NUCLEAR AMRC news
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Infinity and beyond

Nuclear AMRC Midlands opens for business

CATAPULT High Value Manufacturing

Nuclear AMRC Midlands opens for business

The Nuclear AMRC's newest regional research and innovation centre has opened for business at Infinity Park, Derby.

Around 150 regional manufacturers and stakeholders attended the launch of Nuclear AMRC Midlands at the iHub facility in February, joining high-level speakers from industry and government to discuss the challenges facing manufacturers across the region's key sectors, and experiencing a host of advanced manufacturing technologies in the centre's new workshops.

"Our new facility in Derby gives us an incredible opportunity to work with manufacturers of all sizes operating in the most economically important industries across the Midlands," said Nuclear AMRC chief executive Andrew Storer. "As well as helping companies win work in nuclear, the technologies we are developing can tackle the manufacturing challenges in automotive, rail, aerospace, renewable energy and many other high-value sectors."

Nuclear AMRC Midlands is initially based in two workshops and two office suites within iHub. The workshops act as flexible incubators for new manufacturing technologies, operating at an earlier level of manufacturing readiness than the Nuclear AMRC's facilities in Rotherham and Birkenhead, and exploring new technology areas.

The larger workshop is a flexible incubator for new manufacturing technologies, with an emphasis on digitalisation. It is designed to host a series of reconfigurable manufacturing bays where advanced physical and digital equipment can be configured to meet the needs of industry customers.

Technologies on show at the launch event included additive manufacturing in a variety of polymers and metals; intelligent welding tools being developed through the Nuclear Innovation Programme (see p7); innovative sensors for aircraft, part of a project with member company Atlas Composites; and an interactive virtual model of an SMR module developed in partnership with Rolls-Royce and the AMRC.

The second workshop will develop the Nuclear AMRC's capabilities in new technical areas including controls and instrumentation (C&I) and equipment qualification. The centre is working closely with tier one member company Ultra Electronics on initial projects, and delegates were able to view a range of Ultra's innovative technologies including safety-critical radiation and reactor core monitoring systems.

The facility will also act as a regional base for the centre's supply chain development programme, allowing the Nuclear AMRC team to work more closely with companies across the UK's manufacturing heartlands and help them become Fit For Nuclear.

The opening of the new centre was welcomed by minister for nuclear energy Richard Harrington. "Derby is famous for setting in motion Britain's Industrial Revolution with some of the country's first factories and spinning mills," he said.

"Now, as part of our modern Industrial Strategy, this new centre of cutting-edge nuclear technology will help to boost local

Adding value: technology lead Udi Woy presents work in additive manufacturing.

All clear: Barry Roberts of Ultra Electronics demonstrates radiation monitoring technology.

Clockwise from top: project manager Ben Sowerby sets up the larger of the two new workshops; the iHub building; a delegate tries his hand on a welding simulator; NuclearGraduates Jasvinder Clarke Dhadli and Rhodri Williams present work with Atlas Composites.

jobs, growth and expertise. The centre could bring millions of pounds into the region through a thriving supply chain, to ultimately provide low-carbon nuclear electricity to millions of UK homes."

The iHub facility is just the first phase of Nuclear AMRC Midlands. The centre continues to work with Derby City Council, the D2N2 LEP and industrial partners to develop proposals for a bespoke research facility of around 6,000m² on Infinity Park. The proposed centre will focus on later-stage development in technology areas which will deliver the maximum impact for the UK's supply chain.

Regional impact from Infinity Park

Nuclear AMRC Midlands was established in close collaboration with Derby City Council and the D2N2 Local Enterprise Partnership, and will play a vital role in supporting manufacturers across the wider region covered by the Midlands Engine initiative.

"The opening of Nuclear AMRC Midlands is a great milestone for our city and for the wider region, and we know the benefits to the economy, businesses and residents will be huge over the coming years," said Councillor Chris Poulter, leader of Derby City Council.

