Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

Waste container prototyping for **Capsa Solutions**

The Nuclear AMRC worked with engineering specialist Capsa Solutions to produce two prototypes of an innovative waste container which could reduce the costs of long-term storage and disposal of nuclear waste.

The Capsa design is a cylindrical container based on the principles of pressure vessel design, with a unique patented lid which avoids the problems of bolted closure.

The design was originally developed by Rotherham-based Eadon Consulting in response to a challenge from Sellafield Ltd under the Game Changers programme in 2017. That challenge, launched at an event hosted by the Nuclear AMRC, was to propose ways to improve the design and manufacture of intermediate-level waste container for use in the Geological Disposal Facility (GDF).

"We could see the opportunity within the nuclear waste market, and felt we had some ideas that could help with container design," recalls James Hill, director at Eadon. "The Game Changers programme gave us a very effective route in to be able to talk to Sellafield. From an R&D perspective, it was saying give us some brand new ideas."

Eadon secured follow-on funding to develop its proposal, and launched Capsa Solutions to bring the container towards commercial readiness. Like Eadon, Capsa is based at the Advanced Manufacturing Park Technology Centre, a stone's throw from the Nuclear AMRC's main facility.

In 2021, Capsa was awarded a further £500,000 from Innovate UK under the Smart Grant scheme for further development of the container, and called on the Nuclear AMRC to carry out a design for manufacturing study. Such studies aim to ensure that the manufacturing process for a new product will be as cost-effective as possible in volume production, while providing a robust and reliable product.

The Capsa container is based on a rolled and welded steel tube, with an off-the-shelf domed base and a machined ring at the top to secure the innovative lid.

The lid uses a reverse-iris mechanism which can be operated remotely, takes less time to seal than a bolted lid, and doesn't require time-consuming inspections such as torque feedback checks to ensure the seal meets quality requirements. The design also avoids the risk of steel bolts seizing up during storage, so the lid can be easily removed if required for waste monitoring or processing.

The lid itself is machined from stainless steel plate, with the locking mechanism made of laser-cut steel components. These are designed to be straightforward to produce using standard workshop equipment, and don't require onerously high precision to provide a secure seal.

"The design phase is always about balancing potential manufacturing cost savings against user and functional requirements," Hill notes. "A lot of savings came from being able to change material thickness and weight. One of the challenges was being able to verify some of those savings, when we couldn't yet do the actual production process."

To prove that the design could be efficiently manufactured, the team again called on the Nuclear AMRC to produce two prototype containers. The two are different sizes, to show that the design can be adapted to the needs of customers with different storage requirements.

The project used a selection of machining and welding facilities at the centre, with the Nuclear AMRC team selecting keyhole welding equipment from K-TIG for all seam and circumferential joins.

"We selected the K-TIG due to its ability to do single-pass welds which can reduce manufacturing costs and time," says James Leatherland, programme manager at the Nuclear AMRC. "It also has low heat energy, so in theory you get less distortion from stress."

The team completed extensive pre-production trials to optimise welding parameters and minimise the risk of distortion.

"Getting the parameters right in a first of a kind is always difficult, so we did a lot of trial work," Leatherland says. "The key to manufacturing this is all about fit-up tolerances and making the fit-up process as simple as possible. With the relatively thin sections, fixturing and tooling are really important."

The Capsa team also carried out extensive analysis to prove the container's performance in standard operation and under stress. In a simulated drop onto an unyielding surface from 11 metres – the maximum proposed height of stacked containers in the GDF – the lid maintained a safe closure with minimal loss of contained particles, meeting the expected standards.

In March 2023, Capsa submitted the design to Nuclear Waste Services, the division of the UK's Nuclear Decommissioning Authority responsible for long-term waste storage and development of the GDF. A conceptual letter of compliance, which gives the go-ahead for further development, is expected in early 2024.

The team are also approaching the international market, and demonstrated one of the prototypes at the World Nuclear Exhibition in Paris in November. Capsa was one of 20 start-up businesses from around the world selected for the showcase, which also provided mentoring and networking opportunities. "That was a brilliant opportunity for us to go and see what the international market looks like and to make some connections," Hill says.

The Capsa team are now seeking partners and investment to take the containers forward to commercialisation.

www.capsasolutions.co.uk

January 2024