THE BELGIAN RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAM ON THE GEOLOGICAL DISPOSAL OF LONG-LIVED AND HIGH-LEVEL RADIOACTIVE WASTE AND SPENT FUEL IN A CLAY FORMATION: STATUS AND TRENDS

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ABSTRACT

Within the Belgian program for the management of long-lived and high-level radioactive waste (HLW), the Boom Clay is studied as a potential host rock for deep disposal. This paper gives an update on progress and achievements of Research, Development & Demonstration (RD&D) programs at the Belgian Nuclear Research Center SCK•CEN. At SCK•CEN, large interdisciplinary RD&D programs combining underlying and applied science have contributed to extensive expertise on disposal in clay. In this paper, recent developments in a number of key-areas are highlighted. In particular, emphasis is on:

- Investigations concerning the geological disposal of organic waste forms (bituminized reprocessing waste and alpha-contaminated cellulose waste);
- The *in situ* testing of cement-clay interactions and the assessment of the consequences of these interactions for the development of the alkaline plume;
- The CORALUS experiment, which is an integrated *in situ* experiment for the detailed investigation of the interaction of alpha-doped vitrified waste and various candidate backfill materials in the presence of heat and gamma radiation;
- The in-depth geochemical study of trace elements and radionuclides, which are naturally present in the Boom Clay Formation, to gain insight in processes influencing the mobilization/immobilization of radionuclides in clay over geological time-periods;
- Investigations on the compatibility of spent nuclear fuel with geological disposal in clay.

During recent years, large-scale demonstration projects as RESEAL and PRACLAY have become increasingly important within the Belgian radioactive waste management program. In the RESEAL project, the feasibility of a shaft sealing technique is demonstrated. The PRACLAY project is intended to demonstrate the feasibility and overall safety of HLW disposal in a clay formation. As part of the PRACLAY project, the thermo-hydromechanical behavior of a simulated HLW repository in clay will be investigated into great detail. These demonstration projects contribute to building confidence in deep disposal in clay as a safe, feasible and environmentally responsible solution. New research areas where studies have recently started are: (i) the definition of alternative safety indicators, (ii) the evaluation of the technical, economical and institutional consequences of the retrievability concept, and (iii) the development of devices for the long-term environmental monitoring of a geological repository. In addition to scientific-technical aspects, non-technical issues including societal acceptance of geological disposal, risk perception, sustainable development, ethics, and communication have gained increased significance within the Belgian program on geological disposal. It is anticipated that the evaluation of the SAFIR-II safety assessment report will determine to a large extent the scientific-technical content of the Belgian waste disposal program from 2002 onwards.

INTRODUCTION

Within the Belgian radioactive waste disposal program, the Boom Clay Formation is investigated as a potential host rock for the geological disposal of long-lived and high-level radioactive waste and spent fuel. For 25 years, the Belgian Nuclear Research Center SCK•CEN has been involved in many RD&D activities covering a wide variety of topical subjects related to geological disposal in clay. Considerable progress has been achieved in developing a scientific basis for deep disposal in clay and emphasis in RD&D has gradually shifted from the study of basic phenomena to studies investigating complex and interacting processes and to demonstration projects. This paper discusses the ongoing RD&D program in Belgium and highlights results from recent investigations.

THE STEPWISE IMPLEMENTATION OF A GEOLOGICAL REPOSITORY FOR RADIOACTIVE WASTE

Like in other countries pursuing the geological disposal option, the development of a geological repository for radioactive waste in Belgium is a gradual and stepwise process. In general terms, key-elements in the stepwise development process of a geological repository include among others site selection and characterization, the development of a repository concept, the establishment of a scientific-technical basis for geological disposal, the delivery of mature disposal technologies for repository construction, operation, sealing, closure, and, if appropriate, post-closure monitoring and the implementation of technologies for waste retrieval (Figure 1).

