NUCLEAR AMRC news

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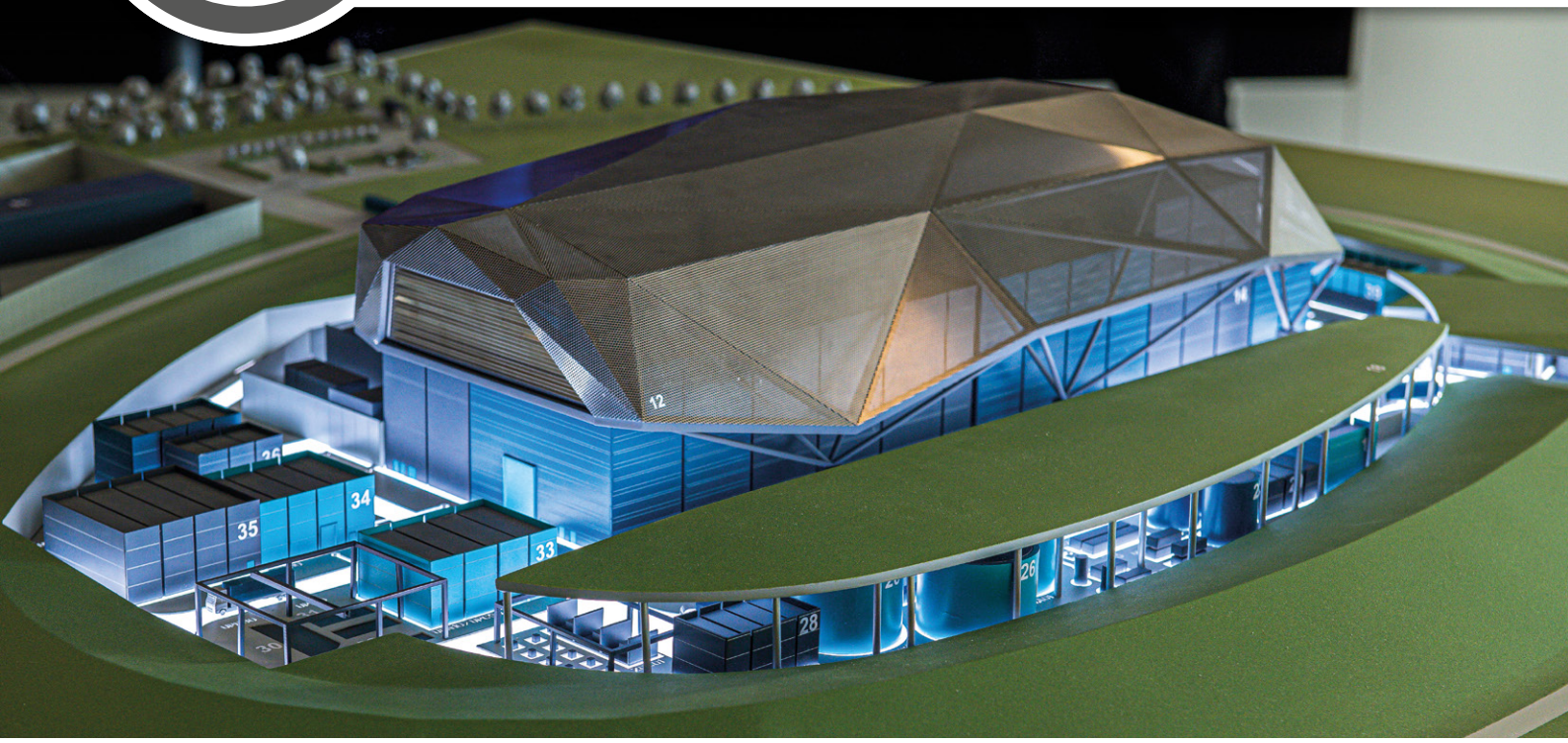
- Advanced metrology
- Manufacturing for fusion
- Energy efficency
- Intelligent robots
- Fit For Nuclear



New generation of compact power

Rolls-Royce SMR launched at Nuclear AMRC

Nuclear Manufacturing Summit

Bringing together the UK supply chain

CATAPULT
High Value Manufacturing

Nuclear Manufacturing Summit 2021

The first Nuclear Manufacturing Summit brought together almost 200 manufacturers and industry professionals for two days of discussion about the opportunities and challenges for the UK's nuclear supply chain.

Held over 16–17 November at the Advanced Manufacturing Park in Rotherham, the event was literally a big-tent affair – delegates from companies of all sizes met in a marquee outside the Nuclear AMRC for a packed schedule of presentations, discussions and networking. With numbers strictly limited by Covid measures, dozens more followed the conference online.

The Nuclear Manufacturing Summit was designed to help manufacturers connect with the opportunities in major nuclear programmes – from Hinkley Point to SMRs, decommissioning to fusion. The event included one-to-one meetings between manufacturers and buyers to really explore supply opportunities, plus an industry exhibition, networking drinks and dinner, workshop tours, and more.

It was not intended to be a normal nuclear industry event, Nuclear AMRC CEO Andrew Storer emphasised in his welcoming talk.

"We've got speakers from large reactors, small reactors, advanced reactors, decommissioning, fusion, and even defence," he said. "We've covered the whole spectrum of the nuclear sector."

Coming just days after the close of the UN's Cop26 climate change conference in Glasgow, the Nuclear Manufacturing Summit emphasised the vital role of new nuclear power as part of the low-carbon energy mix needed to reach the UK's target of net zero emissions by 2050.

The keynote presentation came from energy minister Greg Hands MP, speaking remotely as he was needed in Parliament to guide the nuclear energy financing bill through the committee stage. The bill will allow use of the regulated asset base (RAB) financing model for new nuclear plant, a step seen as essential for enabling investment in projects including Sizewell C and a nationwide fleet of small modular reactors.

"Nuclear energy was very much part of the story in Glasgow," Hands said. "There has been the largest nuclear presence on the ground at any Cop ever, which sends

another blazing signal about the role that nuclear will play in fighting climate change."

Recent spikes in gas prices have increased government focus on energy security, Hands noted, and nuclear offers confidence and security as part of the net-zero energy mix.

"We're clear that a significant proportion of UK future electricity should come from renewables and flexible energy storage," he said. "We've also been clear that the UK needs a stable form of low-carbon power for when the sun doesn't shine and the wind doesn't blow. That's why we're backing new nuclear."

Hands outlined recent announcements on support for new nuclear, including a £120 million future nuclear enabling fund to support deployment of new projects – details to be set out "in due course" – and funding for Rolls-Royce SMR (see p12) and UKAEA's STEP programme.

"A successful nuclear sector will not be built on the back of government action alone. These announcements gave signals and I hope confidence to the private sector about the direction the UK is moving in," he said. "Looking at the future, we want a domestic nuclear market that allows our companies to demonstrate their capabilities and build lucrative exports as well. Government announcements backed by new money should allow the supply chain to prepare themselves."

Tom Greatrex, chief executive of the Nuclear Industry Association, highlighted the scale of the challenge for nuclear to play its full part in the future energy mix. Around a sixth of the UK's current electricity comes from nuclear, he noted, but the bulk of the reactor fleet is set to close in the next few years.

"We're looking at going backwards, despite the rollout of significant amounts of renewables," Greatrex said. "That's the challenge that everybody in this room will have to address."

Cop26 and the growing awareness of the urgent need for decarbonisation have helped raise the public acceptance of nuclear, with recent polling showing that people accept and agree that we should be increasing nuclear capacity alongside renewable sources.

"We've talked over the last few years about a nuclear renaissance – what we've seen in the last few weeks is a nuclear reawakening and growing public acceptance," Greatrex said. "Net zero is really important. The sense of urgency we need to overcome the worst excesses of climate change is here and now. Nuclear needs to be part of it."

From current gigawatt-scale projects to new designs of small and advanced modular reactor, along with continuing opportunities in the decommissioning and defence sectors, the potential scale of the market will stretch the nuclear supply chain's capabilities and capacity to the limit.

On the first day of the Summit, leading figures from all the UK's key programmes shared information about their plans and the coming supply chain opportunities. The second day focused on the support available for the supply chain. All sessions were ably compered by Rosa Wilkinson of the High Value Manufacturing Catapult.

This special edition of *Nuclear AMRC News* presents the highlights of the Summit, with key messages from all the speakers over the following pages.

Like many industries, the nuclear sector faces major challenges in skills and diversity (see p10).

Bethany Cousins, project engineer at the AMRC and Made in Yorkshire Apprentice of the Year, launched the Summit by talking about her personal career journey.

After facing sexism when visiting universities to look at engineering degrees, Cousins applied to the AMRC Training Centre and had interviews with three potential employers.

