University of Sheffield

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

Helping manufacturers **win work in nuclear**

2024

CATAPULT
High Value Manufacturing

Helping you win work in nuclear

The **Nuclear Advanced Manufacturing Research Centre**, part of the High Value Manufacturing Catapult and the University of Sheffield, works with UK companies to improve their capabilities and performance for nuclear and other low-carbon sectors.

Our services are open to companies of all sizes to collaboratively tackle the manufacturing challenges of the energy transition, in markets where quality and long-term performance are critical. We work with hundreds of companies each year to help them realise their ambitions.

You can use our engineering expertise and resources to develop and test new processes on production-scale machines, at minimum risk and without losing capacity in your own factories.

Our researchers focus on developing innovative techniques and optimised processes for large-scale high-precision manufacturing, for the most challenging applications.

We are improving productivity and capability for the current market, and developing innovative processes for future energy technologies such as small modular reactors and fusion power.

As well as technical research and support, we provide a range of business improvement services – including our flagship **Fit For Nuclear** programme – to help manufacturers enter the nuclear supply chain and compete worldwide.

We work closely with nuclear industry leaders including new build groups, reactor developers and decommissioning site licence companies. We advise government on supply chain challenges for nuclear and other low-carbon growth sectors.

To meet evolving industry needs, we continue to expand our capabilities and reach to better support manufacturers in the UK's key nuclear regions.

To complement our established research factory in South Yorkshire, we have opened the new Nuclear AMRC Midlands in Derby (right) to support regional partners, explore new technology areas and tackle cross-sector challenges.

In 2023, we worked with **384 companies** and reported:

910

business interactions

Total since 2018: **5,701**

456

SME engagements

Total since 2018: **4,051**

Note: we monitor business interactions and SME engagements each quarter – the count can include multiple interactions with a single company. The long-term total is the sum of quarterly counts from April 2018 to December 2023.

NUCLEAR AMRC

CATAPULT High Value Manufacturing

University of Sheffield

We help companies through two core work programmes:

Manufacturing innovation

We work with you to overcome your manufacturing problems, and help you develop the technical capability to compete on cost, quality and delivery.

We can take new manufacturing technologies and processes from proof of concept through design and development, towards production readiness.

Supply chain development

We help you compete by raising quality, reducing costs, and developing new capabilities and skills.

We can work with you to identify gaps in performance and capability, make sustainable business improvements, upskill your staff, and help you move into nuclear from other sectors.

Manufacturing innovation

We can work with you to overcome your manufacturing challenges, and help you develop and deploy new technical capabilities to compete on cost, quality and delivery.

Our engineers work alongside manufacturers of all sizes to solve their production problems, expand their capabilities, and boost productivity and competitiveness.

We also work with the developers of innovative low-carbon technologies to help bring their designs into commercial reality.

Our research factory on the Advanced Manufacturing Park in South Yorkshire is designed for production-scale technology development and demonstration across a variety of mechanical engineering areas – including machining, joining, metrology, near-net shape and additive manufacturing.

Many of our manufacturing cells feature unique capabilities, or are the largest or most powerful of their kind available for industrial research anywhere in the world.

We continue to expand our facilities and extend our capabilities to meet industry needs, based on consultation with our customers, members and Fit For Nuclear companies.

The new Nuclear AMRC Midlands in Derby gives us the space to develop new capabilities in controls & instrumentation, digital engineering and equipment qualification.

The capabilities of our workshops are matched by the expertise of our team. Our engineers have extensive experience of working with industry in long-term collaborations to significantly reduce costs and lead times.

We have also completed hundreds of shorter projects with a host of companies to investigate new processes and resolve production challenges.

Industry-focused **research & development**

We provide research, development and technology demonstration with the maximum impact for the UK nuclear industry.

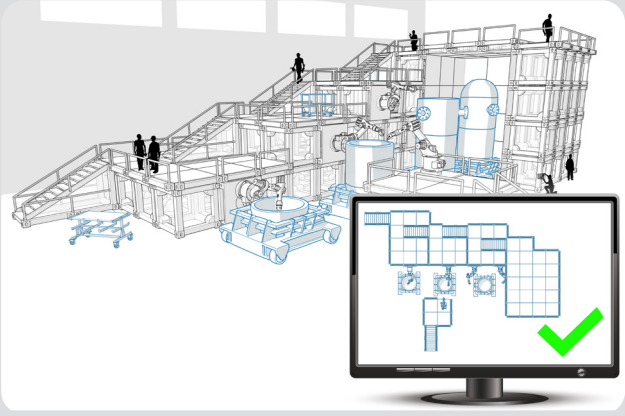
We continually consult with our industry and research partners to make sure we are focusing on the technology areas that will deliver the most value from targeted research and development for the nuclear market.

