DECOMMISSIONING

Innovation is the key at former Magnox stations

The Magnox stations were Britain's first-generation nuclear power plants and are now being decommissioned, with Bradwell A the first to enter the 'care and maintenance' phase. *Nick Cottam* surveys progress around the sites.

Whatever the strictures of Brexit and the global economy, nuclear decommissioning in the UK, you could argue, is a boom business. According to the latest estimates, the cost of decommissioning 17 nuclear sites around the country is running at around £3.2bn a year with Sellafield in West Cumbria, the world's first commercial nuclear power station, accounting for the lion's share of this sum.

The latest, 2019, forecast by the Nuclear Decommissioning Authority (NDA) suggests that total clean-up costs will add up to an eye-watering £129bn spread over the next 100 or more years, of which Sellafield will account for about £96bn. Both the estimated time span and the budget for this project could still be moveable, feasts depending on future developments.

A key priority, suggests David Peattie, the NDA's Chief Executive Officer, is to speed up decommissioning and secure savings. This applies to Sellafield and to the 12 Magnox power plants which between them will cost an estimated £12.6bn to decommission. The Magnox sites have now been taken back under the wing of the NDA and David Peattie, a former oil man who spent several years in Russia with BP, is keen to demonstrate both financial savings in the decommissioning process and advances in technology on behalf of the taxpayer.

The Bradwell site as it enters the care and maintenance phase of decommissioning
Photo: ONR

The NDA's latest, July 2019, *Mission Progress Report* (MPR) highlights progress and priority targets in four key areas: spent fuels, nuclear materials, waste management and site decommissioning and remediation. The long-term target is to hand over 1043 hectares of cleaned-up land and, for all the work done so far, there are 953 hectares still requiring a clean bill of health.

Headline progress to date, notes the MPR, is that 95% of sites have been defuelled of Magnox fuel, 88% of all Magnox fuel has been reprocessed and a significant 79% of all exotic fuel (containing platinum and high-enriched uranium) has been reprocessed. A key short-term target is to have all sites defueled of Magnox fuel, with reprocessing complete by 2020.

With advances in technology and expertise – notably a growing understanding of how to deal with these legacy sites – there has been some debate as to whether a 100-year decommissioning strategy could be reduced to 25 years. A time saving could be achieved, runs the argument, if innovations in artificial intelligence (AI) and robotics could be deployed.

This for example could involve switching to robotic dismantling of the reactor, removing the need for human access and the waiting time required to ensure adequate safety. Until this debate is resolved we are stuck with those 'worst case' decommissioning timescales.

Standardised storage

In the meantime, innovation is continuing to enhance clean-up operations at all the sites, including new approaches to the collection and storage of radioactive waste. While the earliest Magnox waste stores were built to one-off designs, a standardised design has been developed which, by the end of 2019, will be used for all Magnox sites and to store radioactive waste at Sellafield, the UK's largest and most complex nuclear site.

'By developing a standardised

Progress at the other Magnox sites

Sizewell A in Suffolk, a twin-reactor site which closed in 2006 is also making preparations to enter C&M, having completed defueling with the final flask of spent fuel leaving the site in 2014. To date two major projects to accelerate decommissioning work have been completed, removing the site's cooling water crane and two offshore structures. As debate continues over the need for a Sizewell C station in this part of Suffolk, its ageing forerunner is being taken apart piece by piece.

Moving south around the coast is **Dungeness A** which occupies 23 ha and is in the middle of a site of special scientific interest (SSSI). The site closed in 2006 after generating around 115 TWh of electricity and completed defueling in 2012. After an extensive programme of demolition and decontamination, priorities at the site now include draining a first reactor pond, the retrieval of resin and the packaging of nuclear waste. The site is expected to enter C&M in 2027.

Heading west along the south coast to Dorset, the **Winfrith** R&D facility is located on a sprawling site, also in the heart of an SSSI. Winrith's role was to provide vital research into reactor design and of nine experimental reactors originally housed on the site only two remain today. Now in its defueling phase and progressing towards C&M, the site operated successfully until December 2015 and is expected to be free of spent nuclear fuel by 2018.

Work to date has included the emptying of ponds, the removal of bulk asbestos and the retrieval of waste. When C&M is entered, the land will be returned to heathland with public access.

