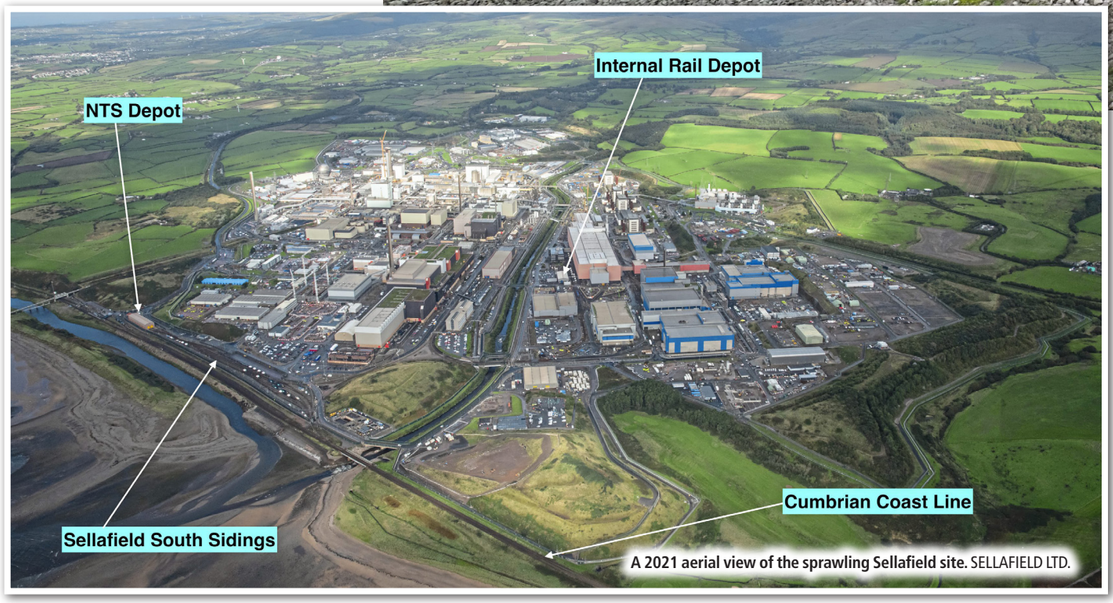
Inside Sellafield... by rail

Sellafield is the home of the UK's nuclear industry and one of our most heavily secured facilities. As BEN JONES discovers in an exclusive visit to the site, railways have been essential to its operation for more than 75 years

Clayton CBD80 hybrid locomotive No. 2 shunts FNA nuclear flask wagons outside the Fuel Handling Plant (FHP) on November 6. The primary task for Sellafield's rail network is moving nuclear fuel flasks between the main line exchange sidings and the FHP. BEN JONES.



A 2021 aerial view of the sprawling Sellafield site. SELLAFIELD LTD.

It's one of the most famous - some might say notorious - industrial facilities in the world.

Europe's largest nuclear site occupies a 700-acre patch of coast in West Cumbria, ten miles south of Whitehaven.

With around 11,000 staff (up to 9,000 of whom are on site on a normal working day), its own police and security forces and miles of rail and road networks, it's equivalent to a small town - albeit one with around 1,000 buildings and more than 200 tightly guarded nuclear facilities.

It's also the most diverse nuclear site in the world and has been essential to the economy of the region since the end of the Second World War.

Supporting up to 40,000 indirect jobs - everything from construction contractors to park-and-ride bus drivers - it's estimated that Sellafield is worth around £2.1 billion a year to Cumbria.

For 75 years, it has fulfilled a wide range of roles: producing weapons-grade plutonium for early atomic weapons in the aftermath of the Second World War; the world's first commercial nuclear power station supplying electricity to the National Grid; reprocessing and storage of nuclear fuel; and the processing of lower grades of radioactive waste for off-site storage. It's also home to the UK's National Nuclear Laboratory.

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> **Mark McSherry,** Rail Operations Manager, Sellafield Ltd

By any measure, it's a significant place - nationally and internationally important to the nuclear sector both as a facility and a world leader in the processes and technologies for handling dangerous radioactive materials.

Since its early days, it's also been important to the railway as a source of freight traffic and workers commuting in from local towns and villages to its seaside station.

Over the years, the railway has been the safest way to move hazardous chemicals, radioactive waste, fuel for Royal Navy nuclear submarines and imported fuel for reprocessing, as well as flasks containing fuel rods to and from British power stations.

Without Sellafield, the economics of the wonderfully scenic Cumbrian Coast Line between Barrow and Whitehaven would be very shaky indeed, especially since the loss of the area's other traditional industries.