Machining technologies – innovative and optimised subtractive manufacturing processes for large and high-value components in a range of materials.

Our engineers and researchers can work with you to optimise your production and help you compete on quality, cost and lead time. We apply a range of machining technologies to significantly reduce cutting time while maintaining the highest material standards. We regularly meet typical industrial challenges of 40 per cent reductions in process cost and time while increasing robustness.

Welding & materials – advanced and innovative joining and cladding techniques tailored to the needs of the nuclear industry.

Our welding engineers have the resources and experience to help you develop new and optimised processes for the most demanding applications. We are also developing a variety of materials engineering processes for nuclear applications, including bulk additive manufacturing and hot isostatic pressing of metal powders.



Simulation & verification – multi-disciplinary support to model, measure, analyse and optimise your production, from overall factory layout to individual manufacturing processes.

We can simulate an entire factory layout to optimise your production, or specific manufacturing processes to identify and mitigate potential quality problems. Our digital engineers can help you evolve your digital manufacturing capabilities, improve communication between systems, and reduce energy consumption and waste.

Controls & instrumentation – developing and applying control and monitoring technologies which can deliver real value in nuclear applications.

Our digital C&I group aims to build capability and capacity for UK businesses across the nuclear sector and in other highly-regulated industries. Core research areas include sensing technologies, industrial control systems, and digital manufacturing using industrial internet of things, cyber-physical and visualisation technologies.

Manufacturing engineering – cross-disciplinary approaches to the design, development and optimisation of complex products for safety-critical applications, including modular manufacturing.

Our manufacturing engineers have extensive experience of shopfloor production, design for manufacturing, new product introduction and cost modelling. We are developing new approaches for the off-site modular production of large-scale complex systems, including new designs of small and advanced modular reactor.

Projects

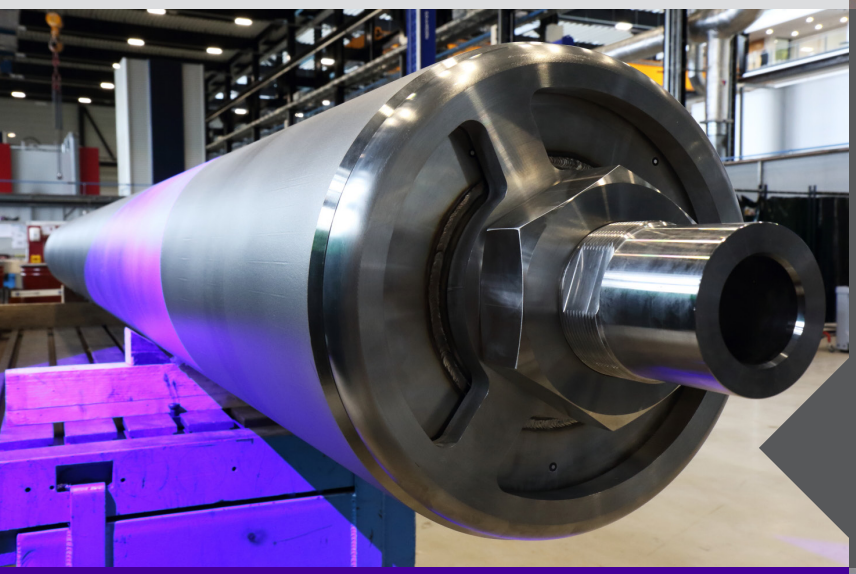
We help companies innovate through a host of commercial and collaborative R&D projects.

The projects below are a selection of our recent and ongoing work with partners in the UK and worldwide.

Slashing production time for pressure vessels

Our welding specialists are working with US research group EPRI to develop new manufacturing and fabrication methods for reactor pressure vessels, with the aim of reducing the total time needed to produce an SMR pressure vessel to less than 12 months.

