



Rise of the robots

Robotic systems are proving critical in the nuclear sector for challenging decommissioning and disposal applications. Louise Davis speaks to a technical expert about how this technology is evolving and what advantages robots are bringing over human personnel



left: In the nuclear sector, robotic systems can be used to automate 'dull, dirty and dangerous' tasks

"Safety is the primary factor in the adoption of robots and automation in decommissioning. There is a massive focus on removing personnel from the risks associated with working in challenging environments," begins Dave Burns, Nuclear Technical projects lead at KUKA Systems, a leading manufacturer of industrial robots and engineering automation systems.

Environments certainly do not come much more challenging than ageing nuclear facilities and it's obvious that reducing reliance on humans to conduct potentially dangerous work is a huge selling point for bringing in robots.

However, Burns points out that safety is far from the only advantage of deploying robotic systems: "Performance and efficiency is also a factor. Although nuclear applications tend to be slow and not focused on cycle time, there is a clear focus on the reliability that a robot system offers." Reflecting these different benefits, KUKA sells around the use of its robots to automate 'dull, dirty and dangerous' tasks.

Expanding on the issue of reliability, Burns says: "If a robot is required to carry out a task, it will perform that task to the same standard every time. A good example here is inserting bolts into a waste container lid. There can be up to 48 bolts in each lid that need tightening to a designated torque.

"A robot will insert the bolt, tighten

and record the torque value. If a bolt is cross threaded or does not reach the required torque, the system's alarm will be triggered, and the problem can be investigated and rectified if required.

"In contrast, when humans are conducting this task, the process is prone to error – simply because it's boring work," explains Burns. "Humans will often miss out bolts, do not tighten them to the correct torque or, if cross threaded, just leave the bolt."

RETURN ON INVESTMENT

Naturally, any robotics systems will require a considerable initial outlay. But when asked how the costs of humans versus robots stack up, Burns observes this is not an easy question to answer.

He notes: "A typical payback period in a normal manufacturing environment would usually be three to four years. However, in the nuclear sector, it is not about the payback but more about safety and reliability. A robot cell is a minute

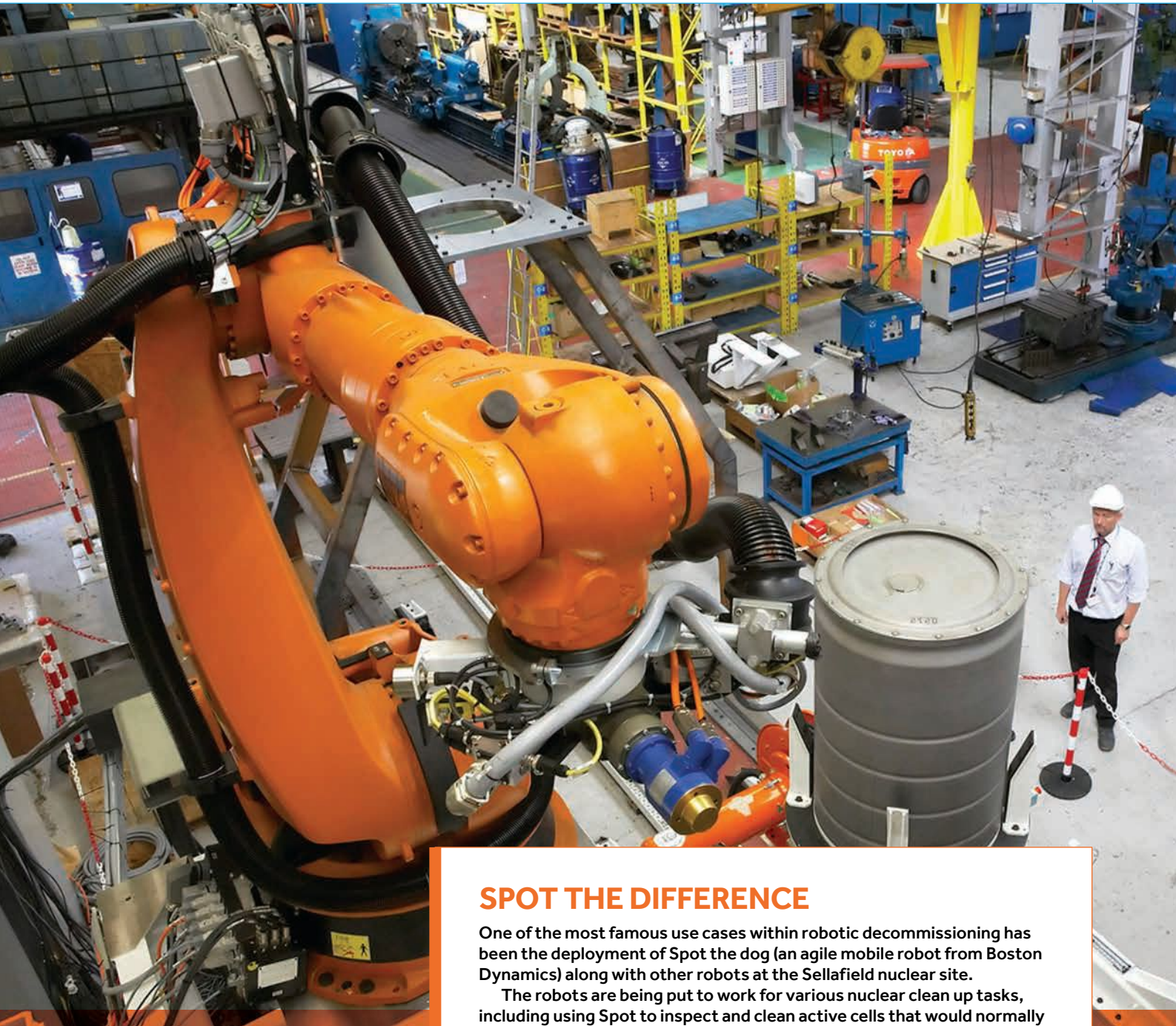
part of the cost of a complete system such as a waste sorting solution or the encapsulation facility in which it would be contained."

