



Dounreay

2023

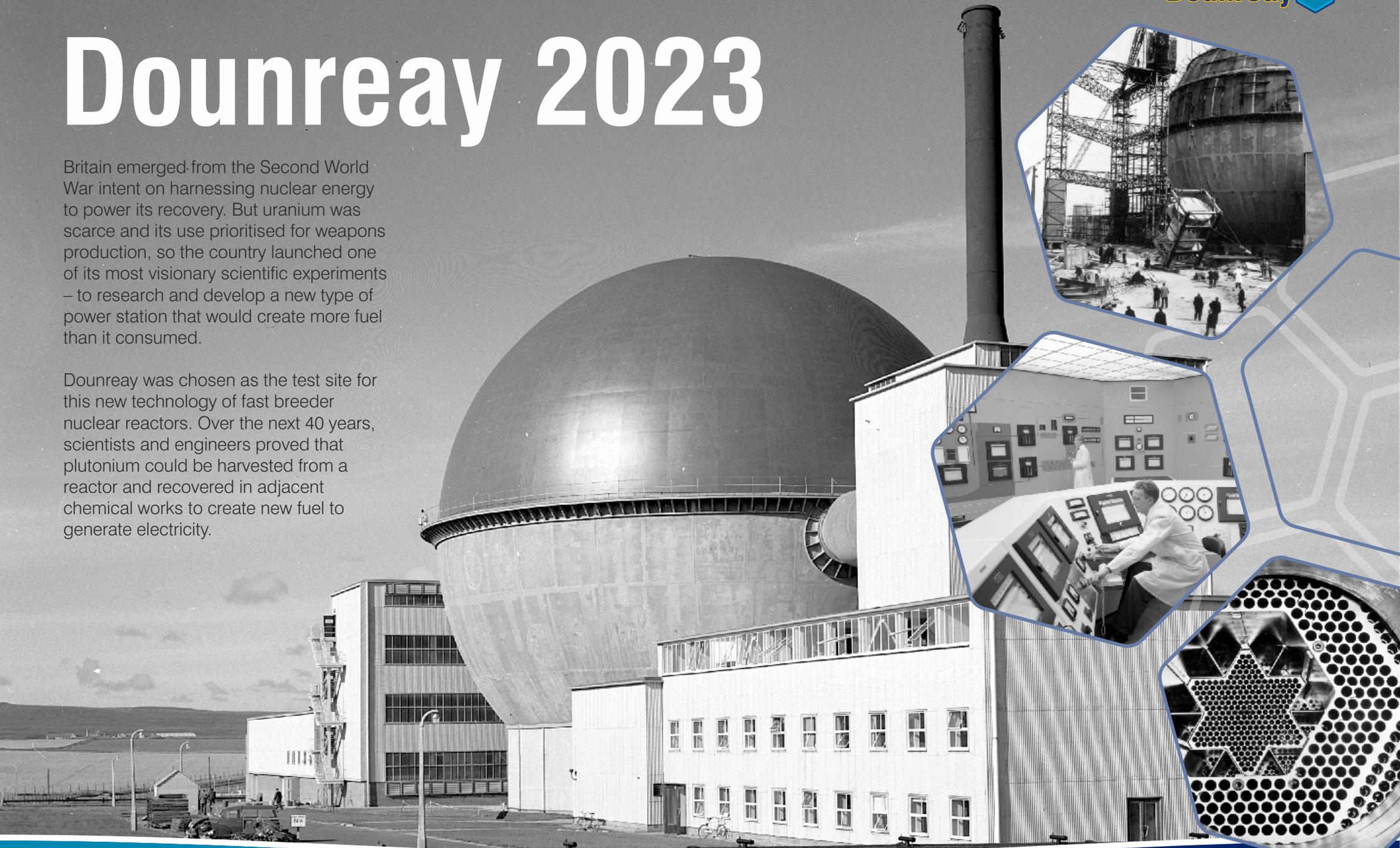
Your guide to Scotland's centre of excellence in nuclear decommissioning



Dounreay 2023

Britain emerged from the Second World War intent on harnessing nuclear energy to power its recovery. But uranium was scarce and its use prioritised for weapons production, so the country launched one of its most visionary scientific experiments – to research and develop a new type of power station that would create more fuel than it consumed.