"By working with Nuclear AMRC, we will assist in job creation, supply chain development and business growth; as well as creating access to research and development facilities with the potential to increase productivity further and help translate academic research from the lab into the production line. We're delighted that Derby has been chosen, but particularly pleased that our own iHub facility is going to be their home."

The iHub is the first development on Infinity Park, to the south of Derby city centre. The 100-acre park is one of four Enterprise Zone sites strategically overseen by D2N2, the private sector-led partnership promoting business growth across Derby, Derbyshire, Nottingham and Nottinghamshire. D2N2 is allocating £12.9 million to develop Infinity Park's infrastructure over six years from its Local Growth Fund allocation.

"With this Advanced Manufacturing Research Centre we are looking to the future, building on Derbyshire and the wider D2N2 LEP area's reputation for manufacturing excellence," said Elizabeth Fagan, chair of D2N2. "As part of D2N2's Nottingham & Derby Enterprise Zone, we are investing heavily in Infinity Park Derby, making it an attractive place for innovative companies to locate to do business."

infinityparkderby.com

Collaboration key to meeting manufacturing challenges

A collaborative approach to research and innovation is vital to meet the challenges facing manufacturers of all sizes, industry speakers emphasised at the launch of Nuclear AMRC Midlands.

Relentless quest: Dr Hamid Mughal of Rolls-Royce at the launch of Nuclear AMRC Midlands.

Directors from two of Derby's largest industrial employers discussed the challenges they face in the global market, alongside representatives from the SME community and national and local government.

In his keynote presentation, Craig Lester, deputy director of nuclear strategy at BEIS, emphasised the importance of long-term strategic relationships between companies, research institutions and government at all levels.

"When large established companies and small more agile and disruptive companies get together, that's a particularly strong principle," Lester said. "This new facility ticks all the boxes, and I'm particularly pleased there's an emphasis on matters digital."

Dr Hamid Mughal, director of manufacturing at Rolls-Royce, highlighted the global power group's relentless quest to create innovative solutions to complex customer demands. Intense competitive pressures come not just from established players, but also from new companies with disruptive ideas, he noted.

To succeed, manufacturers need to combine a culture of continuous improvement with the advantages offered by advanced manufacturing technologies. Integrating technologies such as intelligent machines, data analytics and interactivity with a transparent value chain can provide an order of magnitude improvement, he said.

"This combination of a continuous improvement culture, advanced manufacturing technologies and digitalisation is exactly what's needed by industry to make the difference and retain competitiveness," Mughal concluded. "Centres like the Nuclear AMRC give us the opportunity to be curious and ambitious about our future."

Will Tanner, director of public affairs at Bombardier, also emphasised the importance of new technologies to the group's competitiveness. "Innovation is absolutely key," he said, highlighting areas including composite materials and 3D printing.

Bombardier has more than 2,000 employees in Derby, continuing the city's 180-year history of train making. As in other manufacturing sectors, the firm faces challenges in recruiting young talent and improving the diversity of its workforce. Of more than 500 engineers in Derby, only 10 per cent are female, Tanner noted – but thanks to recent initiatives including schools outreach, a third of current apprentices are women.

With many of Bombardier's suppliers working across a variety of sectors, centres like Nuclear AMRC Midlands provide a place where companies can work together, he added: "Collaboration needs a catalyst, which is why today is so exciting. We need to ensure that we can all talk to each other, because we can all learn from each other."

The SME perspective came from Neil Foreman, chief executive of radiation detector specialist Centronic.

Documentation, standards, import and export requirements and equipment qualification all present significant challenges and burdens to smaller companies, particularly those operating in the nuclear space, he noted.

Centronic has joined the Nuclear AMRC as member (see box) to build a closer relationship with the centre and access the latest research in controls and instrumentation.