"The first one, I was unsuccessful. The second, they were unsuccessful," she said. "The third was with AMRC. It became apparent the AMRC wanted to train young people, and wanted them to strive in their careers to become the best in the industry."

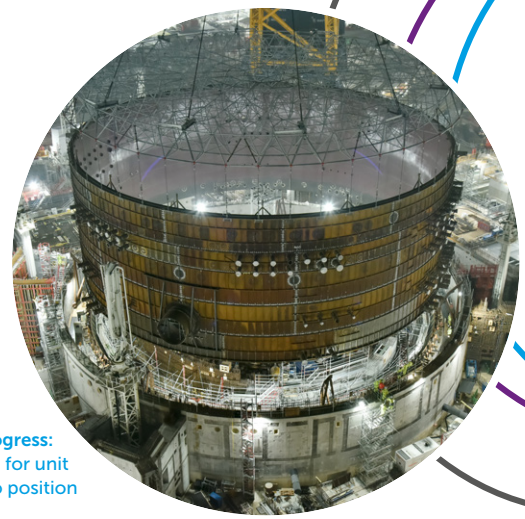
In her year's intake of 150 apprentices, Cousins was one of only three women on a technical pathway, showing the scale of the challenge.

New build & SMRs

With total electricity demand expected to double by 2050 to enable the decarbonisation of transport and heating, building a sustainable energy mix for the UK will be a monumental challenge.

But with potential investment in new nuclear capacity totalling hundreds of billions of pounds, there will be huge opportunities for the supply chain.

The first session of the Nuclear Manufacturing Summit focused on the opportunities of new gigawatt-scale projects in England and Wales, and Rolls-Royce's new design of compact power plant. These projects will form the core of the UK nuclear programme over the next 10–15 years.



Hinkley Point progress: the first steel ring for unit 2 was craned into position on 16 November.

Hinkley Point & Sizewell

Paul Spence, director of strategy and corporate affairs at EDF, highlighted the supply chain opportunities that have already come through the new reactors being built at Hinkley Point C in Somerset, and proposed for Sizewell C in Suffolk.

"Gigawatt-scale nuclear projects are huge, and that means they create huge economic opportunities to do things that are important," he said. "It needs skilled people to do it to nuclear quality, and it needs great companies to supply all the bits that go into nuclear power stations."

EDF is spending around £18 billion in the UK supply chain for Hinkley Point, Spence noted. "We're very very proud we're working with over 3,600 businesses here in the UK to deliver jobs, not just in the South West. The reality is there's jobs all around the UK that come as a result of a nuclear project."

Despite Covid and Brexit difficulties, EDF continues to make good progress at Hinkley Point five years into construction.

The team are now seeing the benefits of learning from work on the first EPR unit to reduce time and cost on the second – for example, reducing the average time needed to install a tonne of rebar from 25 hours to 16.

"What we want to do is take that sort of lesson and keep doing it on gigawatt-scale and on new advanced reactors," Spence said. "We're now readying ourselves to sign contracts for work at Sizewell C. There's more opportunities to have the UK supply chain and UK people working on the project."

EDF expects to receive planning approval for Sizewell C in mid-2022, and for Parliament to approve the nuclear financing bill around the same time to allow EDF to make a positive final investment decision (FID).

"We then have to raise the money and get the project going over the course of 2022, and be ready for FID and to press the accelerator very very soon," Spence said.

Wylfa Newydd

Ivan Baldwin, director at Bechtel, discussed the global company's proposal to build a new nuclear plant on Anglesey in partnership with Westinghouse.

Bechtel and Westinghouse are currently building two 1.1GW AP1000 reactors at Vogtle in the US, due to start commercial operation in 2022. The two firms now propose to build another two AP1000s at the Wylfa Newydd site in North Wales.

"It's all about getting clean power onto the grid by 2035," Baldwin said. "With four reactors operating successfully in China, and the learning from Vogtle, we believe that's really possible."

Westinghouse's AP1000 is a modular reactor, which means sustainable factory-based opportunities for the UK supply chain. "With live export opportunities and factory-based construction complementary with SMR technologies, this is a significant opportunity for the UK supply chain," Baldwin noted.

Wylfa was home to a pair of Magnox reactors, and the adjacent site was previously targeted for new development by Horizon Nuclear Power. It remains the best site in the UK for large-scale reactors, Baldwin said, thanks to local support, favourable geology and marine conditions, and the scale of the site.

As well as the core proposal of large-scale reactors, the real estate offers the potential for additional development with large, small or advanced modular reactors.

Fuel for the two AP1000 reactors would be manufactured at Westinghouse's Springfields plant near Preston. "That allows us to continue to be a country that does nuclear, not just one that has nuclear done to us," Baldwin said.

Bechtel and Westinghouse will start to increase engagement with the UK supply chain in 2022.

Rolls-Royce SMR

One week after officially launching the new Rolls-Royce SMR business (see p12), chief engineer Matthew Blake returned to the Nuclear AMRC to outline the opportunities for the supply chain.

"The programme is very real and moving very quickly," he told delegates. "The problem is not technology – the problem is delivery. How do we deliver a nuclear power station to time and cost in a metronomic way? If we look at the French and Korean programmes, it can be done."

The SMR is designed to be produced in factories as more than 800 modules, each one transportable by road to the construction site for assembly under factory-like conditions.

"You control risk by taking construction away from the site to a situation you can control," Blake noted. "The only bit that's specific to a location is the groundwork. Everything else is produced in a series of factories, and we will be building these factories in this country."

Rolls-Royce is proposing to build three main factories covering three broad categories of modular component: primary plant, focusing on heavy vessels; civil modules, including construction, rebar cages and standardised concrete facilities; and system modules.

Those three factories will then feed a site factory for each build location. "The site factory is a covered unit, a factory in its own right, that changes the skillset from traditional civil skills to assembly," Blake said.

Manufacturing will be absolutely critical to delivery, with the supply chain having a major role in supplying into the heavy vessel and modules facilities, as well as producing modularised components for delivery direct to site.

"How we manufacture efficiently in a timely and cost-effective manner is crucial to the success of this programme," Blake noted. "It's about changing an industry. It's not about product and design, it's about manufacturing and realisation."

The SMR programme will focus on standardisation, with a minimal product set and standardised commodity suite.

Rolls-Royce is also minimising the amount of innovation in the reactor design, but will call on an array of advanced manufacturing techniques which are already deployed in other industries. These could include high-performance fabrication techniques from the automotive industry, robotic machining and automated welding, as well as advanced non-destructive evaluation supported by industrial digital technologies.

"We're trying to create an industry dynamic in the UK that's not been around for a while," Blake concluded. "It has to be affordable, repeatable and deliverable. It has to have all the attributes to be a commercially successful enterprise."

Advanced reactors

New designs of advanced reactor could play a vital role in the energy mix from the mid-2030s onwards.

Development is underway on an array of advanced modular reactors (AMRs) based on both fission and fusion technologies, and the UK government is also betting on large-scale fusion with a major investment in UKAEA's Spherical Tokamak for Energy Production (STEP).

Leaders from four key projects shared their plans with the supply chain at the Nuclear Manufacturing Summit.

U-Battery

U-Battery, a subsidiary of Urenco, is developing a small high-temperature gas-cooled reactor for industrial applications including hydrogen production. The UK government awarded £10 million for development in 2020, and has since confirmed it will focus ongoing AMR support on high-temperature designs.

U-Battery is designed to be deployed at energy-intensive industrial sites and remote off-grid locations. It will provide just 10MW of thermal energy, or 4MW of electricity in cogeneration applications.

"It's a very very small reactor. It's very simple, it's extremely safe, and it's very flexible," chief engineer Professor Tim Abram told the Summit. "Most reactors are characterised by the need to protect the fuel, and that calls for multiple safety systems. The U-Battery stands that on its head."

U-Battery will use the proven Triso fuel, based on spherical pellets of triple-coated uranium. "The fuel is arguably one of the most resilient components of the whole power plant," Abram noted. "That means most of the safety systems you would find in most reactors simply aren't necessary to make sure the fuel remains intact. That allows great scope for simplification and cost saving."

The extreme resilience of the fuel allows the team to think about reactor design in a different way. The U-Battery units will be entirely factory built and tested, using commercially available off-the-shelf technologies as far as possible, and shipped to site on modular sleds.

Most of the technology for U-Battery will be commercially available equipment or very similar variations, Abram said, including Rolls-Royce turbines for electricity generation.

The company sees the UK and Canada as key markets, with potential first deployment by 2028.

"We would like to rely as much as we can on the UK supply chain," Abram concluded. "Most of our consortium partners are UK companies, and I think most of the U-Battery could be manufactured in the UK."

UKAEA

Delivering commercial fusion power will require significant upskilling right across the supply chain, according to Tris Denton, head of commercial and programme development for the Spherical Tokamak for Energy Production (STEP) programme.