Dounreay was chosen as the test site for this new technology of fast breeder nuclear reactors. Over the next 40 years, scientists and engineers proved that plutonium could be harvested from a reactor and recovered in adjacent chemical works to create new fuel to generate electricity.



As the 20th century drew to a close, and uranium prices continued to fall, the economics of electricity from plutonium became uncompetitive and the UK Government withdrew from the technology.

Today, after leading the world for four decades in research and development of nuclear technology, Dounreay is again at the forefront of science and engineering – this time in the skills and innovation needed to dismantle one of the most complex and hazardous legacies of the 20th century.

Dounreay today is a site of major construction, demolition and waste management. The experimental facilities are being cleaned out and knocked down, and the environment is being made safe for future generations.



The story so far

1954



UK Government selects wartime airfield at Dounreay as site for fast reactor research and development

1955



UK Atomic Energy Authority begins construction

1955



Craft apprentice training scheme starts

1955



UKAEA starts building housing estate in Thurso

1956



Ormlie Lodge staff hostel opens

1957



Nuclear reaction takes place for first time in criticality test cell

1957



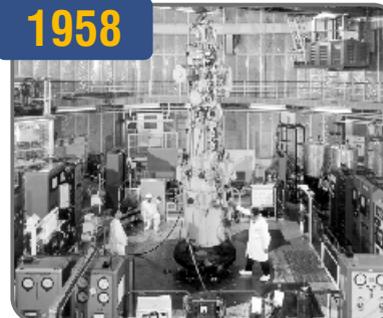
Royal Navy announces submarine reactor test site named Vulcan

1957



Visits by HRH The Queen Mother and The Duke of Edinburgh

1958



Materials Test Reactor goes critical

1958



Fuel reprocessing begins

1959



Experimental Fast Reactor goes critical

1962



First electricity exported to National Grid

1966



Construction begins of Prototype Fast Reactor

1969



Materials Test Reactor shut down

1974



Prototype Fast Reactor goes critical

1977



Experimental Fast Reactor shut down

1977



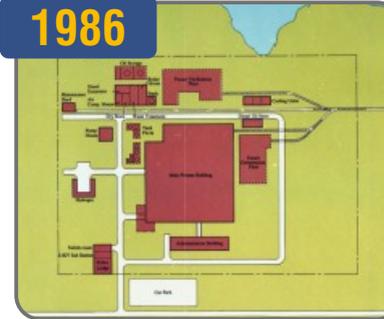
Explosion in underground waste shaft

1983



Radioactive particles discovered on beaches

1986



BNFL and UKAEA announce plan to build European Demonstration Reprocessing Plant

1988



UK Government announces withdrawal from fast reactor technology

1994



Prototype Fast Reactor shuts down

1996



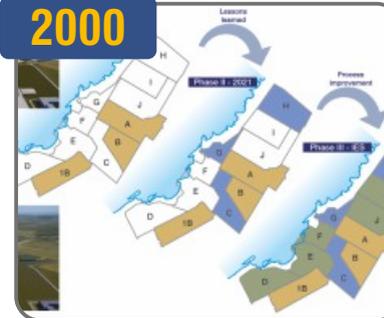
Fuel reprocessing stops

1998



Safety audit by regulators identifies 143 recommendations for improvement

2000



UK Atomic Energy Authority publishes site closure plan

2004



Fuel fabrication stops

2007/8



Nuclear Decommissioning Authority inherits site and Dounreay Site Restoration Ltd becomes its operator

2012

Cavendish Dounreay Partnership

A partnership between
Cavendish Nuclear | CH2M | AECOM

Management contracted out to Babcock consortium

2015



Removal of plutonium and uranium begins

2021



Nuclear Decommissioning Authority takes management in-house

2023



Dounreay becomes a division of Magnox Ltd

Who's who

Dounreay is owned by the Nuclear Decommissioning Authority, a non-departmental public body of the UK Government responsible for 17 legacy sites in the UK. Its funding comes from the UK Treasury via the Department for Business, Energy and Industrial Strategy.

Since April 2023, Dounreay has been a division of Magnox Ltd, a wholly-owned subsidiary of the NDA. Dounreay's turnover of approximately £200 million a year comes from the NDA.

