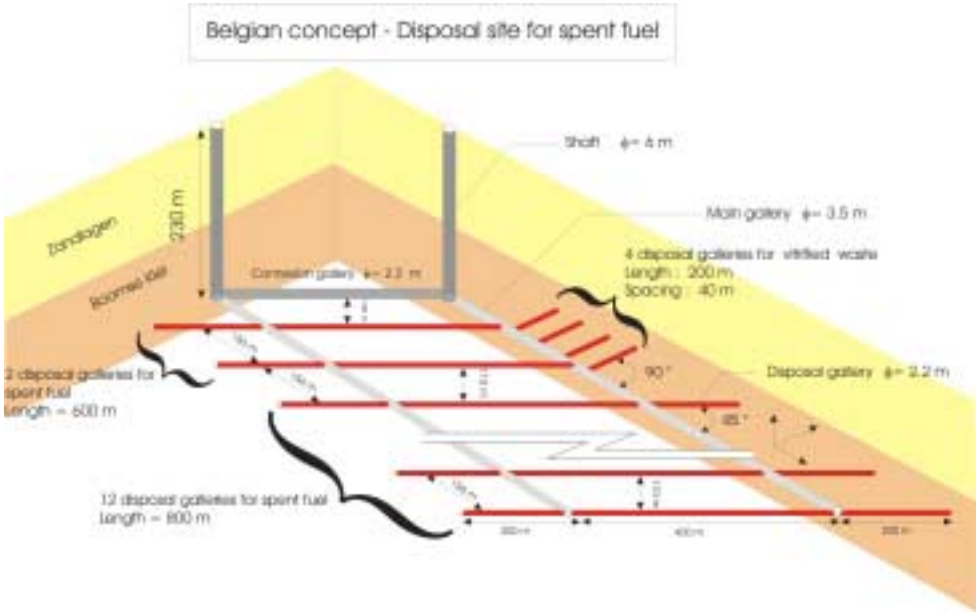

Figure 4-8: *General view of a repository design for spent fuel elements.*

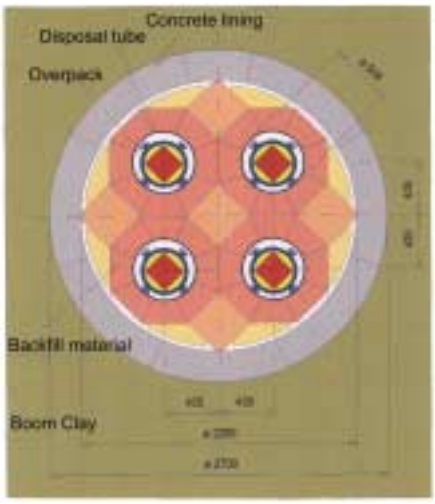

Figure 4-9: *Section through a disposal gallery for spent fuel elements.*

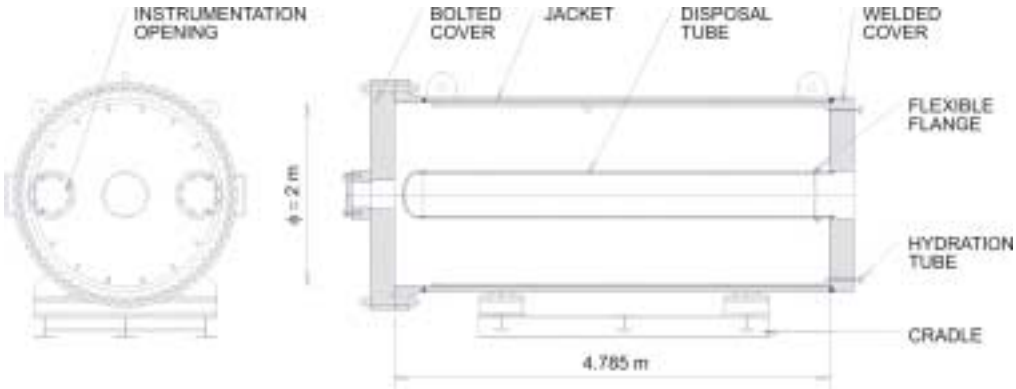

Figure 4-10: *OPHELIE mock-up: linear and transverse section.*

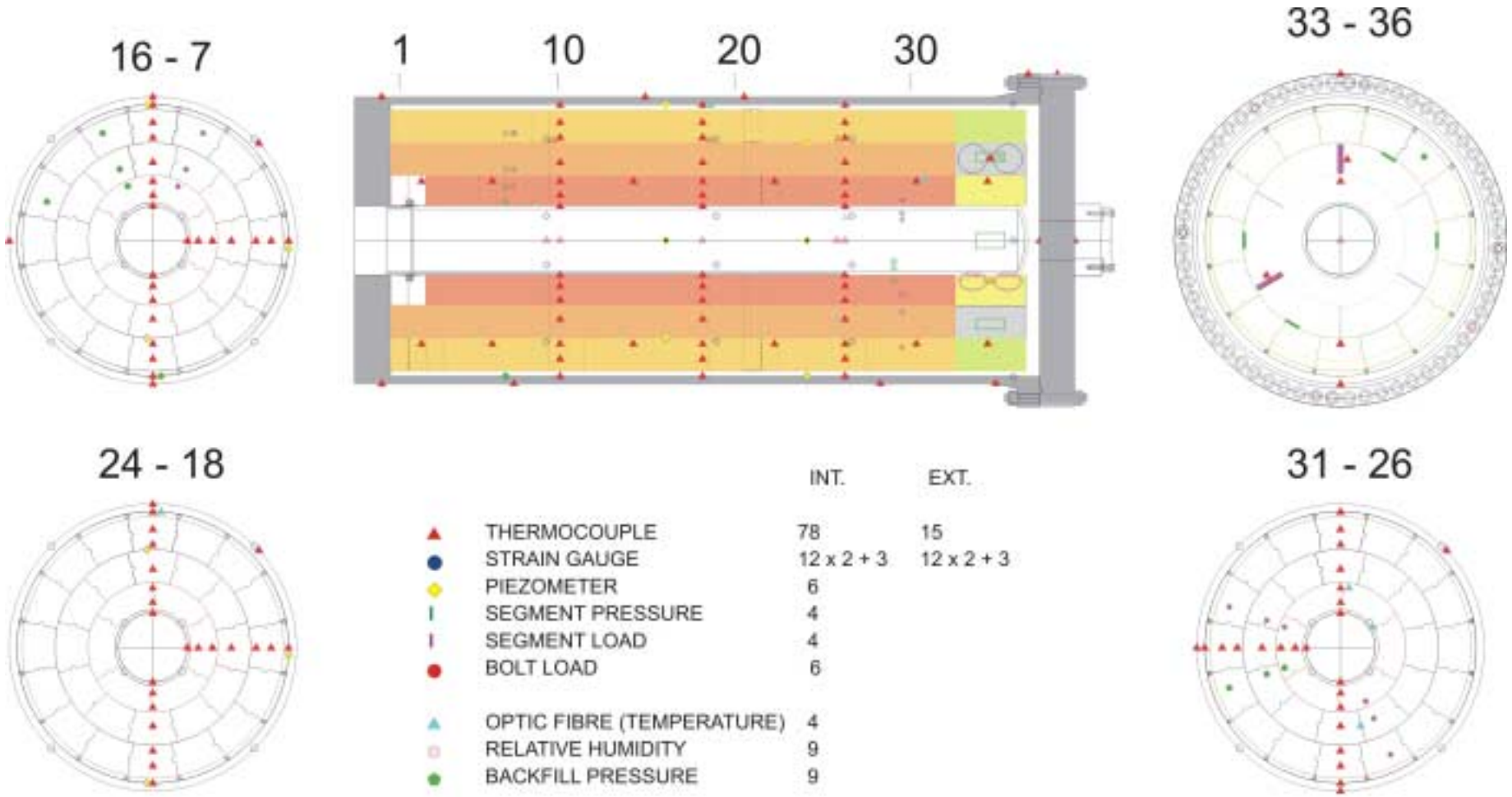

***Figure 4-11**:* *View of the OPHELIE mock-up: instrumentation.*

***Figure 4-12**: General view of the OPHELIE mock-up.*

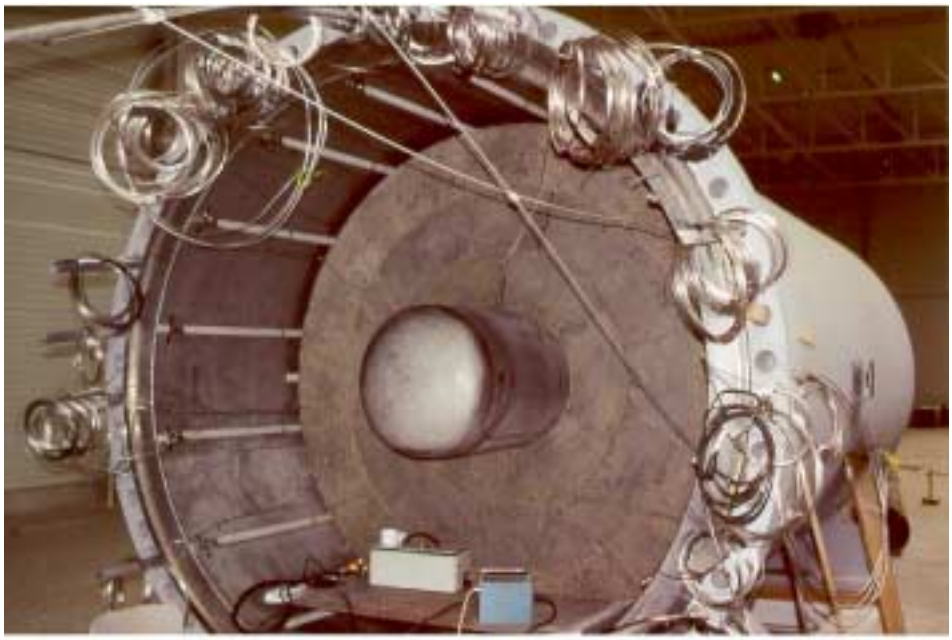

***Figure 4-13**: OPHELIE mock-up: backfill blocks.*

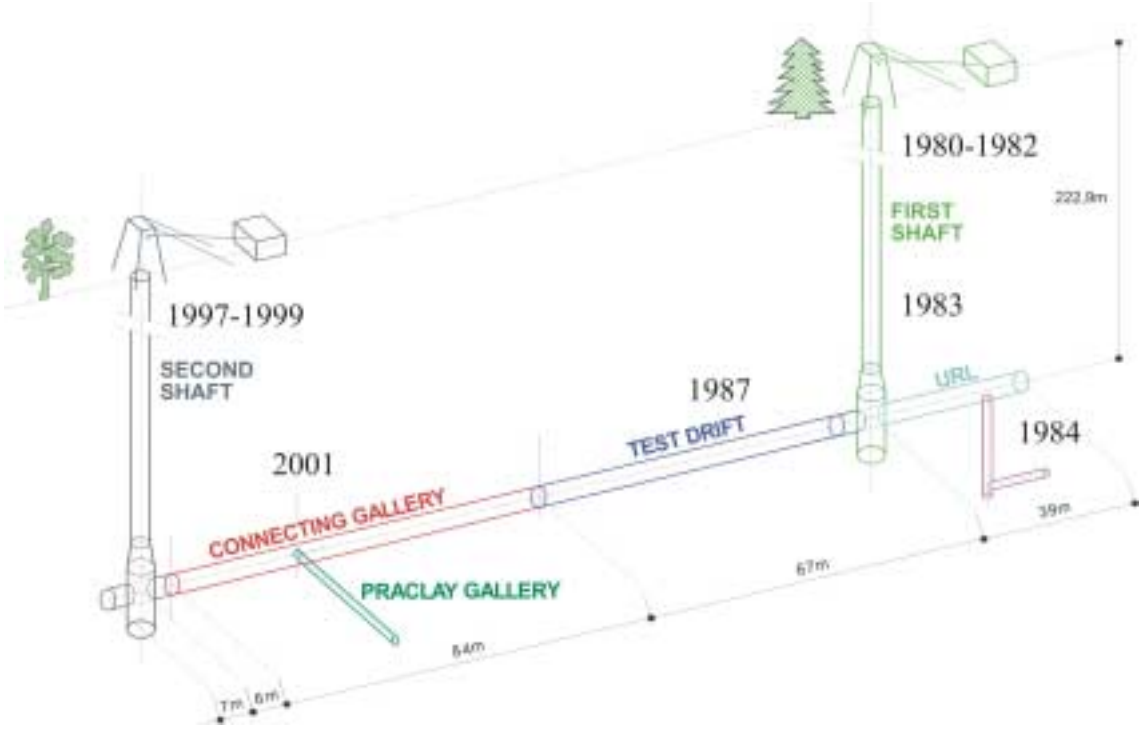

Figure 5-1: *The HADES Underground Research Facility beneath the SCK•CEN site.*

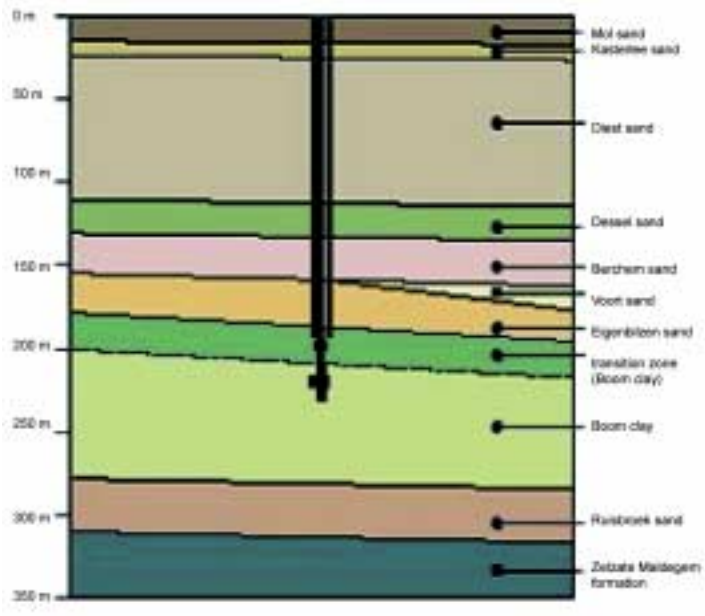

Figure 5-2: *Simplified SW-NE geological section beneath the Mol-Dessel nuclear zone with indication of the approximate position of the second shaft. The dip of the formations is about 1-2%.*

