

World first process achieves significant hazard reduction at Dounreay

Around 1,810 litres of radioactive sodium coolant (approximately 1.7 tonnes) remaining in a 'heel' pool at the base of the reactor vessel in the Prototype Fast Reactor (PFR) has been pumped out using specially designed equipment.

Removing the heel pool was a major hurdle in the programme that has now been overcome, as the amount of liquid metal had to be reduced before the interior of the reactor vessel could be treated. It paves the way for the next step in the decommissioning of PFR to take place.

The project continued through the pandemic, with the team following COVID-19 safe ways of working to keep themselves and their colleagues protected.

Project Manager James Robertson said:

This has been a significant challenge. The team has delivered a project that is really at the cutting edge of decommissioning, something that's truly world class. This was Dounreay at its best delivering a highly complex decommissioning task in a way that demonstrated a really innovative and collaborative working approach.

A project full of challenges and innovation

The DSRL project team worked closely with the supply chain to develop an innovative technical solution to the removal of the sodium; since the heel was difficult to access a flexible 65m long pumping and camera system that could operate in temperatures of several hundred degrees had to be designed, manufactured and tested.

The sodium, which had solidified at the bottom of the reactor, first had to be melted. Bespoke heaters similar in shape to the petals of a flower were designed by the project team, and deployed through holes drilled through the base of the reactor leak jacket and attached to the underside of the reactor vessel to melt the sodium from the outside.

Access to the heel pool at the bottom of the reactor wasn't straightforward either. Locating the sodium heel with the pump was like threading the eye of a needle by the operators on the reactor top. They manoeuvred the flexible pump system through a challenging route, negotiating 90 degree and 180 degree bends and other obstacles on the way to the bottom of the reactor vessel, while maintaining containment.

[Watch the progress of the pump and camera](#)

The heel pool project team has been working for the last 4 years from the initial design to get the project to this stage. They spent months rehearsing the moves and skills required to position the pump in the heel pool, using a mocked up version of the reactor internals and making changes to the equipment where necessary. Extracting the sodium also needed the operators to develop skills to undertake a task never performed previously.

The team believes the process is a world first for the site, and the innovation and learning can be applied to other decommissioning projects UK-wide, where hazards are difficult to access.

Lead Commissioning Engineer Joe Christie said:

The technical and practical challenges to overcome were considerable. The project required the support from all the disciplines and specialists available on site as well as our contractors off site. The project could not have been delivered without this collaborative approach.

The project is also a showcase for the design and engineering skills available in Caithness.

The heel pool pump was designed in-house, and fabricated locally by Gows Lybster Ltd, who also manufactured a shielded tank where the sodium was transferred into.

The special heaters that were used to melt the sodium were also designed in-house and fabricated locally by JGC Technical Services Ltd, Forsyths and Arch Henderson.

Senior Project Manager Graeme Dunnett said:

The removal of the sodium heel from the reactor vessel is a significant achievement and important step forward in the decommissioning programme of the PFR complex by a team of local contractors and DSRL workers. Hazard reduction is a priority for the Nuclear Decommissioning Authority and the site and this takes us another step along that journey. I'm particularly pleased that this work was carried out safely and with no environmental impact.

DSRL Managing Director Mark Rouse added:

A huge well done to the heel pool team – and every single person in the company who supported them in any capacity – for achieving their target ahead of the date we had set. This was not an easy task; it was technically and practically difficult and required a lot of resilience in the face of disappointments and setbacks as they explored the limits of what was known and what has been done

before.

The next phase will be to decommission and remove the pump from the reactor and install a water vapour nitrogen system, using purpose built skids, which will remove the sodium residues from the reactor vessel and pipework. The project is on course to complete the clean out work by the end of 2023.