To the northwest is **Hinkley Point A**, a Somerset site which stopped generating electricity in 2000 after 35 years of operation. Priorities for the site this year have included completing the build and commissioning of the ILW store and installing a modular effluent treatment plant. The site is well on the way to C&M.

Oldbury on the River Severn in South Gloucestershire stopped generating electricity in February 2012 and completed defueling in 2016. Decommissioning activity is currently focused on the removal of waste prior to C&M and good progress has been made in draining the former cooling ponds and installing an alternative electricity supply to allow disconnection from the national grid.

Also on the banks of the Severn is the **Berkley** station which ceased operating in 1989 having generated 43 TWh of electricity. Key activities on the site have included disposing of the 310-tonne boilers before the entry of the two reactors into safestore, which happened in 2010.

With its 14 experimental reactors, **Harwell** in Oxfordshire was the birthplace of the UK nuclear industry and was not used for any commercial electricity generation. The site featured the most advanced radiochemistry laboratories in the world for the safe handling of a wide range of radioactive materials. Of the original 14 reactors, three remain to be decommissioned while construction of the site's ILW store was recently completed.

Snowdonia National Park plays host to the 15-ha **Trawsfynydd** site and what was the first inland Magnox power station, drawing its water from Lake Trawsfynydd. Decommissioning began soon after closure in 1993, when spent fuel rods were removed and sent by rail to Sellafield for processing. Like Bradwell, the site has been singled out for accelerated C&M and a new ILW store is now up and running.

Wylfa on a 20-ha site on the north coast of Anglesey was the last and biggest of the Magnox stations and shut down in 2015 after nearly 45 years of operation. The site has entered its defueling phase and a remediation project is underway to remove and clean asbestos from the reactor buildings and the turbine hall.

Chapelcross, Scotland's first commercial nuclear power station, was built on the site of a former airfield in Dumfriesshire. The site ceased operations in 2004 and after completing defueling ahead of schedule is moving toward interim C&M. Priorities include the recovery of ILW from buildings and from the former cooling ponds.

Also in Scotland, **Hunsterton A** is located on a 36-ha site on the Ayrshire coast. The site is part way through its decommissioning phase and like other Magnox sites has a strong focus on the recovery of ILW from different parts of the site. The twin-reactor site closed in 1989 after generating 73 TWh of electricity.

design and consolidating waste in fewer stores we've seen a real positive impact on the entire Magnox decommissioning programme,' says Matt Buckley, the NDA's Higher Activity Waste Strategy Development Manager. 'This has realised significant savings for the UK taxpayer.'

By sharing radioactive waste for all 12 Magnox sites in seven standardised stores, the NDA claims that there will be a saving of around £45mn, not to mention less disruption from construction works. All seven stores, which should be completed in 2019, have been built collaboratively by a group of contractors sharing information to ensure common standards.

What is termed intermediate level radioactive waste (ILW) will be stored in more than 1,000 sealed blocks per building for up to 150 years. The final three stores to be completed are at Chapelcross, Harwell and Hinkley Point A.

The collaborative working and the sharing of information between contractors has proved particularly beneficial to the project, adds Programme Manager David Hubbard. 'We saw a real opportunity to learn from our experience and make significant savings by coming up with a common design,' he says. 'The design cuts down the need for maintenance and reduces the amount of hands-on control needed to provide a safe and secure environment for the waste containers.'

With curved outer surfaces, the steel-framed waste stores will shed rainwater without the need for gutters, which in turn will significantly reduce the potential for leaks – even in the worst weather conditions. There are also thick concrete internal 'shield walls' to provide additional levels of radiation shielding. While over 99% of radioactivity leaves a site when the spent nuclear fuel is removed, the stores ensure that remaining nuclear waste can be stored safely on site until there is a UK geological disposal facility.

Accelerated decommissioning

One of the first of two stores to be built under the programme was at Bradwell in Essex, which shut down in March 2002 and was one of two Magnox sites – the other is Trawsfynydd, see above – selected for accelerated decommissioning. In November 2018, Bradwell became the first nuclear site to reach care and maintenance (C&M), a milestone which means a site can be managed remotely.

The priority now will be to keep the redundant station safe and secure, allowing radiation levels within buildings – for example the reactor safe stores – to naturally decay over a number of years before the reactors are dismantled and the site is cleared.

According to David Peattie: 'Bradwell has pioneered methods for tackling challenges we face at many of our Magnox sites, and has contributed to a body of expertise that is being shared across the NDA Group.' ●

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