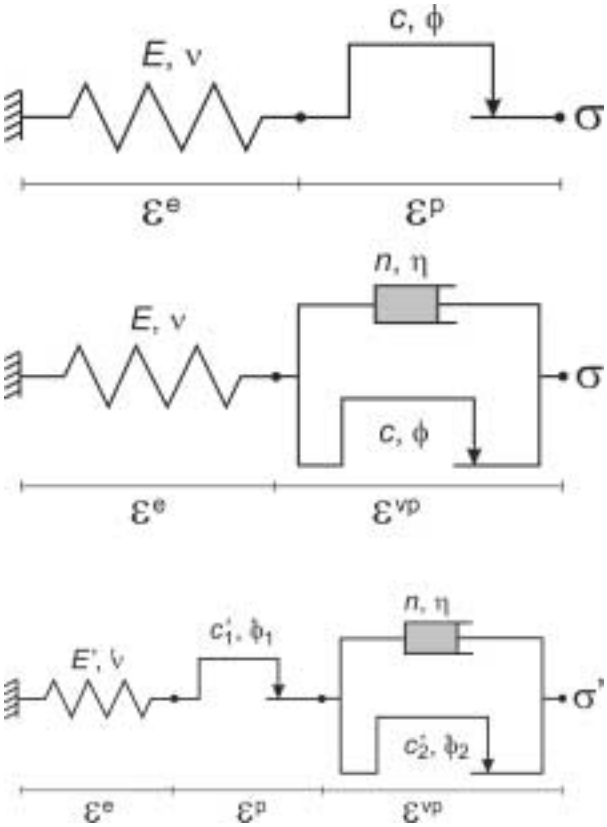

Figure 5-3: *Mechanical analogy of various geomechanical models used to describe the Boom Clay behaviour (from top to bottom: elasto-plastic model, elasto-visco-plastic model, elasto-visco-plastic model modified by addition of a short-term threshold and formulation in effective stresses).*

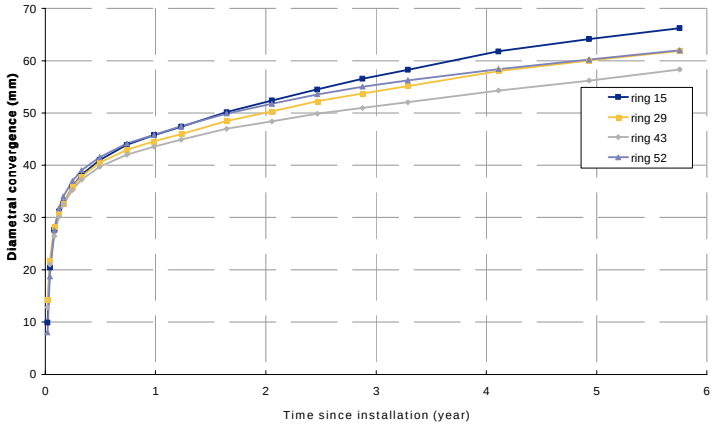

Figure 5-4: *Evolution of the diametrical convergence of the lining of the Test Drift as a function of time since the installation of various concrete block rings.*

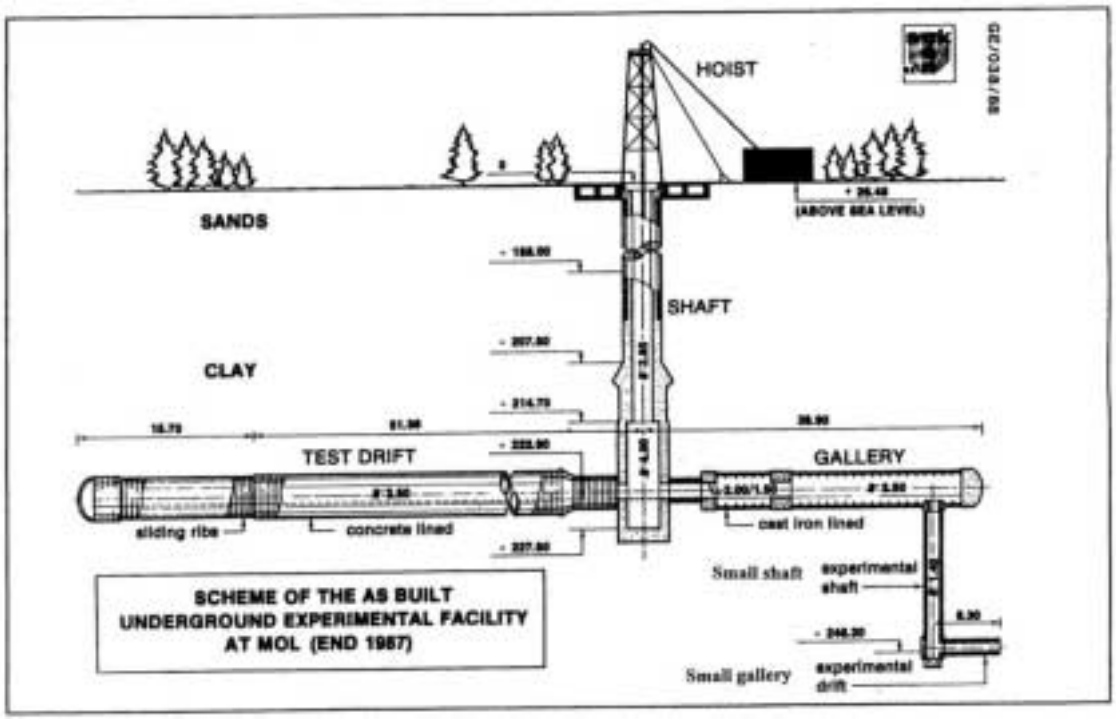

Figure 5-5: *Layout of the underground facility (HADES-URF) as existing in 1987. The experimental gallery (also called 'laboratory') was excavated in frozen clay, while the experimental shaft and drift as well as the Test Drift were excavated without freezing.*