STEP aims to deliver the world's first prototype of a commercially viable fusion plant. The programme secured £222 million government funding in 2019 for conceptual design development, and is due to select the site for the prototype this year.

"We want to have this thing online by 2040," Denton told the Summit. "That means by the end of this decade we need to be ordering long-lead components. By the middle of this decade, we have to be ordering long-lead material."

After the concept design is completed in 2024, the programme will rapidly move onto detailed engineering design and initial procurement, with the industrial programme starting from 2032.

UKAEA will work with a range of engineering, construction and fusion partner organisations to deliver the programme.

"We cannot deliver this programme alone," Denton said. "What we can do is lead the industrial endeavour to deliver this programme."

The STEP team will start building its supply chain over the next few years, with initial opportunities coming during the design phase. "There's a whole range of opportunities to work with us," Denton noted. "It will be a tiered supply chain – STEP will not be the lead customer to many organisations, but we will expect our cultures and values to flow down."

Moltex Energy

UK-Canadian group Moltex Energy is developing a compact stable salt reactor which can be powered by waste fuel from conventional reactors – a double win for sustainability, delivered at a cost which managing director David Landon says can displace fossil fuels.

"We were interested in how we can make nuclear cheaper," Landon said. "We are absolutely driven by cost."

Moltex is developing two variants of its reactor. The waste-burning version, which uses a molten salt derived from waste fuel from pressurised water reactors, is being developed in Canada and will offer limited opportunities to the UK supply chain.

The second variant, a high-temperature stable salt reactor using low enriched uranium fuel, is under development in the UK and will offer significant opportunities for domestic suppliers. "In the near term, we're doing a lot of development and prototyping work, including working towards a full-scale thermohydraulic test rig," Landon said.

In the medium term, the programme will need components including compact heat exchangers, reactor tanks, fuel tubes, and precision control equipment. Longer-term, as Moltex targets roll-out in the early 2030s, there will be further opportunities in construction, supply of reactor components, and mechanical equipment.

Landon highlighted how the Moltex technology can support intermittent renewables as part of a mixed energy system. Using the molten salt as thermal energy storage means that a 500MW plant can produce 1,500MW for part of the day to fill troughs in renewable supply .

"This provides a real opportunity for cheap thermal energy storage," Landon said. "We want to roll this out in significant quantities. It's not just about a demonstration reactor."

Thanks to the reactor's compact size and high temperature, Moltex is also targeting markets in cogeneration, hydrogen production, and industrial applications. The group is close to announcing a new round of private funding, Landon noted.

Tokamak Energy

Tokamak Energy is developing a compact fusion reactor for distributed power distribution, with an output of 150–200MW per module.

Founded by former UKAEA staff, the company secured £10 million from the government's AMR programme in 2020 to support development of high-temperature superconducting magnets and other enabling technologies.

"We're out there trying to address the massive challenge that pretty much everyone here is trying to address, to change the way we generate energy," commercial director Ross Morgan told the Summit. "We are looking at this in a slightly different way to fusion projects in the past – we're looking at a small modular approach, not dissimilar to the Rolls-Royce model."

The key to fusion power lies in controlling an extremely hot plasma within an extremely powerful magnetic field, and the Tokamak team are achieving temperatures of around 100 million degrees and magnetic fields of over 24 Tesla.

The team are now working on a concept design for a pilot power plant in the mid-2030s, and looking to work with supply chain partners who can support the commercial production of high-temperature superconductors and magnetic material at a much larger scale than anything currently available. That will present some major challenges in terms of production capacity and material engineering capabilities.

Tokamak Energy will also need to develop new production capabilities for plasma heating systems, which are currently produced as one-offs by research institutions. "We need to take that technology and work with suppliers to establish how we can build an industrial supply chain in that area," Morgan noted.

Working in partnership with suppliers will be vital to the programme, he emphasised: "We need to establish a commercial supply chain with the capability and capacity to support the evolution of the fusion industry, and we need to work in partnership to deliver that."

Decommissioning

Decommissioning the UK's legacy sites is a decades-long programme, and supply chain requirements are constantly evolving.

The UK's decommissioning programme is currently worth around £1.8 billion a year to the supply chain. The Nuclear Decommissioning Authority (NDA) works with around 3,000 direct suppliers, and is committed to spending at least 31 per cent of its budget with SMEs.

Delegates at the Nuclear Manufacturing Summit heard the latest from Sellafield, the NDA's largest and most challenging site, which is adopting a new approach to its supply chain; and from Magnox, as the organisation prepares to take on responsibility for the UK's fleet of AGR reactors.

Sellafield

The Sellafield site is pretty good at building big one-off components, says head of commercial remediation and retrievals Dave Magrath, but tends to be not so good at some of its other manufacturing challenges, particularly with regards to large numbers of products.

"We tend to take a bespoke mindset to manufacturing products, which does get in the way," Magrath told delegates. "We need to change from a bespoke approach to a mindset which talks the same language as the people in this room. If you require thousands of products, you can't QA every single step."

Magrath set up Sellafield's new Manufactured Products Organisation (MPO) to improve the supply of high-volume manufactured items for use in decommissioning the site.

"It's an attempt by Sellafield to start to think like manufacturers," he explained. "We're trying to move to standard industry arrangements, so when you come to Sellafield you feel it's a place you can do business with."

The MPO is now looking at the manufacturability of a range of products including high-integrity stainless steel containers and hybrid racks for fuel storage. While Sellafield is already engaged with suppliers on many product lines, Magrath noted that demand could rapidly outstrip capacity – projected requirements include upwards of 15,000 boxes to deal with the Magnox silos and the pile fuel cladding silo programme, and hundreds of self-shielded boxes which each require a 24 tonne casting.

To meet the challenge, Magrath's team are introducing tools including lean thinking, capacity planning, cost management and annual improvement cycles, and developing an overarching acquisition schedule to 2040.

Magnox

Magnox currently manages 12 sites and, under new arrangements announced in summer 2021, will take responsibility for EDF's fleet of advanced gas-cooled reactors as they enter decommissioning through this decade.

The organisation has drawn on learnings over the past 20 years to create a decommissioning strategy which chief technology officer Andrew Forrest called a rolling programme of decommissioning with site-specific strategies.

Alternative approaches to standard products can help reduce the cost and schedule for decommissioning multiple sites – for example, Magnox is increasing its use of concrete containers which can be a third of the cost of standard metal products.

"That's a really good example of innovation," Forrest said. "There is also real progress being made on repeatability – we're able to increase repeatability across the Magnox sites as part of programmisation."

Magnox is also increasing its use of robotic technologies for dismantling reactors, with recent projects adapting Kuka products. "Using off-the-shelf technology like that, alongside new technology, is a great way to go," Forrest said. "When we start dismantling at Trawsfynydd, we're going to need more of this – more advancement in robotics, longer reaching robots, new waste plants and thousands of containers."

Forrest also wants to take a new approach to the reuse and recycling of waste material, including around 50,000 tonnes of graphite, 100,000 tonnes of metal, and over half a million tonnes of concrete from the Magnox fleet. "Disposing of that, or reusing and recycling it in a cost-effective way, could save a great deal of money," he noted. "It'd be really nice if someone could take that away and make something out of it."

The team are also developing a new supply chain strategy to enable the new decommissioning strategy. "Because we've got a continuous mission and rolling programme, we can look at much longer relationships," Forrest concluded.

Defence

Many of the manufacturing capabilities required to supply the civil nuclear industry can also be applied to the defence sector, and programme leaders are looking to exploit a wider range of advanced processes to reduce costs and improve through-life performance.

As the UK prepares to invest in a new generation of nuclear-powered submarines and update its warhead programme, key figures from the Ministry of Defence and its suppliers spoke at the Summit.

Ministry of Defence

The UK military is exploring potential applications for nuclear technologies beyond submarines, said Mike Lewis, nuclear capability specialist at the Ministry of Defence.

Alongside the drive to decarbonise, that creates a ripe environment for new nuclear developments and opportunities for increased cooperation between the civil and defence sectors. "Shared supply chains must be pursued to achieve benefits of reduced cost, increased capability and better resilience," Lewis said.

Improving the delivery cost of nuclear programmes is a priority for the MOD, including an increased focus on extrinsic safety approaches to remove risks through measures such as improved design and accident-tolerant fuels.

"One of the big blockers to the exploiting of nuclear technology is cost," Lewis noted. "Advanced manufacturing techniques have real promise in reducing costs, and are strengthening the case for nuclear technology in all its guises."

The MOD will look to exploit cheaper, faster and less resource-hungry manufacturing techniques such as near-net shape manufacturing and automated welding, Lewis said, and will also increase its focus on manufacturing for through-life support.