Dounreay is regulated by:

- The Office for Nuclear Regulation, for nuclear safety and, from 2021, the safeguard functions of Euratom
- The Scottish Environment Protection Agency, for the disposal of radioactive and other waste
- The Highland Council, for land use and planning.

The Civil Nuclear Constabulary is responsible for the armed protection of the site and its nuclear materials.



Dounreay



Magnox



Office for Nuclear Regulation



The legacy

About 180 separate facilities were built on 135 acres of land at Dounreay. About 50 of these had a history of working with nuclear materials.

The facilities covered every aspect of the nuclear fuel cycle – from fuel fabrication and reactors through to plants for the chemical separation of spent fuel, recovery of plutonium and uranium, and disposal and storage of waste.

Each is now in the process of being cleaned out and dismantled.

Their operation also left an environmental legacy – soil polluted with radioactive and chemical waste and radioactive particles on the seabed that occasionally wash up on nearby beaches.



Decommissioning

The objective of decommissioning is to reduce and remove the radiological, chemical and industrial hazards and leave the site in a condition that is safe for future generations.

Decommissioning generates a variety of radioactive, chemical and industrial wastes and these must be stored or disposed of in a way that protects future generations from harm, too.

The first site-wide decommissioning plan published in 2000 envisaged a 60-year programme of work.

Innovation, new technology and experience made it possible to accelerate these timescales. Dates for the completion of decommissioning – known as the interim end state, when the hazards have been reduced or eliminated, and the site enters long-term care and maintenance – are being reviewed.



The projects

Decommissioning a site as complex as Dounreay requires an integrated plan, showing the work needed to dismantle each facility, the routes for managing the different types of waste this creates, the regulatory requirements – all of it matched to a wide range of professional, technical and clerical skills.

The programme can be broken down into the following:

Reactors



Dounreay Materials Test Reactor

All fuel and coolant was removed after closure. Decommissioning is now in the final stage of strip-out and demolition.



