Deep geological disposal, a long-term option for long-lived waste?

SCK•CEN expertise supports the ONDRAF/NIRAS Waste Plan

Certain types of long-lived waste are radioactive for more than 100,000 years. Finding sustainable solutions for the long-term management of them is thus an immense challenge. Since the first nuclear power plant started in Belgium, SCK•CEN has invested in research into the management of long-lived waste. This research, together with ONDRAF/NIRAS, is focused on deep geological disposal in clay as a possible long-term solution. It is the essential scientific foundation of the Waste Plan, with which ONDRAF/NIRAS will publish its strategy for the management of long-lived waste in 2010.

Deep disposal in clay as a possible solution

In the search for safe and feasible options to manage long-lived waste, deep geological disposal has been in the foreground for some decades. Deep disposal not only means that the waste is stored in a place far away from man. Well-chosen deep geological layers are also very stable. In Belgium the Boom and Ypres clay layers can be considered for deep disposal. Clay acts as a natural barrier to the migration of radioactive materials. It is barely permeable to water and has a large internal surface, such that it can absorb metals and radioisotopes to a great extent.

All these properties should ensure that deep disposal in clay is not only safe, but that it also provides a passive solution, such that the generations after us will not have to actively intervene to guarantee the safety of the waste disposal. The extent to which the deep clay layers in Belgium meet these high expectations is the subject of high-technology scientific research at SCK•CEN.

The research programme

Over the last few years this research has focused on the (hydro)geochemical behaviour of the clay. The SCK•CEN experts are, in a context of broad international cooperation, also researching the behaviour of the waste and waste packaging under disposal conditions. Specific processes have also been examined, such as the interaction between the different barriers around the waste and the migration of radioisotopes and gas in the clay.

The PRACLAY programme

Since 1994, EIG EURIDICE (an Economic Interest Grouping between SCK•CEN and ONDRAF/NIRAS) has been conducting a Belgian demonstration programme on the safety and feasibility of deep geological disposal of long-lived waste in the deep clay layers of Boom below the SCK•CEN site. This research is taking place in and around HADES, a research laboratory unique in the world that is 225 metres underground (see page 10).

Today the research is zooming in on experiments in the PRACLAY gallery. This extra gallery, 40 metres long, perpendicular to the HADES laboratory, was specifically excavated a few years ago to conduct research into the effects of the disposal of high-level, heat-emitting waste. The extremely difficult hydraulic seal of this gallery, that must also allow the passage of cables (instrumentation, heating system) – was prepared in 2009 so it could be brought to a successful conclusion in 2010. This needed a combination of a natural seal of bentonite (a type of clay with enormous sorption properties) and a heavy metal construction that blocks the bentonite. EURIDICE will conduct a large-scale heat test at 80 °C in the PRACLAY gallery for more than 10 years. This should enable the behaviour of the
clay layers under thermal stress to be investigated, and thus the feasibility of the deep geological disposal of heat-emitting waste to be confirmed.

In parallel to the research of EIG EURIDICE, SCK•CEN concluded last year a framework agreement with ONDRAF/NIRAS. This agreement replaces the previous cooperation agreement that expired in 2008, and defines the focus of additional research into the management of long-lived waste in the coming years.

Towards a Belgian strategy
In the last few years, the experiments in and around HADES have provided an essential input to the Safety and Feasibility Interim Reports 1 and 2 (Safir) that ONDRAF/NIRAS produced. The purpose of these reports was to take stock of the state of affairs of waste research and to inform the Belgian government of this. With the ONDRAF/NIRAS Waste Plan, to which the expertise of SCK•CEN is providing important support, at the end of 2010 the Federal government will have all information to make a strategic decision on the long term management of waste. The research of today and in the near future is primarily relevant for the development of the geological storage option by developing a Safety and Feasibility Case. Complementary to this, SCK•CEN will research, as soon as the MYRRHA installation is available, how the geological storage of long-lived waste can be further optimised in the future by transmutation.

Finding a safe and passive long-term solution for long-lived waste is one of the greatest challenges of waste management. Our research must contribute to a robust, scientifically based Belgian waste strategy.

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