"We need technology and robust processes that deliver safe and reliable nuclear systems that inspire public confidence," he concluded. "To support our economic success, they must support cheaper production both for civil and defence."

Rolls-Royce

The UK is preparing to invest £31 billion in four new Dreadnought nuclear-powered submarines, to be followed by a replacement of the current Astute-class fleet for the late 2030s.

Rolls-Royce's work on the replacement programme is led by Abi Clayton, director of innovation and future programmes, who told delegates that the organisation is aiming for a 30 per cent reduction in build schedule and cost of ownership, and a 30 per cent increase in availability of the fleet by reducing maintenance requirements.

"We need to look at new manufacturing techniques to get things done quicker," she said. "We've got to deliver schedule certainty and at pace."

Clayton also highlighted Rolls-Royce's work to develop microreactors for military and other applications. A 1–5MW deployable reactor using GenIV+ technology could find applications in a host of areas including space exploration. "Nuclear is the sovereign capability that the UK can offer to the international space programme," Clayton noted.

The firm will start looking at the supply chain for the microreactor shortly, with a prototype under development in Derby within the next year.

"We can't do this without you guys, the suppliers, and we need the cost and schedule certainty to get us there," Clayton said.

AWE

As Lewis emphasised, the UK remains committed to maintaining its nuclear deterrent. In 2020, the government announced a new programme to prepare the way to replacing the current stock of warheads, led by the Atomic Weapons Establishment (AWE).

"We need to do several things that together seem almost impossible," Professor Andrew Randewich, executive director for engineering and science at AWE, told the Summit. "We expect to need to keep the current system going longer than anything has been in service before. And we have to develop new modern warheads without nuclear testing, which no nation has ever done. Over the same period, many of the facilities at AWE will need to be replaced."

Delivering all this will require close engagement with the supply chain, at the same time as suppliers are working on civil programmes. "The supply chain that delivers these things is the same – it's common shared skills and materials," Randewich said, noting considerable uncertainty over whether the resources and capacity available can match all the demands.

AWE recently struggled to source an adequate supply of gloveboxes from UK manufacturers, and the organisation is now working with the Nuclear AMRC to better understand supply chain capacity.

"Long-term partnerships will be key. We'll use existing nuclear forums, or build new ones," Randewich concluded. "Civil and defence can work together to deliver value for money."

Supply chain support

The second day of the Nuclear Manufacturing Summit focused on the support available to help manufacturers develop their capabilities and win work in the nuclear sector, with morning presentations followed by tours of the Nuclear AMRC workshop.

The session was opened by Katherine Bennett, chief executive of the High Value Manufacturing Catapult, who highlighted the increased positivity for nuclear in government and policy-making circles. "As a relative newcomer to this sector, I can really see the opportunity to collaborate, convene and work together," she said.

Given the array of new build, decommissioning and defence programmes discussed on the first day of the Summit, the supply chain's capacity and capability could fall below demand, Bennett noted.

"We have to make sure that the UK supply chain is fully ready for the challenge – if the value of new build isn't to go elsewhere, we need to focus on that," she said. "I'm determined the HVM Catapult should do all it can to help the whole of the sector deliver what we need."

Support panel: Katherine Bennett, Dave Petley, Mark Foy, Beccy Pleasant and Andrew Storer.

Research and innovation

Professor Dave Petley, vice-president for innovation at the University of Sheffield, discussed the role that universities can play in supporting industries such as nuclear. While UK universities punch above their weight in R&D terms, there is still a challenge in connecting academics with industry requirements.

"Our academic community needs to hear from you what the fundamental problems are that you need addressing," he told delegates. "One of the roles we need Catapult centres to play is to provide a communication route from people like yourselves back to our researchers."

Professor Steve Jones, chief technology officer at the Nuclear AMRC, highlighted the centre's work in helping the supply chain develop new manufacturing capabilities. "For our supply chain to be fit for nuclear, we need a resilient and competitive capability," he said.

Industry and researchers need to work together to move away from the current myopic view of technology requirements, Jones argued, and take a longer view at areas such as machine learning and analytics. The industry should focus on performance and standardisation, and draw from other industries. "We have to deploy technologies from automotive and other sectors," he said. "Aerospace accuracy is really needed, alongside nuclear integrity."

Tom Purnell and Steve Lawler, business managers at Frazer-Nash Consultancy, discussed the benefits that their organisation has seen through its membership and collaboration with the Nuclear AMRC.

Having seen success in a series of collaborative R&D projects funded through the government's Nuclear Innovation Programme, Frazer-Nash has now established their Advanced Manufacturing Technology Hub (AMTecH) to support organisations such as the Nuclear AMRC and the wider supply chain on advanced engineering maturity programmes.

"AMTecH is a model whereby we use the existing skills and pedigree in our people at Frazer-Nash to help organisations to identify and manage risks associated with the development of new techniques for nuclear platforms," Lawler explained.

"AMTecH isn't just nuclear though – it is relevant to all sectors, but we see it fitting really well with the Nuclear AMRC's mission and supporting other organisations in the nuclear sector."

Industry programmes

As a highly-regulated industry, nuclear is not always seen as entirely amenable to new technologies or innovative ways of working. The UK's regulators do want that to change, emphasised Mark Foy, chief executive of the Office of Nuclear Regulation (ONR).

"The industry is perceived in many quarters now as being overly conservative and risk-averse, and that's driving complexity, increased costs and protracted timelines," Foy said. "The prevalence of these new technologies is exciting, and we are here as a regulator to support those and the ambitions of the industry."

The ONR is working with universities and research organisations to understand the challenges of innovative technologies, and is keen to engage at an early stage with companies working on new reactor designs or production processes.

"We need innovators to ask for the regulator's view early," Foy said. "Lots of times we've been told 'we haven't done something because we thought the regulator wouldn't accept it'."

New technologies for nuclear aren't necessarily new for other industries, and the ONR is open-minded to transferring technologies and practices from other sectors.

"It's about engaging early, being open minded, supportive and flexible to what your ambitions are, and also being clear on our expectations and receptive to the constructive challenge you may wish to make," Foy concluded. "Our goal is to avoid being a barrier to new technologies."

Back in 2018, the Nuclear Sector Deal set out the ambitions of industry and government to drive innovation and reduce costs across the sector. Programme director Liz Gregory provided a brief update on progress.

"The Nuclear Sector Deal needs to evolve, to better align with policy and net-zero legislation," she said. As part of a refresh of the original deal, the programme management office is now moving to a more delivery-focused model for each workstream, including the Winning UK Business stream led by the Nuclear AMRC.

Skills development is a major focus for the sector deal. Beccy Pleasant of the Nuclear Skills Strategy Group (NSSG) highlighted the need to understand the future requirements coming from the full spectrum of projects for the supply chain to meet demand.

"Unless you know what skills are needed, when and where they're needed, and how transferable they are, you won't have the right skills in the right place," she said.

The NSSG is moving to a route-based approach to identify skills gaps, with modelling to identify overlapping demands from different programmes.

"When we consider sector growth alongside an aging workforce, it identifies some significant gaps in our workforce that we need to address," Pleasant said. The NSSG is working with skills providers to address these gaps, and also working on a national programme to promote nuclear in the schools curriculum, to demystify the sector and attract more people in – and help tackle the industry's ongoing challenges with diversity, including the sector deal's target of 40 per cent women working across the sector by 2030.

Supply chain development

Julian Vance-Daniel, managing director of Vessco Engineering, closed the conference with a supplier's perspective of the nuclear sector. Since working through the Nuclear AMRC's Fit For Nuclear (F4N) programme, the Bridgend-based pressure vessel specialist has won work at Hinkley Point C and is now breaking into the European nuclear market.

"Back in 2010 when we first attempted to enter the industry, there were signs that the new build arena was starting to awaken," Vance-Daniel recalled. "There were very few small or medium businesses ready to step up. I don't mean willing, I mean prepared."

The first steps to selling into the nuclear market are to understand the unique strengths of your own business, and to identify where your products can be of use to nuclear customers.

"We knew that the tier ones would be looking for pressure vessel manufacturers with a history of manufacturing large and heavy vessels. But just because you want to sell into the market, and have some experience of manufacturing the sort of products used, doesn't mean you're ready," he said. "We chose to use the Fit For Nuclear pathway to stamp our credentials in the marketplace."

After winning work with GE Steam Power at Hinkley Point, Vessco has secured business from Balfour Beatty for a number of challenging fabrications.

The F4N programme has helped hundreds of UK manufacturers develop their capabilities for the nuclear sector over the past decade, lead industrial advisor Kevin Shepherd told delegates.

To better understand the full capabilities of the UK supply chain, the Nuclear AMRC's supply chain development team are now working with a database of around 2,500 manufacturing businesses in nuclear and related sectors, and mapping supply chain readiness levels for key component categories.