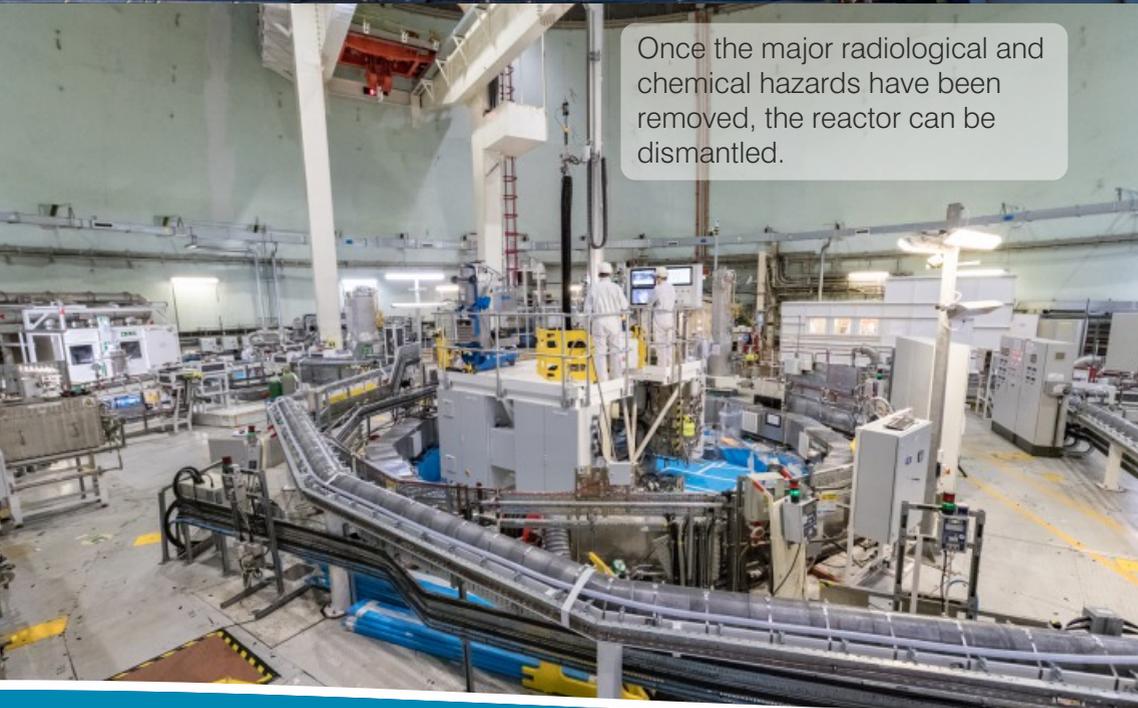
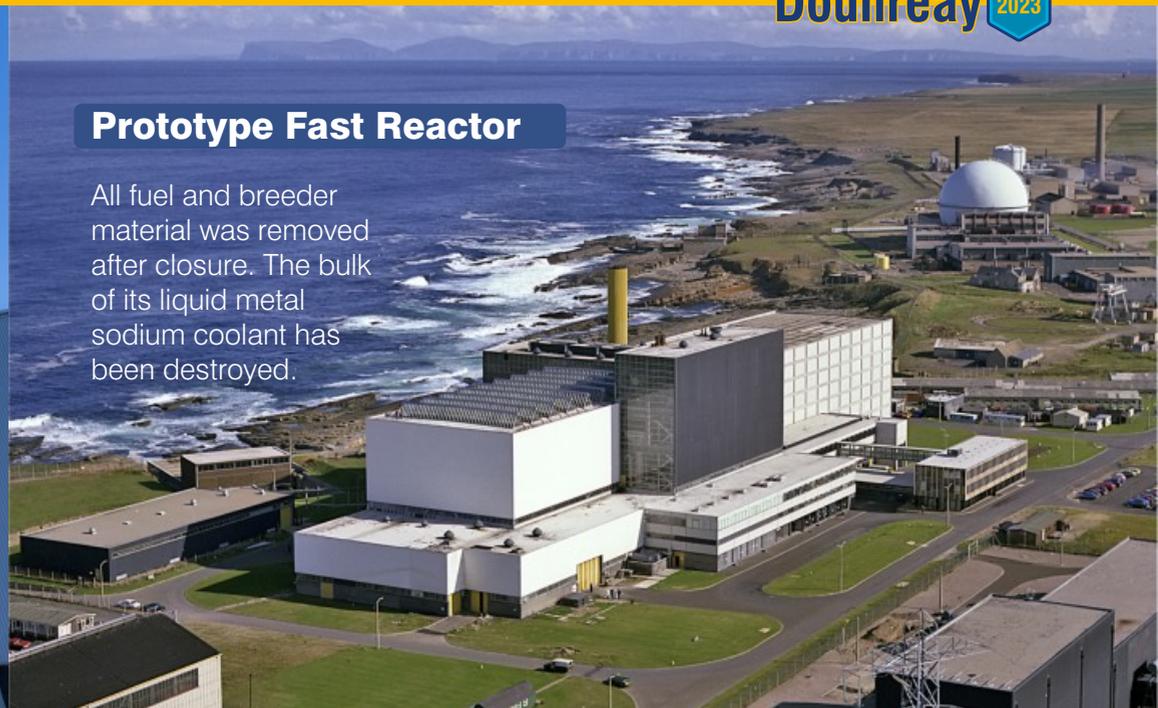
Dounreay Fast Reactor

All fuel was removed after closure. Removal of the last of the breeder material resumed after a hiatus and is now being transferred to Sellafield. Sodium-potassium liquid metal coolant was destroyed, leaving residues to be tackled.



