



NUCLEAR **AMRC**  
**news**

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# Powering up the Midlands

Meet the researchers delivering  
low-carbon innovation



University of  
Sheffield

**CATAPULT**  
High Value Manufacturing

# Nuclear AMRC Midlands opens for business

First look: Nuclear AMRC members visit the new facility (L-R David Atkinson, NDA; Mick Gornall, Cavendish Nuclear; Duncan Steel, Jacobs; Sean Murphy, Nuclear AMRC; Kirsty Armer, Westinghouse; David Mallaburn, EDF).

**The new Nuclear AMRC Midlands is now open to help more manufacturers overcome the challenges and seize the opportunities of the global move towards net zero emissions.**

The £20 million facility at Infinity Park Derby expands the Nuclear AMRC's capabilities in technology areas including digital engineering, control and instrumentation systems, and additive manufacturing. It builds on the success of pilot facilities at Infinity Park's iHub building, which is now home to the Rolls-Royce Nuclear Skills Academy.

The new 4,300m<sup>2</sup> Nuclear AMRC Midlands is based around a large open-plan workshop with ten metre ceilings and 50 tonne cranes to allow work on large fabrications and assemblies.

The building also features a host of specialist laboratories including dedicated space for 3D printing and rapid prototyping, virtual reality and visualisation, and equipment qualification, as well as flexible office and meeting space for up to 130 people.

The centre's programme board of industrial members met in the new boardroom in early July, followed by a tour of the facility.

As befits a building dedicated to low-carbon technology development, Nuclear AMRC Midlands has been designed and built to high standards of environmental sustainability. The facility features 590m<sup>2</sup> of roof-mounted solar panels, generating around 83MWh of low-carbon energy a year – equivalent to the average electricity consumption of 28 households.

Construction has been supported by Derby City Council and the D2N2 local enterprise partnership, with the mission of growing a more resilient manufacturing supply chain in the region.

The centre will also support skills development to help the region's workforce adopt new technologies and seize new opportunities in growing low-carbon industries.





# New research teams tackle the challenges of net zero



Sky-high ambitions: the C&I team prepare a drone for trials of site monitoring sensors (L-R Dr Moupali Chakraborty, Dr Arslan Ahmed, Dr Hafiz Ahmed).

The Nuclear AMRC's newest research teams are expanding the centre's capabilities to apply innovative technologies, reduce emissions and maintain safety across the nuclear industry.

The Nuclear AMRC Midlands facility features a range of specialist laboratories alongside the main workshop, providing dedicated space for applied innovation in technology areas including control and instrumentation systems, additive manufacturing, and digital environments and engineering.

The control and instrumentation (C&I) labs are now home to a range of research equipment formerly housed in the iHub facility, with more resources planned to meet industry requirements and explore new technology areas.

"Our plan is to grow the lab with more equipment, based on discussions with academic and industrial partners about how we can accelerate the transition to net zero," says Dr Hafiz Ahmed, head of the C&I group.

"For example, we're looking at how we can facilitate the power grid of the future to integrate nuclear and renewable energy, and working on some ideas about how we can use nuclear for hydrogen production to support grid stability."

The cybersecurity of C&I systems is a major focus for the team. "This is an issue that everyone is looking at now, as any cybersecurity breach in the nuclear sector can have dangerous consequences," Ahmed notes.

The researchers are also tackling other challenges of security and hazard reduction at nuclear sites. In ongoing research, the team are working with an unmanned ground vehicle (UGV) and an aerial drone to develop new tools for hazard location and monitoring. The team have carried out trials of the UGV with ground penetrating radar and are now testing the technology on the drone, with the aim of adding radiation sensors to both platforms.

The labs also offer specialist testing capabilities for electronic equipment, including a seismic shaker table for components weighing up to 100kg, and a smart power test facility

developed with member company Frazer-Nash Consultancy for testing relays used in nuclear control systems. "Hopefully we'll be testing control relays for Hinkley Point C in this system," Ahmed says.

Advanced sensors are another key area for research, with the team aiming to develop a comprehensive sensor net to enhance the safety and reliability of nuclear plant.

The additive manufacturing laboratory includes a Neotech five-axis printer capable of producing 3D printed electronics straight from a design file.

"We're looking at printing sensors for pressure and temperature as well as printed circuits, so we can build a complete sensor system for nuclear applications in any shape and geometry, with all the components working together," says Dr Moupali Chakraborty, senior research engineer for sensors and instrumentation.

Continued —————>

## Building digital environments

**The Nuclear AMRC's digital environment researchers sit in both Rotherham and Derby, with the new facility focusing on emerging technologies, the industrial internet of things, and cybersecurity technologies.**

The South Yorkshire researchers continue to focus on advanced visualisation including augmented and virtual reality (AR and VR) technologies, digital twins, connected technologies, and artificial intelligence and machine learning systems to manipulate and analyse complex data.

With many organisations increasingly working on complex engineering projects across several sites, the team are seeing strong demand for digital technologies which can share data across different platforms and allow seamless remote collaboration.

"To facilitate the nuclear manufacturing industry's transition towards Industry 4.0, traditional communication and data capturing methods will prove inadequate," says Dr Kwame Akowua, technical fellow for digital manufacturing. "We need to find innovative ways to establish seamless and secure connections between various equipment and facilitate safe data sharing."

The researchers focus on digital technologies which can enhance manufacturing operations and products, to help companies maximise revenue, minimise costs, improve quality and become more flexible. The team draw on a range of technologies, including virtual reality systems developed by immersive visualisation specialist Virtualis, which recently renewed its membership of the Nuclear AMRC.

The Derby team are now fitting out the digital laboratory with a technology demonstration space and VR suite. In the main workshop, they're updating a set of tracked mixed reality cells which were previously installed in iHub. The cells combine tracking technology with VR and AR headsets to create an immersive environment, and can be linked to a remote similar set-up for collaborative working.

While the Nuclear AMRC's original VR facilities in Rotherham were based around large immersive screens and cubes, in recent years the industry has increasingly adopted headsets and desktop installations which can allow more flexible working with less capital investment.

"We are moving away from the wall approach, as the newer advanced technologies give you a different experience," Akowua notes. "There are some companies who are looking at improving the wall approach, and other companies like Apple are looking at new approaches to headsets."