"We not only know the nuts and bolts of what's going on down to SME land, we know what's available to be manufactured in the UK," Shepherd said.

Rolls-Royce SMR launches at Nuclear AMRC

Rolls-Royce SMR, the new business spinning out of the engineering giant to commercialise its compact nuclear power station, announced its successful fundraising and development plans in November at a launch event hosted by the Nuclear AMRC.

With the UK government committing £210 million of funding to match private investment raised by Rolls-Royce, the Nuclear AMRC welcomed business secretary Kwasi Kwarteng, the Rolls-Royce SMR team and investors to its Rotherham centre for the launch of the next phase of development.

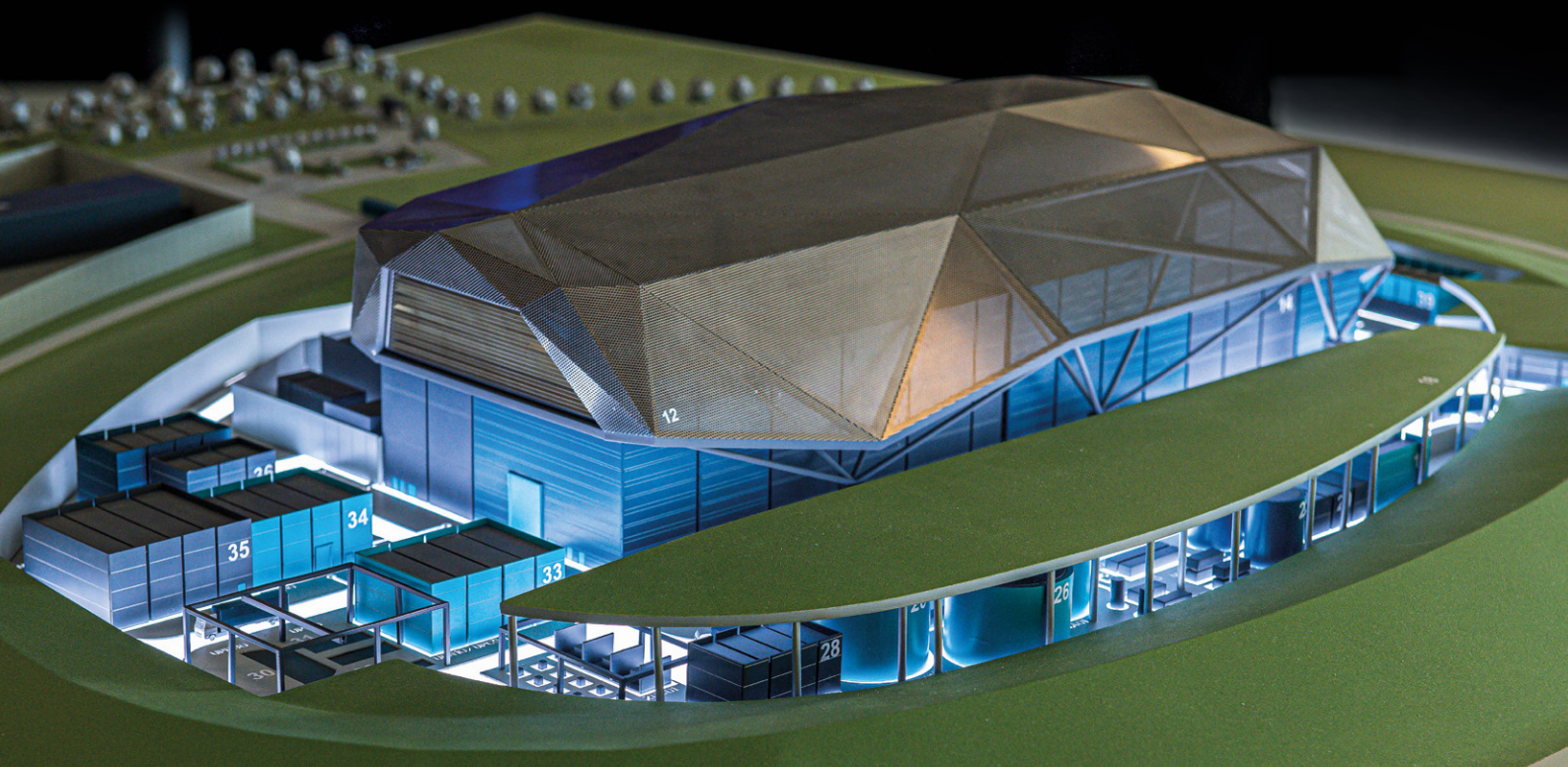
"This is a once in a lifetime opportunity for the UK to deploy more low-carbon energy than ever before and ensure greater energy independence," Kwarteng said. "In working with Rolls-Royce, we are proud to back the largest engineering collaboration the UK has ever seen – uniting some of the most respected and innovating organisations on the planet. Not only can we maximise British content, create new intellectual property and reinvigorate supply chains, but also position our country as a global leader in innovative nuclear technologies we can potentially export elsewhere."

Rolls-Royce, investment group BNF Resources UK and US-based energy group Exelon Generation will together invest £195 million across a period of around three years.

The new company announced a further £85 million investment from the Qatar Investment Authority in December.

"Our transformative approach to delivering nuclear power, based on predictable factory-built components, is unique and the nuclear technology is proven," said Tom Samson, CEO of the new Rolls-Royce SMR business. "Investors see a tremendous opportunity to decarbonise the UK through stable baseload nuclear power, in addition to fulfilling a vital export need as countries identify nuclear as an opportunity to decarbonise.

"The capitalisation of Rolls-Royce SMR takes us a step closer to achieving a



Compact power: model of the Rolls-Royce SMR design.

Engineering collaboration: business secretary Kwasi Kwarteng launching Rolls-Royce SMR at the Nuclear AMRC.

unique, and most importantly investable, proposition in nuclear energy. It is a major vote of confidence in British nuclear technology and the potential for building a world-leading domestic supply chain."

Following the signing of the agreements to launch the business, the team toured the Nuclear AMRC workshop to view some of the technologies which could be deployed in producing modules for the Rolls-Royce SMR in new factories across the UK.

Manufacturing challenge

The entire Rolls-Royce SMR plant is being designed as a number of modular sub-assemblies which will be manufactured in factories, then transported to site for rapid assembly inside a weatherproof canopy. That will cut costs and project risks by avoiding weather disruption, and also secure efficiency savings by using streamlined and standardised manufacturing processes for all its components.

Initial development was carried out by the UK SMR Consortium, a collaboration of Assystem, Atkins, BAM Nuttall, Jacobs, Laing O'Rourke, NNL, the Nuclear AMRC, Rolls-Royce and TWI. The 18-month first phase was backed by an initial £18 million match-funding investment from the government's Industrial Strategy Challenge Fund, and ended in early 2021.

The Nuclear AMRC will continue to play a key role in developing advanced manufacturing capabilities, and helping prepare critical components for commercial production in the UK.

"The Rolls-Royce SMR can play a huge part in the UK's journey to net zero emissions," said Andrew Storer, Nuclear AMRC CEO. "Because it's designed in the UK and will be manufactured here, it can also help drive the economic revival of our industrial heartlands. As a small factory-built reactor, it's a much better fit for the current capabilities of the UK nuclear supply chain, which will help us maximise the economic benefits of the energy transition."

In the first phase of development, the Nuclear AMRC demonstrated how a range of advanced manufacturing techniques can reduce capital costs and production time for SMR modules.

"Our task now is to apply the advanced manufacturing technologies that we've been developing at the Nuclear AMRC over the past decade, and ensure that as much of the SMR as possible can be made in UK factories, as cost-effectively as possible, while meeting all the quality and safety standards expected by nuclear customers and regulators," Storer said.

The centre's engineers will help develop the manufacturing capability for a variety of advanced processes, using the state-of-the-art machining, joining and testing facilities of its Rotherham research factory and other facilities.

The team will continue to carry out manufacturing capability delivery projects in areas including fixed and portable machining, post-process cleanliness, measurement process development, welding and cladding, and digital

Workshop demo: Rolls-Royce SMR chief engineer Matt Blake with CEO Tom Samson and Kwasi Kwarteng MP.

manufacturing. The centre will also support the design of a new UK factory for large SMR components.

Following this process development, the Nuclear AMRC will work with Rolls-Royce to create a fully integrated pre-production proving facility for SMR manufacturing. The proving facility will be used to manufacture large-scale prototypes of the reactor pressure vessel and its closure head.

The centre will also draw on the wider capabilities of the High Value Manufacturing Catapult and UK universities to apply the full range of innovative research and development to SMR manufacturing.

Several of the Nuclear AMRC's industrial member companies have also announced that they will be working with Rolls-Royce SMR.