In terms of what robotic systems KUKA sells into the nuclear sector, Burns reports that over the past 18

years, the firm has delivered numerous solutions to the industry at sites such as Trawsfynydd, Hunterston, Bradwell, Hinkley Point, Winfrith, Dounreay and Sellafield. The company's products have been widely used for decommissioning applications.

But as technology and methodology has evolved, Burns says that a change





Above: A KUKA robot in a nuclear cell build application

Left: Dave Burns, Nuclear Technical projects lead at KUKA Systems

SPOT THE DIFFERENCE

One of the most famous use cases within robotic decommissioning has been the deployment of Spot the dog (an agile mobile robot from Boston Dynamics) along with other robots at the Sellafield nuclear site.

The robots are being put to work for various nuclear clean up tasks, including using Spot to inspect and clean active cells that would normally require workers to enter in air-fed protective suits.

Commenting on this work, Sellafield Ltd operator, Paul Lupton, explains: "It's about us being taken out of harm's way. I do miss the hard work but I've no complaints about sitting down in a safe environment to get it done.

"Before we would have two operators go in, and this would need up to seven other people, taking up to four hours to prepare for an hour's work. With Spot we do an hour, the battery runs out and we re-charge."

in direction has followed: "In the past we have designed and built bespoke robotic automation system for use in the nuclear industry as part of our business model, but our belief now is that the use of commercial off the shelf (COTS) equipment can safely be included within the toolkit of the Site License Contractors in the efficient decommissioning of legacy nuclear sites."

As a result, the firm is now focusing more on the supply of standard KUKA products – or slightly modified standard products – into the nuclear arena.

The business potential here is clear and it's a great reflection of how advanced robotics systems have become if an off-the-shelf product can be picked up and placed into a nuclear site without requiring any adaptation.

Burns rightly points out that there's a strong commercial argument for off-the-shelf systems, too: "Major nuclear automation projects are few and far between and happen only every couple of years at best. And the nuclear industry is prone to projects being delayed, postponed or cancelled. This has impacted business planning and financial forecasting at KUKA in the past. So, we



MEET THE SMURFS

Scientists have suggested that nuclear power stations could be decommissioned in the future with the help of teams of autonomous robots known as the SMuRFs (Symbiotic Multi-Robot Fleet).

Engineers from University of Glasgow, University of Manchester, Bristol Robotics Laboratory and Heriot-Watt University are behind the development of the SMuRF system, which provides a seamless method to enable wheeled, four-legged and airborne robots to collaborate and complete tasks that could be difficult or harmful for humans to undertake on their own.

Instead, a single human supervisor can remotely observe the actions of the robots as they share sensor data between themselves, combining their abilities to achieve results far beyond the reach of a single machine.

SMuRFs could offer authorities, regulators and industry a safer, faster method of monitoring nuclear facilities, as well as opening up new opportunities for the maintenance of engineering infrastructure in challenging environments such as offshore wind power platforms.

now want to capitalise on this USP of using standard KUKA robots in nuclear environments."

SELLAFIELD SUCCESS

A case study that aptly demonstrates how useful robotic systems can be in this sector is the safe decommissioning of a 1950s nuclear waste storage facility at Sellafield.

Detailing this work, Burns says: "Two robot cells were built for the emptying of the Pile Fuel Cladding Silo facility that is on the Sellafield site. One cell is currently active in waste retrieval. In this

Above: Moving beyond bespoke solutions, KUKA Systems is now focusing on the supply of standard products for nuclear environments

application the robot removes bolts from the waste container lid.

"The container is then filled with waste and returned to the robot where the bolts are inserted and tightened to a required torque. A swabbing operation is then carried out by the robot to ensure that the container is clean before export to a storage facility."

This swabbing process is a common use of the KUKA robots in many other facilities, too. "Typically, the robot is swabbing around the lid seal and bolt area. It is also possible to swab the sides of the container if a turntable is used to move the box. Some applications also see the robot swabbing the underside of the box if the engineering study deems it necessary," explains Burns.

He adds that the entire swabbing process is automated – the tooling having a built-in level of compliance ensuring constant and repeatable pressure is used for each container: "Collection of the clean swabs from a cassette and presenting the used swabs to a radiation detector are automated processes performed by the robot."

KUKA robots have also been used for tasks such as waste levelling and housekeeping. On this, Burns comments: "When packing waste into containers it's important to achieve the best packing



Above: KUKA robot working at a nuclear site

fraction possible to reduce the number of containers needed for storage and the costs associated with that in the long-term."

Such successful deployments mean that Burns can now describe KUKA robots as "the preferred robot of choice for processes where radiation is present."

He also notes an edge over other players in the market due to the fact that a KUKA robot can easily be modified to reduce the risk of on-board electronic items degrading and causing failure when exposed to radiation: "Some other robots use different onboard electronics that are very difficult and expensive to remove and replace." 