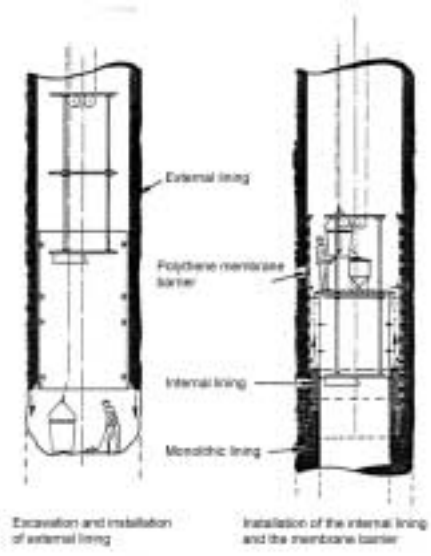

Figure 5-6: *Emplacement scheme for the multi-layer lining of the first shaft (outer layer of concrete, polyethylene membrane, inner layer of concrete).*

Figure 5-7: *View of the top of the freezing tubes (approximately 250 m depth) around the location of the first shaft.*

Figure 5-8: *Passage of a measuring instrument through the watertight polythene membrane used in the lining of the first shaft.*

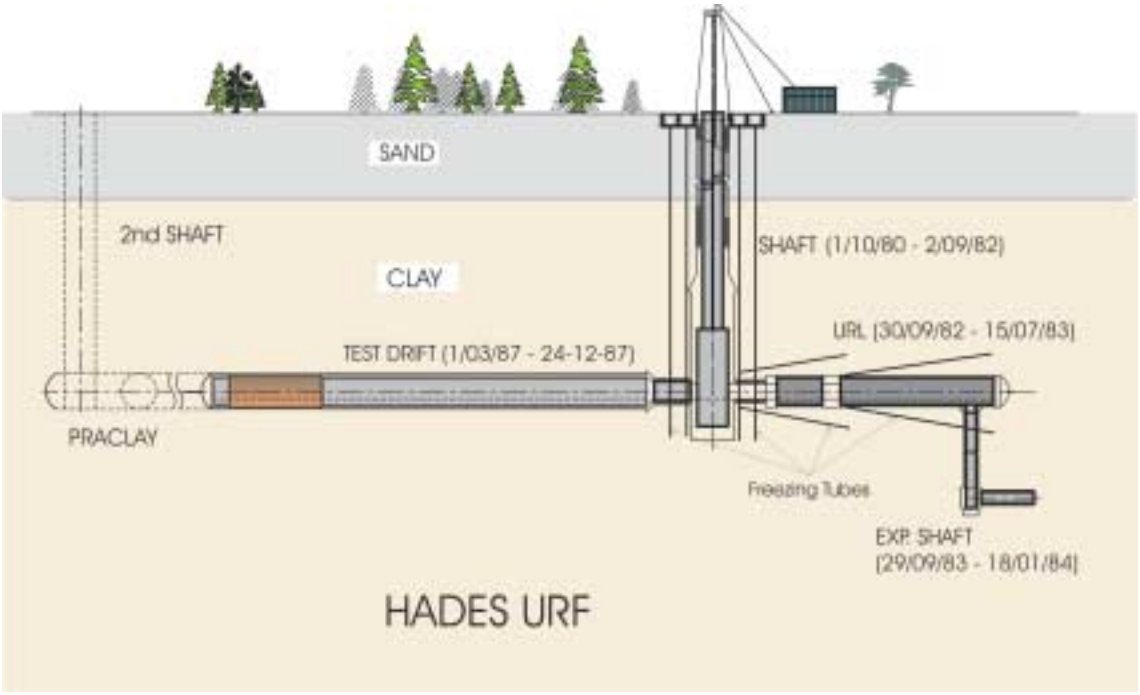

Figure 5-9: *Lay-out of the two successive series of freezing tubes used for the excavation of the HADES experimental gallery.*

Figure 5-10: *HADES experimental gallery: view of the lining made of nodular cast iron segments and of one of the access to the clay massif (on the left).*

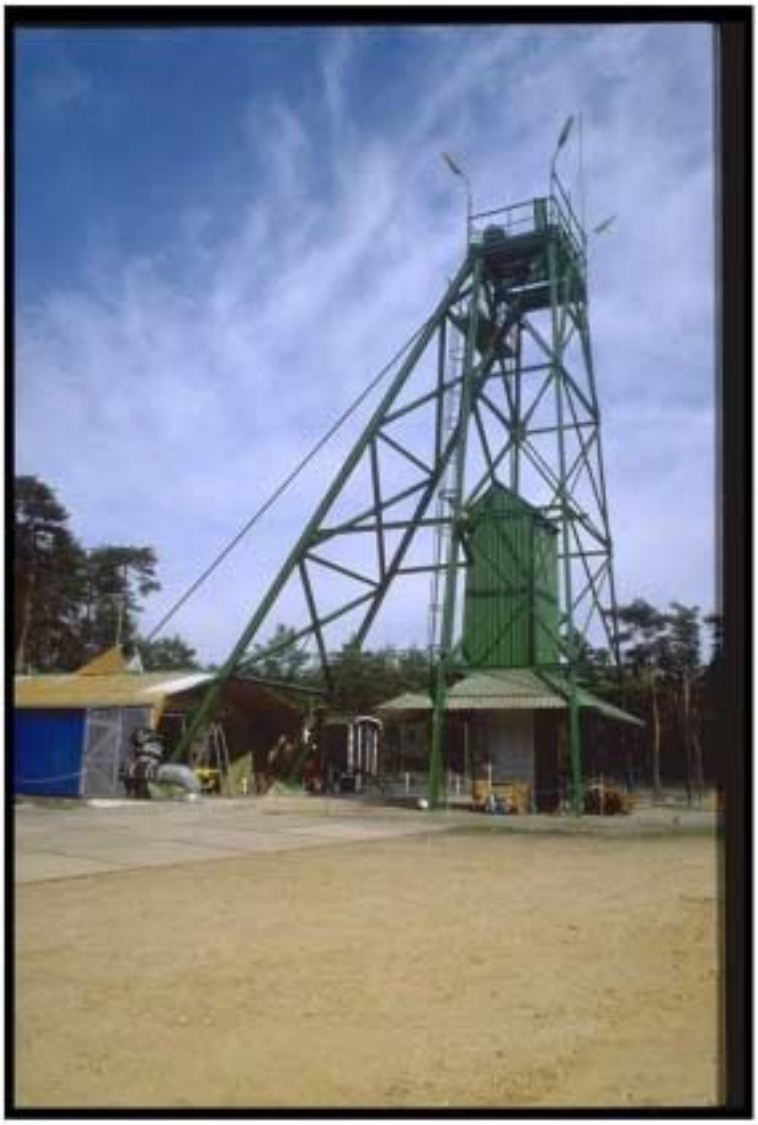

Figure 5-11: *Headframe of the first shaft of the HADES-URF.*

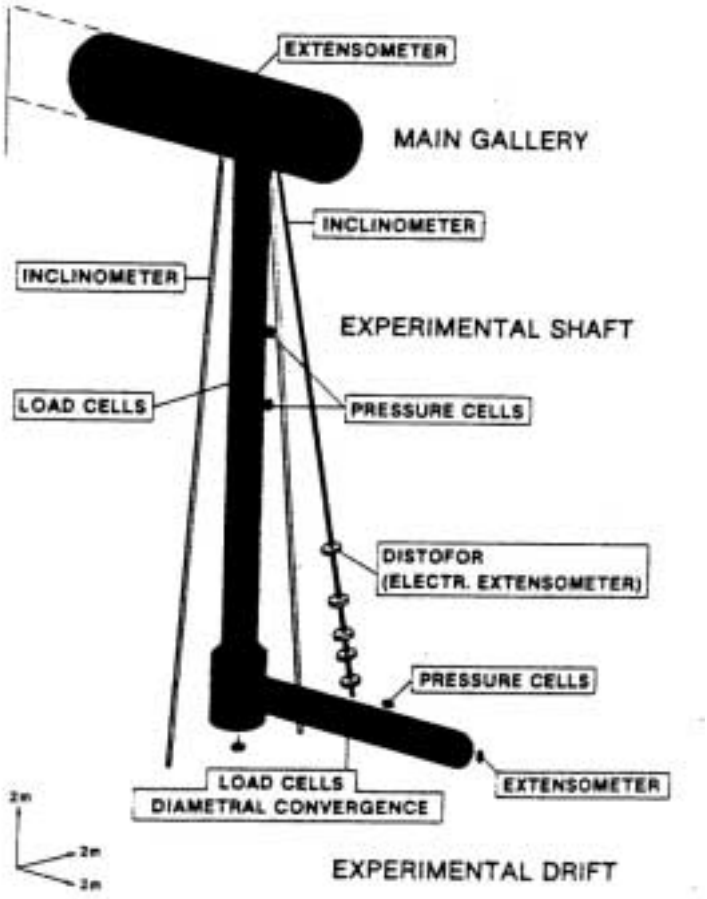

Figure 5-12: *Scheme of the small shaft and gallery of the HADES-URF with indication of the emplaced geomechanical instrumentation.*