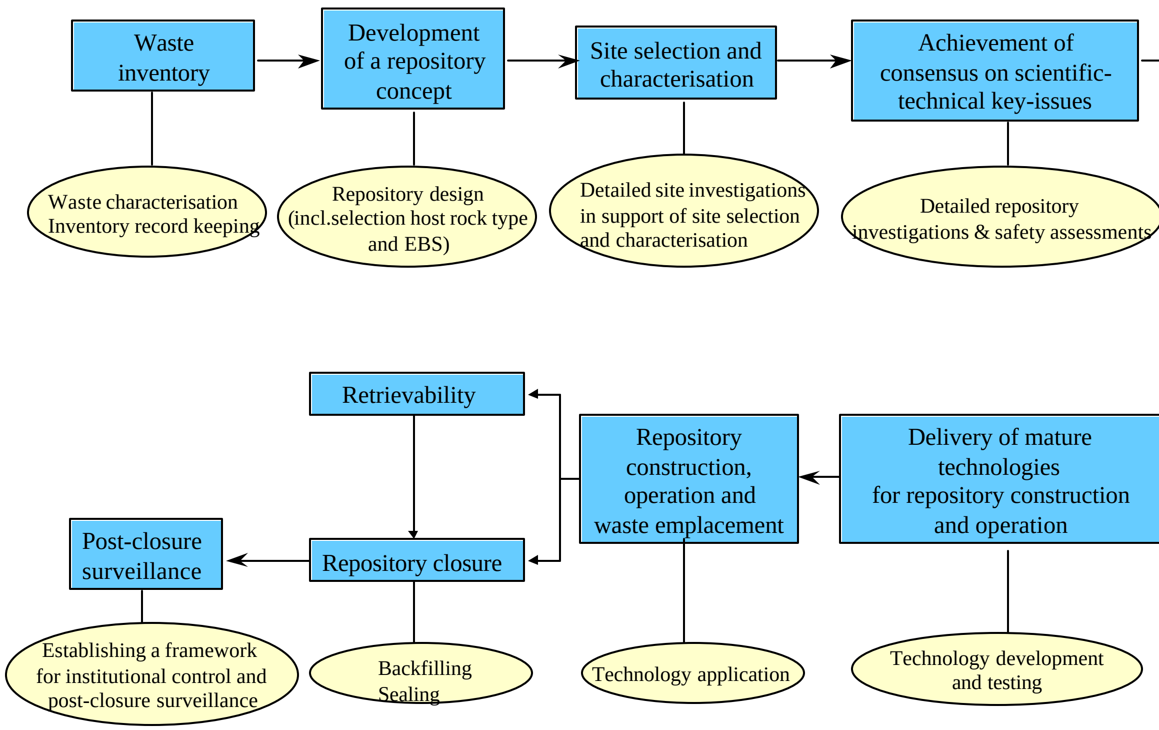

Fig. 1: Key-elements in the stepwise development process of a geological repository for radioactive waste disposal. Milestones are indicated in the squared boxes. The decision-making process may involve both technical and non-technical factors.

RD&D programs on geological disposal in clay are in progress in Belgium for 25 years. These programs cover various key-elements in the repository development process. The next section gives a chronological outline of the Belgian RD&D program on disposal in clay and highlights a number of major developments.

THE REPOSITORY DEVELOPMENT PROCESS IN BELGIUM

Studies on geological disposal in clay were initiated in 1975 by the Belgian Nuclear Research Center SCK•CEN. In Belgium, the HADES underground research laboratory (Mol, Belgium) has played an important role in the development of a scientific-technical basis for disposal in clay. In particular, a large number of investigations have been performed under *in situ* repository conditions of the Boom Clay and have contributed to a better understanding of various processes affecting the long-term safety of disposal in clay.

The construction of the HADES URL in 1980/1983, its extension in 1987, and its operation for two decades are significant milestones in the Belgian RD&D program. Recently, a second access shaft to the URL has been built. During the coming two years, the underground research laboratory will be extended under the management of the Economic Interest Grouping

EURIDICE (EIG EURIDICE), a joint undertaking between the Belgian National Radioactive Waste Management Agency NIRAS/ONDRAF and SCK•CEN.

To a large extent, the scientific-technical content of the work performed at SCK•CEN during the last decade has been based on the conclusions from the evaluation of the first Safety and Feasibility Interim Report (SAFIR-I) (1). This report contained a review of the main achievements and the state-of-the-art of RD&D on disposal in clay. Based on the SAFIR-I report, recommendations on outstanding key-issues requiring further RD&D were made by a committee bringing together national and international experts (the SAFIR Evaluation Committee). The second SAFIR report is in preparation and it is anticipated that, in the same way as for SAFIR-I, the evaluation of the SAFIR-II will outline the RD&D program from 2002 onwards. It is also likely that major scientific-technical issues will be resolved near 2010. By then, the scientific-technical basis for geological disposal in argillaceous media will have been established to such an extent that the government/competent authorities can take a strategic decision on the Belgian repository development program (e.g. selection of the host rock and/or disposal site). It is likely that, in the next phase, a Preliminary Safety Report (PSAR) will be elaborated and presented towards 2015, possibly in parallel with some further pilot tests. For the vitrified HLW, a cooling period of 50 to 60 years is foreseen prior to disposal. Accordingly, the application procedure for a license for the construction and operation of a geological repository will be initiated after 2015 so that, according to present expectations, repository construction could start at earliest near 2025. The operational phase is scheduled for approximately 2035.

