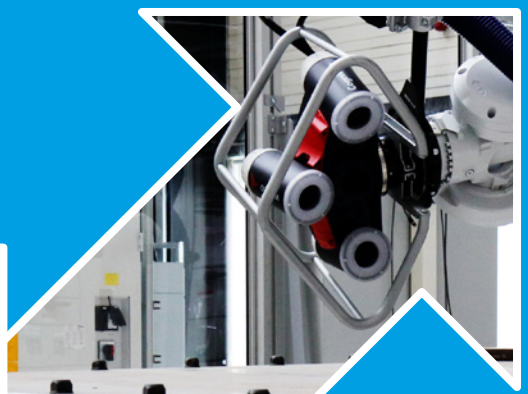
NUCLEAR **AMRC**
annual review 2016



Nuclear AMRC executive

The Nuclear AMRC refreshed its executive team in 2016, ensuring we have the experienced leadership in place to help UK manufacturers win work.

Mike Tynan, chief executive officer

Mike Tynan joined the Nuclear AMRC in 2013, with responsibility for overall leadership and strategy. He was previously chief executive of Westinghouse UK. Mike is also visiting professor in nuclear manufacturing at the University of Sheffield, a member of the UK government's Nuclear Industry Council and Nuclear Innovation Research Advisory Board, and a founder board member of the National Skills Academy Nuclear.

Andrew Storer, managing director

Andrew Storer is responsible for day-to-day leadership of the Nuclear AMRC. He joined in 2015 from Rolls-Royce, where he was programme director of the civil nuclear business with responsibility for leading customer engagement and bids with new build developers.

Steve Lawler, operations director

Steve Lawler joined the Nuclear AMRC in August 2016 from Rolls-Royce, where he held management positions in manufacturing R&D and in-service reactor fleet support. He is responsible for managing the safe delivery of R&D programmes in the Nuclear AMRC's research factory.

Jay Shaw, business development director

Jay Shaw joined the Nuclear AMRC in 2011, becoming head of machining before moving to business development, and was appointed director in December 2016. He is responsible for identifying and creating opportunities for UK manufacturers to win work in nuclear, and for growing the Nuclear AMRC business.

Colin Walters, programme director

Colin Walters joined the Nuclear AMRC in October 2016 after leading facility, business and membership development for TWI over 17 years. He previously spent 18 years with BNFL at Sellafield. Colin is responsible for managing the Nuclear AMRC's resources to deliver the maximum benefit to the UK supply chain.

Safety culture

The safety of our staff and partners is of paramount importance. We have recorded over 1,500 days without a lost-time accident since the Nuclear AMRC started full operations. Over 2016, we recorded three accidents, 31 near-misses or incidents, and 365 flags raised.

We have introduced human performance standards across our operations, to make sure we meet industry expectations for nuclear safety culture. All 114 staff have completed training in error prevention tools, and 12 staff members have been accredited as human performance leaders.

Respect & equality

The Nuclear AMRC's commitment to supporting women in engineering and research has been recognised with the Athena Swan bronze award.

The Athena Swan scheme promotes commitment to advancing the careers of women in science, technology, engineering and related fields at universities and research institutions. The bronze award demonstrates that an institution has a solid foundation for eliminating gender bias and developing an inclusive culture that values all staff.

Executive **overview**

The Nuclear AMRC continued to develop strongly through 2016, building its reputation as a national asset for the UK civil nuclear industry.

A central focus for the industry over the past year has been the opportunity to develop a small modular reactor (SMR) in the UK, and the Nuclear AMRC has been a key asset for both industry and government. There have been two prominent issues: first, what innovative manufacturing will be required to realise savings on potential volume production of an SMR? And second, how might the UK supply chain take advantage of the SMR opportunity?

Throughout 2016, we have worked with SMR technology developers to address both of these issues. We produced a groundbreaking study on SMR manufacturing with Westinghouse, and hosted the very first UK supplier day for SMRs with NuScale. We have also provided independent advice to government, and been closely involved with the government-sponsored competition for a UK SMR technology.

We have continued to build strong relationships with nuclear technology vendors, leading suppliers into the nuclear industry, the SME community for nuclear, and the Office for Nuclear Regulation (ONR). We are differentiated as a centre by our nuclear expertise, and we have strengthened our executive team to reflect our need to sustain our nuclear core capability. We add valuable capability and capacity to drive innovative thinking for UK manufacturers as part of the High Value Manufacturing Catapult, and we lead the national initiative for developing the UK's civil nuclear supply chain.