"We have a small cohort of nuclear qualified people, and we have very great difficulties in justifying investment in R&D," Foreman said. "By joining this community, we're able to access the things that will allow us to keep up with what our clients actually require."

Following his presentation, Neil Foreman of Centronic signed the company's membership agreement with Nuclear AMRC chief executive Andrew Storer.

Croydon-based Centronic is a leading manufacturer of radiation detectors, providing design, prototype and full in-house manufacturing and testing. The firm has supplied the nuclear industry since the 1950s, with reactor control detectors and personal dosimetry products in use worldwide.

Centronic was an early participant in the Fit For Nuclear programme, and was granted F4N status in 2014.

www.centronic.co.uk

CNL signs up for clean energy collaboration

Canadian Nuclear Laboratories (CNL) has joined the Nuclear AMRC to collaborate on new clean energy and next-generation nuclear technologies.

Under an agreement signed at the Canada-UK Energy Summit in November, CNL is joining the Nuclear AMRC as a tier one member alongside leading nuclear organisations from around the world.

"Both CNL and the Nuclear AMRC are committed to fighting climate change through the advancement of clean energy technologies," said Mark Lesinski, president and chief executive officer of CNL. "For CNL, membership offers tremendous benefits including access to unique capabilities and training programmes, participation in cutting-edge manufacturing innovation projects, and networking opportunities with some of the world's leading nuclear organisations. In turn, CNL can offer the Nuclear AMRC access to our expertise and facilities from a wide range of nuclear science and technology disciplines."

Many of CNL's technology areas intersect with those of the Nuclear AMRC. The two organisations intend to collaborate on fields including materials characterisation and performance, and advanced manufacturing methods for small modular reactor (SMR) safety-critical components.

CNL's Chalk River Laboratories campus in Ontario is home to a host of nuclear facilities, and is currently undergoing a C$1.2 billion transformation to develop new capabilities in programme areas including SMRs and next-generation nuclear fuels.

Future research: CNL's new Advanced Nuclear Materials Research Centre at Chalk River.

"These programmes are ambitious in scope, and will certainly require the expertise and technologies of key partners – such as the Nuclear AMRC and their UK-based membership – to fully realise their potential," Lewinski noted.

CNL's membership builds on the strong record of collaboration between Canada and the UK dating back to the 1940s, when both countries established a laboratory in Montreal to jointly begin research into the creation of controlled nuclear power.

"We are very pleased to be strengthening our collaboration with CNL, which is a testament to the longstanding relationship between the UK and Canada in driving innovation in the global civil nuclear industry," said Andrew Storer, Nuclear AMRC chief executive.

"Working closely with CNL will give us access to world-renowned engineering expertise and additional manufacturing research programmes linked to the development of small modular and Candu reactor technologies. We look forward to building a prosperous partnership with CNL in the years to come."

www.cnl.ca

Nuclear networks become members

Two leading nuclear networks are taking tier two membership of the Nuclear AMRC to promote collaboration and best practice across the industry.

The **South West Nuclear Hub**, based at the University of Bristol, provides a focus for the regional nuclear community. Launched in 2016, it brings together academia, industry and the supply chain to address technical challenges faced by the industry, and will play an increasingly important role as the construction and development of Hinkley Point C gathers pace.

Research themes at the South West Nuclear Hub include nuclear materials and modelling, structural integrity, new materials development, robotics, and digital innovation. It incorporates the Nuclear Research Centre (NRC), a collaboration between the Universities of Bristol and Oxford.

Membership of the Nuclear AMRC will give the Hub access to the centre's manufacturing and materials research, and allow both organisations to work together to accelerate early-stage innovation into commercial reality.