"One of the challenges of using headsets is that people get headaches because their eyes keep having to refocus – this is why going fully to VR headsets hasn't happened. We need to find a way of embedding the two technologies together."



Digital integration: Dr Kwame Akowua and Noel Padgaonkar.

## Smart twins for decarbonisation

**The C&I and digital teams are working together on a project funded by the Nuclear AMRC's industrial members to develop digital twins of workshop equipment to help manufacturers reduce their energy use and emissions.**

The project aims to create an AI-assisted platform to analyse the performance of individual machines, with a variety of sensors on machines feeding into the digital twins. The principle is being trialled on a 3D printer and other assets in Derby, as a first step towards a demonstration system which will monitor energy use across the Nuclear AMRC's three sites.

"By integrating data from sensors on each asset, people can monitor how much energy they're using and the carbon emissions they're creating in their facility," says software developer Noel Padgaonkar. "We are developing a plug-and-play digital twin platform for net zero manufacturing, to make it easy for companies to integrate in their own operations."

To reduce the cost and complexity of adoption, the system uses a modular approach based on open-source software. It will also be able to take account of varying energy sources, such as on-site wind and solar installations, to calculate the emissions caused by each manufacturing operation.

"Most companies will now have a target for net zero and reducing carbon emissions," Akowua notes. "One of the suggestions we've had is to incorporate those targets into the system, and suggesting how they can get there."

For all this data, we will use AI models which can generate suggestions on reducing emissions, and help you reach net zero in your own operations."

The work supports a new initiative led by the High Value Manufacturing Catapult, which is drawing on specialist expertise from across its seven centres to help smaller businesses minimise energy use and emissions.

With smaller manufacturers often finding it difficult to dedicate time and resources to new digital technologies, the project promises to deliver real benefits to the supply chain. "If we can make things easier for companies, they can integrate it by attaching a few sensors which will give them the information they need so they can make data-driven decisions regarding energy consumption and carbon emissions," Akowua says.

# University of Derby joins to drive innovation

The University of Derby has joined the Nuclear AMRC to collaborate on industrial research and skills development for nuclear and other low-carbon sectors.

The University of Derby is taking tier one membership of the centre, joining major industry players in nuclear new build, manufacturing, engineering services and research.

“We are delighted to become a member of the Nuclear AMRC – an organisation which we have worked closely with on the delivery of the Nuclear Skills Academy in Derby,” said Professor Warren Manning, Provost for Innovation and Research at the University of Derby.

“Collaborating together in such a way will further strengthen our partnership and enable us to share research and development opportunities, as well as exchange knowledge and expertise, supporting and addressing the local, regional and national skills needs. This is an exciting time for the sector with many opportunities, and we look forward to driving forward innovation together.”

The University of Derby will occupy around a quarter of the new Nuclear AMRC Midlands building, with researchers from the Institute for Innovation in Sustainable Engineering (IISE) moving into dedicated laboratories and workspace in the autumn.

IISE specialises in developing sustainable life-cycle design and manufacturing processes for products in sectors from transport to healthcare to help reduce their environmental impact. IISE offers collaborative innovation and research using a range of equipment for design, manufacture and testing, supported by specialist expertise including advanced manufacturing, computational modelling of materials and structures, life cycle management and data science.

The university and centre will work together on research projects in areas where the university has proven expertise, including process and materials modelling, composite materials, data science and visualisation, and thermofluids and combustion simulation.

The two organisations will also collaborate on skills development and provision to meet the needs of employers in the regional and national supply chain.

“The Midlands is home to a host of companies and organisations which can play a vital role in meeting the challenges of decarbonisation and energy security,” says Tom Purnell, Nuclear AMRC business development director.

“The University of Derby is at the heart of collaboration, innovation and skills development in the region, and it’s a pleasure to formally welcome them to the Nuclear AMRC’s network.

“With our shared facility now open for business alongside the Nuclear Skills Academy at Infinity Park, we are perfectly placed to work together to help manufacturers in Derby and beyond to seize the opportunities of the energy transition, and deliver sustainable growth and skilled employment for generations to come.”

[www.derby.ac.uk/research/centres-groups/iise](http://www.derby.ac.uk/research/centres-groups/iise)



Collaboration with impact: Professor Warren Manning with the Nuclear AMRC's Tom Purnell.



# Investment ambitions at Infinity Park

Nuclear AMRC Midlands welcomed its first ministerial visitor in May to discuss the growth of skilled employment at Infinity Park Derby and the wider region.



Virtual skills: Michael Gove tries his hand at a welding simulator.

Michael Gove and colleagues from the Department for Levelling Up, Housing and Communities visited the new facility to meet regional leaders for a round-table discussion and tour – with the minister taking the opportunity to try out virtual weld training equipment.

Discussions focused on regional devolution proposals in the East Midlands, including a potential investment zone in Derbyshire and Nottinghamshire – one of eight areas shortlisted across England with the aim of driving regional growth by linking universities with high-growth industries.

South Yorkshire was named as the UK's first investment zone in July, with £80 million government investment to build on the success of the advanced manufacturing innovation district between Sheffield and Rotherham which is home to the Nuclear AMRC's original facility on the Advanced Manufacturing Park. The investment is forecast to support 8,000 new jobs and £1.2 billion of private investment by 2030.

The South Yorkshire investment zone was welcomed by the University of Sheffield.

“Regions working collaboratively with universities to focus on innovation-led growth is absolutely the right strategy to drive forward opportunities,” commented Professor Koen Lamberts, President and Vice-Chancellor. “What the investment zone allows us to do is go further and create a more holistic approach, rooted in partnership between central and local government, in addition to research institutions and the private sector.”

Infinity Park Derby is meanwhile fast developing as a nationally important cluster for nuclear engineering. The pilot Nuclear AMRC Midlands facility opened in 2019 within iHub, the first building to open on the 100 acre development site.

iHub is now the home of the Rolls-Royce Nuclear Skills Academy, which was also visited by the minister and entourage. The first cohort of 200 apprentices completed their first year of training in July, with another 200 starting in the autumn.

The Nuclear AMRC worked with partners including the University of Derby, National College for Nuclear and Derby City Council to create the Academy, and ensure that apprentices in Rolls-Royce's submarines business have access to the best courses and mentors throughout their training.