Sheffield Forgemasters has secured a £3.7 million contract with Rolls-Royce SMR to provide development forgings as part of Rolls-Royce SMR's work to achieve regulatory approval. Cavendish Nuclear has signed a memorandum of understanding to explore opportunities for cooperation on the programme, and Frazer-Nash Consultancy has entered an agreement to provide technical and consultancy services.

Compact power

The Rolls-Royce SMR is a compact power station design, producing 470MWe from a Gen III+ pressurised water reactor (PWR). This proven nuclear technology will be coupled with a unique factory-made module manufacturing and on-site assembly system to reduce the cost and schedule risk of nuclear new build. Each SMR will cost around £1.8 billion in mass production, with electricity delivered at an estimated £40–60/MWh.

Nine-tenths of an individual Rolls-Royce SMR power plant will be built or assembled in factory conditions, and around 80 per cent could be delivered by a UK supply chain. Much of the venture's investment is expected to be focused in the north of the UK, where there is significant existing nuclear expertise.

A single Rolls-Royce SMR power station will occupy the footprint of two football pitches and power approximately one million homes. It can support both on-grid electricity and a range of off-grid clean energy solutions, enabling the decarbonisation of industrial processes and the production of clean fuels to support the energy transition in the heating and transportation sectors.

"The SMR programme is one of the ways that Rolls-Royce is meeting the need to ensure the UK continues to develop innovative ways to tackle the global threat of climate change," said group CEO Warren East. "With the Rolls-Royce SMR technology, we have developed a clean energy solution which can deliver cost-competitive and scalable net-zero power for multiple applications, from grid and industrial electricity production to hydrogen and synthetic fuel manufacturing."

Rolls-Royce SMR is targeting a UK fleet of around 16 power plants, with the first coming online around 2030. By 2050, a full UK programme could create up to 40,000 jobs and £52 billion of value to the UK economy. Developing an SMR in the UK could create an estimated £250 billion of exports.

Rolls-Royce also announced that it has entered the SMR for the UK's generic design assessment (GDA). Managed by the Office for Nuclear Regulation and Environment Agency, the GDA is intended to support the construction of a number of new nuclear power stations by approving a standard reactor design which can be built in different locations.

www.rolls-royce-smr.com

Executive **view**

Real strides on the road to net zero

2021 was another challenging year for most of the industry, but I hope that many of you have begun the new year with a little more confidence about the future of the UK's nuclear industry and the transition to net zero emissions.

The Cop26 climate change conference in November wasn't really the breakthrough that many of us hoped for, but it did deliver some successes in committing countries to ever-tighter targets for decarbonisation, and emphasising the need for a varied mix of technologies.

On the back of Cop26, we held our Nuclear Manufacturing Summit which is covered well in this edition. I would like to say a big thank you to all the speakers and exhibitors for their support. It was a huge success and we will be building on this.

As several of the speakers at our summit noted, nuclear energy was very much part of the Cop26 story, with growing public acceptance and sense of urgency.

After what can feel like years of delay and dithering, the UK is now making real strides towards developing and deploying new nuclear technologies. We were honoured to host the launch of the Rolls-Royce SMR programme, and we will be playing an important role in helping turn the reactor design into engineered reality.

We also saw significant advances in the next generation of advanced reactor development, including the launch of UKAEA's new Rotherham facility, and a new focus on high-temperature reactors which can support wider decarbonisation through cogeneration and hydrogen production.

We now need to deliver as an industry on these investments and commitments, to ensure we can meet our national commitment to zero-carbon electricity generation by 2035, and total decarbonisation by 2050.

Let's not forget that the UK is losing the bulk of our current capacity for reliable low-carbon power, just when we need it most. A few days into the new year, Hunterston B followed Dungeness B into retirement, with the rest of the AGR fleet to follow in the next few years. We need to fill that gap, and continue to invest in new capacity to meet our future needs.

The nuclear financing bill should help unlock investment in new gigawatt-scale developments and a national fleet of SMRs. The inclusion of nuclear in the European taxonomy for sustainable investment should also help spur investment internationally, creating export opportunities for our experienced manufacturers.

Helping the UK supply chain get ready for the coming opportunities is an important part of our role. Last year, we marked 10 years of our Fit For Nuclear programme. The companies we've worked with through F4N and our other supply chain initiatives, including new Fit For programmes in other low-carbon sectors, have told us that our support has helped them win around £2 billion of new contracts.

This year, we hope to launch a major new supply chain programme – first mooted in 2018 in the Nuclear Sector Deal – which will aim to help up to 100 UK companies win a further £60 billion of new business by 2050. We also heard recently about the Australian, UK and US collaboration around submarines for Australia, which will provide huge supply chain opportunity and challenges for skills in the sector.

As we heard at the Summit, the sector deal has undergone a thorough review and update to better align with evolving market conditions and policy. I am pleased that there does appear to be the appetite across government and industry to really focus on the changes and opportunities in the sector, and the potential impact for the supply chain.

We're also continuing to enhance our technical capabilities with the expansion of our modules facility, and work starting soon on the full-scale Nuclear AMRC Midlands facility in Derby. Of course we are working with our sister centres across the High Value Manufacturing Catapult, operating from some 18 locations across the UK, to bring the full array of manufacturing innovation and expertise to bear on nuclear industry challenges.

The nuclear sector has a lot of the foundations in place to deliver what is needed. However, we must work efficiently and show everyone that the industry can deliver affordable clean energy on time and cost. We can all play our full part in delivering nuclear's full potential. We will have to if we are to achieve our ambitions.

2022 promises to be a very exciting step towards realising our full potential as an industry, and giving us, and engineers of the future, a sound footing for the next 10 to 30 years on the road to net zero. Here's to a great 2022 for you all.

Andrew Storer, CEO

Nuclear AMRC joins **fusion manufacturing support programme**

The Nuclear AMRC has joined a new framework agreement to provide manufacturing support to UKAEA's Spherical Tokamak for Energy Production (STEP) programme.

The centre is one of five lead organisations joining the £3.5 million manufacturing support services framework agreement as part of UKAEA's plans to deliver the first prototype fusion energy plant in the UK. Each will work with a number of collaborators from industry, academia and research organisations.

The Nuclear AMRC will be supported by international engineering group Jacobs, specialist pressure vessel manufacturer Vessco Engineering, the Science and Technology Facilities Council (STFC), and three other centres within the High Value Manufacturing Catapult – the Advanced Forming Research Centre (AFRC) at the University of Strathclyde, the University of Sheffield Advanced Manufacturing Research Centre (AMRC), and the Coventry-based Manufacturing Technology Centre (MTC).

"We are delighted to be leading an exceptional group of leading companies and research organisations, to help de-risk the manufacturing and deployment of advanced fusion technologies," said Jay Shaw, Nuclear AMRC programme director.

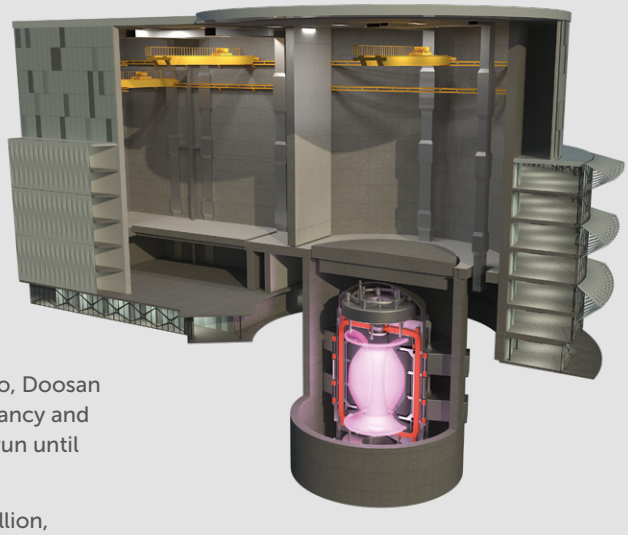
"We have drawn on our industrial network from along the nuclear supply chain and our research partners to bring together a consortium which can cover the biggest manufacturing challenges on the road to commercial fusion power. Together, we can apply our innovation and expertise in areas such as advanced joining, near-net shape production and inspection, to help produce prototype components ranging from high-integrity pressure vessels to immensely powerful magnets."

The other lead organisations on the manufacturing support services framework are Ansaldo, Doosan Babcock, Frazer-Nash Consultancy and Rolls-Royce. The agreements run until March 2024.

UKAEA has also signed a £4 million, four-year engineering embedded resource framework agreement with seven companies – Assystem, Atkins, IDOM, Morsons, Nuvia, EASL and Norton Straw Consultants – covering specialist technology areas including fusion research, power plant design, robotics, modelling and materials.

