



Steam Generating Heavy Water Reactor – SGHWR

The final chapter



‘I defy anyone who was remotely concerned with the construction of this reactor to deny that it has been a fascinating and satisfying experience.’

Duke of Edinburgh, at the SGHWR switching on ceremony in February 1968.

Contents

History in the making	1
A powerhouse project	2
Decommissioning	3
Where we are today	4
SGHWR timeline	4



History in the making

Of the nine experimental reactors constructed on the Winfrith site, the Steam Generating Heavy Water Reactor (SGHWR) was undoubtedly the most iconic. The only water-cooled reactor ever to be built in the UK, its cooling towers became the Dorset's site most recognisable landmark.

In the 1950s, the Winfrith site was established as a research centre looking into cost-effective ways of generating electricity from nuclear sources. Water-cooled reactors seemed to offer major advantages over the gas-cooled alternatives, since much of the plant could be factory fabricated, making them simpler and cheaper to build.

Winfrith's SGHWR was built as a prototype power-producing water-cooled reactor to demonstrate the viability of the system. Though its design was advanced, its engineering was based on conventional techniques in use at the time.

Designed and built in record time, construction of the SGHWR began in

1963 and was completed in 1967. The reactor reached full power of 100MW soon afterwards in January 1968. In the same month, the SGHWR was switched on by HRH the Duke of Edinburgh, at a ceremony that attracted worldwide attention.

The SGHWR reactor also operated as a power station. In its heyday, it generated enough electricity to power the needs of a small town, earning sufficient revenues to offset some of its operating costs.

Winfrith is managed and operated by Magnox, the site licence company responsible for the decommissioning of the site, on behalf of the Nuclear Decommissioning Authority (NDA).

A powerhouse project

The SGHWR was a heavy water moderated reactor, which used ordinary (light) water as coolant. In its long lifetime, it proved to be technically, experimentally and commercially successful.

The reactor core consisted of 104 zirconium alloy pressure tubes, which passed through vertical aluminium tubes into a tank (calandria) of heavy water. The fuel elements in the pressure tubes were made up of bundles of rods of uranium oxide pellets contained in zirconium alloy.

Light water was pumped over the fuel elements and boiled in the core. The resulting steam was passed directly to the turbine. Condensate was returned to the reactor to be mixed with the re-circulating water.

Operational success

Over 23 operational years, Winfrith's reactor demonstrated the reliability of the SGHWR system; supported a major experimental programme, which provided data, information and experience on the operation and development of water-cooled reactors; and operated as a power station earning revenues by feeding electricity into the national grid.

As well as generating electricity, the SGHWR played a significant part in experimental programmes in the 1970s and 1980s. Initially, experiments focused on areas crucial to the commercial development of the SGHWR system. After 1976, when the government decided against adopting the SGHWR design for the UK nuclear power programme, the focus of the research widened.

With the ending of the SGHWR development project, the Winfrith reactor continued to operate successfully as a power station. It was also a source of unique research data, making important contributions to developing water reactor technology in the UK, particularly in the fields of fuel testing and coolant chemistry, establishing Winfrith as a centre of expertise on water-cooled reactor technology, supporting an evolving pressurised water reactor (PWR) programme.

Shutdown

In October 1990, it was announced that the SGHWR was to close down. The decision was made following a review of operating costs and projected income from electricity sales. An extensive programme of decommissioning began immediately, a programme that is still underway today.





Decommissioning

Stage 1 decommissioning of the SGHWR began with the defuelling and transfer of the 279 fuel elements to Sellafield, the flushing of the heavy water moderator circuits, and the emptying and decontaminating of the fuel ponds.

In 1991, the landmark cooling towers were demolished, as were the diesel house and the round house, which were later followed by the stack.

Stage 2 decommissioning, which began in 2005, took the process a stage further. Work began with the removal of many large pieces of redundant equipment from more than 250 rooms and areas, dramatically changing Winfrith's skyline.

Over the next years, an extensive decommissioning programme was undertaken by the SGHWR team, concentrating on the decommissioning of major items of plant and equipment in the secondary containment building.

The complex and challenging undertaking included the decommissioning and removal of:

- SGHWR's rotating shield and refuelling machine – with a combined mass of 760 tonnes
- Steam turbine, alternator and auxiliary components, cut up using diamond wire cutting techniques
- Condenser beneath the turbine
- Feed heater cell and equipment
- Clearator from the reactor building
- Low pressure rotor from the steam turbine
- Flume chamber doors, each weighing 20 tonnes
- SGHWR's 120-ft ventilation stack, the highest structure on the Winfrith site.

WETP and EAST

One of the major projects carried out as part of SGHWR decommissioning was the transfer and encapsulation of sludges stored in four External Active Sludge Tanks (EAST). To achieve this, the unique Waste Encapsulation Treatment Plant (WETP) was designed and built. Running from 2005 until 2011, the plant processed more than 1,000 drums of sludge before it was demolished later that year.

With the transfer of the last drum from WETP to an on-site storage facility, work began to decontaminate and dismantle the empty sludge tanks and WETP. After post operational clean out and decontamination, the tank roofs and walls were size-reduced and removed.

Innovative technology

With a project as demanding and complex as this one, many techniques from other fields in industry have been adapted and employed.

Diamond wire cutting equipment was used to cut the reinforced concrete ventilation shaft, high pressure rotors, high pressure water tank, and the concrete walls of EAST, which were more than half a metre thick. High pressure water was used to cut through redundant underground cooling water pipes which once linked the reactor to the cooling towers.