But that reliance on railways doesn't end at the formidable security gates of the plant. Within the huge site, there's an extensive internal rail network that remains essential to the safe and efficient operation of the site.

Although Calder Hall Power Station closed in 2003, and reprocessing of spent fuel ended in 2022, Sellafield's ongoing role in receiving, stripping and storing nuclear fuel from decommissioned power stations will continue to provide work for its 11-mile internal rail network for many years to come.

Dedicated team

"The main role of the railway is to get flasks from the railhead [next to the Cumbrian Coast Line] to the Fuel Handling Plant," says Mark McSherry, Sellafield Ltd's rail operations manager.

McSherry leads a dedicated rail team of 36 staff operating in three shifts, 16 hours a day, seven days a week.

"We used to run 24 hours a day, but there's no need now as the traffic has reduced. Our main customer is EDF, which sends us around 13 or 14 flasks a week from various power stations around the country.

"They're delivered by DRS to the railhead at Sellafield South Sidings and we move them up the hill to the Fuel Handling Plant (FHP). We run trains six days a week, but Mondays are usually quiet."

After unloading at the FHP, every empty wagon is thoroughly checked at the monitoring depot before being tripped back down to South Sidings for its next outing.

The main line fleet consists of 40 FNA-D flask wagons, 27 PFA two-axle container flats, six huge KXA-C eight-axle 'Flatrol' wagons designed to carry 110-tonne international flasks to and from Barrow Docks, and two 150-tonne-capacity French-built KUA wagons with distinctive silver sliding hoods for MoD traffic, also carried on four bogies to spread the weight.

The latter work 'as required' under tight ➤

Rendered surplus by the arrival of the CBD80s, Hunslet 0-4-0 DHs Nos. 1 and 3 and Thomas Hill 0-6-0DH No. 2 line up with two internal 'skeleton' wagons on November 6. BEN JONES.

security between Sellafield and Royal Navy dockyards at Devonport or Rosyth, usually accompanied by DRS's Mk 2 escort coaches and armed guards.

The PFAs, previously employed on containerised coal traffic in the 1980s and 1990s, were acquired from 1999 onwards and can carry a range of specialist containers for spent fuel, intermediate and low-level nuclear waste.

Their best-known working is to the low-level waste repository at Drigg, a few miles south of Sellafield, but they can be seen further afield.

Much more rarely seen are the bespoke internal wagons, which never venture beyond the boundary fence.

This fleet includes around 20 'skeleton' wagons for moving various types of containers between buildings and 13 stainless steel-clad internal flask wagons of similar design to the previous generation of main line FNAs, which were replaced in 2018.

No longer used for moving flasks for reprocessing, these wagons are now only employed moving stored flasks around the plant.

> **"We're limited by train length rather than weight now. A CBD80 can manage 640t uphill, rather than the previous 600t maximum. The new locomotives take it in their stride, but you were on the limit with the old diesels."**
>
> **Mark McSherry,** Rail Operations Manager, Sellafield Ltd

"We're gradually overhauling and upgrading the internal fleet," says McSherry.

"But it's difficult to buy new vehicles, as they're bespoke and designed exactly for our requirements."

Battery power

The most significant change to Sellafield's internal rail fleet arrived in 2021, in the form of two new Clayton CBD80 battery-diesel hybrid shunting locomotives.

Costing more than £2 million each, Nos. 1 and 2 (works numbers B4659/1 and B4659/2 respectively) replaced six elderly industrial diesel locomotives, which worked at the site for many years.

The CBD80s have transformed operations on the Sellafield internal network. Although they are fitted with a diesel engine to charge the batteries, it is rarely needed, and the nature of operations means that the locomotives can run for ten days before the batteries need to be charged.

The sloping topography of the site also allows regenerative braking to charge the batteries as the locomotives run downhill towards the exchange sidings.

Around 80% of braking is done by the electric dynamic brake, rather than traditional tread brakes. However, all the hard work is done heading uphill with loaded flask trains.

"We're limited by train length rather than weight now," explains McSherry.

"A CBD80 can manage 640t uphill, rather than the previous 600t maximum. The new locomotives take it in their stride, but you were on the limit with the old diesels.

"Battery locomotives give us another unique advantage too. The storage buildings here have lower air pressure inside to prevent radiation leaks, which means that they suck air in from outside.

"With the CBD80s, there are no diesel fumes to be sucked inside, which improves the air quality for everyone."

For obvious reasons, Sellafield is extremely sensitive to fire risks, and the CBD80s use lead-acid batteries, as they are more stable than other types, such as lithium-ion.

A CBD80 shunts one of the two French-built eight-axle KUA wagons reserved for Ministry of Defence nuclear fuel traffic at South Sidings. MARK MCSHERRY.