Infinity Park is located next to Rolls-Royce's Sinfon site, to the south of the city centre, and within 20 minutes drive of major manufacturers including Toyota, Alstom and JCB. The masterplan for the park includes focused zones for manufacturing-focused research and technology, learning and the supply chain.

[infinityparkderby.co.uk](https://infinityparkderby.co.uk)



Keystone development: Nuclear AMRC Midlands on Infinity Park.

# Government urged to set nuclear strategy

The Nuclear AMRC has welcomed a report urging the government to take a strategic approach to nuclear development.

The Science, Innovation and Technology Committee report on delivering nuclear power warns that the UK's target of 24GW of nuclear generating capacity by 2050 is at risk without a comprehensive detailed and specific strategy.

The 24GW target is almost double the highest installed nuclear capacity the UK has ever achieved. The total is expected to include a mix of new gigawatt-scale nuclear power, small modular reactors (SMRs) and advanced modular reactors (AMRs), as well as potential fusion power plants.

The committee warned that reaching the target will require substantial progress on technologies, financing, skills, regulation, decommissioning and waste management, and recommends that a comprehensive nuclear strategic plan is drawn up, consulted upon and agreed before the end of the current Parliament.

"The select committee report is very welcome, and we strongly support their call for a comprehensive nuclear strategic plan," said Chris Pook, government policy director at the Nuclear AMRC. "However, this must include a plan for building UK supply chain capability and creating long-term economic benefit.

"We need to see more targeted action to open up opportunities for UK companies to bid for and win work in delivering new nuclear build, with support for innovation in the supply chain to increase competitiveness and drive down costs. We have the opportunity to build a competitive world-class industry to not only deliver domestic energy security needs but also win future business overseas. We urgently need clarity on what measures will be put in place to deliver supply chain capability and skills across the nuclear sector."

The government will respond to the report by the end of September.

Shortly after the report was published, the government announced a new Nuclear Skills Taskforce to help meet the workforce requirements of the energy and defence sectors. According to the select committee, the current civil nuclear workforce of over 65,000 people will need to more than double to meet the 2050 target, requiring between 75,000 and 150,000 new recruits.

The taskforce is headed by Sir Simon Bollom, former CEO of the Ministry of Defence's Defence Equipment and Support agency, and will include representatives from government, academia and professional bodies.

"We very much welcome this announcement and look forward to working with Sir Simon Bollom and the taskforce," Pook commented. "Making urgent progress on building the skills base for the nuclear industry is essential if we are to meet our ambitious target of delivering 24GW by 2050 and end our reliance on fossil fuels.

"Our experience in helping create the Nuclear Skills Academy in Derby shows just how important it is to build connectivity across the sector and bring together government, industry and universities to deliver the skills that industry urgently needs for the future."

## The Science, Innovation and Technology Committee report includes recommendations and requests for clarity in several key areas:

- **A clearer role for Great British Nuclear** – beyond the current SMR competition.
- **Establishing the right mix of technologies** – what proportion should be met by gigawatt-scale plants, and how much by SMRs and AMRs.
- **Financing of new nuclear** – including the cost of the risk transfer from the Regulatory Asset Base (RAB) model.
- **Small modular reactors** – whether technologies should be from a single supplier or multiple; sites for deployment; and what financial model would be used.
- **Skills** – coordinated actions by the whole sector.
- **Decommissioning** – a clear understanding of the waste consequences of new nuclear technologies, how they will be dealt with, and at what cost.
- **Fusion** – the UK needs to demonstrate a long-term approach, giving confidence and stability to investors and international partners.

# SMR competition opens selection phase

Panel discussion: nuclear minister Andrew Bowie with Andrew Storer at the GBN launch event.

**The UK government has opened the next phase of the small modular reactor competition managed by Great British Nuclear, and announced a string of investments to bring advanced nuclear reactors closer to market.**

Great British Nuclear (GBN) is now inviting SMR developers to register their interest in its competition for product development funding. First announced in March, the competition could result in billions of pounds of public and private sector investment.

GBN will select up to four SMR technologies which meet its criteria in the autumn, then enter into detailed discussions with the successful companies with the aim of helping one or more reach a final investment decision on a UK new build project by 2029. Support will include funding for technology development and site-specific design, and help in accessing sites.

The government says it remains committed to gigawatt-scale projects, and has released £170 million of previously announced funding to support construction of Sizewell C. It will work with GBN to consider the potential role of further large nuclear power plants in the UK energy mix.

Originally announced in April 2022, GBN is a government-funded arm's-length body to drive delivery of new nuclear projects. Interim chair Simon Bowen said the start of the SMR selection process signifies a step forward in delivering new power stations at scale.

"We look forward to working with all interested parties – technology vendors, the supply chain, the wider industry and local communities – as we move this essential programme forward," Bowen said.

The competition was welcomed by SMR developers. "We look forward to playing our part," said Jay Wileman of GE Hitachi. "We believe our BWRX-300 small modular reactor is an ideal solution for the UK's decarbonisation and energy security goals."

Chris Cholerton of Rolls-Royce SMR said the competition gives GBN a clear mandate. "We're eager to progress through the SMR selection process and enter detailed negotiations as quickly as possible," he said. "As the only SMR technology in the UK regulatory process, we are at least 18 months ahead of any competitor and are ready to work with the government at pace."

Speaking at the GBN launch event in July, ministers also provided an update on other nuclear support programmes.

The Future Nuclear Enabling Fund, first announced in 2021, will grant up to £77.1 million to three as-yet-unnamed companies to support the development of advanced reactor designs: two have been shortlisted for a full award, and one for partial funding.

In the advanced modular reactor (AMR) research, development and demonstration programme, the government will provide further support for three projects involving high-temperature reactors for industrial applications such as hydrogen and sustainable fuel production.

Ultra Safe Nuclear and Jacobs were jointly awarded £22.5 million for design development of their Micro-Modular Reactor (MMR).

"The UK has long and unique experience with gas reactor technology the MMR builds on, and this is the right team to demonstrate the design's versatility to meet the world's market needs," said Francesco Venneri, CEO of Ultra Safe Nuclear.