Prototype Fast Reactor

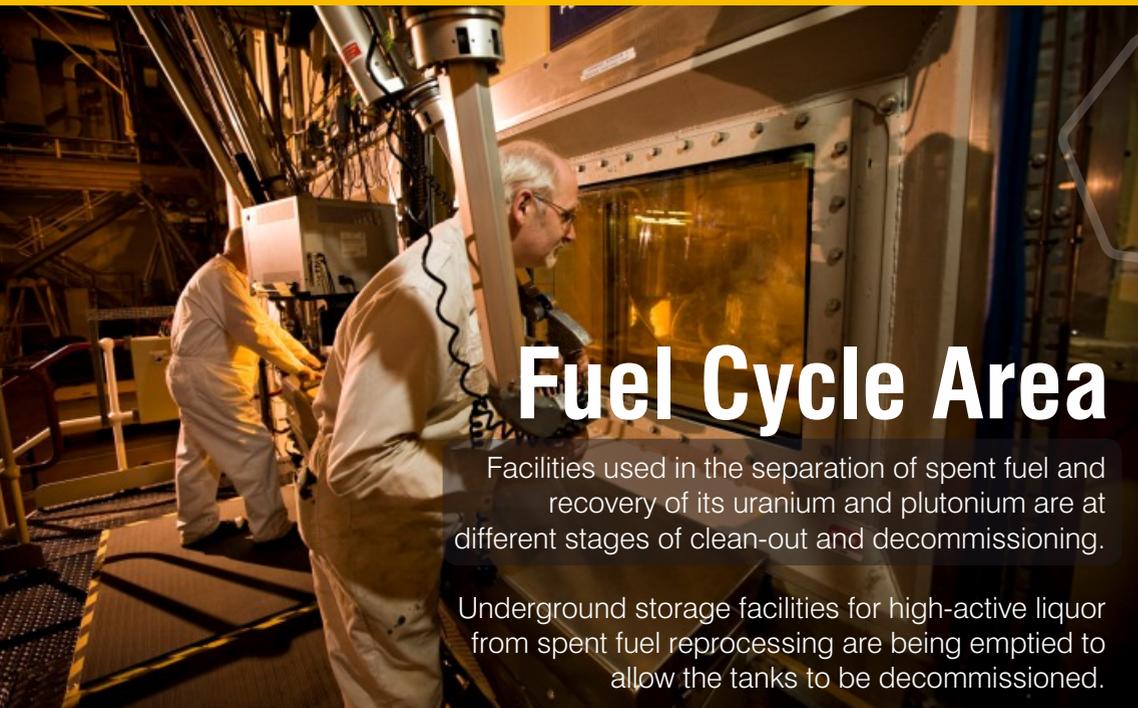
All fuel and breeder material was removed after closure. The bulk of its liquid metal sodium coolant has been destroyed.



Once the major radiological and chemical hazards have been removed, the reactor can be dismantled.



Once the residual coolant has been removed and destroyed, the reactor can be dismantled.



Fuel Cycle Area

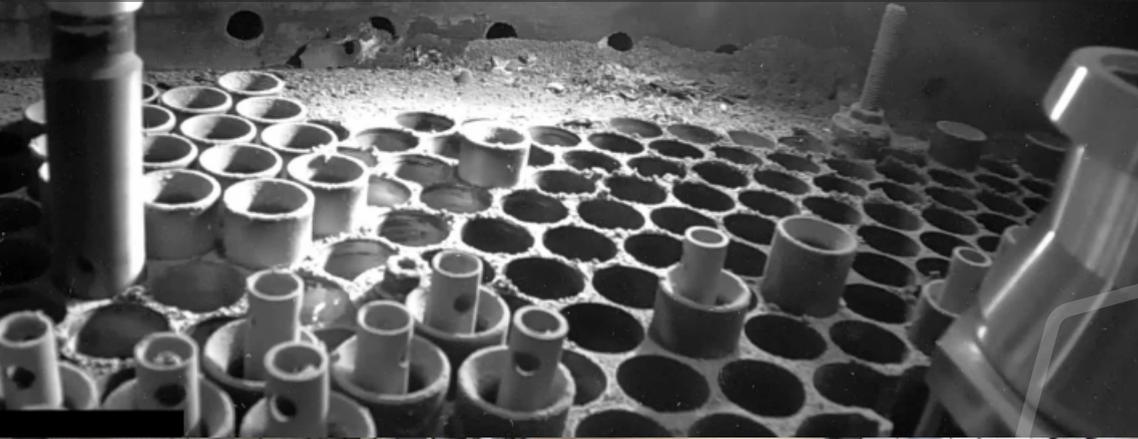
Facilities used in the separation of spent fuel and recovery of its uranium and plutonium are at different stages of clean-out and decommissioning.

Underground storage facilities for high-active liquor from spent fuel reprocessing are being emptied to allow the tanks to be decommissioned.