THE BELGIAN RD&D PROGRAM ON THE GEOLOGICAL DISPOSAL OF LONG-LIVED AND HIGH-LEVEL RADIOACTIVE WASTE AND/OR SPENT FUEL IN A CLAY FORMATION

Ongoing studies at the Belgian Nuclear Research Center SCK•CEN cover a wide range of research activities including site characterization, quality control of conditioned reprocessing waste, the long-term behavior of waste packages and engineered barriers under geological disposal conditions, various engineering aspects such as repository construction, backfilling and sealing, the migration and transport of radionuclides under reducing conditions in clay, and the evaluation of the impact of the Excavation Disturbed Zone (EDZ). As a consequence of the suspension of a decision on the future reprocessing of spent fuel from Belgian nuclear power plants, studies on the direct geological disposal of spent nuclear fuel in a clay formation have gained increased interest during the last few years. Within the Belgian RD&D program, Safety and Performance Assessments play an important role in the evaluation of the long-term safety of disposal as well as in the definition of research priorities. In addition, these assessments are fundamental in the process of building confidence as well as for making recommendations for improving the repository concept.

Emphasis has gradually shifted from basic research to large-scale demonstration experiments. This section highlights a number of recent investigations at SCK•CEN addressing outstanding key-issues on geological disposal in clay. In particular, RD&D on the geological disposal of organic waste forms, the interaction between cementitious materials or vitrified waste and clay and the issue of the geochemical behavior of radionuclides in clay over geological time-periods are discussed. Special attention is also given to large-scale demonstration tests such as RESEAL and PRACLAY. The RESEAL project aims at demonstrating the feasibility of a shaft sealing technique including the removal of the shaft liner. The main objective of the PRACLAY project is to demonstrate the technical feasibility and overall safety of the geological disposal of long-lived and high-level radioactive waste in a clay formation. Accordingly, EIG EURIDICE will construct a full-scale disposal gallery. This gallery will be based on the present reference repository concept and will be used for the detailed investigation of the thermo-hydro-mechanical behavior of the host rock.

Recent developments in investigations on the geological disposal of waste forms containing organic materials

In Belgium, organic waste forms and organic matrices containing waste mixed with long-lived radionuclides are considered for geological disposal. Accordingly, the understanding of the long-term properties and behavior of organic waste forms under geological disposal conditions in clay is of major concern to the Belgian RD&D program. Two waste forms including organic substances have to be considered in the Belgian waste management program, notably bituminized radioactive waste and cemented cellulose waste. In recent years, SCK•CEN has investigated various aspects affecting the long-term safety of disposal of these organic waste forms.

Since the late 1960's, bitumen has been widely used by the nuclear industry as a matrix for the immobilization of low and intermediate level waste including evaporator sludge, ion-exchange resins, liquid concentrates, incinerator ashes, and filter materials. These wastes arise from the reprocessing of spent fuel from power and research reactors. In the Belgian RD&D program, the compatibility of two types of bituminized waste with disposal in clay are being studied: Eurobitum, which is produced by the former Eurochemic facility (now Belgoprocess) at Dessel (Belgium) and Cogéma bitumen, which is produced by Cogéma at the UP3 facility at La Hague (France). Main emphasis is on Eurobitum since this is in terms of quantity the most important bituminized waste form arising in Belgium.

Various processes including the release of soluble salts, the build-up of swelling pressure due to gas generation and the uptake of water, and the generation of water soluble organic complexing substances might affect the long-term safety of geological disposal of bituminized waste (2,3). In addition, the intrinsic properties of bituminized waste will evolve due to the physico-chemical aging, in turn affecting the extent of the above mentioned processes. Ongoing studies at SCK•CEN address these issues and intend to clarify the nature and the impact of these processes.