Where we are today

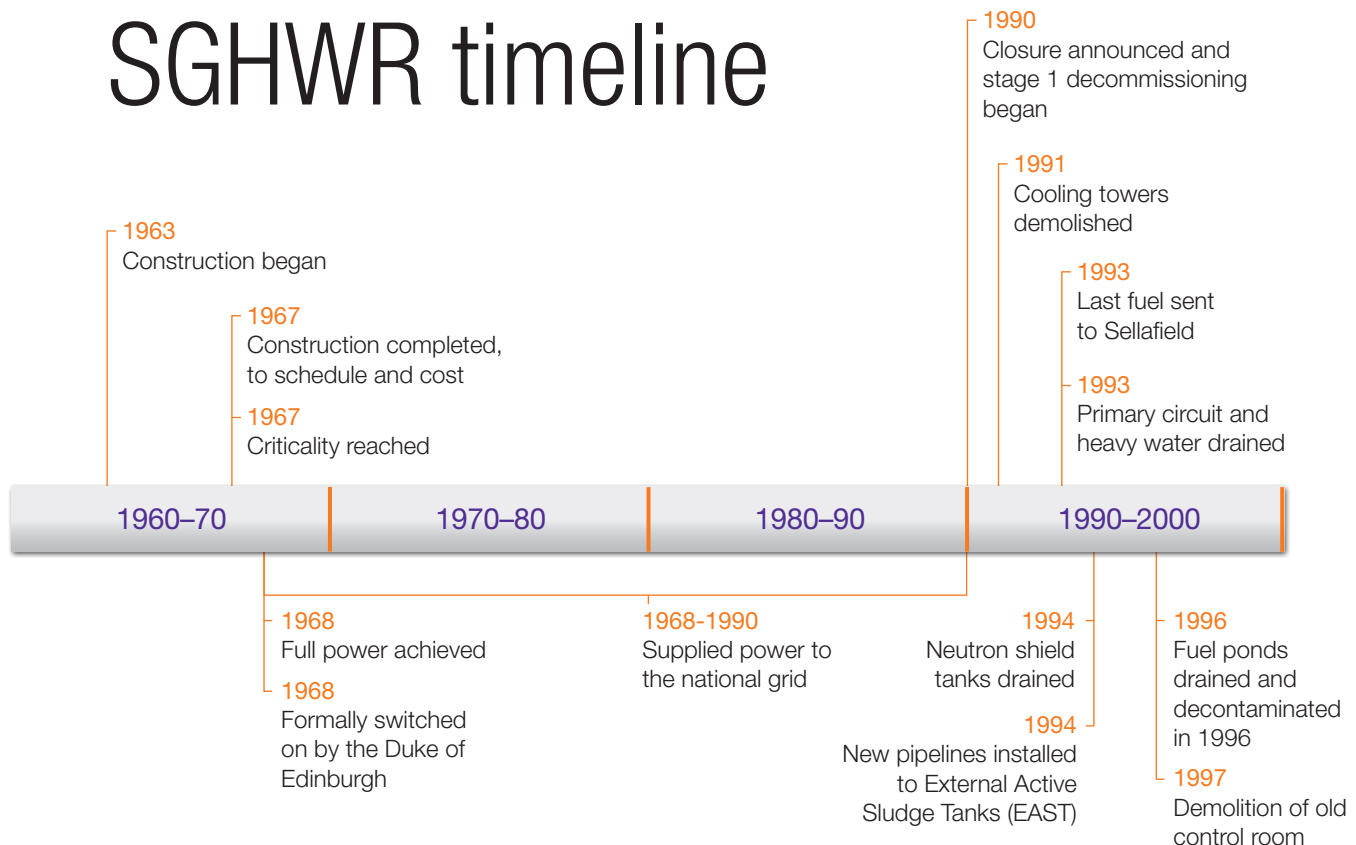
The decommissioning of the SGHWR is a huge task. Work that began in the 1990s will continue until completion in 2021.

With the removal of all the ancillary plant and equipment in the secondary containment and non-containment areas complete, the next step in the project will be to decommission the primary containment, the reactor core and, finally, demolish the building and all remaining facilities. With the land cleared and restored, the area will be landscaped.

With the final decommissioning of SGHWR – along with DRAGON, the only other remaining reactor on site – the way will be clear for the final restoration and delicensing of the whole site.

Once completed, this will make Winfrith the first site in the Nuclear Decommissioning Authority's (NDA) nuclear estate to be totally cleaned up, restored and made ready for non-nuclear use.

SGHWR timeline



2000

Decommissioning
of EAST began

2002

Ventilation stack dismantled

2005

Stage 2 decommissioning began

2005

Waste Encapsulation Treatment Plant
(WETP) begins operation

2000–10

2010–20

2006/7

Removal of
redundant
ancillary
systems
and external
facilities

2013

Primary containment
decommissioning began

2011

WETP
closed and demolished

‘Winfrith’s SGHWR
occupied a
substantial fraction
of the working life
of many dedicated
people and they
achieved successes
of which they can
be rightly proud.’

**Bert Negus, Head of SGHWR
operations 1980-1991.**



For further information

Visit us at www.magnoxsites.com
Telephone us at 01235 820220

We have gone to considerable trouble to ensure that the facts presented in this brochure are correct. They are not intended to be a comprehensive report of work carried out over the decades.

Magnox is owned and operated by Cavendish Fluor Partnership (CFP) on behalf of the Nuclear Decommissioning Authority (NDA).

The NDA works with CFP, the Magnox management team and other stakeholders to oversee the delivery of programmes, building confidence amongst Government and others that the nuclear legacy is being tackled effectively, safely and responsibly.



Magnox

Winfrith Site

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