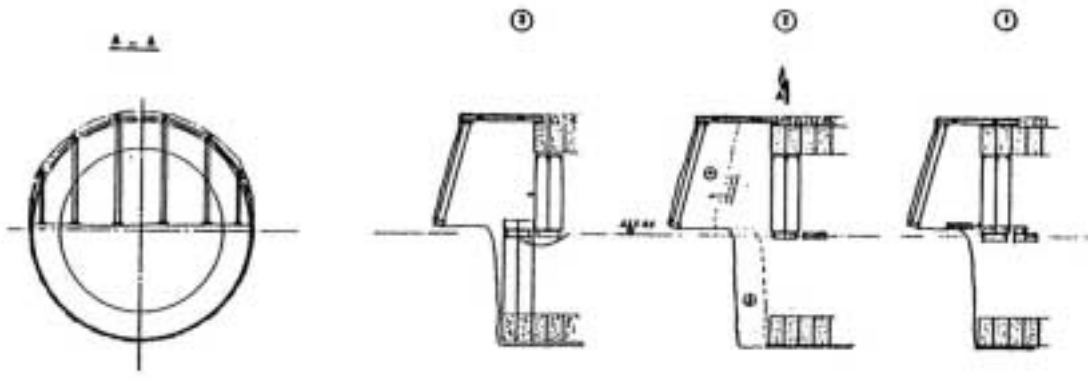

Figure 5-13: *Test Drift excavation scheme.*

Figure 5-14: *View of the excavation face of the Test Drift while emplacing the 60 cm thick concrete block lining.*

Figure 5-15: *Test Drift: view of the lining made out of sliding steel ribs.*

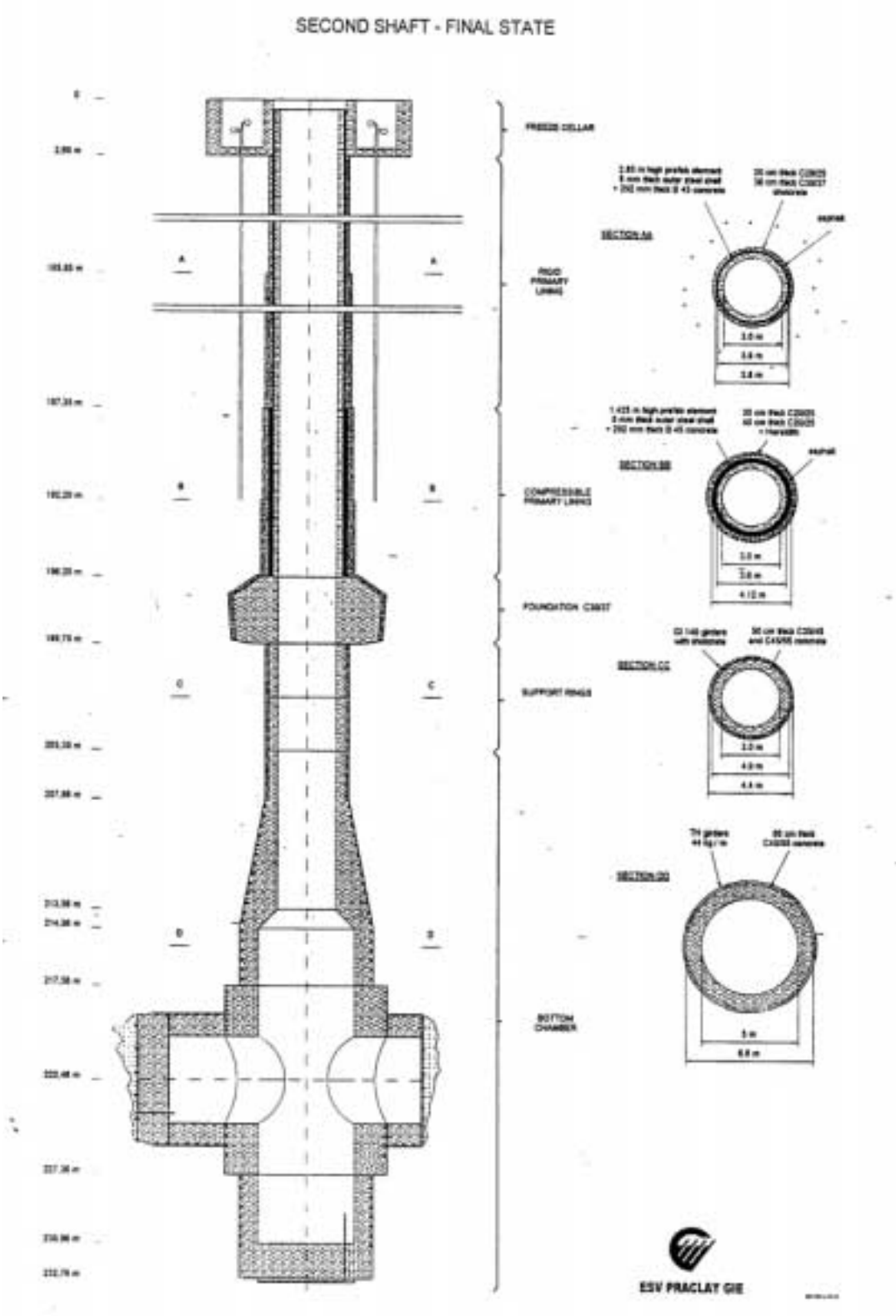

Figure 5-16: *'As built' plan of the second shaft showing the foundation in the top part of the Boom Clay as well as the two starting chambers.*

Figure 5-17: *Second shaft: excavation in the frozen sands (jackhammer mounted on an hydraulic arm and manual air hammers).*

Figure 5-18: *Second shaft: guniting of the outer lining (20 cm of shotcrete on reinforcing mats).*

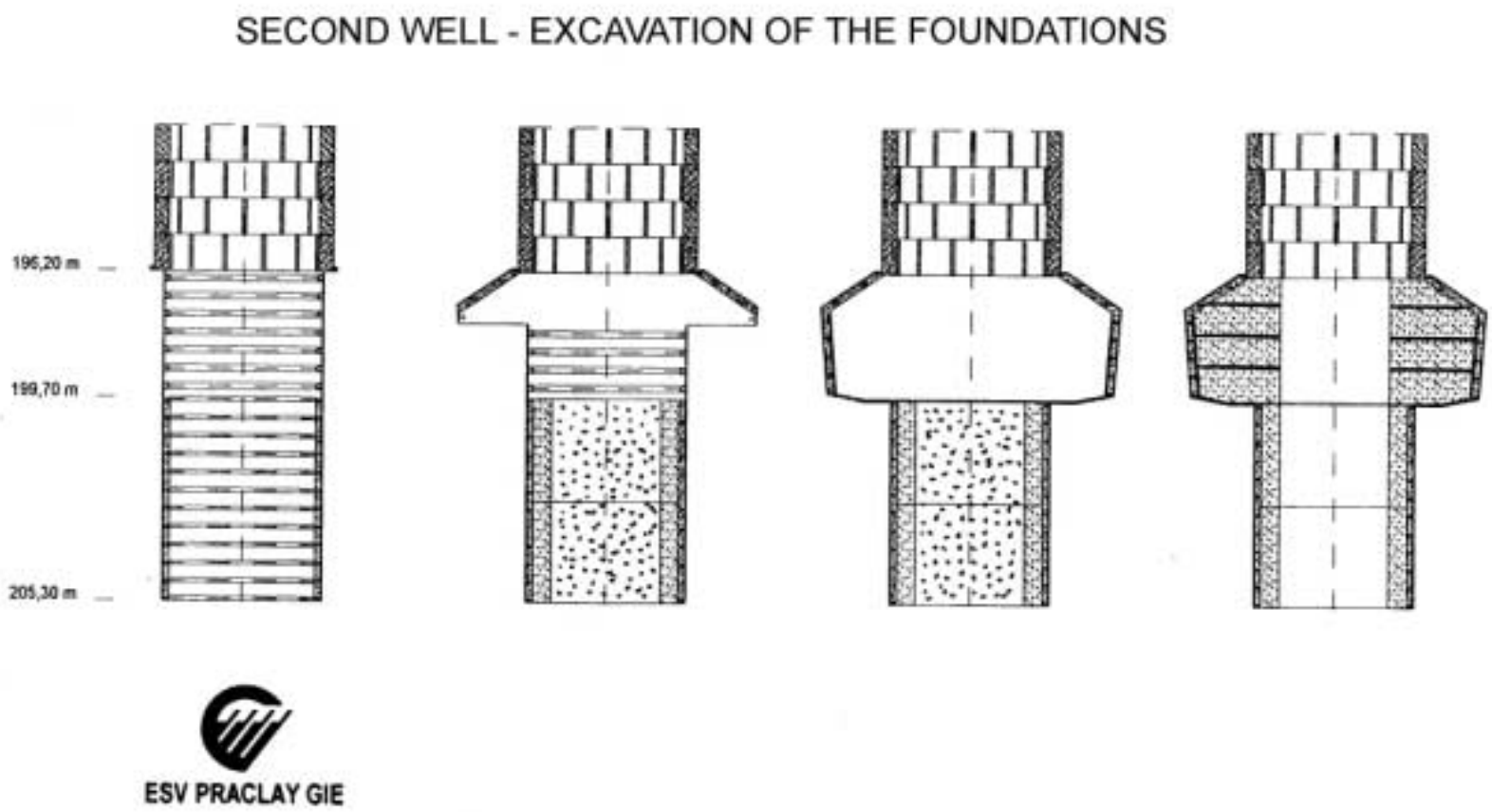

Figure 5-19: *Second shaft: scheme of the excavation of the foundation.*

Figure 5-20: *Second shaft: prefabricated section of the inner lining in the headframe waiting to be lifted onto the service platform prior to descent.*