Laboratory leaching experiments were performed on active Eurobitum and Cogéma bitumen samples in view of determining the release rate of soluble salts and radionuclides (4). For Eurobitum, high leach rates were found for sodium and nitrate. The release of nitrate will lead to the oxidation of pyrite, lower pH and increase redox potential in the surrounding clay. The nature and the effect of these processes on radionuclide mobility and the retardation properties of the Boom Clay are now being investigated.

Another process affecting the long-term behavior of disposed bituminized waste arises from swelling. The uptake of water and the generation of gases by radiolytic and microbial degradation cause the swelling of bituminized waste. Alpha-radiolysis is the main source of radiolytic gases. For Eurobitum, the estimated cumulative gas production due to alpha-radiolysis over a 100,000- year period varies between 0.8 and 6 m^3 per drum containing 216 kilograms of bituminized waste product (3).

Complex-forming organic ligands may arise from biodegradation or chemical and radiolytic degradation of bituminized waste. To assess the impact of organic degradation products on radionuclide solubility, SCK•CEN has performed solubility experiments on solutions containing radiolytic organic degradation products. It was found that in such solutions, the solubility of Pu and Am increases with a factor of 7 and 4 respectively relative to pure Boom Clay water.

Future investigations will focus on the biodegradation of organic waste forms in repository conditions (5-7), the detailed assessment of various processes affecting the long-term behavior of organic waste forms under geological disposal conditions and their effect on the migration of radionuclides in clay.

The long-term behavior of cementitious materials in clay: implications for geological disposal

Cementitious materials are widely applied by the nuclear industry as a matrix for the conditioning of low- and intermediate-level radioactive waste. In addition, cement-based materials are used in geological repositories for construction purposes or as backfill. In various repository concepts, cements play an important role as an effective physical and chemical barrier restricting the release of radionuclides into the environment. Under geological disposal conditions however, cementitious materials may interact with the host rock and repository groundwater. Until recently experimental data on cement-host rock interactions were inadequate. For this reason, SCK•CEN has initiated an experimental program investigating the nature and the extent of cement-host rock interactions and their consequences for the long-term safety of disposal (8-10). To this end, *in situ* experiments were performed in the HADES Underground Research Laboratory to investigate interactions between various cementitious materials and the Boom Clay Formation under representative disposal conditions. The main objective of this work was to gain insight in cement-clay interactions under representative repository conditions and to assess the impact of potential alteration processes on the long-term safety of disposal.

Seven cement formulations including backfill materials, cemented ion exchange resins, Ordinary Portland Cement (OPC), OPC + Blast Furnace Slag were selected for *in situ* testing. Ring-shaped samples of these materials were exposed to the Boom Clay. The testing conditions were chosen so as to study cement degradation processes as a function of time and temperature: *in situ* tests were performed at two nominal heating temperatures (25 and 85°C) and at two testing durations (12 and 18 months). The higher testing temperature was selected to accelerate potential reactions or interactions between the cements and the Boom Clay. After sample retrieval, the chemical and the mineralogical composition of the cement samples in contact with the Boom Clay was analyzed by electron-optical methods including EPMA, IR microscopy and X-ray powder diffraction.

The analytical data have shown that significant mass transport of calcium, magnesium, aluminum, iron, silicon, and sulfur occurs across the cement-clay interface resulting in the local alteration of both the cement and clay part (8-10). The thickness of the affected zone is limited and extends after 18 months testing over a thickness between 100 and 200 µm in both the cement and the clay part. The observed cement-clay interactions result in the development of new-formed phases including a (hydrated) magnesium aluminate phase, probably a hydrotalcite, which precipitates at the interface cement-clay. Redox and carbonation reactions can explain these interactions and lead to an increase in porosity of the cement matrix. As a consequence of the neutralization and buffering capacity of the Boom Clay and clay porewater, the development of an extensive alkaline halo ("alkaline plume") in the surrounding clay is highly unlikely (10). The impact of cement-clay alteration processes, in particular of the new-formed phases, on the source term and mobility of critical radionuclides requires further research.

CORALUS, an integrated *in situ* experiment to investigate the performance of vitrified waste in a geological repository in clay

Over the past decade, SCK•CEN has set up a number of research programs to investigate the long-term behavior of various types of vitrified radioactive waste in representative geological disposal conditions of a clay formation. The experimental program has been focussed on laboratory tests to study (1) the influence of clay and engineered barriers on the corrosion mechanisms, the kinetics, and the release of mobile radionuclides as well as (2) the sorption and diffusion of leached silica in a clay host rock. Experiments performed at conventional surface laboratories have been complemented with modeling studies using geochemical and mathematical (analytical and Monte Carlo-based) computer codes.

