

# Decommissioning nuclear installations

SCK•CEN expertise ready for export

**When a nuclear installation is permanently shut down it is crucial to completely dismantle and decontaminate it on account of radiological safety. The expertise that SCK•CEN has built up in the decommissioning operation of its own BR3 reactor is now available nationally and internationally. Last year SCK•CEN played an important role in the newly started dismantling and decontamination of the MOX plant (Mixed Oxide) of Belgonucleaire in Dessel, and the decommissioning of the university research reactor Thetis in Ghent.**

## **BR3 as an experience**

SCK•CEN has built up impressive and unique expertise in the dismantling and decontamination of nuclear plants, thanks to the decommissioning of the BR3 reactor. This BR3 reactor was the prototype of a pressurised water reactor, such as the production reactors in Doel and Tihange, and was started in 1962. The reactor was stopped in 1987. The European Commission selected the SCK•CEN BR3 as one of the demonstration projects to show the technical and economic feasibility of decommissioning a reactor in real conditions.

First, the BR3 project enabled various techniques, for example cutting and chemical decontamination

of radioactive materials, to be compared and characterised. Moreover, in the course of the operation SCK•CEN collected a wealth of information on costs, waste production and radiation protection during decommissioning. All this expertise should enable the technical and financial impact of future decommissioning projects to be forecast.

## **Highly radioactive components dismantled**

In the last decade, in the first step the SCK•CEN experts removed and transported the nuclear fuel of the BR3 reactor. Then the highly radioactive components and contaminated circuits were dismantled. Last year, the dismantling of the last highly radioactive component was completed, i.e. the neutron shield. This is a double walled cylindrical tank filled with water that is around the reactor vessel and is used as a radiation shield. This type of tank has a highly complex structure and can only be dismantled on site. Hence the SCK•CEN experts selected high-pressure water jet cutting with the addition of abrasives as the most suitable technique. The cutting equipment was held on a robot arm so that it could be operated remotely in three dimensions.

When dismantling all highly radioactive components, SCK•CEN did pioneering work by developing robots and remote-control tools. This special equipment is needed to keep the ionising radiation exposure of employees during this work as low as possible. In 2009, the finishing touches were applied to the clearance of the ventilation building and the decontamination of the ventilation components.

/ BR3 was a unique experience. The great challenge with decommissioning is after all to always find a balance between safe and economically feasible decommissioning. The expertise we built up from the BR3 operation we can now make available to other nuclear installations around the world. /

**Jérôme Dadoumont**



*The chimney of the BR3 reactor is dismantled.* ↑

### **Decontamination and demolition of the buildings as the final piece**

The decommissioning of the reactor then came to a subsequent crucial phase: the decontamination of the building infrastructure. This operation was prepared in 2009 and will start in 2010. SCK•CEN plans to demolish all buildings after decontamination. After dismantling, decontamination and demolition, the safety authorities can release the entire site as a 'green field'. The site can then be given a new industrial destination.

The (low-level) radioactive debris is taken to Belgoprocess while awaiting permanent disposal on the surface in the future disposal installation for low-level, short-lived radioactive waste in Dessel. Non-radioactive debris is collected selectively. After release according to the release procedures of the physical inspection department of SCK•CEN, and the accredited inspection organisation Bel V, it is taken away for recycling. The disposal of radioactive waste costs money and hence SCK•CEN developed an innovative measuring methodology to minimise