Figure 5-21: *Second shaft: excavation method (hydraulic arm) and support (sliding ribs) below the foundation.*

Figure 5-22: *Second shaft: service platform and support of sliding ribs (looking upwards).*

Figure 5-23: *Second shaft: placement of reinforcement for the starting chambers.*

Figure 5-24: *Second shaft: excavation of the starting chambers.*

Figure 5-25: *Second shaft: slip planes and fractures observed during excavation of the starting chambers. The upper picture shows a fallen block in the south starting chamber due to a circular (vis-à-vis the centre of the second shaft) slip plane. The below picture shows the side wall of the same starting chamber displaying cross-sections of two of the encountered fractures (average dip was 35° towards the centre of the shaft).*

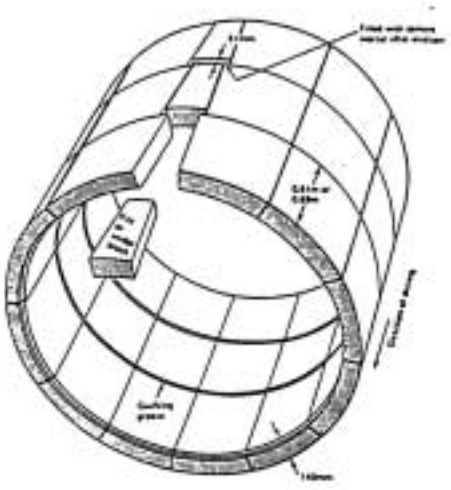

Figure 5-26: *Principle of the expended segmental lining consisting of rings of unreinforced concrete segments plus 1 or 2 'wedge blocks' (or key) per ring. The wedge blocks are used to ensure close contact with the rock mass.*

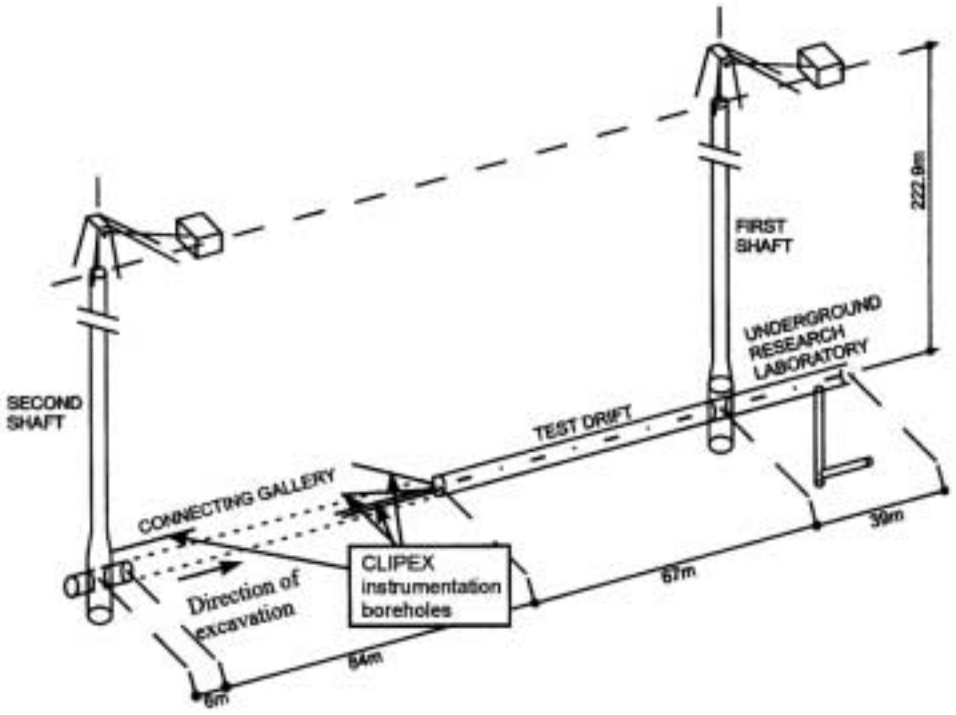

Figure 5-27: *Scheme of the HADES-URF (2000 situation) indicating the location of the CLIPEX instrumentation boreholes on both ends of the planned connecting gallery.*

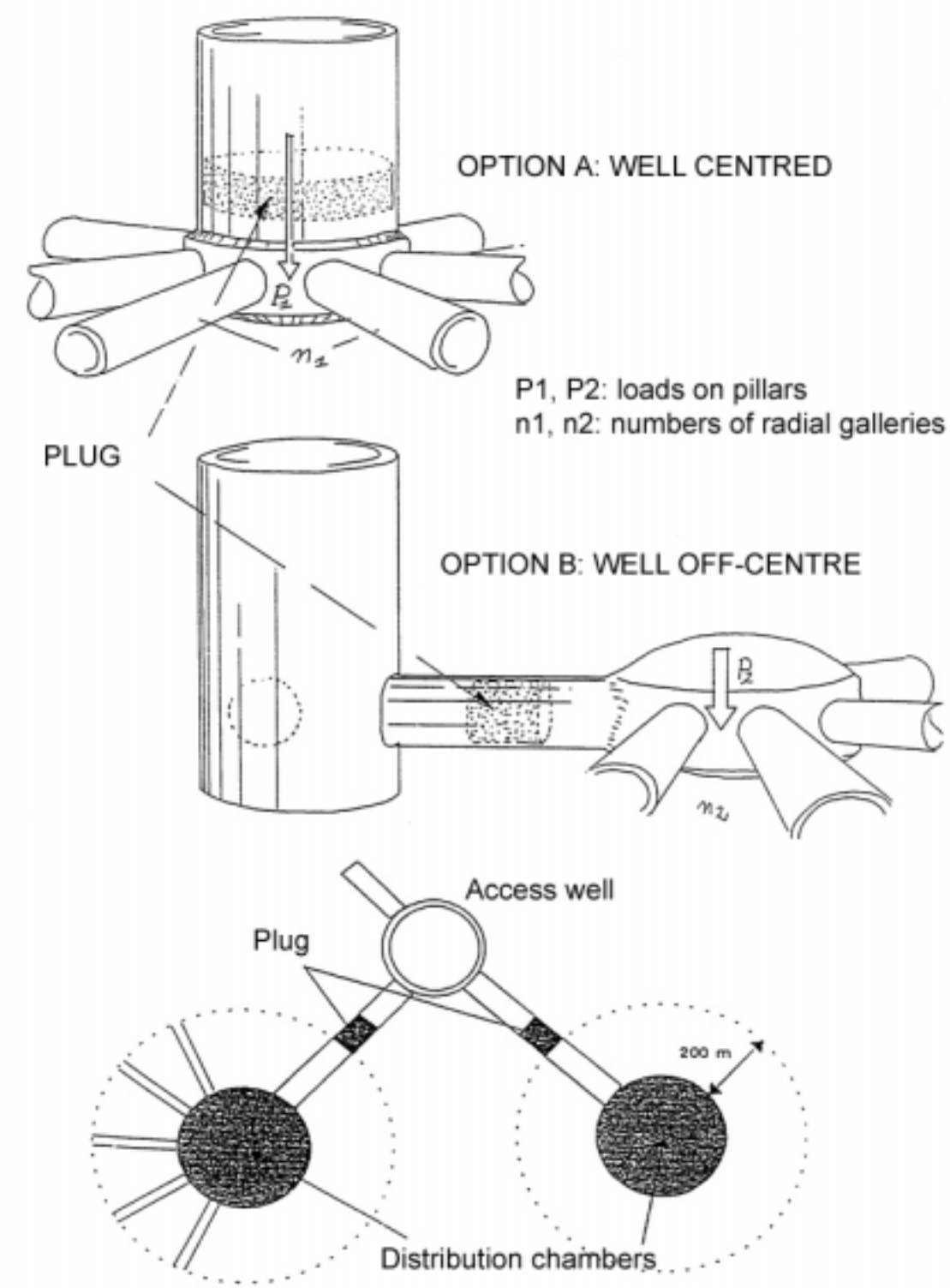

Figure 5-28: *Alternative repository designs for spent fuel disposal based on the possibility to excavate large cavities in the Boom Clay.*