In 2023, we demonstrated new ways of preventing defects during electron beam welding of circular thick-walled vessel sections, and collaborated with engineers from South Africa's Nelson Mandela University to prove a new weld repair technique to meet nuclear quality requirements.



Bringing new waste container designs towards production

We led production of a full-size prototype canister for the safe geological disposal of spent nuclear fuel and high-level waste in deep boreholes.

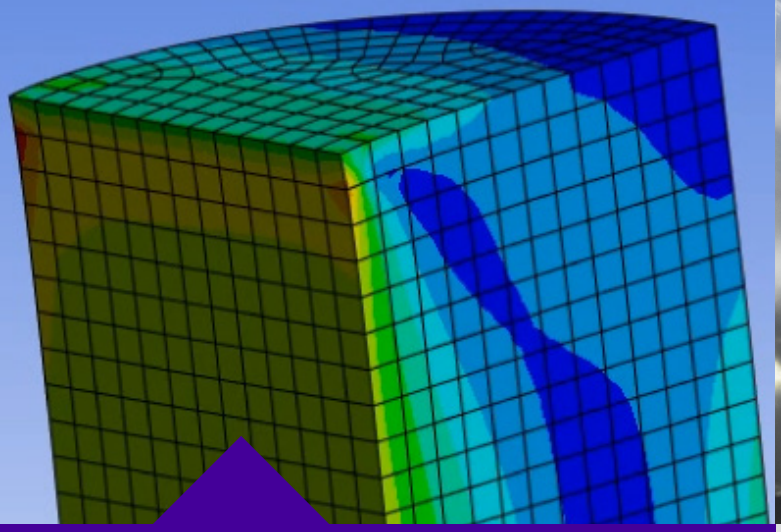
The five-metre, two-tonne prototype was produced as part of an ongoing collaboration with US-based Deep Isolation. We also carried out extensive manufacturability studies, and reviewed the capabilities of the UK supply chain for mass production.

Several million such canisters could be required globally to dispose of current and future waste over the coming decades.

Reducing waste in additive manufacturing

We are helping improve the environmental impact of metal additive manufacturing by investigating the performance of recycled steel powder.

We carried out extensive trials using laser metal deposition to understand the material performance of parts made with recycled powder, and optimised the process for different combinations of primary and recycled material. The work was part of the EnerAM project, funded by Innovate UK, to dramatically reduce waste in additive manufacturing.



Cutting emissions from heat treatment

Our digital engineers completed a set of complex simulations to help improve the efficiency of industrial heat treatment.

We carried out finite element simulation of heat treatment on metal and glass products, and validated the results against physical test data. The research was part of the AI6S collaboration, funded by UKRI, to develop a suite of tools to reduce energy consumption in heat treatment.