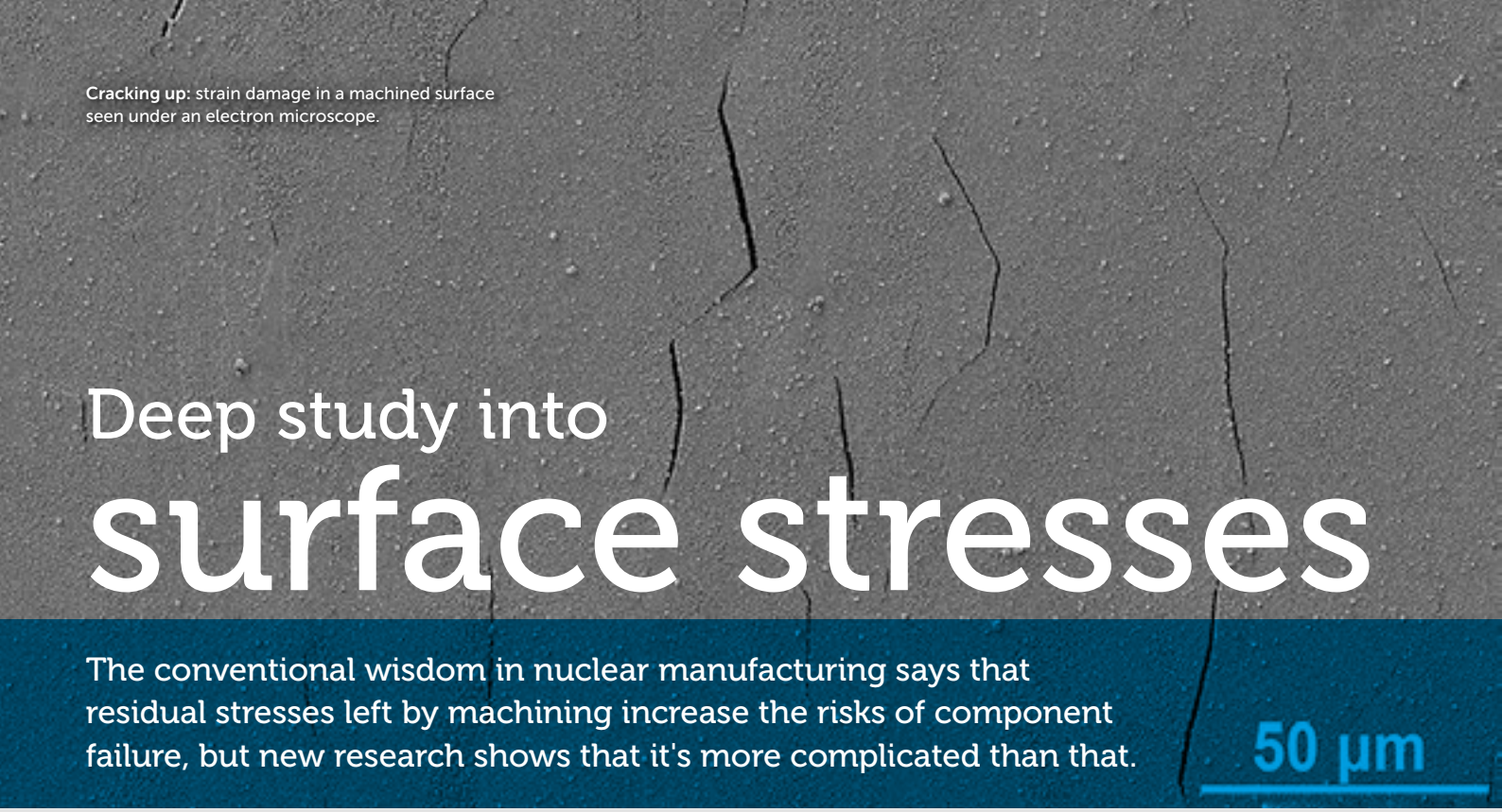
The **National Skills Academy for Nuclear** (NSAN) is also taking reciprocal membership with the Nuclear AMRC, building on years of collaboration in focused training and support for manufacturers in the nuclear supply chain.