During 2016, we have been part of key national forums for nuclear strategy, nuclear skills development, nuclear research and development, and the advancement of nuclear technology – and the results of our collaboration with industry, government and academia have been outstanding.

The 10 companies in our high-intensity Civil Nuclear Sharing in Growth programme have reported almost £400 million of new work won, creating or sustaining 5,000 high-value jobs in UK manufacturing. We have demonstrated that innovative manufacturing techniques developed here can halve the lead time for an SMR reactor pressure vessel. We have welcomed over 6,500 industry visitors to our showcase centre, and recorded over 1,500 days of operations without a lost-time accident. And in what is, for me, one of the most satisfying of our achievements, we received the Athena Swan Bronze award for gender diversity and equality in our workforce.

I am proud to say that, throughout 2016, the entire team at the Nuclear AMRC have delivered the centre's best ever performance, and have established the centre as part of the UK's civil nuclear backbone. With the opportunities for UK civil nuclear looking good for 2017, we are poised to go from strength to strength as a world-leading centre of excellence for nuclear advanced manufacturing.

Mike Tynan,
chief executive, Nuclear AMRC

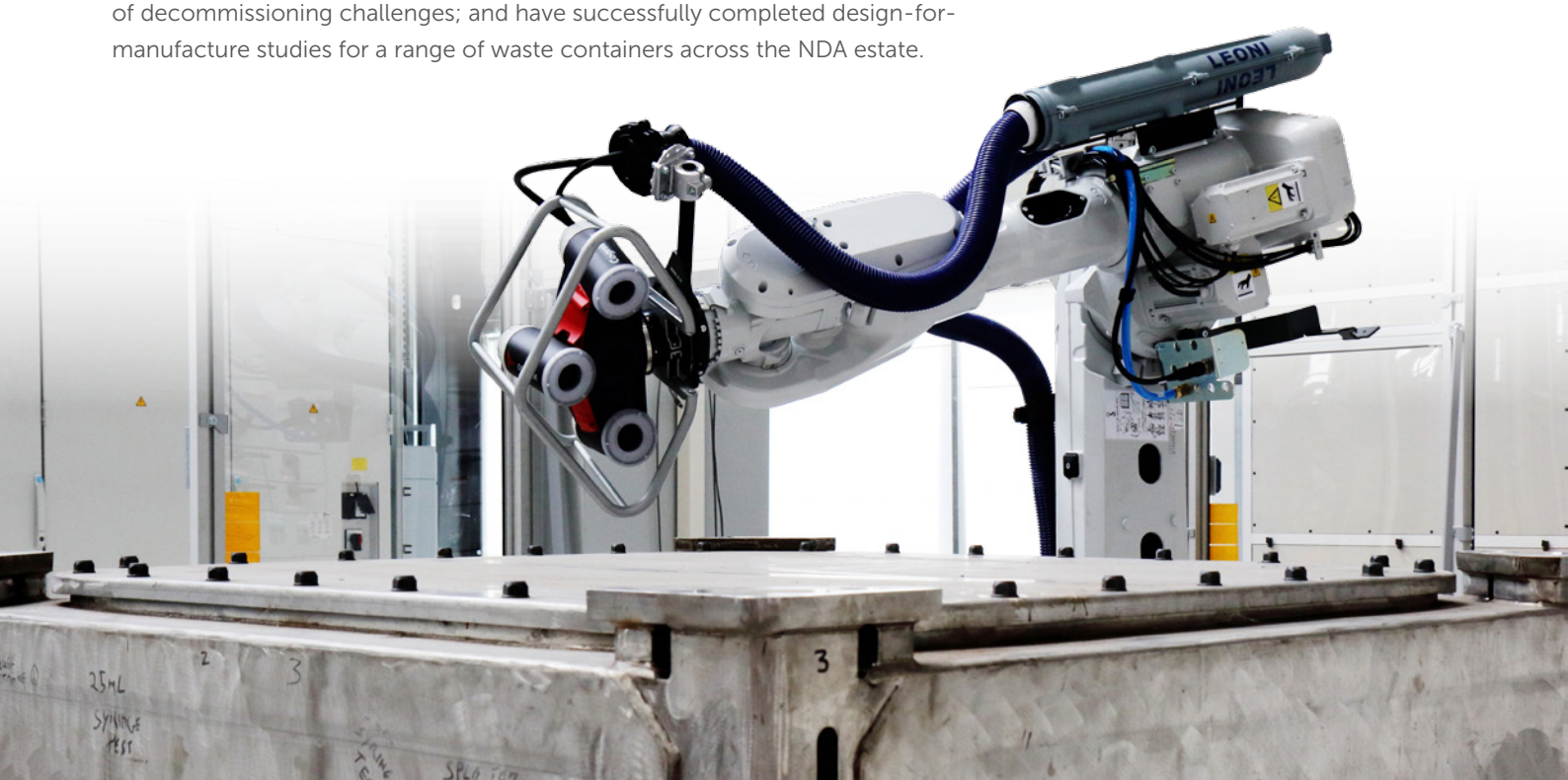
Manufacturing **innovation**

We continue to work with a wide range of companies to solve their manufacturing problems, and help them develop the technical capability to compete on cost, quality and delivery.

We worked with companies along the supply chain in 2016 to help them win work and overcome problems in all areas of civil nuclear – new build, operations, decommissioning and advanced technologies – as well as in other quality-critical industries such as aerospace and oil & gas.

With **small modular reactors (SMRs)** at the top of the agenda, our collaboration with Westinghouse drew international interest. We demonstrated that the UK has the advanced manufacturing capabilities to effectively manufacture Westinghouse's SMR reactor pressure vessel, one of the largest and most demanding parts of any reactor. We showed that Westinghouse's use of UK advanced manufacturing techniques offers a potential 50 per cent reduction in delivery lead times and substantial cost savings. We continue to work with Westinghouse and modular construction specialists from Cammell Laird to explore potential design efficiencies.

We are leading a key programme to reduce the cost of making **decommissioning waste containers**, potentially saving taxpayers hundreds of millions of pounds. We are working with Sellafield Ltd to significantly reduce the cost of the standard 3m^3 box, focusing on optimising and automating welding of the container, and casting the lid flanges. We are also leading the new waste container integrated innovation team, part of a new initiative led by Sellafield Ltd to tackle a range of decommissioning challenges; and have successfully completed design-for-manufacture studies for a range of waste containers across the NDA estate.



New capabilities commissioned in 2016 include:

Advanced machining – the Heckert HEC800 is an advanced and adaptable platform for milling, drilling and turning in a single set-up. Provided by member Starrag UK, the HEC800 is ideal for five-sided machining of components such as valve bodies and housings.

Rapid arc cladding – the new hot wire TIGer system provided by member Polysoude can clad at up to ten times the speed of conventional systems while maintaining material quality.

We offer UK manufacturers access to over £30 million worth of state-of-the-art manufacturing equipment, including many of the largest and most advanced machine tools and welding cells available for collaborative R&D anywhere in the world, and continue to invest to make sure that our services meet industry demand.

X-ray diffraction – the Proto LXRD system quickly and automatically maps surface stress on samples of up to 1.5 metres, supporting our research into advanced machining technologies such as cryogenic machining.

We are carrying out applied research into some of the fundamental challenges in nuclear manufacturing.

Recent and ongoing projects include:

- **Diode laser cladding –** we demonstrated record-breaking rates of over 10kg/hr for a nickel-based alloy clad, and over 8kg/hr for a high-performance stainless steel, using a bespoke large powder nozzle.
- **Single-platform machining –** we showed that thousands of deep holes (length-to-diameter >30) can be drilled through a steam generator tubesheet using a standard machining centre, offering significant savings in manufacturing cost and time.
- **Automated welding –** we have integrated advanced welding tools with robotic control to automatically form complex joints in waste containers and other demanding fabrications to high quality standards.
- **Safety-critical machining –** we led the McScamp collaboration to develop machining techniques to reduce the risk of component failure over a reactor's lifetime.
- **Powder metallurgy –** we led the PowderWay collaboration to create a strategy for developing powder-based processes such as hot isostatic pressing and additive manufacturing for civil nuclear applications.

We lead and participate in numerous collaborative R&D projects, supported by UK and international funding programmes.

New and ongoing projects include:

- **Nnuman –** a £8 million, four-year EPSRC-funded programme to develop new R&D capabilities to support the future needs of the UK and global nuclear industry. We have completed studies involving a range of advanced machining techniques.
- **Amos –** a European-Canadian collaboration into innovative repair technologies for the aerospace industry. We are using our bulk additive manufacturing cell to develop weld-based techniques for repairing damaged components to a high quality standard.
- **Innovative forging and fabrication solutions for the energy sector –** a £4 million Innovate UK project led by Sheffield Forgemasters to reduce the cost, lead time and embodied energy of large forgings. We are providing machining and other process development support.
- **Coroma –** a European collaboration to develop cognitively-enhanced modular industrial robots which can flexibly perform a range of manufacturing tasks with minimal input from human operators. We are working with Equipos Nucleares to demonstrate deburring, polishing and examining processes for large reactor components.