Other features include a modern cab layout with driving positions on both sides, excellent all-round visibility, combined power-brake handles, manual sanders, automatic headlights and on-board diagnostics. It's a comfortable 'office' for the drivers and a big improvement over the old locomotives.

Diesel No. 4 has been retained, as it was the most recently overhauled - at a cost of £700,000. Of the others, two have been donated to the Chasewater and Eden Valley heritage railways.

The Clayton pair will be joined in January 2024 by a smaller CBD40 two-axle shunter, acquired for lighter duties and to serve parts of the network the CBD80s can't reach.

"Parts of the rail network date back to the [Royal Ordnance Factory] Windscale days," says McSherry.

"The site was built and then the railway was made to fit it, which means that there are lots of tight curves and sharp gradients.

"When we upgraded the track, we couldn't use flat bottom rail, as some of the curves are too tight, so we are one of the few places still using bullhead rail.

"It took six months to iron out the bugs with the CBD80s and adapt them to our requirements, but we're very happy with them now."

The sentiment is echoed by our train crew when we venture out to deliver a couple of FNAs to South Sidings later that morning.

With around £8bn worth of construction work currently taking place to create new waste management facilities, and the manufacturing of tens of thousands of new waste containers, it's a very busy site and every effort is made to ensure internal rail movements are safe.

The plant's rarely seen fleet of specialist internal wagons includes multi-purpose 'skeleton' wagons and stainless steel-clad vehicles for moving nuclear fuel flasks. Now limited to moving empty flasks for storage, wagon 5 stands with an FNA-D at Sellafield DRS depot on November 6. BEN JONES.

"We try to operate as close to main line rules as we can. We have regular independent inspections and work with the Office of Rail and Road (ORR) to ensure we are as safe as possible," says McSherry.

A blanket speed limit of 7mph applies across the network, which is split into three operating zones. These work on a 'one engine in steam per zone' basis to avoid conflicting movements. Once a train crew inserts the key to activate the zone they wish to enter, all other road and rail traffic has to stop and wait until the move has been completed.

Each crew consists of a driver and two shunters, who ride on the outside of the locomotive to act as extra pairs of eyes and undertake changes of points, reversals and coupling/uncoupling as quickly as possible.

Handovers to Direct Rail Services (DRS) take place in South Sidings, which, blasted by winds off the Irish Sea, must rank as one of the

> **"Nuclear trains are sporadic and seasonal, but there can be up to 15 or 20 a week. Some are short distance, such as to Drigg or Barrow, but we also run as far as Georgemas Junction (for Dounreay) and Bridgwater in Somerset."**
>
> **Danni Wilson,** Senior Competence Advisor, DRS

CBD80 No. 2 delivers two empty FNA-D flask wagons back to South Sidings on November 6, where they will be handed over to DRS to collect their next load of spent nuclear fuel rods. BEN JONES.

DRS usually has two Class 68/88 locomotives based at Sellafield. On November 6, 68007 *Valiant* and 88007 *Electra* stand at South Sidings with a short train of PFA flats. BEN JONES.

CBD80 No. 2 shunts FNA-D flask wagons outside the Fuel Handling Plant (FHP) on November 6. Flask wagons are shunted inside for unloading under strict safety regulations. This enormous structure is one of more than 1,000 buildings on site. BEN JONES.

➤ bleakest locations on the British rail network.

On the day of *RAIL*'s visit, 88007 *Electra* and 68007 *Valiant* were stabled awaiting their next trip, while two more Class 68s were parked next to Sellafield station.

DRS favours its newest Vossloh/Stadler locomotives for nuclear traffic, as they offer reliability and, in the case of the '88s', the potential to reduce diesel consumption by working on 25kV AC electric power when it is available.

Taking advantage of the changes brought by the privatisation of British Rail, British Nuclear Fuels Ltd (BNFL) chose to take its rail operations in-house.

Since 2021, DRS has been part of Nuclear Transport Solutions (NTS), but it remains a wholly owned subsidiary of the Nuclear Decommissioning Authority.

"Safety and reliability are essential for nuclear traffic, which remains our core business. We've taken that approach to non-nuclear commercial traffic, where customers such as Tesco demand high performance."

Oliver Schepisi, Head of Operations, Nuclear Transport Solutions

Sellafield was the first home of DRS from 1995, although its major depots at Carlisle Kingmoor and Crewe Gresty Bridge are now responsible for the fleet. The original depot is still used to service locomotives and wagons as well as providing a base for local train crews.