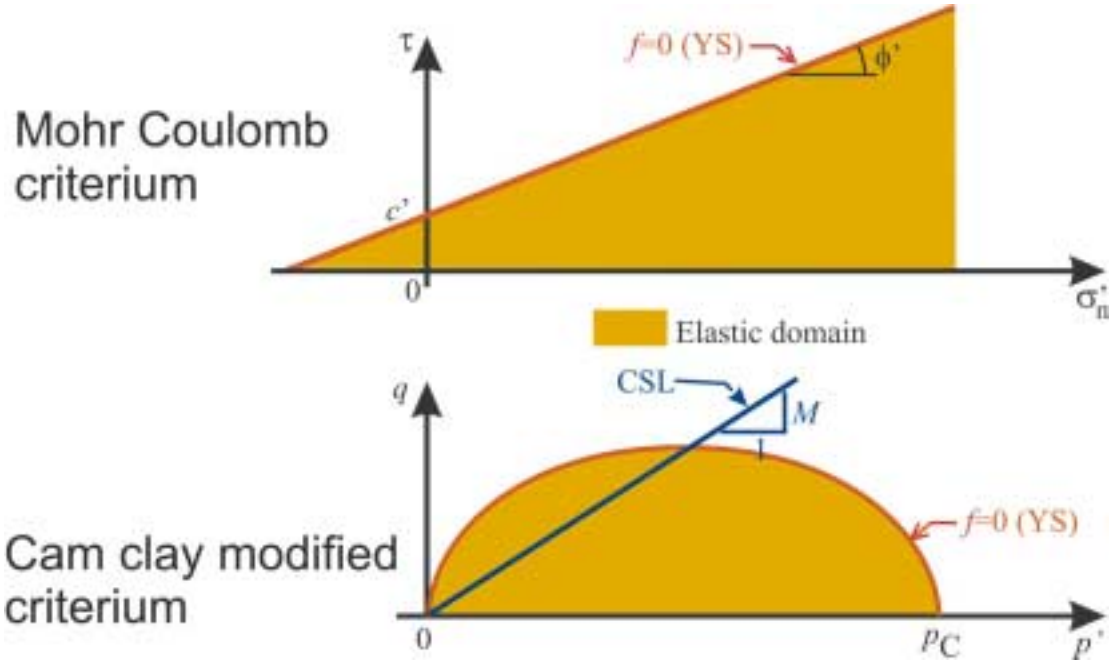

Figure 5-29: *Principle of the Cam-clay model.*

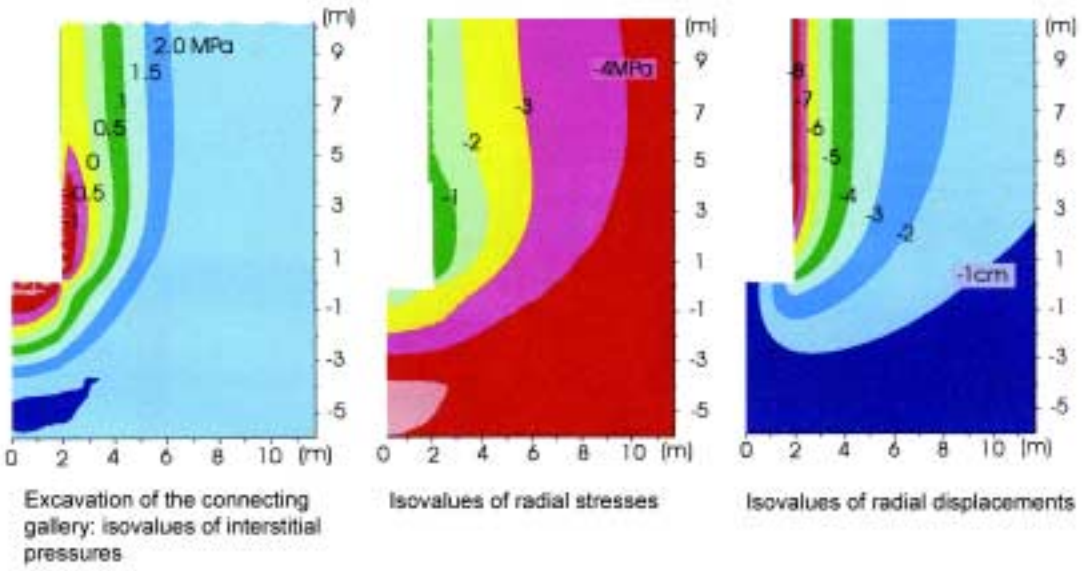

Figure 5-30: *Results of the modelling (interstitial pressures, radial stresses, radial displacements) of the excavation of the connecting gallery with the Cam-clay model.*

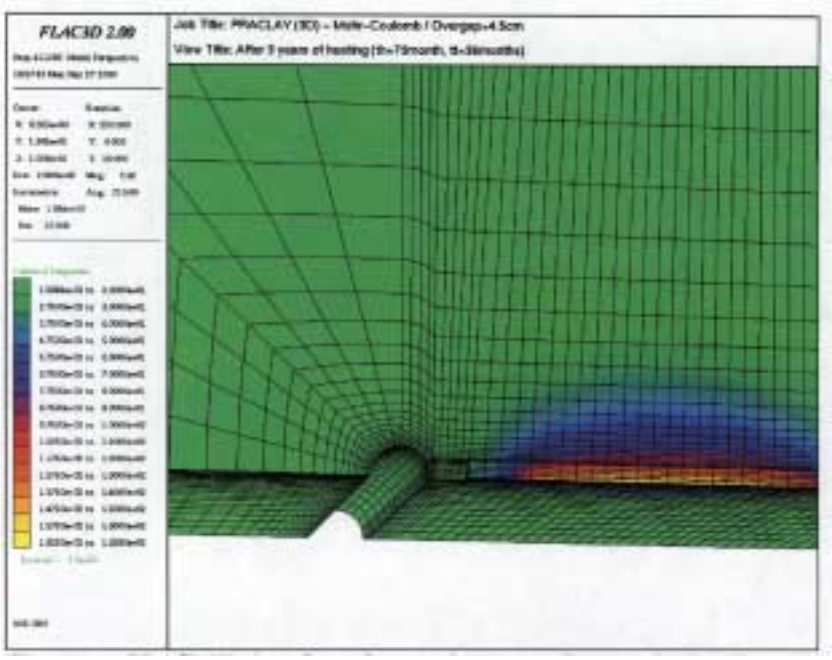

Figure 5-31: *PRACLAY: contours of equal temperatures after 3 years of heating (3D Mohr-Coulomb model).*

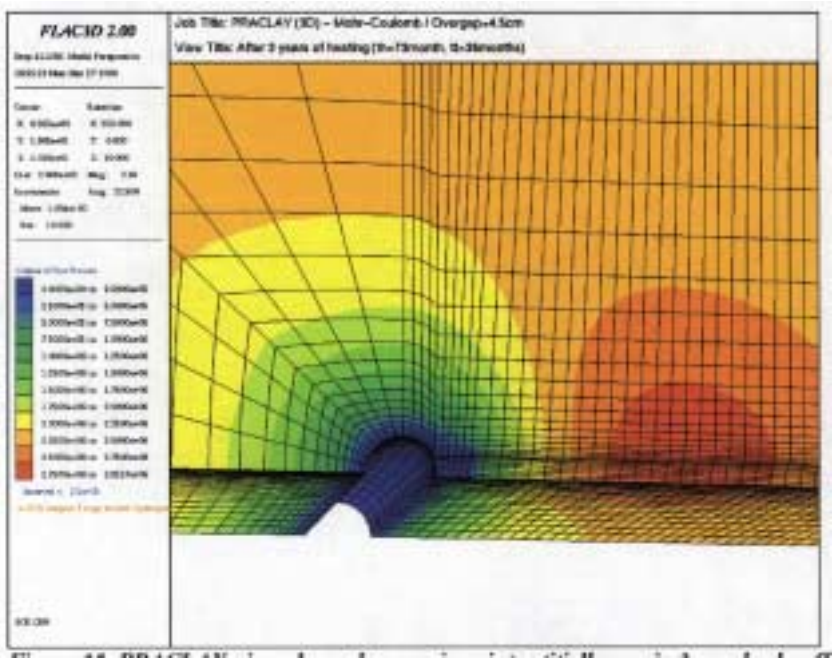

Figure 5-32: *PRACLAY: contours of equal interstitial pressures after 3 years of heating (3D Mohr-Coulomb model).*