NNL meanwhile secured £15 million to develop a high-temperature reactor based on a Japanese design, plus £16 million to develop coated particle fuel capabilities.

The new Nuclear Fuel Fund is supporting eight projects to develop fuel production and manufacturing capabilities. Westinghouse secured £10.5 million to manufacture innovative fuels at its Springfields site, and Urenco has £9.5 million to support high-level uranium enrichment.

Nuclear Transport Solutions was awarded £1 million to develop a transport package for new uranium fuels, and MoltexFlex secured £1.2 million for molten salt fuel development rigs.

"This award represents an important signal of support from government for advanced modular reactors in the UK, and helps MoltexFlex make significant progress in commercialising the fuel salt manufacturing route," said CEO David Landon.

For the latest from Great British Nuclear: [www.gov.uk/government/organisations/great-british-nuclear](https://www.gov.uk/government/organisations/great-british-nuclear)



## Executive view



# One step towards delivery

July's long-awaited launch event for Great British Nuclear was a welcome step towards new reactor development in the UK, but it was only a small step at a time when we really should be powering ahead.

**GBN's initial mission to select the best SMR technologies for the UK is welcome, as a clear delivery plan will give business the confidence to invest in the sector, and help us build a clean and secure energy supply for the future. However, we still need to be clear how we will deliver our national target of at least 24GW of nuclear power by 2050.**

To deliver low-carbon power and ensure that Britain secures the huge economic opportunities, we need to be working at a pace such as we adopted during the Covid pandemic to deliver vaccinations and ventilators. There must also be investment in the supply chain to build manufacturing capability and capacity.

Having been closely involved with the initial development of GBN last year, I know there are a lot of recommendations for action by the new team, including 11 to tackle issues in the supply chain and skills provision.

With this in mind, I am disappointed that investment in the supply chain wasn't included in the initial announcements, but will continue to work with government and GBN to bring forward much-needed investment as soon as possible.

The Nuclear AMRC's unique position as a trusted partner to industry and government means that we can help deliver the innovations, supply chain capability and skills needed to create a vibrant and dynamic nuclear industry that delivers jobs and growth across the UK.

Fit For Nuclear (F4N) and our other supplier development programmes have proven their value over the past decade, with participating companies reporting a total of

more than £3 billion of new contracts won through our support – that equates to more than 11,000 jobs created or sustained.

We'll be helping even more companies during the next phase of F4N, which we're launching in Parliament in September, but maximising the benefits for UK suppliers will require sustained support from government and the whole industry.

More than ever, we need to work as one sector. The UK's new build programme stands at a pivotal point, and we also need to decommission our legacy fleet, industrialise fusion power, and develop innovative technologies for space missions and difficult-to-decarbonise industries.

We've also seen an increased national focus on defence and security, including the delivery of a new fleet of nuclear-powered submarines for the UK and Australia. There's huge overlaps between the supply chain for civil and defence nuclear, in terms of technologies and companies – that means great opportunities for collaboration and sharing best practice, but also competing demands on scarce capabilities and capacity.

We must work much more efficiently across the sector than we have in the past, sharing resources, facilities and expertise across the industry.

For the supply chain, the biggest near-term benefits could come from a single approved vendor list, agreed across the industry. There's currently more than 300 vendor lists that the supply chain has to qualify on, just to be allowed to bid for work, which means that suppliers who want to grow their business spend a lot of

time and effort jumping through similar hoops time and again. One (or even 10) vendor lists would reduce the effort and costs significantly.

It is working differently and innovating across the whole sector that will bring the demand of people down.

With an estimated 150,000 people needed to deliver the UK's new build targets, the skilled workforce to build and operate nuclear plant has rightly attracted a lot of attention recently. I am very proud of our collaboration with Rolls-Royce, the University of Derby and other partners to launch the Nuclear Skills Academy last year, and skills development will be a key part of work at our new Midlands facility.

We will need to embrace innovation to reduce the on-the-job hours required and to help attract a broader diversity of people into the industry.

I don't recall a time that we have had so many opportunities for growth and for a new generation of people to be attracted. We can't afford to spend the time we do talking to each other (the jibber-jabber) about what we may do here or there. We have done enough talking about it. Now is the time for action and decisions, but decisions that are taken as a whole sector to ensure a connected delivery plan.

This will be the theme of our Nuclear Manufacturing Summit in October, where we will be discussing all these issues alongside updates from the GBN team and the industry's top tier. I look forward to seeing many of you there.

**Andrew Storer, CEO**

# International collaboration investigates new approach to weld repair

Rapid repair: the WeldCore equipment inserts a plug at 5,000 rpm.

**The Nuclear AMRC is working with engineers from South Africa and the US to develop a new weld repair technique to meet quality requirements for safety-critical fabrications.**

The research involves WeldCore technology developed for the power generation and petrochemical industries by eNtsa, an engineering technology institute based at Nelson Mandela University in South Africa.

WeldCore was developed to cut core samples for material analysis from high-pressure components such as steam pipes, and uses a solid-state welding technique known as friction tapered hydro pillar processing (FTHPP) to permanently plug the hole and allow the component to remain in operation.

The FTHPP process can also be used to tackle other engineering and manufacturing challenges – such as repairing a defective weld in a thick-walled pressure vessel.

The Nuclear AMRC has been developing electron beam welding techniques for reactor pressure vessels since 2018, in an ongoing collaboration with US-based research institute EPRI. The team have successfully demonstrated how electron beam welding can help slash the production time and cost of reactor pressure vessels for a new generation of small modular reactor (SMR), by replacing multiple arc welded passes with a single deep-penetration power beam weld.

But as in any welding process, there's always the risk of a defect which could lead to significant costs and delays, or even the scrapping of the entire fabrication. Before the process can be used in the nuclear sector, there must be a proven method for repairing such flaws.

"Codes and standards require you to have an effective repair strategy in place," notes Will Kyffin, head of welding and materials at the Nuclear AMRC. "This work is addressing one of the most severe types of flaw, where the electron beam welding process can't be used to repair the flaw itself."

To develop a solution to this worst-case scenario, EPRI introduced the Nuclear AMRC to eNtsa to explore the potential of using WeldCore in a pressure vessel manufacturing facility to repair defective welds with minimal delays.

