

DECOMMISSIONING OF THE NUCLEAR FACILITIES AT RISØ





Danish Reactor 2 (DR2) as seen from the main road along the Roskilde Fjord. This reactor is now fully decommissioned.

ESTABLISHING RISØ IN THE 1950s

The nuclear facilities were established between 1956 and 1964 as part of the establishment of Risø National Laboratory with the main objective to prepare the way for a peaceful use of nuclear power in Denmark. The facilities included three reactors together with The Hot Cell Facility, The Fuel Fabrication Plant and The Waste Management Plant.

CLOSING THE NUCLEAR FACILITIES

In 2000 the board of Risø National Laboratory decided to shut down the remaining nuclear facilities except The Waste Management Plant. This was due to the fact that the scientific outcome no longer was significant enough to justify the investments required for maintaining the DR 3 reactor.

WHO ARE WE?

Danish Decommissioning (DD) is responsible for decommissioning of the nuclear facilities at Risø. We are an independent governmental institution under the Ministry of Higher Education and Science. We were established in September 2003 based upon a resolution passed by the Danish Parliament (B48).

WHAT IS OUR OBJECTIVE?

Our overall objective is “greenfield”, which is the stage, where the remaining contents of radioactive material in buildings and adjacent sites are below the clearance levels set up by the authorities.

WHAT IS DECOMMISSIONING?

Decommissioning is a technical term for dismantling of the facilities and cleansing them to a stage where the radiological restrictions are lifted.

The decommissioning of the Risø facilities is one of the largest environmental projects ever carried out in Denmark and has a time frame of 11 – 20 years with an estimated total cost of 1 billion DKK (130-140 million EUR) in year 2003 price level.

SAFETY FIRST

The decommissioning project is one of a kind in Denmark and represents many challenges. Safety is the primary concern in all stages of the project and every day we follow a wide range of detailed safety procedures in accordance with high international standards. This is done to ensure the safety of employees, the public and the surrounding environment.

DD has gathered a team of highly qualified employees, who will carry out the project together with local authorities and international experts. Many staff members have previously been working at Risø National Laboratory and thus bring along considerable experience and expertise regarding the nuclear facilities.

Among these is a team of highly qualified Health Physicists and Health Physics Technicians, who monitor the radiological safety of employees as well as the surrounding environment at all times.

Our Health Physicists and Health Physics Technicians are continuously surveying premises and surrounding environment and routine checks and laboratory analyses are carried out on a daily basis. All work processes involving radioactive materials are carefully planned. All materials leaving the Risø area have been through a control measurement or an accredited clearance measurement.



QUALITY ASSURANCE

Our quality management system is certified in accordance with the DS/EN ISO 9001:2008 standard. Our clearance function (see “Handling the Waste”) is accredited in accordance with the DS/EN ISO/IEC 17025 standard. We annually publish an Operation- and Decommissioning report for the nuclear authorities (National Institute of Radiation Protection and Danish Emergency Management Agency). In addition, we annually publish a report on the work environment on our company website.

OUTLINE OF OUR PROJECTS



DR 1 – Danish reactor 1 was a so-called zero-power reactor (maximum 2 kW), thus the amount of radioactivity it contained was modest compared to reactors DR 2 and DR 3. The reactor was commissioned in 1957 and shut down in 2001.

DR 1 (photo left) has been fully decommissioned. In January 2006 the reactor building and surrounding areas were released for unrestricted use for other purposes.

DR 2 – Danish Reactor 2 was a 5 MW light-water reactor of the pool type, i.e. open at the top, which enabled one to see the reactor core through seven meters of water, which served as a coolant, moderator and radiation shield. DR 2 was commissioned in 1959 and used for physics research and production of radioactive isotopes. The reactor was shut down in 1975 and brought to a state of safe enclosure.

DR 2 (photo right) has been fully decommissioned and the final report was approved in 2008. We are currently using the reactor hall as a handling facility for radioactive items originating from the decommissioning of the remaining facilities; it will therefore be finally released later on.