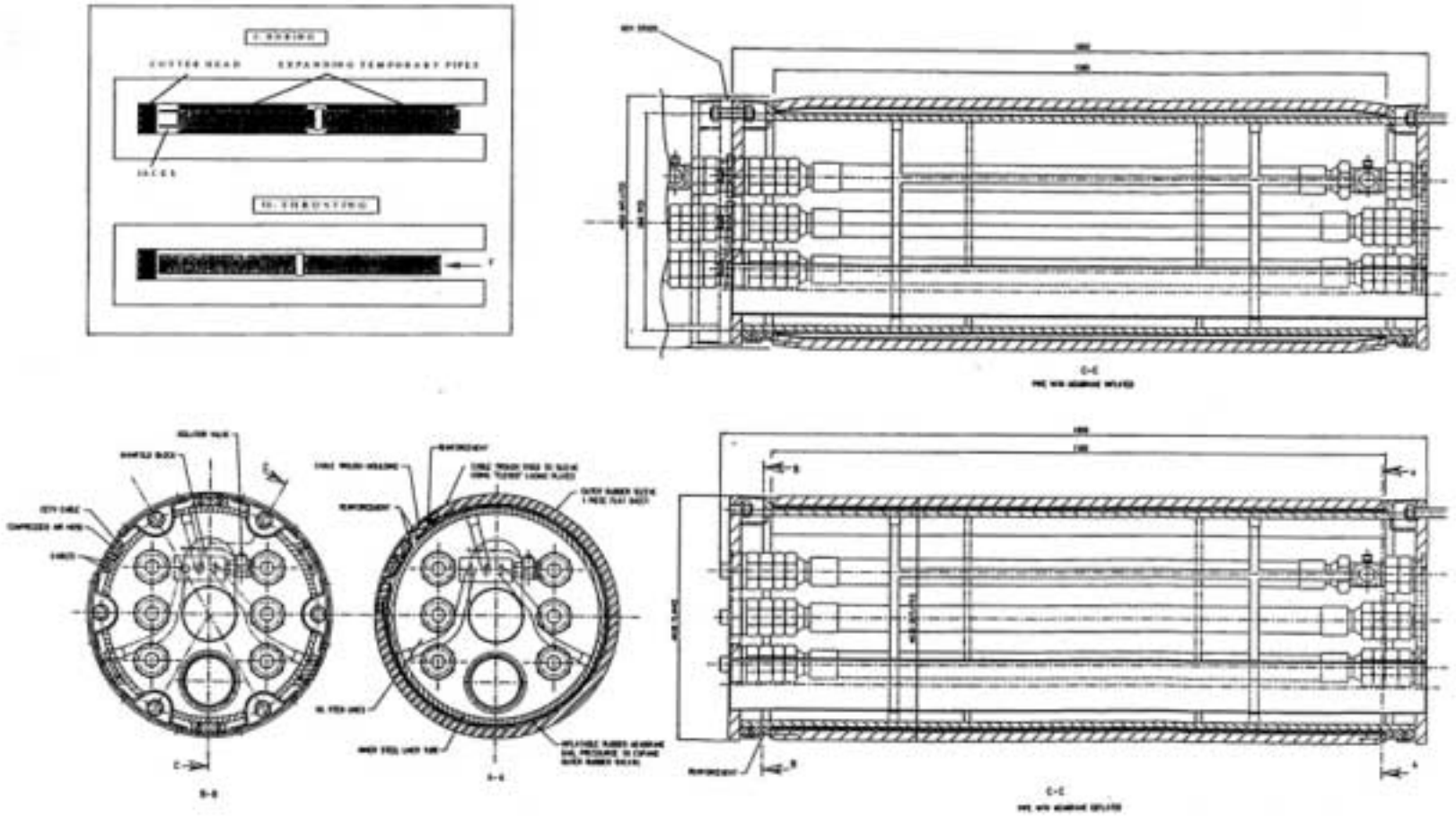

Figure 5-33: *Principle of the expandable lining for the microtunneller.*

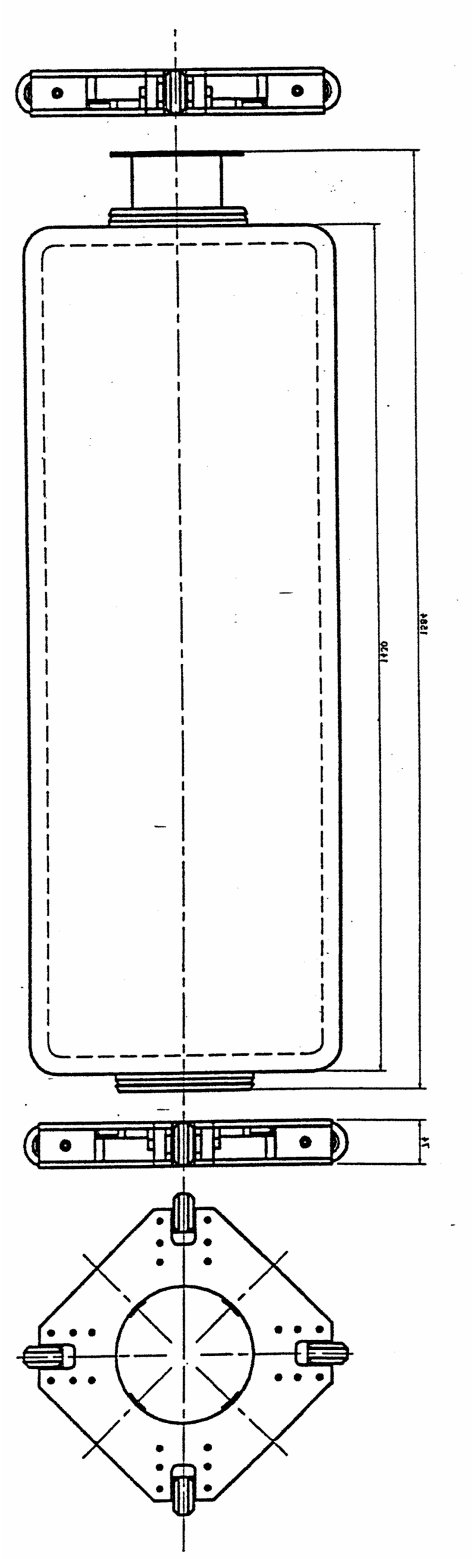

Figure 6-1: *Overpack used for primary packages of SYNATOM vitrified waste (shown without trolleys).*

