

Decommissioning

This briefing note explains what decommissioning is and how we decommission nuclear sites. It looks at the different stages of the process and our experience in carrying out decommissioning projects, including the Windscale pile chimneys.

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The briefing note is approximately 2,200 words.

Introduction

- All industrial plants, when they reach the end of their useful lives, need to be decommissioned. Within the nuclear industry, decommissioning is a process where a building which has had radioactive materials inside it, is turned into a state where the building or land may be used for other things.
 - During the next 15 years, the demand for decommissioning will grow steadily. We estimate that throughout the world about 250 nuclear facilities will be waiting to be decommissioned by the year 2010.
 - BNFL have gained a lot of experience in decommissioning nuclear plants over the last 25 years. We already have the technology to decommission, and are carrying out continuous research and development into new procedures to reduce the costs and make the job easier and safer.
- [Why do we decommission a building which has had nuclear materials inside it?](#)

- We decommission a building for several reasons:
 - To make sure the site and the environment stay safe.
 - To follow Government policy.
 - To have the option of continuing to use older buildings whose original purpose has now finished.
- In the long-term, it is cheaper to decommission nuclear plants than to keep them in a safe and secure monitored state.
- Our policy is to start the first stages of decommissioning a plant as soon as possible after it has stopped working. We do this in a way which is safe for the workforce, the public and which also meets regulatory conditions.

How safe is decommissioning?

- The UK nuclear industry is regulated by an independent regulator, the Nuclear Installations Inspectorate (NII). The regulator gives us licences for our sites. To keep these licences we must show that the work we carry out is safe. One of the regulator's conditions is that all plants should have decommissioning plans. For Sellafield, we have developed this into an agreed 'decommissioning milestones' programme which is updated every year. For each project, we have detailed discussions with the regulator.
- Any extra waste produced and any extra radioactivity discharged (released) into the environment, as a result of doing the work, needs to be authorised by our regulators.
- We pay special attention to keep to a minimum the doses of radiation which our workers may get.

There are three stages in decommissioning a nuclear plant:

Initial decommissioning

We start the first decommissioning stage as soon as possible after the plant has finished working. This stage takes the plant out of service permanently. When the plant has finished working, we wash it out and clean it using the installed equipment. We start decommissioning immediately afterwards by removing most of the radioactivity that is left. Most of the waste at this stage is intermediate- level (medium) waste.

We then prepare for a period of maintenance to allow radioactivity levels to reduce. This may involve weather proofing the building to make sure none of the radioactivity gets out. We then keep the plant under routine maintenance.

We use computers to help us work out what needs to be done inside a plant to make sure that the radiation doses to workers is kept as low as possible.

Dismantling

This stage may happen immediately after the first stage or it may take place after many years. We sometimes leave the plant alone for a period of time to let some of the radiation decay naturally.

During the dismantling stage, we remove the equipment and pipework which is contaminated with radioactivity. The waste produced from this stage is a mixture of intermediate and low-level waste. We also remove contamination layer by layer from the inside of the plant. This stage is technically the most difficult.

Demolition

We then demolish or develop the actual building for another use. We demolish it in exactly the same way as any other industrial building, and monitor the rubble to check whether it contains any small amounts of radioactivity. We may class this rubble as low-level waste.

Decommissioning experience

New plants, such as the Thermal Oxide Reprocessing Plant (Thorp), are designed and built with decommissioning in mind. The decommissioning costs have already been taken into account. This was not the case for the older plants which were built with little thought to what would happen to them once they stopped working.

When BNFL was formed in 1971, we inherited old plants from the United Kingdom Atomic Energy Authority (UKAEA). We have gained a great deal of experience through decommissioning old plants, and have completed around 50 decommissioning projects since 1988.

- Our experience in controlling the risks involved with decommissioning nuclear facilities has gained worldwide recognition. BNFL Inc. (our American subsidiary based at Fairfax, Virginia) has been able to increase its services to US customers based on the technologies and waste management and decommissioning practices we have developed over the past 25 years at our Sellafield site. Some examples of decommissioning projects being carried out BNFL Inc. include:

- East Tennessee Technology Park (ETTP) project
The East Tennessee Technology Park, formerly known as the Oak Ridge K-25 gaseous diffusion plant, was built during the 1940s to enrich uranium for

nuclear weapons and later was used to produce uranium fuel for nuclear reactors. These activities were shut down in 1985.

- BNFL Inc. is leading a massive effort to decontaminate and decommission three process plant buildings that cover an area equivalent to 64 football pitches.

The main aims of the project are:

to remove and decontaminate process equipment and materials from the buildings;

to decontaminate the inside of the buildings;

to manage the wastes and make areas of the first building available for reuse by the year 2001.

- Rocky Flats project

BNFL Inc. is part of a team which is managing the Rocky Flats Site in Colorado (another former nuclear weapons facility). This project involves supplying technology for equipment to stabilise and store plutonium, as well as responsibility for site waste management.

The project also involves decontaminating and decommissioning plant, and environmental restoration.

- Examples of UK decommissioning projects:

- Windscale Pile Chimneys

The Windscale Piles were the first major nuclear reactors built in the UK. Their main purpose was to produce plutonium for Britain's nuclear defence programme. The Pile Chimneys provided ventilation for the original nuclear reactors at Windscale, an area on the Sellafield site. They were built in the 1940s to a height of 125 metres and a diameter of 12 metres. Both piles were shut down following a fire in Pile 1 in 1957.