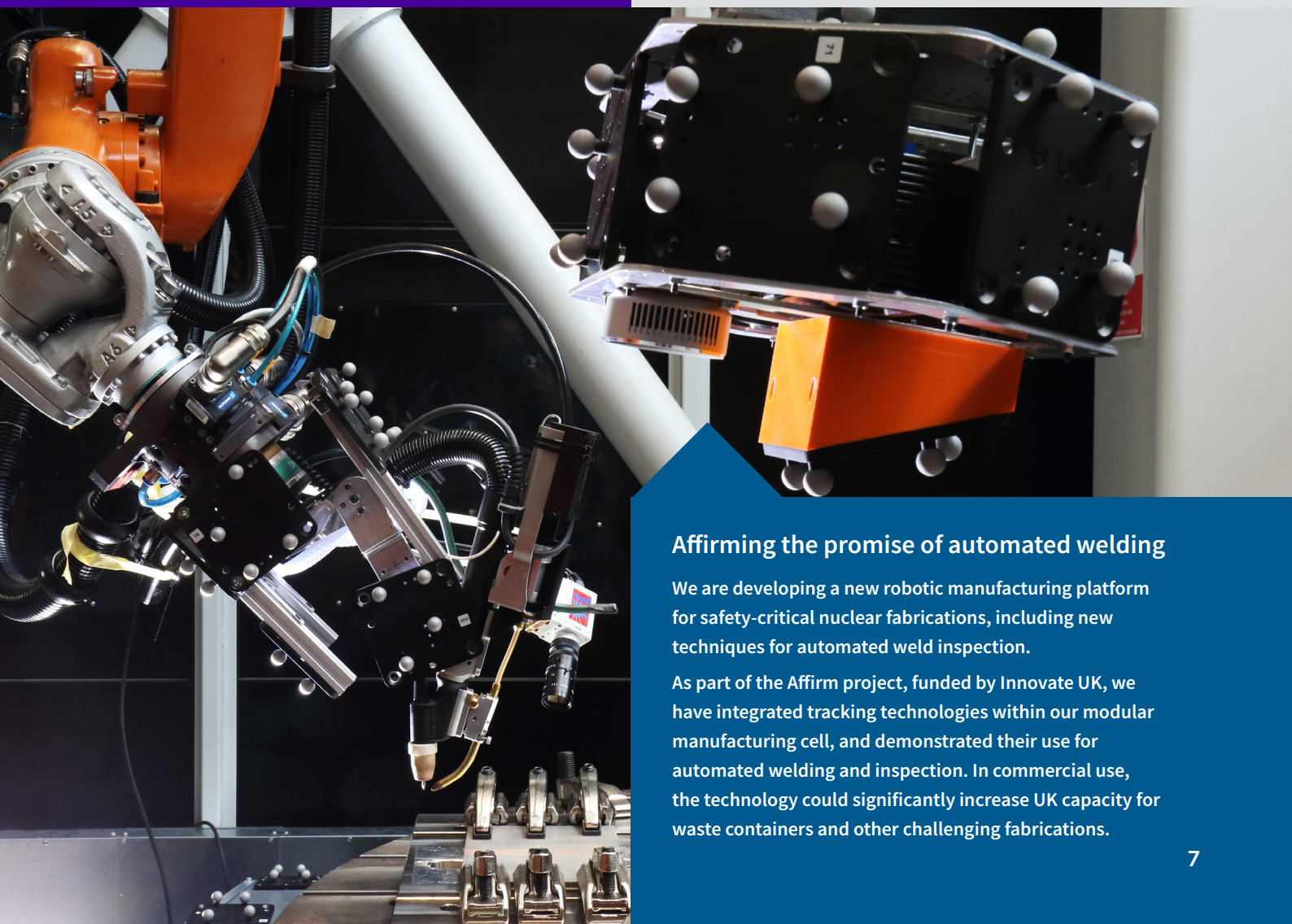
The results could save 21,800 tonnes of CO_2 emissions a year in the UK alone.

Developing sustainable machining coolants for challenging metals

We are leading research into the use of supercritical carbon dioxide as a clean coolant with significant business benefits.

We have demonstrated how combining supercritical CO_2 with minimum quantity lubricant (MQL) can radically improve machining efficiency for an array of challenging materials, while reducing costs and environmental impacts.

In 2023, we investigated their use on tungsten, an extremely difficult-to-machine metal which is needed for fusion reactor components. We confirmed that conventional oil coolants are unsuitable for tungsten, and demonstrated that CO_2 and MQL can provide significantly better performance than dry cutting.



Affirming the promise of automated welding

We are developing a new robotic manufacturing platform for safety-critical nuclear fabrications, including new techniques for automated weld inspection.

As part of the Affirm project, funded by Innovate UK, we have integrated tracking technologies within our modular manufacturing cell, and demonstrated their use for automated welding and inspection. In commercial use, the technology could significantly increase UK capacity for waste containers and other challenging fabrications.

Supply chain development

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

We demystify the nuclear sector and reduce barriers to entry.

Most of the companies we work with are small and medium-sized enterprises (SMEs). We help smaller manufacturers understand what the market expects from them, what they may be capable of supplying, and where they could fit in the supply chain.

Our flagship **Fit For Nuclear** programme helps UK manufacturers get ready to bid for work in civil nuclear, allowing companies to measure their operations against industry standards and drive improvements to take their business to the next level.

We also work with partners to adapt the Fit For model for other low-carbon sectors and territories. We work with the Offshore Renewable Energy Catapult on the ongoing **Fit For Offshore Renewables** (F4OR) programme and, in 2023, led the pilot **Fit For Hydrogen + CCUS** programme for the Zero Carbon Humber Partnership.

We also offer tailored supply chain consultancy services to build links and share knowledge between suppliers and top-tier customers, and to help new-build and decommissioning groups develop their UK supply chains.