Nuclear materials

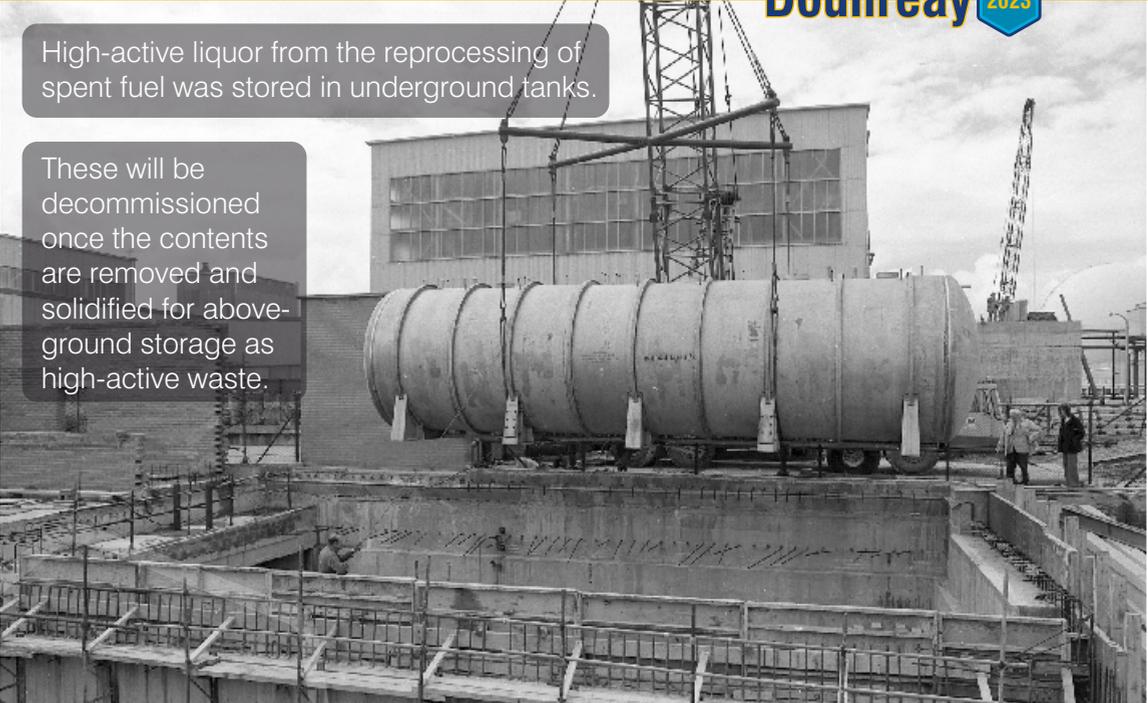
The site's inventory of unirradiated plutonium and highly-enriched uranium was removed between 2015 and 2019. Breeder material continues to be removed from the Dounreay Fast Reactor and transferred to Sellafield. Irradiated spent fuel is also scheduled to leave the site.



Legacy waste facilities



A 65 metre deep shaft was used historically for the disposal of solid high-active waste and was succeeded by a near-surface silo. Preparations to empty both are at an advanced stage.



High-active liquor from the reprocessing of spent fuel was stored in underground tanks.

These will be decommissioned once the contents are removed and solidified for above-ground storage as high-active waste.



Solid low-active waste was disposed of in a series of shallow pits. Preparations are at an advanced stage to retrieve this waste.

Radioactive waste

Decommissioning generates large quantities of scrap and other materials that can be recycled. But some of this is contaminated with radioactivity and must be managed as radioactive waste in accordance with the policy of the Scottish Government.



High-active waste is conditioned in cement and stored in containers in above-ground storage facilities at the site

Low-active waste is compacted, cemented in containers and sent for disposal to a series of shallow engineered vaults adjacent to the site.