NSAN works with nuclear sector employers and training providers to improve the performance of people across the sector. It links more than 100 employer members with dozens of training providers across the country.

The two organisations will work together to analyse skills needs and training provision, and plan for the training needs of future nuclear programmes. NSAN will also support the Fit For Nuclear programme by tailoring training programmes for participating companies.

southwestnuclearhub.ac.uk

www.nsan.co.uk



Cracking up: strain damage in a machined surface seen under an electron microscope.

Deep study into surface stresses

The conventional wisdom in nuclear manufacturing says that residual stresses left by machining increase the risks of component failure, but new research shows that it's more complicated than that.

The research, part of the Nnuman programme led by The University of Manchester and Nuclear AMRC, sheds new light on the different ways that machining processes can affect the long-term performance of safety-critical reactor components in core internal and auxiliary circuits.

The project focused on stress corrosion crack initiation in 304L stainless steel. Austenitic stainless steels such as 304L are widely used in reactors for their resistance to corrosion when immersed in high-pressure water at temperatures of several hundred degrees.

However, 304L components are still at risk from stress corrosion cracks. Crack formation is usually more likely if the metal surface exposed to the water has residual tensile stresses which can be created during manufacturing.

These stresses can be reduced through post-machining treatment such as electropolishing, but the new study found that this can actually increase the risk of cracking by removing the machining-affected layer.

"We have found that the surface microstructure evolution during machining is more important that the generation of tensile stresses on the metal surface," says Dr Fabio Scenini, senior lecturer in materials performance at The University of Manchester and lead researcher for the project. "Tensile residual stresses from machining can be huge, but the presence of an ultrafine microstructure induced by machining can improve oxidation and counter-balance the negative effects."

Scenini's team investigated crack formation in warm-forged 304L stainless steel, which has similar material properties to the heat affected zone around a welded join. The Nuclear AMRC's machining team milled samples under a range of cutting conditions. As-machined and polished samples were then subjected to carefully controlled strain in a reactor-like environment.

Surprisingly, the as-machined samples showed fewer and shallower cracks than the polished samples. They also showed no correlation between residual stresses and crack initiation, even for samples subjected to abusive machining conditions.

The team believe that the machined samples are protected by a more homogeneous oxide which forms on an ultrafine-grained layer of around one micron thickness, on top of a deformed surface layer of several microns. The smaller grains mean that the as-machined surface oxidises faster and more uniformly. With the polished surfaces, all of the cracks started at the boundaries between larger grains.

"This is quite a significant result, and could switch the focus from reduction of residual stress to the generation of a more uniform nano-crystallised layer," comments Dr Agostino Maurotto, Nuclear AMRC technical fellow and co-author on the paper published in *Acta Materialia* in February.

The team have confirmed, in a forthcoming paper, that partly removing the deformed surface layer makes it more susceptible to cracking. But additional research is needed to understand whether the same is true for other materials and machining processes, and for long-term performance in real reactor conditions.

"We don't know what happens after very long exposures, say 20 years, in real reactor conditions," Scenini says. "What we don't know is whether you are simply retarding the crack initiation – once a crack does start to grow, it might grow faster."

Further research is already underway through the Meactos project, a European-funded collaboration to reduce the risk of stress corrosion cracking, involving 16 partners including the Nuclear AMRC and The University of Manchester.

The five-year EPSRC-funded Nnuman (New Nuclear Manufacturing) programme addressed new R&D capabilities to support the future needs of the UK and global nuclear industry. The programme's work continues through the Nnuman community, a forum led by the Nuclear AMRC to support the development of the next generation of nuclear technology.

To read the full paper:
doi.org/10.1016/j.actamat.2018.11.046

Nnuman community:
namrc.co.uk/services/nnuman

Look into the future of nuclear innovation

Future factories, modular design and nano-structured steels were just a few of the manufacturing and materials technologies discussed at a Nuclear AMRC seminar exploring research funded through the Nuclear Innovation Programme.