"We did not have the opportunity or explore any WeldCore work on nuclear applications prior to this, so this is the first application of WeldCore on nuclear-related components," says Donnie Erasmus, deputy director for engineering and business development at eNtsa.

Following initial proof-of-concept trials at eNtsa's facility in Gqeberha in the Eastern Cape Province, the team visited the Nuclear AMRC in South Yorkshire to demonstrate the technology on a two-thirds-scale mock-up of an SMR pressure vessel.

In repeated trials, the WeldCore equipment cut out a conical section of the SA508 steel wall, and repaired it with a plug of a similar material.

The plug is spun into the hole at around 5,000 rpm under loads of up to 35kN, generating enough friction and heat to mix and permanently join the surfaces.

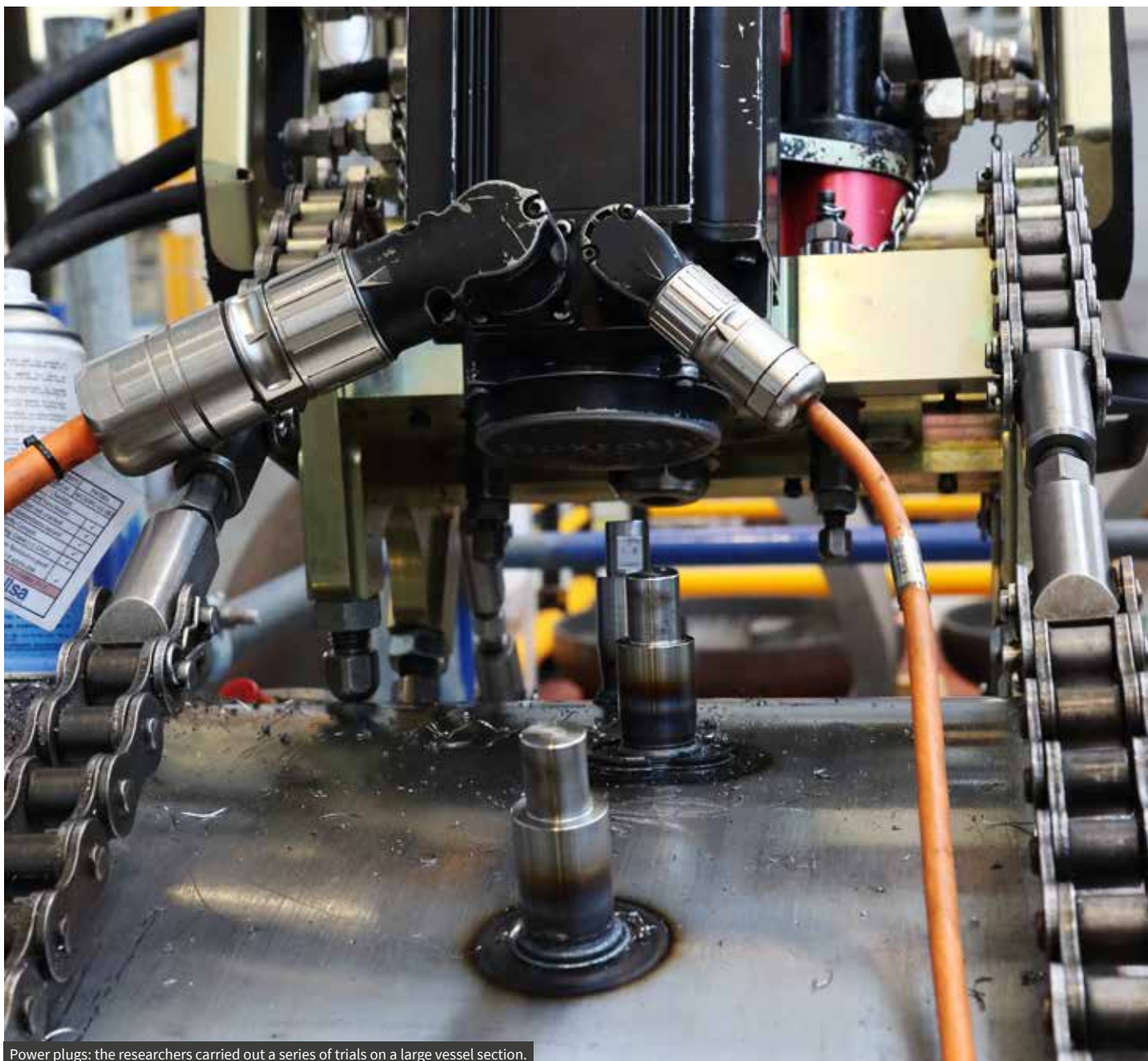
The plugged sections were then machined out of the workpiece for detailed metallurgical analysis.

Similar to an electron beam weld, the repair process produces an autogenous weld with no filler material, which is critical to the long-term material performance of the vessel. In commercial deployment, the plugs could be made from the same forging as the main vessel sections to provide an optimal repair, Kyffin notes.

The heat affected zone of the weld is also restricted, reducing the risk of material effects around the repair.

The collaboration has demonstrated that the most serious defects in an electron beam weld can be repaired using this approach, and shown that it can be deployed in the factory environment, Kyffin says. For larger faults, a number of overlapping plugs can be used to replace a longer section of the defective weld.





Power plugs: the researchers carried out a series of trials on a large vessel section.

Researchers from EPRI saw the results during their annual visit to the Nuclear AMRC in late June. The next phase of the research will form part of a new joint industry project led by EPRI to remove the barriers which prevent electron beam welding from being fully deployed in the nuclear sector. The project will investigate a selection of repair strategies, including WeldCore, to cover the full range of potential welding defects and anomalies.

For more information about eNtsa and WeldCore: [www.entsaengineering.co.za](http://www.entsaengineering.co.za)

To find out more about the new project led by EPRI: [www.epri.com/research/products/000000003002027860](http://www.epri.com/research/products/000000003002027860)



Team effort: researchers from the Nuclear AMRC and eNtsa.



# Reducing waste from additive manufacturing

**A new collaborative project aims to improve the environmental performance of additive manufacturing.**

Reducing the emissions, material waste and costs associated with metal additive manufacturing will allow wider use of these advanced production technologies.

