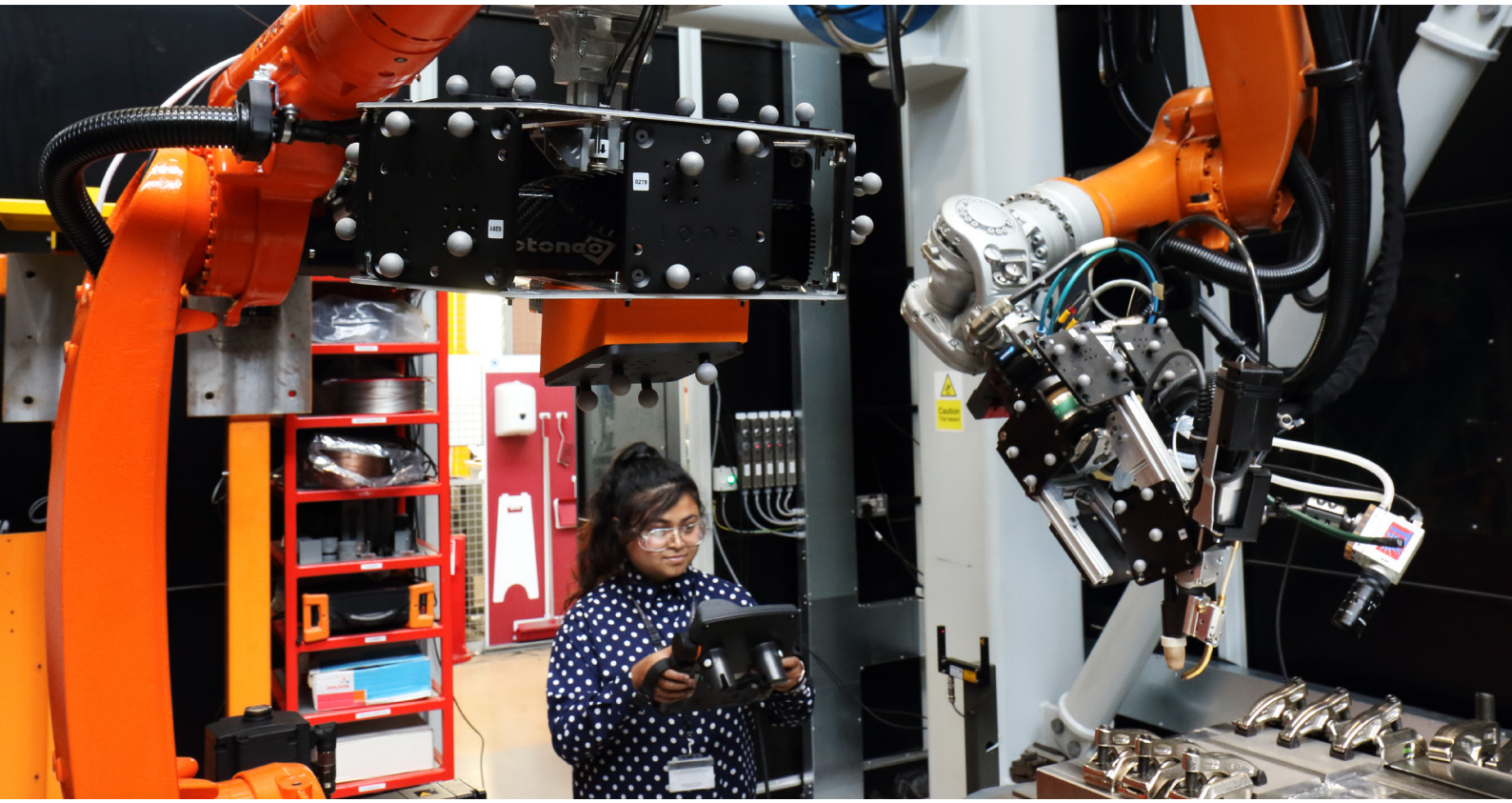
Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE



Affirming the promise of **automated weld inspection**

Researchers working to automate the fabrication of nuclear waste containers have successfully demonstrated a new advanced tracking system.

The technology forms part of a research collaboration called Affirm (advanced photogrammetry for flexible intelligent robotic manufacturing), which aims to develop a new platform for robotic manufacturing and autonomous inspection of safety-critical fabrications for the nuclear sector.

The two-year Affirm project is backed by £1 million funding from Innovate UK's Smart Grant programme. It is led by Insphere, a tier two member of the Nuclear AMRC, with support from Cumbrian technology specialist Createc.

The team have now integrated technologies from the two companies into the Nuclear AMRC's modular intelligent manufacturing and inspection cell, which features two Kuka robot arms working in tandem.