In the mid 1980s, following a structural survey, a decision was made to remove the upper 30-metre section of chimney which contains the filters. We have now removed a large part of the upper section of both chimneys. Rubble is lowered to the waste-packaging building at the bottom of the chimney where it is managed as intermediate and low-level waste. The lower part of each chimney will stay and be 'capped off' when they have been decontaminated. The first chimney has already been 'capped-off' and the second chimney will be completed in the near future. In addition, work has already begun on dismantling the core of Pile 1 reactor.

- Reprocessing Plant

The first reprocessing plant began working in the 1950s. It was used to recover plutonium from the fuel from the Windscale Piles. The plant is 61 metres tall with two reprocessing lines. Most of the vessels in the plant are far

too bulky to be removed in one piece, so we must cut them into manageable pieces. We will store the more radioactive pieces as intermediate-level waste. We have developed a special remote-controlled dismantling machine to do this work. Dismantling has now started and this, the first phase of the project, is almost finished.

- Research reactor

The Manchester and Liverpool Universities' research reactor at Risley near Warrington, began working in 1962. This reactor was fuelled with highly-enriched uranium. Decommissioning work, which began in 1992, has now been finished. We have reprocessed or recycled the fuel, and the rubble has been moved to Sellafield for permanent storage.

The building has no further use, so we demolished it. The site has since been 'de-licensed' by the Nuclear Installations Inspectorate (NII) and sold for reuse. It is now home to a suite of offices. This is the first 'de-licensing' of a total site in the UK under the new Nuclear Installations Inspectorate regulations. The experience we gained in the successful decommissioning of the Universities' research reactor has helped us to win a contract to decommission a research reactor for ICI at Billingham in the north east of England.

- Diffusion Plant (Capenhurst)

This was the first plant used for enriching uranium at Capenhurst. Operations stopped within the plant in 1982. One of the world's largest nuclear decommissioning projects then began.

The main aim of this project was to recycle as much material as possible. We developed a number of new and specialised techniques to use in the project. The plant has been dismantled and we have recycled the aluminium and steel which was removed. The recycled metals are cleaned to remove any radioactive contamination so they can be recycled for unrestricted use (this means that the metals can be used for anything). The metals are less radioactive than many natural materials, including some foodstuffs.

Of the 160,000 tonnes of material which made up the plant, over 99% will have been recycled. Our dismantling and decontamination process has allowed us to clean around 7000 tonnes of metal to allow it to be reused through the metals market.

The metals recycling service is now being offered to other organisations. This will help reduce waste and save valuable natural resources.

- Magnox Nuclear Power Stations

Magnox Nuclear Power Stations

We are currently actively decommissioning three of our Magnox power stations:

Berkeley;
Trawsfynydd; and
Hunterston A

In addition, Bradwell and Hinkley Point A are now shutdown and beginning their defuelling.

Our strategy for decommissioning each station is known as 'Safestore'. This strategy was selected after a detailed analysis of a range of options and relevant factors. The Safestore strategy, as it relates to the reactor structures (the most radioactive components on the sites following defuelling), is based on the principle that the longer we leave the radioactivity to decay naturally, the simpler and more economic it becomes to clear away. Under the Safestore strategy, decommissioning will take around 100 years to accomplish, and we will achieve this over three phases as follows.

Defuelling and Care & Maintenance Preparations

We remove the nuclear fuel from the closed station for reprocessing. When this defuelling is complete, it results in a 99.9% reduction of the radioactivity on the site as compared to an operating station. We demolish most buildings on the site, including ones which contain radioactive plant and equipment. We package and encapsulate intermediate level wastes (ILW) in cement and put the packages into a storage building pending the availability of an off-site disposal route. We do not dismantle the reactor buildings in this phase but do remove some of the plant and equipment they contain.

Care & Maintenance

We will continue to monitor, inspect and maintain the sites (e.g. the reactor buildings and waste stores) to ensure that they remain in a passively safe and secure condition for a period of deferral prior to final dismantling. When an ILW disposal route becomes available the waste stores will be emptied.

Site Clearance

After around 85 to 100 years, the radioactivity within the reactors will have decayed naturally to a level that will allow workers to enter inside wearing standard protective clothing and to use simpler technology to demolish the structures. We therefore propose to remove the remaining structures and completely clear the site, making it fully available for alternative use, after this deferral period.

- Nuclear liabilities

A liability is how we describe the future cost of decommissioning a nuclear plant and managing the waste that is produced. We have to make sure that all of our plans take future liabilities into account.

- This includes what needs to be done, the research and development needed to support the work, the management of contracts to do the work and the financing to allow the work to take place.

- The liabilities are paid for by us and our customers. We have set aside a series of investments which we hold separately from our other financial assets to pay for these liabilities.

Decommissioning and the future

There are future overseas markets for decommissioning in most countries with nuclear power and weapons programmes. Outside of the US, the next largest decommissioning opportunities are in Eastern Europe and the former Soviet Union.

- Our decommissioning activities are supported by one of the largest ongoing research and development programmes in Britain. We have already shown that we can achieve decommissioning with the technologies we already have. However, the programme also supports longer term developments, sometimes involving totally new technology.

- The overall aim is to reduce the cost of decommissioning even when the actual limits for radioactive discharges and radiation doses are likely to get even tougher.

- We will continue to develop our decommissioning programme, making sure that we do not leave this important work for our future generations to deal with. We will make sure that the work is carried out with safety as the top priority.