Figure 6-2: *Overpack for SYNATOM vitrified waste.*

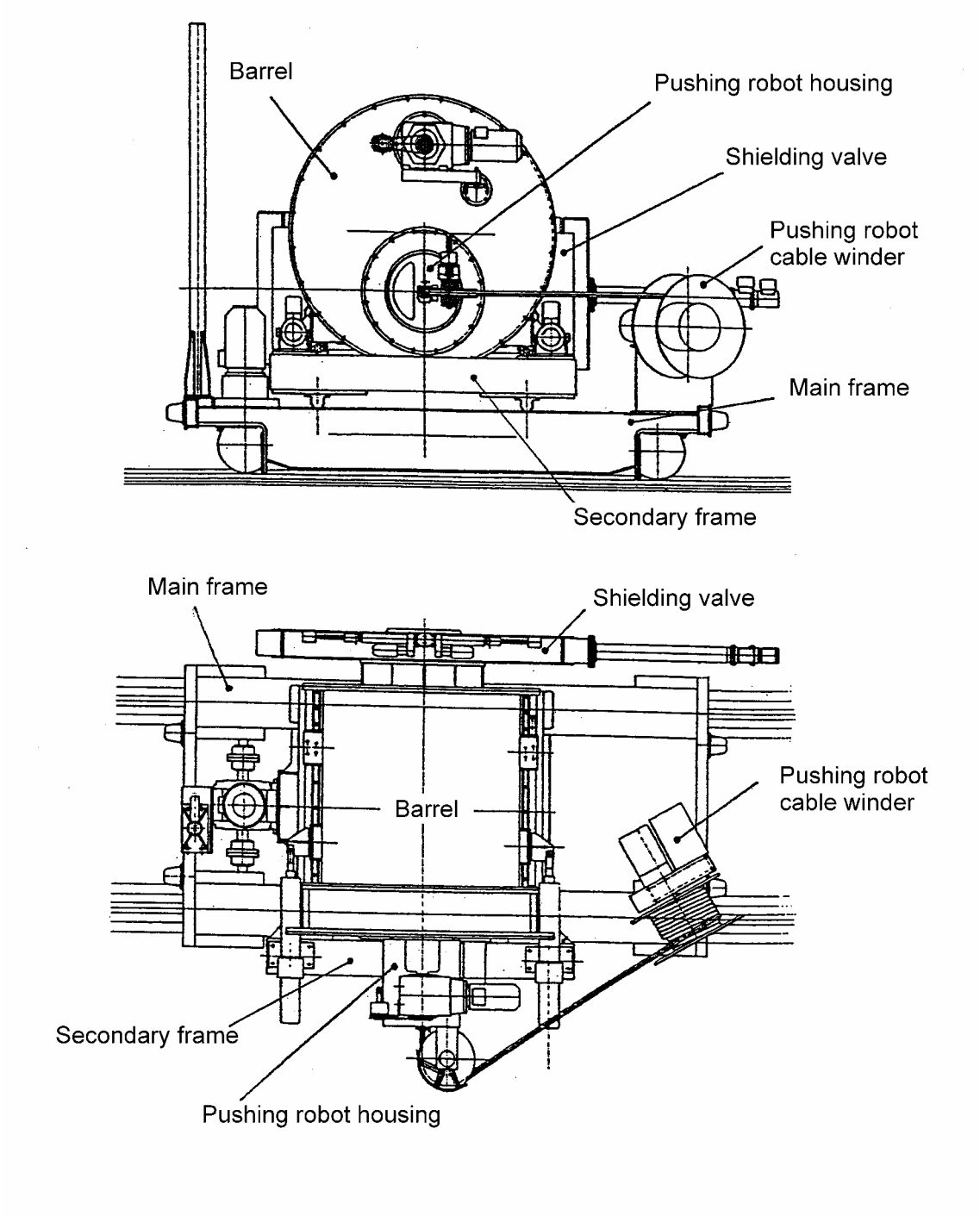

Figure 6-3: *Transfer wagon.*

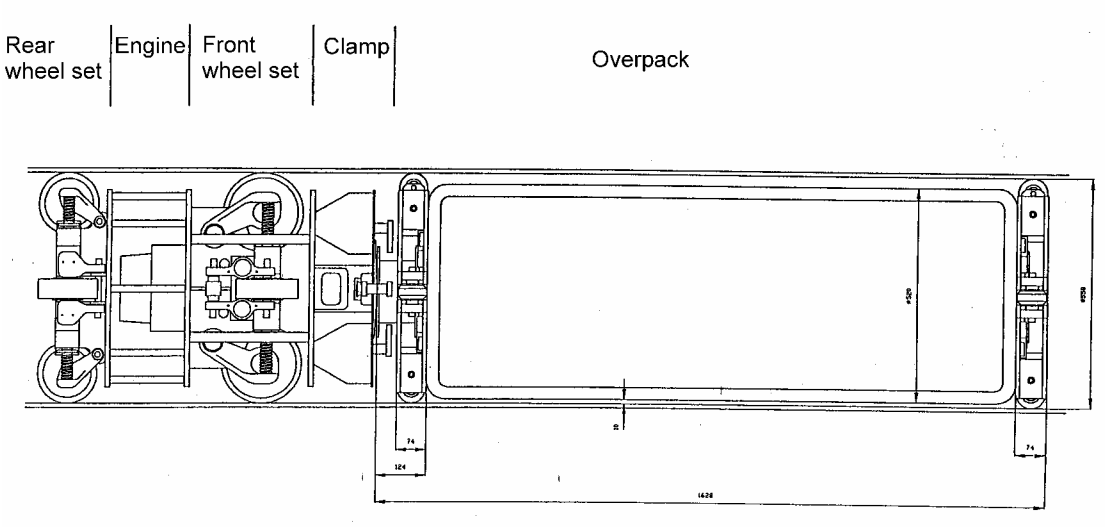

Figure 6-4: *Pushing robot pushing an overpack.*

Figure 6-5: *Transfer wagon (PRACLAY demonstration hall).*

Figure 6-6: *Transfer wagon (PRACLAY demonstration hall).*

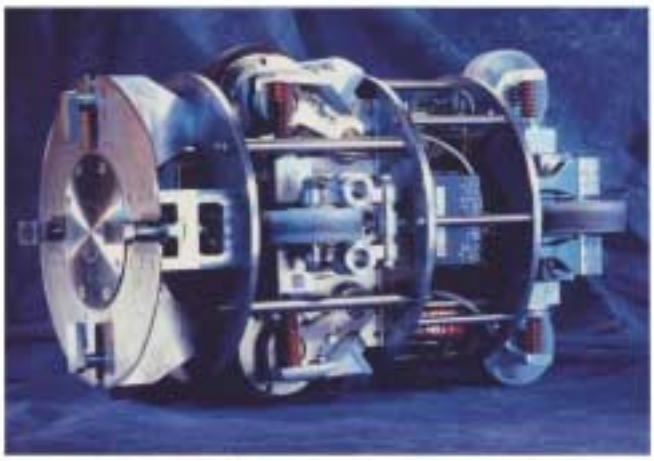

Figure 6-7: *Transfer wagon (PRACLAY demonstration hall).*

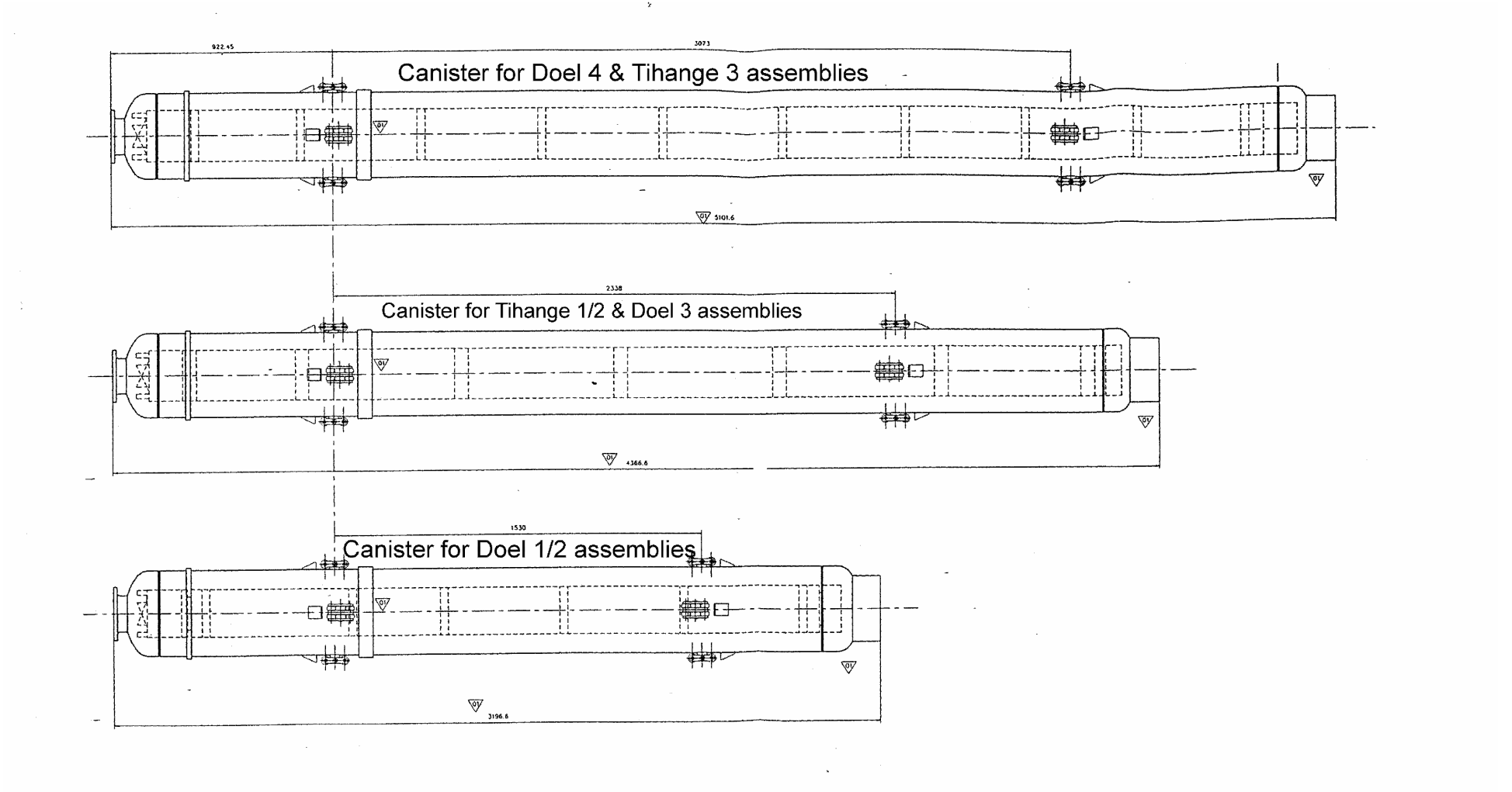

Figure 6-8: *'Bottles' for spent fuel.*

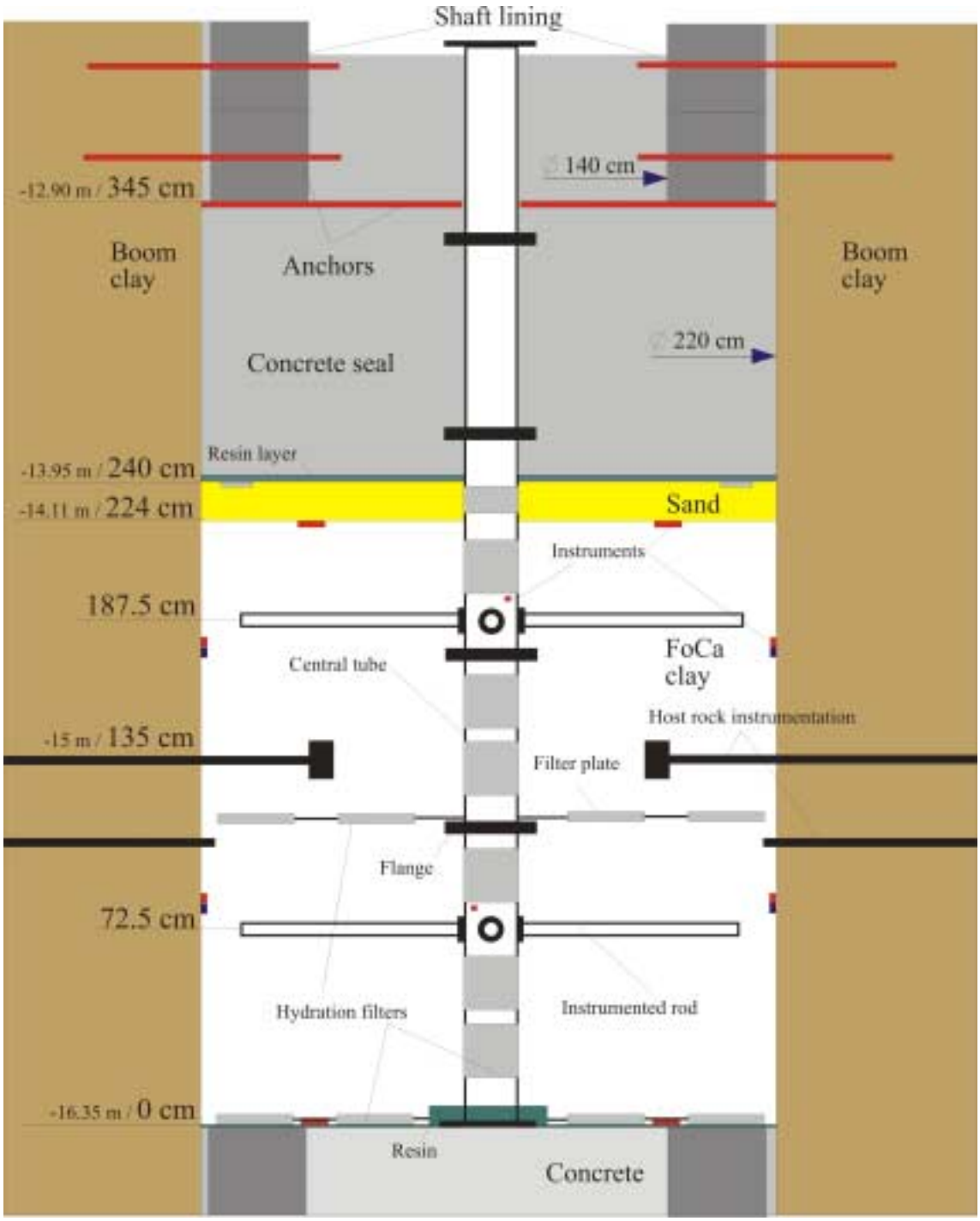

Figure 9-1: *Experimental setup of the RESEAL demonstration test.*