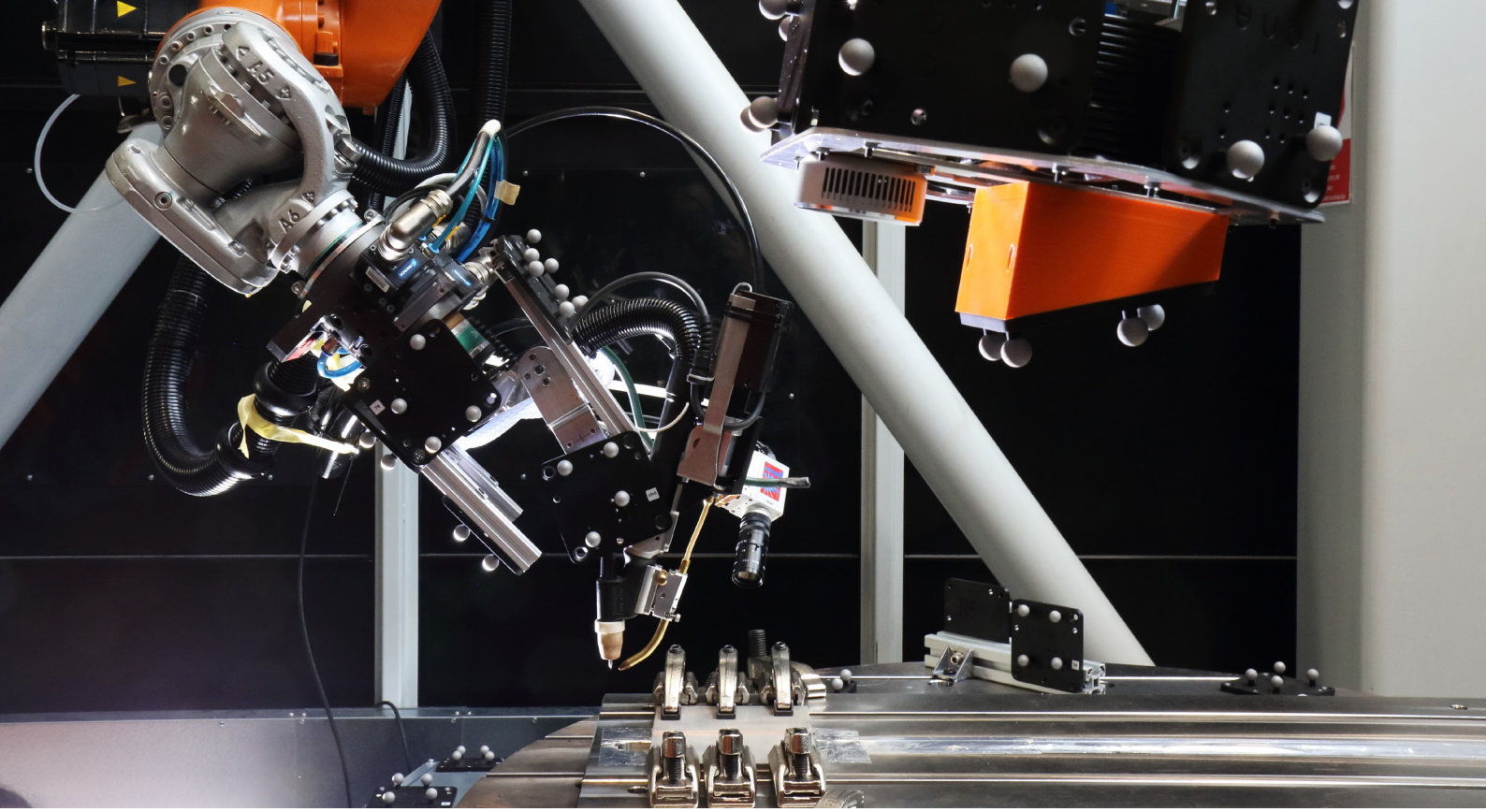
One robot is suspended from a multi-axis gantry over a rotary welding table. The other floor-mounted arm carries a weld inspection sensor produced by 3D imaging specialist Photoneo.

The robots and table are continuously tracked by Insphere's Iona camera system, which has been developed specifically for high-accuracy tracking and guidance of industrial robots.

"Iona is integrated with the robot controllers, so that its measurement data can be used directly for control and correction of robot position and orientation," explains Craig Davey, chief operating officer at Insphere.

Once the plates to be welded are clamped onto the table, the floor-mounted arm tracks the Photoneo sensor along the gap between them. The measurements it collects are used to plan the path for the welding robot.

The Iona system then tracks the robot's precise movements as it welds, to validate weld accuracy and correct its path where necessary. Finally, the sensor arm is again tracked along the weld to collect assessment data and detect any deformation of the steel plates.



The complexity of the cell made it a good test of the Iona technology, notes Dr Faris Nafiah, senior research engineer at the Nuclear AMRC. The Insphere engineers typically install four nodes to track the targets attached to each part of the robot cell, but used six in the Affirm cell to ensure full coverage.

"The cell involves a lot of components, including the robots, welding torch, table and gantry, and tracking the position of all the complex components made it a bit more complicated than normal," Nafiah says. "We've also got different control systems and interfaces, and the challenges for us were mostly to do with understanding how the interfaces of each system worked together."

After installing the system and successfully demonstrating the workflow, the team are now carrying out trials to assess robot accuracy, the influence of environmental variables, and material performance when parameters are varied.

"High temperatures, high-intensity radiation, smoke and sparks all have the potential to hinder tracking and even damage system components," Davey says. "These influences are being rigorously tested, and the Nuclear AMRC cell is proving very valuable to maximise the learning from the project."

The data gathered during the trials will also be used to feed machine-learning algorithms, which will be used to automatically optimise robot paths, drive down errors and further enhance performance.

Following the trials at the Nuclear AMRC, the researchers aim to install demonstrator cells with companies working on waste container fabrication. Several major companies are already engaged as part of the Affirm project's industrial committee. "They're very interested in this, because being able to track the welding robot is key to these companies," says Nafiah.

The Affirm technology could significantly increase the UK's capacity to produce waste containers for the decommissioning programme, tens of thousands of which are needed over the coming decades.

One current constraint on the UK supply chain is a shortage of skilled welders. Fully automated robotic welding could reduce the demand on welders' time, while reducing production costs and ensuring consistent quality, allowing UK manufacturers to meet the huge demand from the decommissioning sector.

Automated welding and inspection can also be deployed in other markets such as modular reactors, offshore wind, automotive and aerospace, Davey adds.

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