DR 3 was a 10 MW heavy-water reactor commissioned in 1960. It has been used for basic neutron physics research, material research and the production of radioactive isotopes as well as for neutron doping of silicon used in the semiconductor industry. DR 3 was shut down in 2000. We began the decommissioning of DR 3 in 2005 and presently we are working on the block and the interior parts. Photo left: The DR3 control room while still operating (around 1999).



The Hot Cells Facility is a row of adjoining concrete cells that have been used for investigating irradiated reactor fuel and for packaging of radioactive sources for irradiation facilities. The Hot Cells were in service from 1964 to 1989. In 1993 the concrete cells were sealed. We began the decommissioning of the Hot Cells in 2008. This is one of our most complicated projects and we take many precautions to ensure the safety of employees and the environment. The project includes sandblasting of the interior surfaces, where tiny radioactive particles are deposited on tables, floors and walls.

The Fuel Fabrication Plant has been used for the fabrication of fuel elements for DR 3 using enriched uranium powder. The production ceased in 2000 when the reactor was closed. The decommissioning is scheduled to 2013-14 and will include cleaning or removal of inventory and equipment, followed by clearance measurements of the hall in order to ensure that clearance levels are met.

The Waste Management Plant receives and handles all radioactive waste in Denmark, for instance from hospitals and laboratories as well as from DTU



Nutech and our own projects. Because the plant is needed for handling the decommissioning waste, it will be the last of our six nuclear facilities to be decommissioned.

We assume that in the future, a new waste management plant will be built for handling radioactive waste. The establishment and design of this facility will depend on the long term solution for handling of generated waste.



The Fuel Fabrication Plant: Here, uranium powder was rolled out for fuel elements for the DR 3 reactor



Initiating a decommissioning project requires taking drilling samples. Here: the DR3 reactor

HOW TO GO ABOUT THE TASK?

The decommissioning of the nuclear facilities is a complicated project both technically and environmentally, thus comprehensive planning is necessary. After many years of service, parts of the facilities contain radioactive material in greater or lesser amounts. It therefore requires thorough preliminary studies, careful planning of the work processes and special equipment and facilities to carry out the work.

The first step in the decommissioning process is characterization, i.e. mapping the levels and types of radioactive materials in each facility. How high are the levels of radioactivity? Which isotopes are present? In which form? Where are the radioactive materials placed? What kind of protection will the decommissioning require?

DOCUMENTS

Before we start a decommissioning project, we must prepare a project description for the approval of the nuclear authorities (National Institute of Radiation Protection and Danish Emergency Management Agency). Then a budget for the project is sent for approval by the Parliament's Finance Committee. Upon completion of each project we issue a final report and after carrying out our own clearance measurement of buildings and areas, we apply for release of the area by the authorities.

HANDLING THE WASTE

All decommissioning waste is initially categorized as radioactive. After thorough measurements and sampling, the waste is divided in either radioactive or presumably non-radioactive waste. The decommissioning produces large amounts on non-radioactive waste and waste with a low content of radioactive isotopes.

We determine the levels in our Clearance Laboratory and on-site measuring of items and waste, which is radioactive contaminated only on the surfaces, using sensitive detectors. When confirmed non-active, the waste is recycled or disposed of as conventional waste such as ordinary metal scrap.



Waste which is only surface contaminated is cleaned in a decontamination cabin by sand- or glass-blasting. The cabin can be operated from the outside through a glove box or from the inside by an operator wearing a protective suit, if the item is too large and heavy to be handled through the glove box.

The radioactive waste is characterized in our Activity Laboratory enabling us to document the content of radioactive isotopes. Furthermore, conventional data such as weight and type of material is documented.

We barcode all waste items and containers. We register all items in our waste documentation system ADS, where we also store all relevant information about the waste.

THE LONG-TERM SOLUTION

Since 2003 we have participated in the process of finding a suitable location, examining repository concepts and preparing safety analyses for a Danish Final Repository. Parallel to this, we contribute to the investigation of possible alternatives, as requested by the Ministry of Health and the Parliament.

In 2012 it was politically decided to investigate two alternative solutions parallel to the continuous process towards a final repository: an intermediate storage facility, where the waste can be stored for 50-100 years or export of all the Danish waste. The final decision will be made by the Parliament.

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