In a geological repository for high-level vitrified waste, several repository components (e.g. backfill, overpack, host rock) may interact with the glass matrix and, by consequence, may have an impact on glass corrosion mechanisms and kinetics. In addition, physico-chemical conditions in the near field will change with time due to, among others, the cooling of the waste packages, γ-irradiation and radiolysis of the backfill, corrosion of container materials. In general, the complexity of the repository system cannot be entirely reproduced by conventional laboratory experiments. An additional difficulty arises from the fact that in conventional laboratory experiments, representative repository conditions can in most cases not be maintained over sufficiently long time periods. Subsequently, it is essential to conceive integrated *in situ* corrosion tests taking into account the complexity of the repository system. Integrated *in situ* corrosion experiments are indeed an important step towards the full understanding of the long-term behavior of high-level vitrified waste in argillaceous host rocks. To this end, SCK•CEN has developed the CORALUS experiment, an integrated *in situ* test to study the corrosion of vitrified high-level waste in conditions representative for a repository in clay (11). The main objective of the CORALUS experiment is to verify long-term predictions on the performance of vitrified waste based on conventional laboratory experiments and modeling studies. The comparison of results obtained from laboratory studies and the CORALUS *in situ* experiment forms an essential part of the project objectives.

The HLW glass studied in the CORALUS experiment is the SON 68 18 17 L1C2A2Z1 glass, which is a generic composition simulating the COGEMA (French) R7T7 HLW glass that is used for the vitrification of long-lived and high-level liquid radioactive waste. Four modular test tubes will be assembled. These test tubes will carry both active α-doped (doped with $^{237}NpO_2$, $^{238-242}PuO_2$ or $^{241}Am_2O_3$) and inactive glass samples and will contain three types of backfill material (dried Boom Clay and two bentonite-based backfill materials). The experimental matrix allows performing *in situ* tests to study the time-dependence of glass corrosion as well as the combined effect of temperature and radiation. A schematic view of one test tube is given in Figure 2.