Skills

With an estimated 150,000 skilled people needed to meet the UK's target of 24GW of nuclear power, we are expanding the support we provide on skills and training.

We work with the National Skills Academy for Nuclear to provide a one-stop shop for companies along the nuclear supply chain. Our sister centre, the University of Sheffield AMRC Training Centre, provides practical skills from apprenticeships through to MBAs – including a new Nuclear Scientist & Nuclear Engineer Degree Apprenticeship.

In 2022, we worked with Rolls-Royce and partners including the National College for Nuclear, University of Derby and Derby City Council to launch the Nuclear Skills Academy which is now training 200 apprentices a year. We are working to replicate this model for other parts of the nuclear sector.

During 2023, companies on our supply chain development programmes reported that our support helped them secure:

1,145
jobs created or safeguarded
All-time total: **12,479**

£690 million
new contracts won
All-time total: **£3.55 billion**

£18 million
additional investment
All-time total: **£161 million**

Note: totals are the sum of numbers reported by companies on F4N (2011–date), F4OR (2018–date), F4H$_2$+CCUS (2023) and Civil Nuclear Sharing in Growth (2013–17). For CNSIG only, the jobs impact was estimated from contract values. All-time totals are to end of March 2024.

Fit For Nuclear (F4N) is an industry-recognised hallmark of business excellence.

Delivered exclusively by the Nuclear AMRC, F4N allows you to benchmark your operations against nuclear customer expectations and take the necessary steps to close any gaps.

More than 1,000 companies – mostly SMEs – have taken the F4N assessment since its launch in 2011. Around 100 are currently granted F4N status after driving improvements through a tailored action plan and maintaining excellence across their business.

Granted companies have reported a wide range of benefits, including new contracts won in nuclear and other sectors with a total value of over £2.1 billion.

New support for 2024

We have now launched the next evolutionary phase of F4N, following extensive consultation with industry leaders and stakeholders along the supply chain.

As well as the core areas of business excellence and sector-specific assessment and improvement, F4N now offers additional services and upgraded nuclear elements.

We have also introduced a new subscription-based operating model, with companies joining as part of a cohort to share best practice and lessons as they progress together.

Support available through F4N now includes:

- **Events** to help you engage with customers and decision-makers, discuss shared challenges, network and share knowledge with your industry peers.
- **Services** to help you secure work with nuclear customers, including signposting to opportunities and tenders, and access to UK supply chain benchmarking data.
- **Training** to increase your knowledge and understanding of nuclear sector topics, delivered with industry-leading skills partners.

Recently granted companies include:

Trillium Flow Technologies – a global designer and manufacturer of engineered valves and pumps. Trillium entered F4N to benchmark its capabilities, as part of a strategic move to re-enter the UK nuclear market.

"When we're talking to our customers, companies are asking are we F4N? People are pleased that we're F4N granted, because that's what they're looking for now."
Ged Chauveau, head of engineering

Michell Bearings – a designer and manufacturer of specialist bearings to the industrial and marine markets. Michell used F4N to demonstrate its capabilities for the nuclear sector, and upgrade its safety culture.

"We found the F4N process both enlightening and rewarding as it has enabled us to identify potential areas for improvement, and to improve awareness throughout the business on the safety-critical nature of this sector."
Jeff Hall, quality manager

Lion Engineering – a contract machining specialist with a long history in the oil & gas industry, Lion entered F4N as part of a strategic diversification into low-carbon sectors. The Norfolk-based firm has now won its first work in nuclear.

"Working with the Nuclear AMRC has opened a lot of doors in terms of projects, funding and training."
Ashley Sewell, quality manager

Our centres

Our production-scale facilities are designed to tackle your manufacturing challenges with no risk to your own operations.

We are based on the Advanced Manufacturing Park (AMP) in Rotherham, as part of the University of Sheffield's world-leading cluster of engineering research and training centres.

Our 8,000m² research factory is home to a wealth of state-of-the-art manufacturing equipment, dedicated to developing innovative and optimised processes in machining, joining, inspection and other large-scale precision manufacturing techniques.

In 2023, we opened the doors of Nuclear AMRC Midlands, a new 4,300m² facility at Infinity Park Derby. The building includes a large open-plan workshop for work on large fabrications and assemblies, plus dedicated laboratories for 3D printing and rapid prototyping, virtual reality and visualisation, and equipment qualification.