The EnerAM project focuses on recycled 316L steel powder for additive manufacturing, with the aim of dramatically reducing material waste. Researchers are investigating a variety of manufacturing and recycling processes, using optimisation models and analytics to improve material recovery, and assessing the commercial viability of recycling.

Work at the Nuclear AMRC involves laser metal deposition (LMD), with researchers aiming to optimise the process for different combinations of primary and recycled materials.

To understand the material performance of parts made with recycled powder, the team built a testpiece measuring 80cm square from standard steel powder, and extracted samples for material testing.



Additive build: the EnerAM workpiece takes shape in the Nuclear AMRC's diode laser cell.

The workpiece and excess powder will then be recycled back into powder, for a second workpiece to be built and tested in the same way. The results will identify any material differences and potential problems with recycled powder.

The EnerAM project is supported by £1 million funding from Innovate UK, and led by Sheffield-based metal powder specialist Atomising Systems. Other partners include Laser Additive Solutions, HyBird Technologies and Brunel University.

# Explore the future of cooling

**This September, the Nuclear AMRC hosts its seventh annual cooling seminar to explore the state of the art in advanced coolant techniques for the most demanding machining applications.**

The one-day forum, held at the AMRC Knowledge Transfer Centre on 21 September, will bring together industrial users with researchers to discuss the opportunities and challenges of advanced cooling methods, and share the latest knowledge and innovation.

The Nuclear AMRC has led research into supercritical carbon dioxide coolant over the past eight years, with a focus on combining CO<sub>2</sub> with minimum quantity lubricant (MQL) techniques for the most challenging machining tasks.

Recent projects include work with difficult-to-machine refractory metals such as tungsten for applications in the fusion power sector.

These advanced cooling techniques can improve component surface integrity, cleanliness, reduce the cost of the components, reduce waste and cut the environmental impact of machining. But in applications where quality and performance are critical, dedicated research and development is needed to optimise delivery parameters and cutting conditions.

For full details and registration:  
[advancedcooling23.eventbrite.co.uk](https://advancedcooling23.eventbrite.co.uk)



Cool tech: milling trials with supercritical carbon dioxide coolant.

# Inside the international heart of fusion research

Nuclear AMRC staff recently joined a UK delegation visit to the Iter international fusion project in the south of France. Charles Carpenter, interim chief technology officer, outlines what he learned.

In June, the UK's Nuclear Industry Association and France's Groupement des Industriels Français de l'Energie Nucléaire organised a trip to the south of France to visit the Iter fusion project, and build connections between UK and French organisations for future opportunities.

A Nuclear AMRC team including myself, supply chain director Liz Gregory and CEO Andrew Storer supported the UK delegation to highlight advanced manufacturing research and innovation in the UK, as well as wider supply chain development initiatives such as our Fit For Nuclear programme.

The visit included networking events, sponsored by French engineering groups Egis and Assystem, which provided opportunities to engage with organisations that are actively working across the nuclear sector including fusion energy, generation IV reactor developers and decommissioning.

The UK's status for future opportunities around Iter is uncertain at this time, but the increasing number of private organisations developing fusion technologies – enabled by projects like Iter and the UK-based Joint European Torus – provided ample areas to discuss future opportunities for collaboration.

The visit showcased the science, engineering, manufacturing and construction required to develop a large-scale demonstrator, and the international collaboration which enables it.

The Iter assembly hall is absolute inspiring to see – not just because of the engineering and planning required for the vacuum vessel modules and toroidal field coils, but also because it highlighted the magnitude of the challenges that Iter has faced and will in the future.

The Iter site itself demonstrates the value of international collaboration with the European Union, India, China, Japan, Korea, Russia and United States all working together since the programme's launch in 1985.

The contributions of each partner can be seen across the site in the form of components, systems and buildings, and displays in the boardroom showed key milestones of the project, and how the collaboration has grown over the years with additional nations joining.

It was amazing to see a project that has provided the private sector with the confidence to invest in fusion energy, and that will inspire generations for decades to come.

[www.iter.org](http://www.iter.org)



Inspiring engineering: Charles Carpenter inside the Iter assembly hall.

# Express Engineering taps into nuclear opportunities

**Gateshead-based Express Engineering is targeting new opportunities after being granted Fit For Nuclear (F4N) status. The company has also expanded its capabilities by acquiring Middlesbrough-based QA Weld Tech, which was itself granted F4N in 2018.**

**Quality manager Martyn Baker explains how F4N is helping the company diversify its operations.**

Express Engineering is a contract manufacturer specialising in precision machining, welding and cladding, test and assembly, based in Gateshead on the Team Valley.

We thought that nuclear could be an interesting and potentially untapped area of alternative industry, which may align with our particular areas of expertise and capabilities.

We have previous experience in the nuclear industry, having participated in the Sellafield decommissioning project in 2018, supporting the fabrication and machining of radioactive waste containers. Our customer was Darchem Engineering.

The initial F4N assessment identified that diversification into the nuclear industry had not been formally documented as part of our strategic plan. We closed that gap by ensuring that nuclear was formally part of our strategic development plans for diversification, and that the strategy was disseminated downstream to key people who could affect change.

It also identified the potential to improve efficiency in the storage of workholding equipment such as clamps, jigs and fixtures. We now take a proactive approach to organising equipment and tooling.



Fit for the challenge: the Express Engineering management team.

Another gap was around the communication of health and safety matters within the workforce. We have introduced a quarterly campaign of relevant health and safety initiatives to improve focus and encourage feedback.

Having only just been certified, the benefits of being Fit For Nuclear are yet to flow through. However, we have identified several interesting projects which will align with our capabilities with several customers, and we feel the F4N approval will strengthen the weight of our enquiries.

We previously had success in the waste management side of the nuclear industry. Since then, we have increased the complexity of our processes, especially in areas such as additive manufacturing. We believe this will enable us to manufacture parts with deeper involvement in nuclear power generation.

In five years' time, we see ourselves producing high-value complex parts for customers, which have developed into key accounts.

[express-engineering.co.uk](http://express-engineering.co.uk)



# F4N evolution readies for launch

**The next phase of the Fit For Nuclear programme will be launched in the autumn, to help even more companies across the UK enter and win work in the nuclear sector.**

In early 2023, the Nuclear AMRC's supply chain team started a wide-ranging consultation with companies at all levels of the industry to ensure that the F4N programme is delivering value for the UK nuclear industry and supporting the work of Great British Nuclear and other stakeholders.