Civil Nuclear **Sharing in Growth**

Our flagship programme of intensive business development for key members of the UK civil nuclear supply chain, supported by the Regional Growth Fund, continues to exceed its targets.

After three years of the four-year programme, the CNSIG companies have reported:

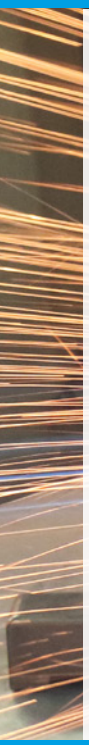
£395.5 million of new contracts won against a target of **£177.4 million**

Created or sustained **4,361 jobs** against a target of **2,077**

Committed **£30.8 million** of **additional private sector investment**

Highlights include:

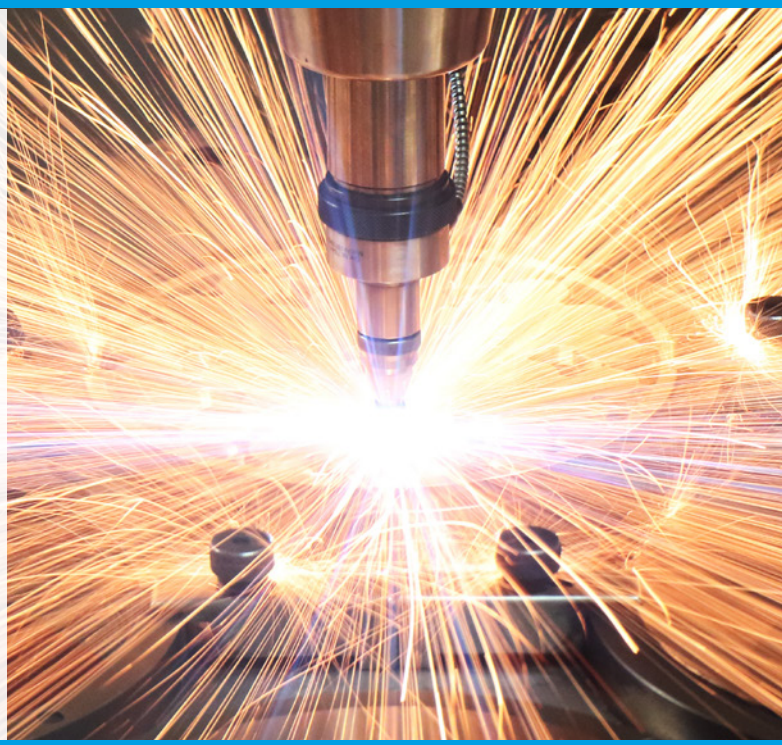
- **Stainless Metalcraft** opened a new manufacturing facility to produce waste containers for Sellafield, after winning a £47 million order in 2015. The Cambridgeshire firm has invested over £2 million in new tools and capabilities. Metalcraft also won the Minister's Award at the NDA Supply Chain Awards.
- **TSP Engineering** reduced manufacturing time for an order of specialist bogies for a decommissioning project by over a quarter. TSP engineers worked with the CNSIG team to identify a range of process improvements, and cut overall transport distance for each assembly by 70 per cent.
- **Therco** improved on-time delivery rates by 88 per cent in 12 months using business improvement techniques in the machine shop, and is investing in new automated welding equipment to meet growing customer demand.
- **NIS Ltd** achieved the ISO 3834 and EN 1090 welding quality accreditations, and applied them to new automated welding processes. The team also introduced a new quality management system to improve process efficiency.



Supplier **development**

We are working with companies along the UK's civil nuclear supply chain to help them compete by raising quality, reducing costs, and developing new capabilities.

We work from the bottom up, helping manufacturers of all sizes to enter and compete in the civil nuclear supply chain; and from the top down, working with reactor developers and site licensees to identify UK suppliers with the capabilities to meet their specific needs.