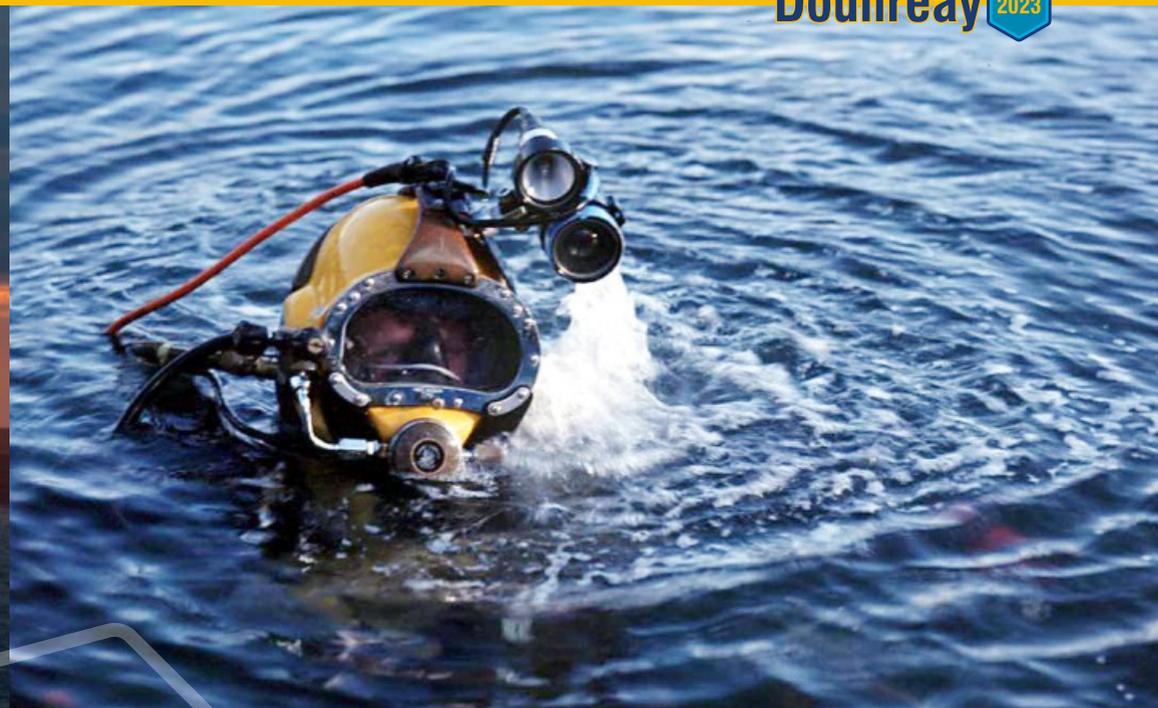
Decommissioning also generates gas and liquors containing low levels of radioactivity. This waste is not stored and can be discharged to sea or air under a formal authorisation granted by the Scottish Environment Protection Agency.



Monitoring of the environment around Dounreay provides assurance these discharges do not harm people or the environment.

Particles in the marine environment

Radioactive swarf from the historic dismantling of spent fuel is known to have entered the site's effluent system prior to 1984 and was discharged to sea. The seabed around the disused outlet was cleaned up between 2008 and 2012.



Monitoring of local beaches continues to detect radioactive particles that are a legacy of these discharges.



Interim End State

This is the time when all the major hazards have been reduced or eliminated, the historic facilities have been decommissioned and the site and the environment is in a safe state for future generations. This will be followed by a period of care and maintenance that will endure for a further 300 years.

The site today



The site at Interim End State



Beyond Dounreay

Dounreay employs approximately 1500 people directly. Its annual spend of some £200 million a year generates approximately 10% of the GDP of the North Highlands.

Staffing levels and spending will decline as more of the hazards are reduced and removed.

Some workers will see out their careers at Dounreay and others will transition to new roles and other sectors.

An important part of the decommissioning programme is supporting staff to plan their futures beyond decommissioning and supporting the community to diversify its economic base.

The site does this in two ways:

- Helping staff adapt to the changing profile of the work through reskilling and transition to new employment opportunities
- Investing in major infrastructure projects identified by a local regeneration partnership as essential to the diversification of the area's economy.



At a glance

678

acreage owned by the Nuclear Decommissioning Authority at Dounreay

135

acreage of the licensed nuclear site

1500

size of the workforce

300

number of facilities to be removed

50

number of facilities with a history of radioactive use

73

number of operational facilities

5

number of reactors built at Dounreay and Vulcan





www.dounreay.com