In May, the team held a review day with reactor providers, decommissioning site owners and government regulators to gain insight into the supply chain needs of the industry's prime organisations. Following similar discussions with tier one suppliers in June and July, the team are now consulting

with a host of small and medium-sized companies working at lower tiers.

"We're collecting views from all levels of the supply chain to better understand what is really valued and wanted by industry," says Liz Gregory, Nuclear AMRC supply chain and skills director.

F4N was created in 2011 as an online assessment to help manufacturers gauge their readiness to bid for work in the UK's nascent nuclear new build programme. The programme has since undergone continuing improvement and refinement to support a wider range of companies in greater depth.

The last major review in 2017 introduced additional post-granting support to help companies maintain their journey of business excellence, with companies required to renew

their granted status after three years, and launched the F4N Connect supply chain portal.

More than 100 companies are currently granted F4N. As of the end of July, granted businesses have reported that F4N has helped them create or safeguard 2,730 jobs, leverage £38.7 million private investment, and win contracts worth over £1.97 billion total.

The next phase of F4N will be launched in September, at a special event with industry and government stakeholders as part of Nuclear Week in Parliament. The Q4 edition of *Nuclear AMRC News* will include full details.

## Congratulations to the latest companies to be granted Fit For Nuclear.

These companies have benchmarked their performance against the standards demanded by the nuclear industry's top tiers, and driven business improvements to fill any gaps.

**Express Engineering** is a contract manufacturer specialising in precision machining, welding and cladding, and test and assembly.  
[express-engineering.co.uk](http://express-engineering.co.uk)

**William Cook Cast Products** manufactures specialist steel components for safety-critical applications in markets including defence, rail and nuclear.  
[www.william-cook.co.uk](http://www.william-cook.co.uk)

### Congratulations also to the following companies on being regranted F4N:

Berry & Escott Engineering, Fort Vale Nuclear, G R Carr, Graham Hart (Process Technology), Hardstaff Barriers, Heatsense Cables, Helander Precision Engineering, Induchem UK, Laker-Vent Engineering, Ledwood Mechanical Engineering, Lestercast, NE Components, Oldham Engineering, R-Tech Materials, Site Heat-treatment Services, Swagelok Manchester and Vessco Engineering.

For details of F4N-granted companies: [namrc.co.uk/services/f4n/companies](http://namrc.co.uk/services/f4n/companies)



# Safety first on blood bike runs

When he's not working as project manager and principal engineer at the Nuclear AMRC, David Anson volunteers with the Whiteknights Yorkshire Blood Bikes charity to safely carry medical material to where it's urgently needed. He explains what he does, and the parallels with nuclear manufacturing.

I've been volunteering with Whiteknights Blood Bikes since Covid started. The charity exists to provide out-of-hours service to the NHS, with three divisions covering the whole of Yorkshire – I work in the southern division, covering the Sheffield-Rotherham area.

Everybody on the bikes has to be an advanced motorcyclist, which I have been for five or six years now. When Covid came along and it was a case of seeing what I could do to help, it seemed a natural progression for me to be involved in this.

We provide an emergency service to the NHS around the area. For example, I was on call-out from seven o'clock last night to seven o'clock this morning. I had five call-outs: three before I went to bed, and two I was woken up to do.

The first one was taking some records from the Hallamshire Hospital to Northern General, then there was two lots of picking up emergency medication from radiology and taking them out to people who had emergency appointments in the morning. Then the two runs at night were both taking samples from the Children's Hospital to the Northern General labs.

Because the charity is part of a national system, we also do relay runs for emergencies and also for research. The longest relay I've been involved in was something that had to go from the very south of England up to Newcastle – there were five legs involved, and I was the fourth. Normally it would have been taken by private aeroplane, but the weather forecast wasn't good.



Cutting through: David Anson hits the road.

It was deemed to be too bad for an aeroplane, and it still wasn't exactly brilliant for a motorbike. Nonetheless, it got through in the end. I haven't a clue what it was, which is the case for most of the things that we carry.

The research stuff that I do know about is called FMT, which helps people who have serious issues with antibiotics not being able to cure them. You can look it up – we carry it, and it's frozen in little envelopes.

There is a parallel between doing this and working in the nuclear sector, and it's all down to health and safety. We want zero defects, we want zero accidents.

We are having to work in some unpleasant weather conditions and challenging situations.

The bike has the great advantage of being able to cut through traffic, but you have to do that safely. The bike is liveried up so we do get noticed, but it doesn't stop people pulling out in front of us. We're not allowed to speed, we're not allowed to use blue lights.

It's also about what's in the head, and being a qualified advanced rider. It's about defensive riding, it's about stopping accidents happening in the first place even when it hasn't been your fault.

There are people out there who don't necessarily see what's happening, so it's about having that safety-first attitude all the time.

To find out more about Whiteknights, and how you can support the riders: [whiteknights.org.uk](https://whiteknights.org.uk)

# Hiking, flexing, selling and skydiving for Macmillan

Nuclear AMRC staff have been pushing their limits to raise funds for Macmillan Cancer Support.

The centre has committed to raising at least £25,000 to help people with cancer live as fully as they can.

In May, Andrew Storer, Liz Gregory, Tom Purnell, Sean Eley, Jay Shaw and Jamie Nemeth from the executive team completed the 40-mile Keswick to Barrow walk, raising over £2,500.

In June, senior research fellow David Malley raised £780 – more than triple his original target – by completing 100 push-ups and sit-ups each day alongside his son.

The team in Rotherham meanwhile raised over £300 from selling cakes, books and jumble to colleagues from the University of Sheffield's centres on the Advanced Manufacturing Park.

And later this summer, business support analyst Isobel Storer will defy her fear of heights to take part in a tandem skydive.

Nuclear AMRC staff will continue to carry out a variety of fundraising activities over the year, including special events at the Nuclear Manufacturing Summit supply chain conference in October.

As well as supporting Macmillan, the team are also raising funds to support regional charities based in the communities around the Nuclear AMRC's facilities.