Danni Wilson, DRS senior competence advisor, based at the depot, explains: "Usually, we have two locomotives based at South Sidings. Nuclear trains are sporadic and seasonal, but there can be up to 15 or 20 a week. Some are short distance, such as to Drigg or Barrow, but we also run as far as Georgemas Junction (for Dounreay) and Bridgwater in Somerset."

Inside the depot, several PFAs are undergoing overhauls or exams, while outside sit a unique and diverse collection of specialist wagons, both internal and external, including one of the massive eight-axle KXA-Cs.

Specialised wagons for unusual loads have always been a rarity on the railway, but with the disappearance of traditional heavy industries and the loss of more 'difficult' traffic to road haulage, the DRS vehicles are now the last of their kind on the British network.

Like everything related to the nuclear industry, this specialist equipment is based on a significant, long-term investment.

"Nuclear is part of our future for the next 100 years," says Oliver Schepisi, Head of Operations for DRS's parent organisation, Nuclear Transport Solutions (NTS).

"For the next eight years, operations will remain pretty much stable, but beyond 2032 all the old nuclear power stations will be closed. We don't yet know what the requirements will be for the new generation of power stations [such as Sizewell C], but it will be nuclear-related.

"For us, it's not about cost, it's about performance. Safety and reliability are essential for nuclear traffic, which remains our core business. We've taken that approach to non-nuclear commercial traffic, where customers such as Tesco demand high performance."

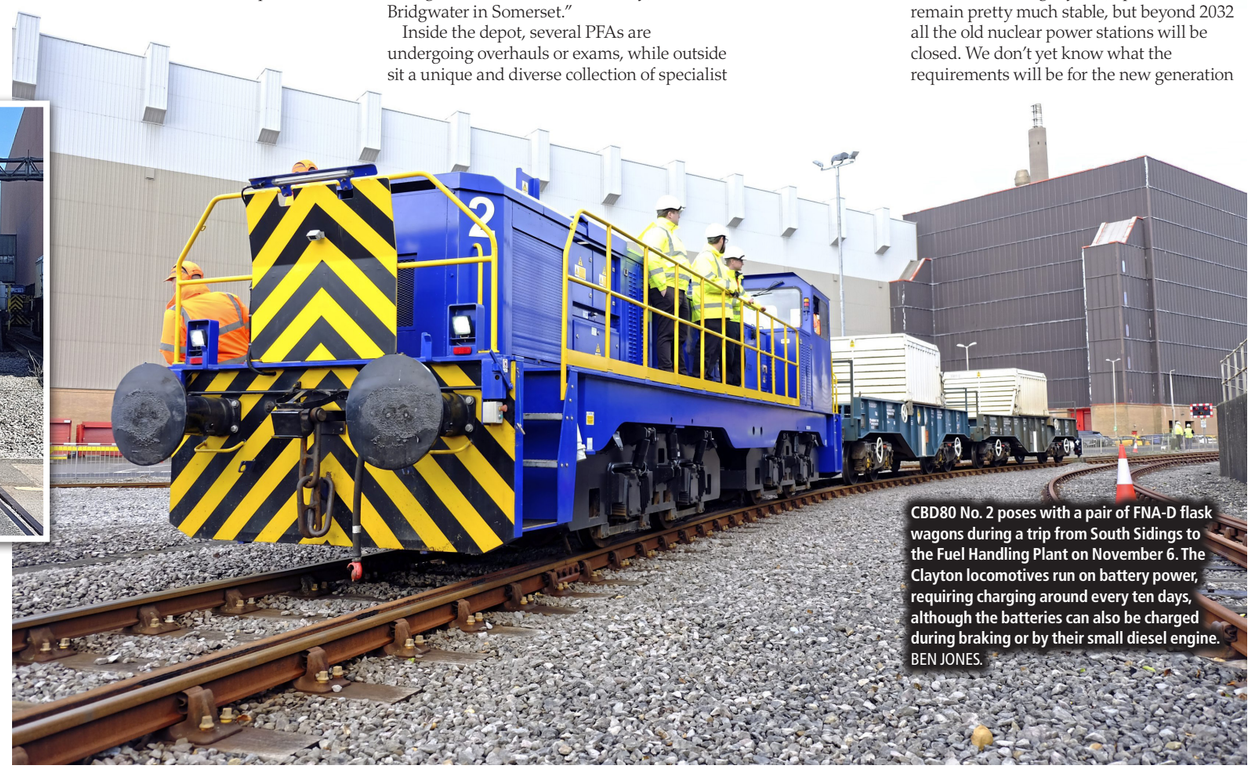
Another milestone will come in 2050 when the UK government is expected to decide whether the weapons-grade plutonium stored on site is classed as an asset or waste for disposal.