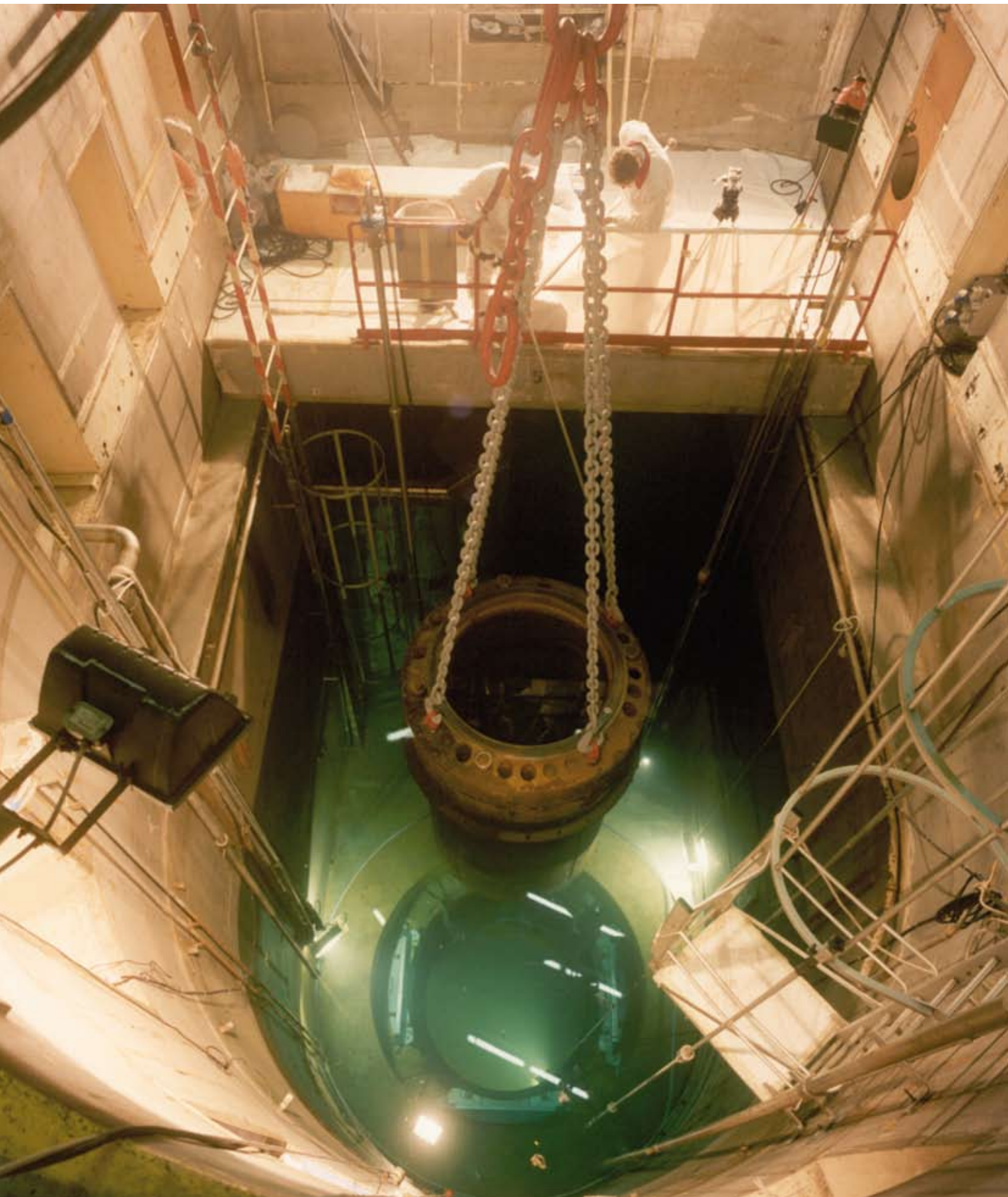
the quantity of radioactive waste. The experts are also setting out a new release methodology for concrete infrastructure.

#### **ALARA**

During the entire decommissioning special attention was and is paid to the radiation protection of the personnel, who often have to work in a complex nuclear environment. SCK•CEN works according to the ALARA principle (As Low As Reasonably Achievable). In order to estimate the possible doses beforehand, SCK•CEN developed a three-dimensional planning tool for work in nuclear environments. This tool (VISIPLAN) is used internationally and is also used to prepare for the dismantling work of BR3.

All techniques used for decommissioning are approved by the physical inspection department of SCK•CEN and Bel V. They also monitor the implementation of the dismantling and decontamination work, for example for the observance of the protective measures for employees.





## The complete decommissioning of the MOX factory must be completed within five years.

### Large-scale decommissioning of MOX plant starts

Belgonucleaire, with a participation of SCK•CEN of 50 %, has produced mixed oxide fuel (MOX), a mixture of depleted uranium oxide and plutonium oxide, for nuclear power plants for more than 20 years. The last production programme was completed on 15 August 2006. Since 2009 Belgonucleaire has had the MOX factory in Dessel decommissioned. SCK•CEN, in consortium with Belgoprocess, is one of the partners responsible for the decommissioning. In the MOX factory there is a quantity of plutonium-containing waste that is being removed for disposal. In addition, there are all kinds of infrastructure and buildings on the site that are decontaminated. After the decontamination, these buildings are no longer a radiological risk. They can therefore be safely released for a new non-nuclear purpose.

SCK•CEN provides advice on material management for part of the project, the characterisation of the waste, the quality control of the entire process, the methodology of the decommissioning and safety. Belgoprocess is responsible for the actual dismantling of part of the site. The complete decommissioning of the MOX factory must be completed within five years.

The decommissioning of BR3 is already at an advanced stage, but as a result of the amended regulations, the licence to decommission BR3 was only requested in 2008. Last year, SCK•CEN submitted the extensive licence application for this licence to the FANC.

### Thetis ready for decommissioning

Thetis is a research reactor that has been installed in the buildings of the Universiteit Gent. It is a small nuclear reactor used by Flemish universities for scientific research. Thetis was primarily used for investigating the composition of samples by irradiating them, with applications in medicine, environmental remediation and archaeology. The reactor was permanently stopped at the end of 2003. The Universiteit Gent asked SCK•CEN to draw up the legally required decommissioning plan for the reactor, and to take on the project management of the entire commissioning. In 2009 SCK•CEN started preparing for the decommissioning. The actual dismantling will start in 2010 with the removal of the reactor fuel as the first step.

← *The reactor vessel of BR3 is removed: a crucial step in the decommissioning.*