We continue to develop Fit For Nuclear (F4N),

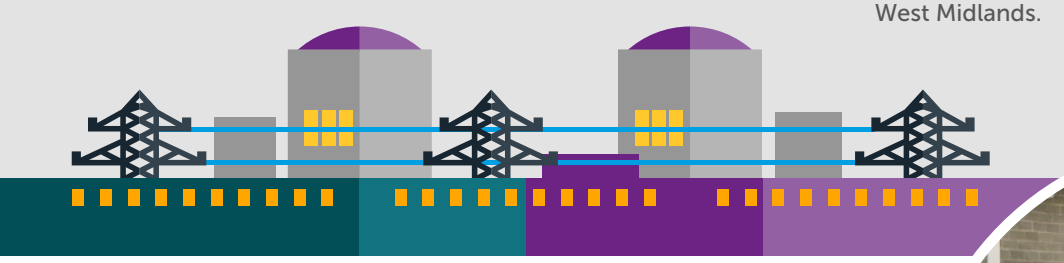
our unique service to help UK manufacturing companies get ready to bid for work in the civil nuclear supply chain.

During 2016, 126 companies completed the online F4N assessment, bringing the total since the programme's launch to over 570. A record-breaking 47 companies completed the programme and were granted F4N during the year, 102 to date.

A survey of participating manufacturers at the start of the year showed F4N's impact on the UK supply chain. Seventy per cent of respondents said they have increased confidence in entering the nuclear market, and half reported a better understanding of buyer requirements. As one respondent said: *"It has helped to remove the fear of the nuclear industry."*

Programme developments in 2016 include:

- Online portal to help companies manage every step of their F4N journey.
- Five industrial advisors joined the team to help companies across the UK.
- F4N Wales – a new collaboration with the Welsh government, with 20 companies receiving dedicated support.
- Regional engagement events to introduce even more UK manufacturers to F4N support, with launch events in South Yorkshire and the West Midlands.



F4N milestone for **Paul Fabrications**

Precision engineering group Paul Fabrications became the 100th company to be granted Fit For Nuclear, after driving business improvements through a tailored action plan.

Based near Derby, Paul Fabrications has decades of experience in civil nuclear and aerospace. It currently produces intricate spacer grids for the fuel assemblies produced at Westinghouse's Springfields facility, but wanted to target new opportunities in new build and other markets.

F4N allowed the company to focus on the particular requirements of the modern nuclear sector, and identify opportunities in new build, decommissioning and SMRs.

"Fit For Nuclear helped us see what the nuclear industry requires that is a little different to what we do in aerospace, and gave us some structure about how these improvements go across the site," said business development executive Kevin Dexter.

Other new F4N companies profiled in our quarterly newsletter include **Flamgard Calidair, Fan Systems (Witt UK), Lloyd Morris Electrical, Abbey Forged Products,** and **Lestercast**.

Industry engagement

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

We are actively engaging companies and stakeholders along the UK's civil nuclear supply chain.

Our business development team includes dedicated account managers targeting opportunities in nuclear new build, operations, decommissioning and small modular reactors; and building relations with key government stakeholders.

In 2016, we welcomed over **6,500** industry and stakeholder visitors to our centre in South Yorkshire – from the UK secretary of state for business, innovation and skills; to international delegations from China and the US.

We presented and exhibited at key industry events including:

- World Nuclear Exhibition (Paris)
- SMR Summit (Atlanta, US)
- NDA supply chain event (Manchester)
- NIA Nuclear2016 (London)

We hosted industry events including:

- NuScale's first UK supply chain event.
- Technology showcases for members Polysoude and Hexagon Manufacturing Intelligence.
- RCC-M technical awareness day.
- Technology roadmapping for SMRs, welding & cladding, and additive manufacturing.
- Forums on bulk additive manufacturing and cryogenic machining.

We gave the AMRC Mantra lorry a major upgrade to take our message on the road. The new-look showcase made its public debut at a nuclear manufacturing event in Swansea in March.

Our website received almost **40,000** unique visitors in 2016.

Over **2,700** companies and individuals follow @NuclearAMRC on Twitter, and over **1,100** on LinkedIn.

Our media coverage included:

World Nuclear News, Nuclear Energy Insider, Nuclear Future (Nuclear Institute), Industry Link (NIA), Energy World (Energy Institute), Production Engineering Solutions, Machinery, MWP Advanced Manufacturing, Aerospace Manufacturing, Laser User, Powder Metallurgy Review, The Register, The Times, Financial Times, The Economist, Reuters, Yorkshire Business Insider, Sheffield Star, Today (BBC Radio 4)

To find out more about how we can help your business,

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