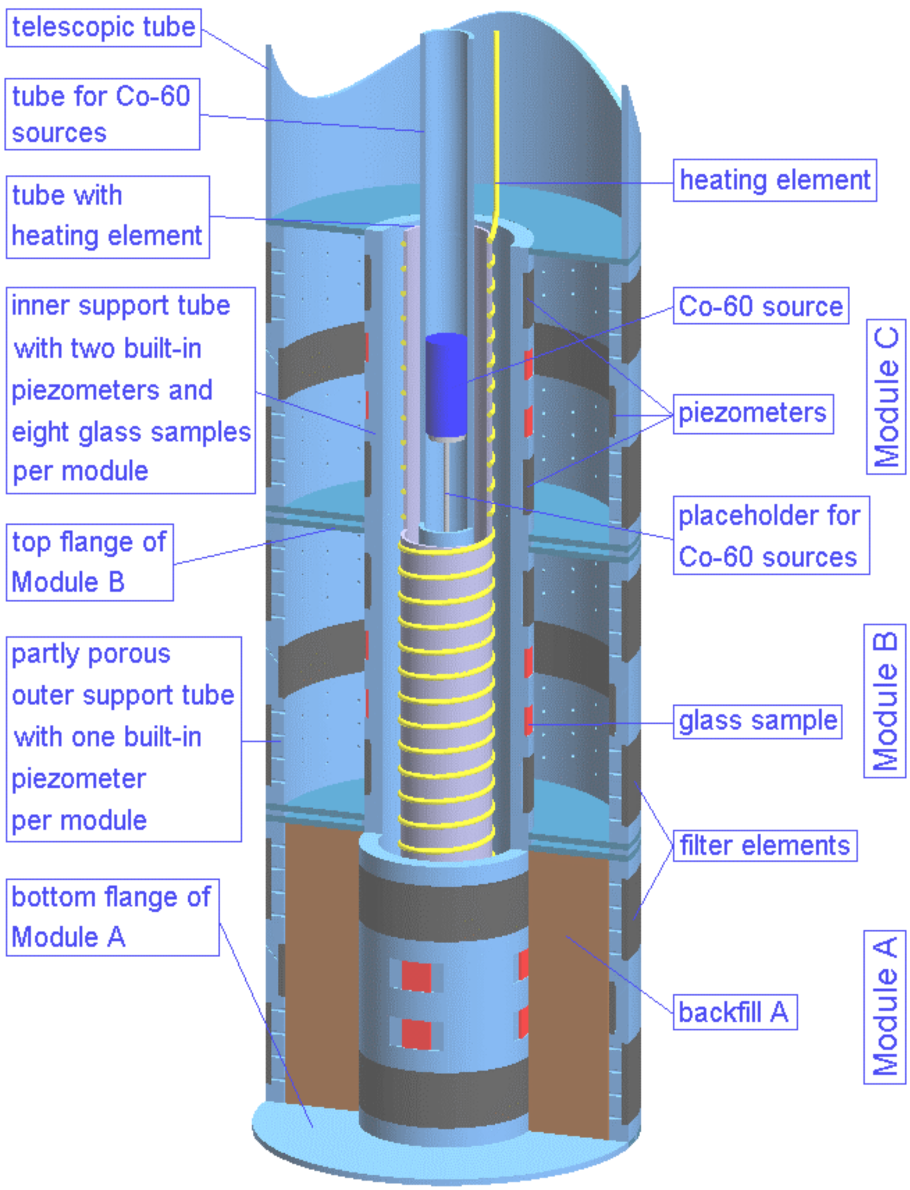

Fig. 2: Modeling image of a CORALUS test tube

During the *in situ* tests, pH and redox conditions in the interstitial backfill solution will be monitored. Interstitial porewater solutions will be sampled for measuring the ionic and organic composition and dissolved gases. After retrieval and dismantling of the test tubes, glass samples will be subjected to surface analysis (SEM-EDS, EPMA) to measure global dissolution and specific radionuclide release. This analysis will be complemented with element profiling by SIMS. Data obtained from the *in situ* experiments will be used to improve insight in the mechanisms and kinetics of the corrosion of vitrified waste under representative repository conditions. Radionuclide migration profiles as well as mineralogical changes in the interacting materials are also investigated.

In-depth study of the geochemical behavior of trace elements and radionuclides naturally occurring in the Boom Clay Formation

Within the Belgian repository concept, the Boom Clay Formation is an important barrier preventing the release of radionuclides from a geological repository to the biosphere. Its low permeability and excellent sorption characteristics favor the barrier performance of the Boom Clay. Accordingly, data on the migration of radionuclides and gases are considered as a key-element in the assessment of the overall safety of disposal.

SCK•CEN has performed both laboratory and large-scale *in situ* experiments to study the migration of gases and radionuclides. Special attention is paid to the influence of organic matter dissolved in the interstitial clay water on radionuclide migration. In addition, SCK•CEN has developed conceptual and mathematical models for the migration of radionuclides in clay as well as models for the thermohydromechanical and chemical behavior of unsaturated clay-based backfill materials.

As a complement to the traditional and lengthy migration experiments, SCK•CEN has developed electrokinetic methods, which have proved to be extremely effective in determining key-migration parameters by accelerated migration experiments (12).

The extrapolation of data and processes, derived from short-term laboratory experiments, to the extremely long time periods pertinent for geological disposal remains one of the major concerns in most safety assessments. To overcome limitations inherent to short-term experiments, SCK•CEN has started an in-depth geochemical study of trace elements and radionuclides that are naturally present in low background concentrations in the Boom Clay Formation. The main objective of this work is to gain insight in processes influencing the mobilization/immobilization of radionuclides in clay over geological time-periods. Data from this study are used for supporting and building confidence in predictions on the long-term behavior of radionuclides released from waste packages. To this end, trace element and radioisotope concentrations were measured in clay and clay water probes that were sampled from a drilling core intersecting the Boom Clay Formation (13). It was found that the Th and U concentration in clay samples varied between respectively 9-12 ppm and 3-4 ppm, which are values typical for marine clay. Within the Boom Clay, four zones with elevated uranium concentrations, one containing up to 13 ppm U were found. The higher U-content is considered to be primary in origin and is associated with the presence of U-Th-bearing accessory minerals and elevated concentrations of organic matter. U- and Th-concentrations also tend do decrease at the highest and the lowest stratigraphical levels of the Boom Clay Formation. These geochemical differences mirror lithological variations, in particular a decreasing clay/silt ratio. Possibly, low U concentrations can also be ascribed to the leaching of U by the over- and the underlying aquifers in respectively the Voort Formation and the Ruisbroek sands but this hypothesis requires further investigation.