Funded by the UK government, the Nuclear Innovation Programme is closely linked to the nuclear sector deal launched in summer 2018. It funds research into advanced manufacturing and materials for the nuclear sector, and supports development of new designs of advanced modular reactor (AMR).

Future factory: design concept for a new approach to assembling pressure vessels, part of the Inform project.

"The Nuclear Innovation Programme is the first public investment in future nuclear fission for a generation," Paul Nevitt, senior technical advisor at the Nuclear Innovation and Research Office, told delegates.

The Nuclear AMRC is leading two major R&D projects as part of the programme. Research engineer Craig Hamer presented the latest from the Inform project, which is addressing a series of challenges in forming, machining and assembling large components such as reactor pressure vessels.

Current research involves new techniques to scan raw components shaped by forging or near-net processes, and using the data to generate optimised toolpaths and ensure perfect alignment during machining. The Inform team are also developing conceptual designs for future factories which could significantly reduce cost and lead times for major nuclear assemblies.

Technical lead Matt Smart presented an update on the Simple project to develop tools for single-platform manufacturing (see last issue). The first phase focuses on integrating a range of sensors onto a welding head to allow real-time monitoring and automation, with ongoing trials to understand which sensors provide most value and how they work together.

Many of the manufacturing technologies being developed in the programme could be used to produce new designs of AMR.

John Eldridge, principal engineer at Cammell Laird, presented work from the Fit For Modules project to develop fundamental systems for modular design. The project brought together Cammell Laird's experience from the decommissioning and shipbuilding sectors with the R&D capabilities of the Nuclear AMRC's modularisation facility in Birkenhead. The first phase involved intensive consultation with industry partners including Arup, Laing, Frazer-Nash Consultancy and Westinghouse, to identify how modules can take the risk out of schedules and reduce costs while improving quality and safety.

"You can't backfit modular build," Eldridge emphasised. "If you're going to build something in the factory rather than on site, you have to design it with that in mind from the beginning."

Other projects focus on fundamental material challenges. Andrew Moffat, senior consultant at Frazer-Nash Consultancy, discussed key areas of advanced joining technologies, drawing on electron beam and laser welding trials at the Nuclear AMRC.

Andrew Wisbey, principal consultant at Wood, presented the Mattear project on materials and manufacturing technology evaluation for advanced reactors. Mattear focuses on four key manufacturing technologies – electron beam welding, transition joints between dissimilar metals, hot isostatic pressing, and additive manufacturing – with processing trials carried out at the Nuclear AMRC and TWI.

At the exotic end of the materials world, Mike Gorley, materials technology programme director at UKAEA, introduced research into nano-structured steels which could extend the operational life of reactors.

These steels include a fine dispersion of nitride or carbide particles which, in initial laboratory tests, can improve strength at high temperatures and reduce corrosion risks. Scaling up to full-sized industrial components will be a major challenge, Gorley noted. The project is led by the University of Sheffield, with Sheffield Forgemasters helping assess the technology and its potential exploitation.

Further development of these projects could be funded through a new £20 million phase of the advanced manufacturing and materials programme, which opened in January. A further £100 million of funding calls will be launched in early 2019, Nevitt said.

www.gov.uk/guidance/funding-for-nuclear-innovation

The Nuclear AMRC is organising a two-day conference on research supported by the Nuclear Innovation Programme, on 2–3 July in Sheffield. To register your interest, email: **register@nuclearinnovation.co.uk**

Cool thinking to extend tool life

Combining supercritical carbon dioxide coolant with a tiny amount of lubrication can significantly improve tool life across a range of machining applications.

Researchers and industrial users came together for an advanced cooling forum at the Nuclear AMRC in January to discover the latest research into carbon dioxide and minimum quantity lubricant (MQL) techniques.