For the latest information and links to donate: [namrc.co.uk/about/charity](https://namrc.co.uk/about/charity)



Milestone: senior staff hit the halfway mark from Keswick to Barrow.



Triple flex: David Malley pushes up his total.



# NDE specialists flock to Sheffield

**The Nuclear AMRC welcomed more than 150 experts in non-destructive evaluation (NDE) from the global nuclear industry to its research factory.**

The visit was part of the international NDE in Nuclear conference, hosted in Sheffield over three days in June.

Following the main conference and technical presentations in the historic Cutlers' Hall, delegates came to the Advanced Manufacturing Park for tours of the Nuclear AMRC workshop, discussions about the centre's R&D work, and an industry exhibition at the AMRC Knowledge Transfer Centre.

Showcased facilities included the new modular intelligent manufacturing and inspection cell, which features two Kuka robots working in tandem to weld components and then inspect the joints using a variety of non-destructive techniques.

The cell uses advanced technologies from two member companies: the Iona system of positioning sensors and tracking software developed by Insphere, and Siemens NX programming software provided by Kaizen PLM.

"It was a pleasure to welcome delegates to the Nuclear AMRC, and show them our work in



Inside view: international NDE experts view the Nuclear AMRC's intelligent manufacturing and inspection cell.

innovative manufacturing and qualification for the biggest challenges in nuclear," commented John Crossley, NDE technology lead.

The NDE in Nuclear conference provides an international forum for professionals from nuclear utilities, inspection vendors, inspection equipment manufacturers, qualification bodies, research laboratories and other stakeholders.

The 2023 event was organised by the Sustainable Nuclear Energy Technology Platform (SNETP), the European association for innovation to support civil nuclear power.

For the conference proceedings, visit: [www.ndt.net](http://www.ndt.net)

## Making a difference to workplace culture

**The Nuclear AMRC is supporting a new initiative to help young nuclear professionals create a more inclusive and rewarding culture in their workplaces.**

The Calm Design School is backed by the Nuclear Institute's Young Generation Network, Women in Nuclear UK and the Nuclear Skills Strategy Group, and delivered by specialist consultancy Calm In A Box.

The five-session programme is designed to let participants challenge current systems

and thinking around workplace culture, and create innovative ways to help people thrive and deliver better business outcomes.

"This pilot cohort will be focused on tapping into next generation thinking to innovate new ways of working across the nuclear sector, to support the sector in its goal of becoming an inclusive industry of choice for new skills, as well as building a diverse and sustainable workplace culture where everyone can thrive," says Sarah Markham, Calm in a Box CEO.

The Nuclear AMRC is sponsoring the first cohort of six women, who will begin the design school in the autumn.

"We need to take the opportunity to think differently about work," says Liz Gregory, Nuclear AMRC supply chain and skills director. "People want to work in a different way, and we need to understand how organisations can respond to that to help people find their optimum work-life balance."

[calminabox.co.uk](http://calminabox.co.uk)



**11–12 October 2023**

**Magna, Rotherham**

**The Nuclear Manufacturing Summit returns for its third year, to share the latest information and insight with the supply chain as key programmes move towards delivery.**

**Again held at the Magna Science Adventure Centre in Rotherham, the 2023 summit will bring together hundreds of manufacturers with nuclear industry leaders to discuss how we can drive towards delivery.**

Speakers include:

- Simon Bowen & Gwen Parry-Jones, Great British Nuclear
- Stuart Broadley, Energy Industries Council
- Kirsty Gogan, LucidCatalyst
- Tom Greatrex, Nuclear Industry Association
- Plus key figures from all the UK's major nuclear programmes

The two-day event aims to help UK manufacturers make the most of the opportunities in nuclear programmes worth hundreds of billions of pounds over the coming decades, supporting long-term growth, skilled jobs and innovation while moving the UK towards net zero emissions.

The summit is supported by the industry's top tier, with Sheffield Forgemasters and Ultra Electronics as platinum sponsors.

New for 2023 are the **UK Nuclear Manufacturing Awards**, recognising the best of the best in the nuclear manufacturing sector. Thanks to everyone who has submitted their entries – the shortlist will be announced in late August.

For the latest on the agenda, registration, sponsorship and exhibition opportunities: [nuclearmanufacturingsummit.co.uk](https://nuclearmanufacturingsummit.co.uk)

# Work with us

## The Nuclear AMRC helps UK companies win work in the nuclear sector.

We are here to support manufacturers and technology developers, from SMEs to global giants, which want to enhance and expand their capabilities for nuclear customers. If we can help your company, we want to hear from you.

We help companies through manufacturing innovation, supply chain development and skills support.

We can help you develop world-leading manufacturing processes and technologies. We have the facilities and expertise to help you improve quality, reduce time and costs, and bring new products to market.

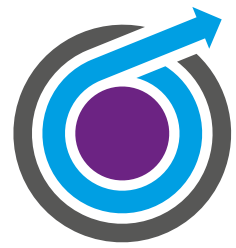
We can work with you to raise your capabilities and competitiveness to meet the needs of the global nuclear supply chain.

And we are developing new services to help fill the skills and training gaps across the sector.

As part of the High Value Manufacturing Catapult, our capabilities and services are open to all UK companies.

We also offer full membership of our centre, giving you access to our generic projects and the opportunity to help determine our core research programme.

To find out more about how we can help you win work, contact the Nuclear AMRC business development team: [business@namrc.co.uk](mailto:business@namrc.co.uk)



**NUCLEAR AMRC**  
ADVANCED MANUFACTURING RESEARCH CENTRE



University of  
Sheffield



### Contact us:

#### Nuclear AMRC

The University of Sheffield  
Advanced Manufacturing Park  
Brunel Way, Rotherham, S60 5WG

tel: +44 (0)114 222 9900

email: [enquiries@namrc.co.uk](mailto:enquiries@namrc.co.uk)

online: [namrc.co.uk](http://namrc.co.uk)

twitter: [@NuclearAMRC](https://twitter.com/NuclearAMRC)

#### Nuclear AMRC Midlands

Rutherford Way, Infinity Park, Derby DE73 5SS

#### Nuclear AMRC Birchwood

The Renaissance Centre, 601 Faraday St,  
Birchwood, Warrington, WA3 6GN

### Tier 1 members:



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