We also operate a facility at Birchwood Park in north-west England, hosted by our member Jacobs at the heart of the UK's largest nuclear region.

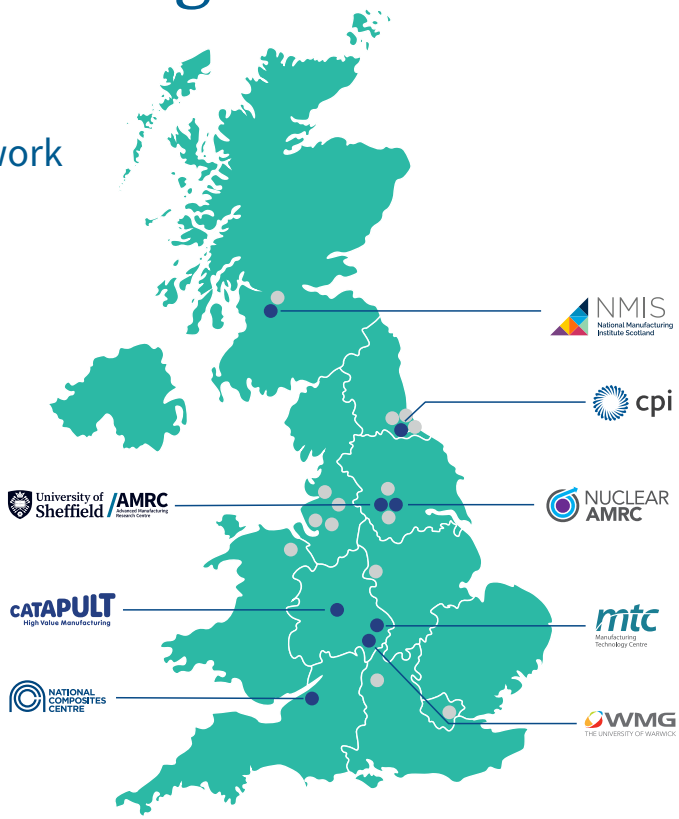
High Value Manufacturing Catapult

We can help you tap into a national network of advanced manufacturing innovation.

The Nuclear AMRC is part of the High Value Manufacturing Catapult, an alliance of seven specialist industry-focused research centres with facilities across the country.

Established and supported by Innovate UK, the High Value Manufacturing Catapult bridges the gap between business and academia, helping to turn great ideas into commercial reality by providing access to world-class research and development facilities.

Being part of the HVM Catapult allows us to tap into this network on your behalf – if a particular technology falls outside our areas of expertise, we can call on our Catapult sister centres for the support you need.



Work with us

Our services and capabilities are open to all UK manufacturers.

You can commission commercial research to meet your specific needs, or collaborate with partners to resolve a shared problem or develop innovative technologies.

Commercial research

- Directly commission research to resolve your manufacturing challenges, optimise production, or explore new technologies.
- We operate in full commercial confidentiality. You own any resulting intellectual property.
- Costs are based on staff and equipment time plus material and consumables.

Collaborative R&D

- Work with industry and research partners on a shared challenge, supported by external funding.
- We track new funding opportunities and can tailor a bid to meet your business needs.
- We can build a research consortium, write bids, and manage projects – or bring our capabilities to your project.

Joint industry project

- Work alongside industry peers to tackle a common technology challenge.
- We carry out targeted research to meet your shared requirements.
- Projects are funded by a small consortium of companies, with results shared exclusively between participants.

Membership

Becoming a member of the Nuclear AMRC gives you the highest level of engagement and support, and a place at the heart of the UK nuclear manufacturing industry.

We are led by our member companies, ensuring that everything we do delivers value to industry. Our membership brings together manufacturers and specialist equipment providers with OEMs and reactor developers.

Membership is a strategic alliance, and a mutually advantageous relationship.

We offer our members significant business development benefits, networking opportunities, and priority access to market intelligence and targeted support.

As a member, you can help determine our research priorities and capabilities, and leverage your R&D investment through our board-directed research.

Our tiered membership structure and flexible terms allow us to tailor your membership to the specific needs of your business. The annual fee supports your own targeted R&D, plus a contribution towards our board-directed generic research projects into topics of shared interest.

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UKRI Innovate UK

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