The frameworks will allow companies to embed their own specialists in project roles or add experience and expertise to UKAEA research into the development of fusion energy.

"Signing these two major framework agreements in the run-up to Christmas is a big boost for UKAEA and our partners," said Paula Barham, UKAEA head of procurement. "Joining forces with such world-class organisations brings exciting opportunities for us to team up with a wide range of experts, with this type of collaboration vital to UKAEA succeeding and positioning the UK as a leader in sustainable fusion energy."



One STEP beyond: concept design for the fusion power plant.

STEP is a UKAEA programme that will demonstrate the ability to generate net electricity from fusion through a prototype power plant. It will also determine how the plant will be maintained through its operational life, and demonstrate its potential to recycle fuel. Five sites have been shortlisted across the UK, with a decision on the final location around the end of 2022.

step.ukaea.uk

Breeder blanket innovation

Nuclear AMRC researchers have contributed to an innovative concept design for the breeder blanket for the STEP reactor.

A breeder blanket is one of the most challenging parts of a fusion reactor. It provides shielding from plasma fusion neutrons, extracts heat for power generation, and breeds tritium to allow self-sustaining fusion.

Nuclear AMRC senior research engineer Pablo Gordillo and metallurgist James Connell worked with researchers at IDOM and UKAEA to propose an innovative design which could be produced using current manufacturing technologies.

The proposed design, published in the journal *Fusion Engineering and Design*, encapsulates the breeding material within hollow spheres to form a gas-cooled packed bed. The concept could be used with a range of different breeding materials.

doi.org/10.1016/j.fusengdes.2021.112909

Intelligent tools to optimise **heat treatment**

The Nuclear AMRC is part of a new collaborative project to improve the efficiency of heat treatment for energy-intensive foundation industries such as glass and metal forming.

The AI6S project will develop a suite of new process optimisation tools which can significantly reduce the energy used in heat treatment while reducing waste and scrap rates.

The two-year project is led by London-based industrial software developer HyBird, with £1.4 million funding from UKRI's Industrial Strategy Challenge Fund through the Transforming Foundation Industries Challenge.

Other partners include Abbey Forged Products and Glass Technology Services, both based in Sheffield; Derby-based technology specialist Ivy Tech; and the Brunel Innovation Centre in Cambridge.

The consortium will focus on new approaches to optimising the heat treatment used to improve the material performance and integrity of components produced by casting, forging and other forming processes. Heat treatment is energy intensive in its own right, and any errors can lead to the component being scrapped with heavy costs in time, money and energy.

With steel castings, for example, heat treatment is often a matter of expert judgement, based on temperature-time curves for the specific alloy, and considering other factors such as the expected residual stresses and microstructure created by the casting process.

The temperature-time curve can be optimised in terms of energy consumption, while keeping required material properties. The AI6S project aims to develop optimisation algorithms which can automate and accelerate this process, by combining artificial intelligence and machine-learning technologies with lean manufacturing and six-sigma practices.

Current lean six-sigma methods can increase efficiency through a process of continuous improvement – in essence, trial and error over a number of iterations. The AI6S tools will instead let companies optimise heat treatment processes so that they're right first time, meeting all specifications and quality criteria while reducing energy consumption.

Energy intensive: heat treatment at Abbey Forged Products.

The partners estimate that the tools, if applied across a range of foundation industries, could reduce annual emissions by the equivalent of 21,800 tonnes of carbon dioxide in the UK alone.

The Nuclear AMRC is leading research into process simulation and verification. The team will carry out a series of simulated heat treatments and tests on steel and glass samples, collecting data on process parameters, manufactured product quality and energy consumption.

"The results from the mechanical and metallurgical tests, along with finite element simulation of the heat treatment process, will let us understand the effect of the key parameters of heat treatment on material integrity and performance," says Tauseef Syed, technical lead for in-process inspection. "Our project partners will then use this matrix of data to train a machine-learning framework which will predict material properties after heat treatment."

Those models will in turn be fed into the optimisation tool, using multiple evolutionary algorithms to optimise the heat treatment process to meet customer requirements.

The Nuclear AMRC researchers will also use their expertise in factory simulation to look at how factory layout can be optimised to reduce energy consumption, eliminate bottlenecks, and future-proof facilities using legacy equipment.

"We will develop a simulation to replicate the real-time process at both Abbey Forged Products and Glass Technology Services, using value stream mapping and discrete event simulation to identify bottlenecks," Syed says. "We can then use these same tools to provide recommendations on improving the process flow at both companies to eliminate these bottlenecks, and reduce energy and wasted movements."

The techniques can be applied to factories of all sizes in a range of sectors to apply lean practices to manufacturing process flow, he notes.

Measuring up to the future

New portable metrology equipment at the Nuclear AMRC will allow researchers to cut production time and cost for a host of large complex products, and gain a deeper insight into advanced manufacturing processes.

Flexible precision: the AS1 Absolute Scanner mounted on the Absolute Arm.

The equipment has been provided by Hexagon Manufacturing Intelligence, a tier one member of the Nuclear AMRC, in its largest investment in any High Value Manufacturing Catapult centre.

The new equipment includes Hexagon's ATS600, the first direct-scanning laser tracker on the market.

The ATS600 can provide metrology-grade accuracy without requiring a reflector at the point of measurement. In practice, it can locate a point to within 300 microns from up to 60 metres away. With a reflector, it can work over greater distances of up to 80 metres.

Its direct-scanning capabilities offer unique advantages over conventional laser trackers, says Simon Cavill, technical lead for metrology at the Nuclear AMRC.

"The ATS600 will allow scanning of large parts where physical access with a conventional scanner is challenging," Cavill says. "The system can be pre-programmed and, because it doesn't need a reflector, can provide fully automated inspection without the need for operator input."

The tracker allows a single engineer to rapidly create a 3D model of complex objects which would previously have required significant time to model, and to extend quality control and digital modelling into new areas of production.

The operator can also define the measurement area and density of measured points, allowing them to balance data quality and process speed to meet the demands of the job or software requirements.

The Nuclear AMRC are now looking at integrating the ATS600 with the Husky unmanned ground vehicle platform (see p20) for autonomous inspection of large fabrications.

Hexagon has also provided its new AS1 Absolute Scanner, an advanced 3D laser scanner to build up detailed digital models of large objects. The new model features intelligent software and control systems which avoid problems with highly reflective materials, composites and other challenging surfaces.

"The AS1 will be ideal for in-situ capture of complex reflective features such as nozzle junctions on large vessels," says Cavill. "It's also very easy to transfer the scanner from measurement arm to laser tracker, which gives us great flexibility in applying it to a wide variety of applications."

The AS1 scanner can be integrated with a range of hardware, with modular design allowing seamless use in the laboratory on the shopfloor. It can be handheld, with visual and haptic tools to help the user maintain accuracy. It can be mounted on a portable measuring arm, or a robot arm for fully automated inspection.

Cavill's team are initially using the AS1 on a new 2.5 metre Absolute Arm from Hexagon. Boasting positioners at each of its pivot joints to provide absolute tracking of the scanning tool, the Absolute Arm promises to be 5–10 per cent more accurate than previous designs.

The arm can also carry a range of contact probes, structured light scanners and other tools – in many cases, avoiding the need to take a part to a CMM room for inspection, saving hours during production. To protect the operator's health and safety, the arm is counterbalanced and features ergonomic grips to minimise fatigue.

Hexagon is also providing the Nuclear AMRC with its Inspire metrology software, plus ongoing support and training for the new equipment.

Hexagon's membership of the Nuclear AMRC means that the centre's engineers can deploy state-of-the-art metrology equipment to add value to commercial and collaborative research projects with manufacturers of all sizes, Cavill notes.

"Working with Hexagon is invaluable in allowing the supply chain to access state-of-the-art metrology equipment for R&D projects, letting them develop a full understanding of advanced inspection processes before they commit to investment," he says.

www.hexagonmi.com

Rapid modelling: Simon Cavill prepares the new ATS600 laser tracker for automated scanning.

Rugged research platform: senior technician Jack Powell programmes the new UGV.

Husky tackles nuclear challenges

The latest addition to the Nuclear AMRC Midlands team sounds like the ideal candidate for a demanding job – intelligent, flexible, rugged, and thrives in a challenging environment.

The Derby-based team have bought a Husky unmanned ground vehicle (UGV), a robotic development platform produced by Clearpath Robotics in the US, to help tackle a range of nuclear industry challenges.

In recent years, UGVs have been deployed in a variety of civilian, industrial and military applications, to work in hazardous or unpleasant conditions, or carry out tasks which are too risky, difficult or dull for humans. But so far, they have not been widely used in the nuclear sector.

The first job for the Nuclear AMRC's Husky is developing its capabilities for safely patrolling a potentially hazardous site, to monitor radiation levels and collect environmental data.