U-Th series disequilibria were measured in clay samples throughout the entire Boom Clay Formation as well as in the over- and underlying Voort Formation and Ruisbroek sands. In general, ^{238}U series isotope activity ratios in the Boom Clay are close to unity. One sample, taken from the silty 'double band' layer shows a $^{230}Th/^{234}U$ activity ratio larger than one. This silty layer corresponds to a zone with a higher permeability and pore water mobility relative to the under-and overlying strata richer in clay. Significant variations in $^{226}Ra/^{230}Th$ activity ratios were observed with $^{226}Ra/^{230}Th$ ratios larger than one in the clay-rich strata and lower than one in the more silty layers. The ^{226}Ra deficiency in the siltiest layers is ascribed to the preferential leaching of ^{226}Ra from the silty layers, followed by migration to and sorption at the adjacent clay-rich layers. U-Th disequilibrium data also indicate that Ra mobility may exist in the Voort Formation and the Ruisbroek sands resulting from porewater mobility and leaching of radionuclides in aquifers over- and underlying the Boom Clay Formation.

Results from the detailed geochemical study of the Boom Clay Formation indicates that the Boom Clay is radiochemically stable for U and Th isotopes. Increased radionuclide mobility at the contact zone of the overlying and underlying aquifers of the Voort Formation and the Ruisbroek sands are explained by increased groundwater mobility in silty strata with the cited leaching of radionuclides.

Investigations on the compatibility of spent nuclear fuel with geological disposal in clay

As a consequence of the suspension of a decision on the future reprocessing of spent fuel from Belgian nuclear power plants, studies on the direct geological disposal of spent nuclear fuel in a clay formation have gained increased interest during the last few years.

Predictive models and accurate data on the source term for the release of critical radionuclides from spent nuclear fuel are fundamental for the assessment of the long-term safety of disposal (14). At present, various models describing the dissolution of spent fuel or UO_2 under oxidizing conditions are available. The application of existing models to the site specific reducing repository conditions of the Boom Clay Formation is however not straightforward. Therefore, SCK•CEN has developed an experimental program to provide data for confirmation of the source model used in performance assessments and to obtain information on spent fuel dissolution mechanisms. To this end, dissolution tests are carried out on UO_2 and simulated fuel in complex media representative for the Boom Clay (15).

LARGE-SCALE *IN SITU* DEMONSTRATION EXPERIMENTS

RESEAL: demonstrating the sealing of a repository

An important factor affecting the long-term safety of disposal is associated with the sealing of the repository. Within the RESEAL project, SCK•CEN investigates various aspects of repository sealing (16). The RESEAL project is a large-scale *in situ* experiment to demonstrate the feasibility and effectiveness of the sealing a repository in a clay formation.

The RESEAL experiment is conducted in an experimental shaft within the HADES underground research laboratory. This experimental shaft has been backfilled with a sealing material consisting of a mixture of pre-compacted bentonite pellets and bentonite powder. An extensive instrumentation and monitoring program was set up to measure various parameters within the seal and the adjacent Boom Clay such as water pressure, axial and radial stress and displacement. Data obtained from the monitoring program yield valuable information on the saturated and unsaturated hydro-mechanical behavior as well as the water and gas tightness of the sealing material and the EDZ in the host rock. These data will be applied for model calibration and validation.

PRACLAY: demonstration of the feasibility of HLW disposal in clay

The PRACLAY project is a large-scale *in situ* experiment, which will allow to demonstrate various engineering aspects of excavating in clay and which is intended to investigate the thermo-hydromechanical behavior of the Boom Clay in the near-field of a repository for the disposal of high-level waste. The PRACLAY project is managed by the Economic Interest Grouping EIG EURIDICE (17).

In the Belgian disposal concept, each high-level vitrified waste canister will be disposed off in an overpack. Concrete-lined galleries with an inner diameter of 2 meters will encompass a central stainless steel tube with diameter 0.5 meters. The space in between the disposal tube and the concrete gallery will be backfilled by a bentonite-based material.

The main objective of the PRACLAY project is to demonstrate the feasibility and the overall safety of the geological disposal of long-lived and high-level radioactive waste in a clay formation. To this end, a second access shaft to the URL is constructed, the existing HADES Underground Research Facility is being extended and a full-scale disposal gallery in which the PRACLAY experiment will be conducted, will be constructed.