Recent investment by Sellafield and DRS in new wagons and more environmentally friendly traction bodes well for the future of one of the UK's last remaining internal rail networks and for the dedicated team who operate and maintain it.

With decommissioning, storage and clearance work set to continue for at least the next century, it looks likely that the internal rail network and the Cumbrian Coast Line will go on serving this uniquely challenging site for decades to come, providing much-needed jobs and economic support for a remote region of northwest England. R

■ Thanks to Ben Chilton, Mark McSherry and the Sellafield Ltd Rail Team, and Andrew Butler, Oliver Schepisi and Danni Wilson of Nuclear Transport Solutions for making this feature possible.

Above: The internal rail network operates a strict safety regime, with three operating zones. When a train enters a zone, all road traffic is halted at crossings and only one train is permitted to move in each zone. MARK MCSHERRY.



CBD80 No. 2 poses with a pair of FNA-D flask wagons during a trip from South Sidings to the Fuel Handling Plant on November 6. The Clayton locomotives run on battery power, requiring charging around every ten days, although the batteries can also be charged during braking or by their small diesel engine. BEN JONES.

Sellafield: a short history

The sprawling coastal site now occupied by Sellafield opened as a Royal Ordnance Factory in 1942 and was formerly known as Windscale. Briefly owned by chemicals giant Courtaulds for the production of rayon after the Second World War, it was re-acquired by the Ministry of Supply in 1947. Its isolated location, far from major centres of population, was considered ideal for the production of weapons-grade plutonium following Britain's decision to develop its own nuclear deterrent.

The initial plant included the 'Windscale Piles' (currently being dismantled), which were the scene of one of the world's worst nuclear accidents in 1957, when uranium metal fuel ignited inside one of the piles, releasing radioactive contamination into the surrounding area. Up to 750 tonnes of fuel a year was produced until the plant closed in 1973.

In 1956, a second facility opened on the opposite side of the River Calder, which runs through the site. Calder Hall Power Station was the world's first full-scale commercial nuclear power station, although, along with its sister plant at Chapelcross, near Annan, its primary purpose was the production of weapons-grade plutonium.

Calder Hall closed in 2003 after 47 years of use and dismantling will continue until 2032, although the de-fuelled nuclear reactor cores and their shielding will be left in place on a 'care and maintenance' basis until the early 22nd century.

Between 1964 and 2022, Sellafield was responsible for the reprocessing of reactor fuel for Magnox power stations across the country, with rail being used to move flasks containing fuel rods between the plant and power stations such as Sizewell, Hinkley Point and Dungeness.

In 1994, further capacity was added with the opening of the Thermal Oxide Reprocessing Plant (THORP) to handle fuel from later Advanced Gas-cooled Reactor (AGR) plants. Reprocessing ceased at THORP in 2018, but it will continue to store fuel until the 2070s.

Despite the end of reprocessing activities in July 2022 due to the closure of the ageing Magnox reactors, Sellafield Ltd - a subsidiary of the Nuclear Decommissioning Authority (NDA) - remains the central location for receipt and storage of used AGR fuel. It has also processed spent nuclear fuel from overseas, including France and Japan, which arrives/departs by sea from Barrow Docks and is transferred by rail as required via the Cumbrian Coast Line.

Decommissioning is the process whereby a nuclear facility is dismantled to the point that it no longer requires measures for radiation protection. Sellafield's highest-priority challenges are mainly the legacy of the early nuclear research and nuclear weapons programmes in the late 1940s and 1950s. Numerous buildings on site have ceased operating, but are in 'care and maintenance' awaiting final decommissioning.

In other parts of the site, nuclear waste, fuel and radioactive sludge is being retrieved from legacy storage ponds and silos and made safe for long-term storage. Early nuclear facilities such as Windscale No.1 pile are gradually being cleaned up and prepared for demolition.

Low and intermediate-level waste is encapsulated in concrete drums, while high-level waste is encased in glass - a process known as 'vitrification'. The latter was a by-product of reprocessing and is no longer generated at Sellafield. Elsewhere, spent nuclear fuel from power stations is stored in specialist buildings, while 'special nuclear materials' are stored securely in the high-security area of the site.

Decommissioning of the various legacy facilities is expected to continue until at least 2120, with final costs predicted to exceed £120 billion.

About the author

Ben Jones, Contributing Writer

Ben Jones is a freelance railway and travel writer, a former *RAIL* writer and editor of *Model Rail* magazine. As well as a long-standing follower of the contemporary UK rail scene, his travels across mainland Europe have left him with a deep interest in its railways, especially those in Germany, Switzerland and France.
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