"For the nuclear industry, the UGV has the potential to provide real-time location measurement and mapping of radioactivity with isotope identification," says Dr Ali Imam Sunny, technical lead in the Nuclear AMRC's control and instrumentation team. "In the near future we will work on routine and repeated monitoring of the site to actively provide data, to highlight anomalous changes in radiation as well as other anomalies within the ground with the help of ground-penetrating radar and other sensor elements."

The project, funded by the High Value Manufacturing Catapult, aims to develop an intelligent control and guidance system for unmanned logistics vehicles, based on proven artificial intelligence concepts.

The Derby-based team will integrate a selection of advanced sensor systems to the Husky platform, including light detection and ranging (lidar) and gamma ray spectrometers, along with satellite navigation and positioning devices.

The team will also develop software for combining radiation intensity and geolocation data to create a live map of radiation levels, and test the system in a safe environment before the Husky is let loose on a real nuclear site.

"Our current research focuses on generating simulations of the kinds of environment in which a UGV might be deployed, to assess the efficiency of the system in various scenarios," Sunny notes.

As well as monitoring operational and decommissioning sites, the Husky could have a role to play in the development of new reactors. The team are planning to integrate advanced laser scanning equipment which can profile complex structures during the production and assembly of modular reactors, to support the development of digital twins.

clearpathrobotics.com/husky-unmanned-ground-vehicle-robot

F4OR goes national

Companies across the UK can now apply to join the Fit 4 Offshore Renewables (F4OR) programme to assess and develop their readiness to supply the fast-growing offshore wind market.

The first national F4OR programme is delivered by the Offshore Renewable Energy Catapult and funded by the Offshore Wind Growth Partnership (OWGP), with support from the Nuclear AMRC and business consultancy Opergy.

It will support 14 companies from across the UK through a rigorous 12-18 month programme focusing on improving business operations and sector competence.

The Nuclear AMRC has previously worked with ORE Catapult and regional partners to pilot and roll out F4OR in key regions including North-East Scotland and East Anglia. More than 70 companies have enrolled, with around 20 already granted F4OR status.

"Seeing our successful regional programme being launched on a national scale is just what is needed to open the doors to any promising business from across the country," says Andrew Stormonth-Darling, F4OR programme manager for ORE Catapult. "Our regional initiatives have been heavily oversubscribed, so by working with the OWGP we can tap into talent, wherever it emerges. This allows us to focus on supporting the entry and growth of the most committed businesses with the most in-demand products and services."

Companies progressing through the F4OR programme typically see an increase in turnover of almost 23 per cent, and job creation up 13 per cent. Based on the proven Fit For Nuclear programme, F4OR aims to develop an increasingly competent, capable and competitive UK offshore renewable energy supply chain.

The national F4OR programme sits alongside a suite of other business transformation programmes developed and delivered by OWGP and partner organisations, including the foundation-level Wind Expert Support Toolkit and the advanced Sharing in Growth Offshore Wind Programme.

"This initiative is complementary to our existing programmes and ensures we can provide progressive support to companies as they grow and increase their capability delivering to the sector," says OWGP programme director Andrew Macdonald. "I'm looking forward to seeing the development of the selected companies and opportunities which arise for them on completion of the F4OR programme."

owgp.org.uk

Some of the events that the Nuclear AMRC will be attending or supporting in the coming months. Please be aware than plans may change in response to the changing Covid situation and local restrictions.

Diary namrc.co.uk/news/events

AMP Technology Exhibition

25 May, Rotherham

The Nu-Tech Engineering & Technology Solutions Exhibition comes to South Yorkshire's Advanced Manufacturing Park (AMP) in collaboration with the Nuclear AMRC. The event will bring together engineers, technologists and researchers with exhibiting suppliers.

www.technologyexhibitions.co.uk/AMPEvent

NIA Decom 2022 & NDA Supply Chain Event

20–21 July, Telford

The Nuclear Industry Association hosts its Decom 2022 conference at Telford's International Centre. The following day, the Nuclear Decommissioning Authority's supply chain event returns at the same venue, with all the usual networking opportunities.

namrc.co.uk/events/nda-supply-chain-2022

F4N
Fit For Nuclear

New industrial advisor looks East

Dug Harrison has joined the Fit For Nuclear team as industrial advisor covering the East of England and central southern counties. *Nuclear AMRC News* asked him to introduce himself.

My early career saw me serve two engineering apprenticeships in my home town of Sunderland. The first was within manufacturing as a pipefitter and welder, working on the Thorp project for Sellafield and others. The second was in the drawing office at the same company, where I became a piping draughtsman and designer.

I spent 15 years in the drawing office, and decided a move was necessary when CAD was introduced as I felt that computers killed the art of draughting. I moved into the world of learning and development, and held jobs such as apprentice training officer and competence assurance advisor following a move down to Norfolk.

I spent nine years at the ECITB looking after companies who paid the training levy, where one of my proudest achievements was the recruitment and training of nearly 300 apprentices in the East of England for the energy sector.

I then spent ten years with the National Skills Academy for Nuclear (NSAN) in a similar role, looking after companies in the Southeast and East of England. I have experience in the full training cycle, from design to evaluation, and have picked up a wealth of knowledge throughout my career which stands me in good stead with helping companies achieve their F4N status.

I have worked with some of the existing F4N companies in the East of England during my time with the ECITB and NSAN, so I look forward to continuing that relationship. Forging ahead, I am looking to engage with manufacturing companies that are looking to break into the nuclear sector, who believe their products and services have a place in the industry.

The East of England is a main hub for energy in the UK, with companies covering the oil & gas, offshore wind and nuclear sectors. I believe that most of the companies have transferrable skills that would suit working in the nuclear industry, and I see my role as working with them to learn and understand what is required to make a success in nuclear.

With the possibility of Sizewell C being announced very soon, I feel passionate about local companies taking advantage of the work packages that will become available, meaning that the region takes its fair share of contracts and continues to invest in the future of engineering for the local population.

Having worked in most parts of the energy sector in my working life, I believe companies that are looking to break into nuclear really need to focus on health and safety, as nuclear is seen as an exemplar when it comes to attitudes, behaviours and safety culture.

Nuclear is highly regulated and, again, companies need to focus on improving their current operations in terms of policies, procedures and continuous improvement in order to win nuclear contracts, with the F4N programme being at the heart of companies achieving their goals.

I look forward to being part of their journey and helping them to become successful nuclear manufacturers.

dug.harrison@namrc.co.uk

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.

AKP Precision Engineering has over 30 years' experience in the precision engineering industry, delivering a friendly first-class machining service to a variety of sectors.
www.akp.ltd

Delkia is a leading systems integrator providing engineering and technology services for control, electrical and instrumentation systems.
www.delkia.co.uk

Gadcap Technical Solutions produces monitoring systems for the power and aerospace sectors, and manufactures cable for nuclear applications.
gadcap.co.uk

Congratulations also to **WES Hardmetal Engineering** on being regranted F4N.

For details of all F4N-granted companies: **namrc.co.uk/services/f4n/companies**

Fit For Offshore Renewables (F4OR) is a collaboration between the Offshore Renewable Energy Catapult and the Nuclear AMRC, based on the proven Fit For Nuclear model of supplier development. Following regional programmes in key regions of England and Scotland, F4OR is now open to companies across the UK.

F4OR
Fit For Offshore Renewables

Congratulations to the latest companies to be granted F4OR, all from Norfolk and Suffolk.

Aquaterra Energy provides equipment and solutions to the global offshore energy industry, including installation and mooring equipment for wind projects.
aquaterraenergy.com

Prior Power Solutions supplies diesel, alternative and sustainable power systems, equipment and services to offshore and other industries.
priorpower.com

Fern Communications designs and manufactures bespoke communication systems and products for offshore renewables and oil & gas.
ferncom.com

Warren Services provides high-quality manufacture of components and mechanical/electrical sub-assemblies.
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To find out more about F4OR: **ore.catapult.org.uk/f4or**

Work **with us**

The Nuclear AMRC is here to support manufacturing companies, from SMEs to global giants, which are seriously interested in winning business in the nuclear sector.
If we can help your company, we want to hear from you.

We help manufacturers through **supply chain development** and **innovation**.

We can work with you to raise your quality, capability and cost competitiveness to meet the needs of the global nuclear industry.

And we can develop world-leading manufacturing processes and technologies. We have the production-scale facilities and the manufacturing expertise to help you improve cycle time, reduce lead time, improve quality and reduce costs.

Our capabilities and services are open to all UK manufacturers. We provide a responsive service to help you solve your manufacturing challenges and win new work.

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

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

NUCLEAR **AMRC**
ADVANCED MANUFACTURING RESEARCH CENTRE

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