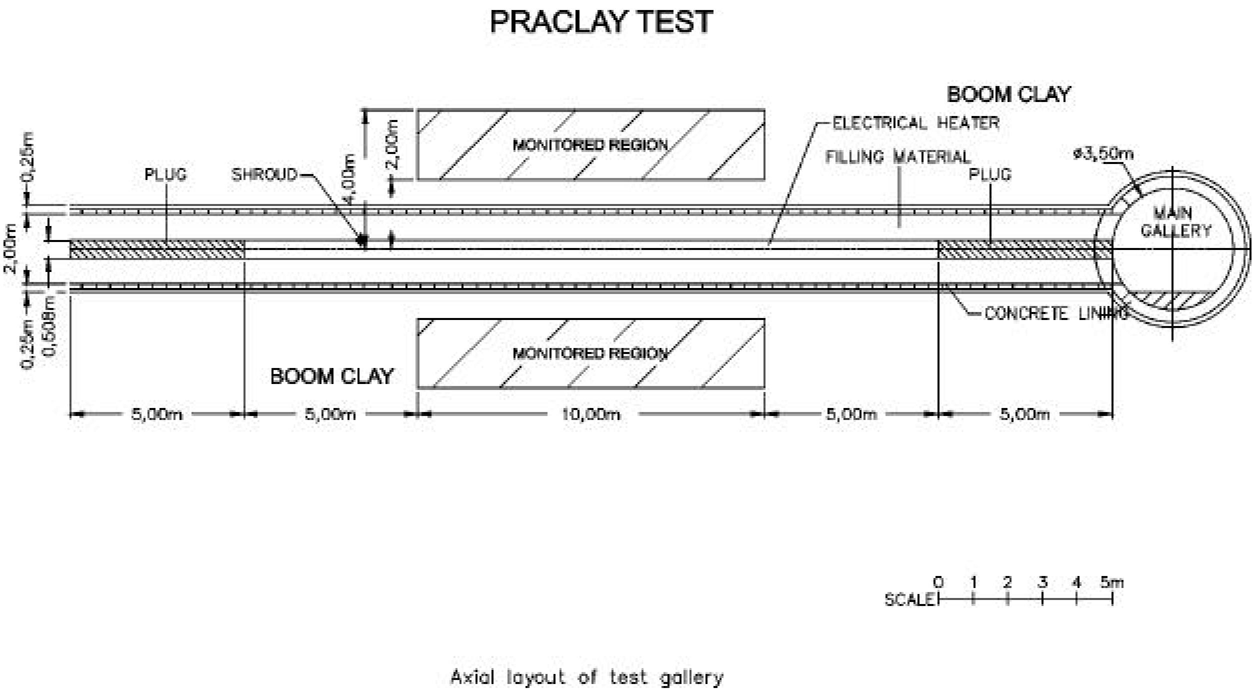

Fig. 3. Schematic overview showing a cross-section of the PRACLAY gallery.

The PRACLAY project will contribute to extend knowledge on deep excavations in plastic clay formations as well as to demonstrate the construction and the operation of a repository for the geological disposal of high-level radioactive waste in a clay formation. During the excavation of the connecting gallery, an extensive monitoring program (CLIPEX project) will examine the hydro-mechanical behavior of the Boom Clay. In addition to activities planned in the underground research laboratory, a surface mock-up (OPHELIE) has been constructed. This mock-up simulates a disposal gallery and will be used for the detailed investigation of the thermo-hydro-mechanical behavior of a HLW disposal repository (including the hydration of the bentonite-based backfill) prior to investigation in the underground research laboratory. The mock-up consists of a steel liner confining the reference backfill material, sensors and heating devices allowing to obtain thermal conditions similar to those expected to prevail for the *in situ* test.

FUTURE DEVELOPMENTS

New research areas where studies have recently started are the definition of alternative safety indicators, the evaluation of the technical, economic and institutional consequences of the retrievability concept, and the development of devices for the long-term environmental monitoring of a geological repository. In addition to the scientific-technical aspects, particular emphasis will be on non-technical topics including the societal acceptance of geological disposal. Within this context, SCK•CEN has recently initiated a number of socio-economic studies addressing issues like risk perception, nuclear energy and sustainable development, ethics, and communication.

By the end of 2001, the Belgian Radioactive Waste Management Agency NIRAS/ONDRAF will present the Second Safety and Feasibility Report (SAFIR-II) to the Belgian Ministry responsible for energy. It is anticipated that the results of the evaluation of this report will influence to a large extent the orientation and content of the Belgian RD&D program on geological disposal from 2002 onwards.

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