The Nuclear AMRC is leading research into supercritical carbon dioxide coolants, with technology from Fusion Coolant Systems fitted to the centre's Starrag HEC1800 horizontal boring machine. A supercritical fluid combines the physical properties of both a liquid and a gas, offering desirable flow properties and a relatively high density.

Recent research has focused on combining supercritical CO_2 with MQL – typically adding just one millilitre of lubricant to 650g of CO_2 each minute. The Nuclear AMRC team have worked with researchers from other institutions to demonstrate the benefits for a variety of applications.

Dr Nikolaos Tapoglau of the AMRC presented a study involving the aerospace alloy titanium 6-4 (Ti6Al4V), which showed that combining supercritical CO_2 and MQL can improve tool life from around 50 minutes with flood coolant to around 150 minutes. Adding MQL makes a huge difference, he noted – with CO_2 alone, tool life was just 20 minutes.

François Laforce of French research institute Cetim also presented work on milling titanium 6-4 using a variety of coolants, which showed that supercritical CO_2 and MQL can extend tool life by up to 600 per cent compared with traditional flood coolant.

The Nuclear AMRC team are now investigating the benefits for milling a range of stainless steels used in the nuclear sector. Cutting trials with 304L stainless steel have shown significant improvements in cutting tool performance – inserts which fail after cutting 25 metres of steel with flood coolant can reach 65 metres with CO_2 and MQL. Initial material analysis shows no problems with hardening of the machined surface, and very low surface roughness.

Technical lead Dr Krystian Wika will present full results at the 22nd International Conference on Wear of Materials in Miami in April. He is now leading similar trials with duplex 2205 steel, which is usually machined dry.

Nuclear AMRC researchers are also studying the effects of MQL alone for heavy manufacturing applications, where large components are currently machined dry in situations where flood coolant cannot be safely contained.

"MQL is the most mature technology that can be used in this sort of application," technical fellow Dr Agostino Maurotto told the forum.

The team are now carrying out trials with a range of metals and lubricants including soya bean oil. The centre is also consulting with machining companies which have taken part in the Fit For Nuclear programme, to understand the obstacles to deploying MQL techniques in the nuclear supply chain.

Insphere launches machine verification innovation

Innovative metrology company Insphere is preparing to launch a new rapid machine tool verification technology, developed with the help of the Nuclear AMRC.

The Bristol company's Baseline technology provides full verification of a large machine tool in less than one hour, facilitating regular checks and providing confidence in performance prior to cutting metal. It can reduce machine downtime and material scrap rates, and supports the move towards Industry 4.0 philosophies.

The Insphere team worked with the Nuclear AMRC over the past year to test and develop Baseline on a large Soraluce machining platform, and returns to the centre on 21 March to launch the system to customers.

The Baseline launch event will include technical presentations from Insphere, Hexagon Manufacturing Intelligence and the Nuclear AMRC, plus shopfloor demonstrations of the Baseline technology.

To reserve your place: **inspherebaselinelaunch.eventbrite.co.uk**

Executive **view**

Diversity in the energy mix

Diversity is key to the future of the nuclear industry – diversity of reactors, diversity of research, and diversity of people.

If the UK is to meet its goals of providing affordable, secure, low-carbon energy for the generations to come, nuclear has to be part of a diverse energy mix. But as recent developments have shown, we can't take anything for granted.

One of the big messages from the launch of our new Nuclear AMRC Midlands facility was that nuclear has to be more competitive. As Craig Lester of the nuclear directorate at BEIS emphasised, it can't be considered as a special case for government support.

Hitachi's decision to suspend new build at Wylfa and Oldbury, following Toshiba's withdrawal from Moorside, leaves a worrying gap in the network as our current nuclear power stations reach the end of their operational life. That adds weight to the case for a new generation of small modular reactor (SMR), which could be built at the same nuclear-licenced sites with a much less challenging investment profile.

The government is currently reviewing proposals to support the UK SMR programme led by Rolls-Royce, as well as proposals from eight developers of advanced modular reactors (AMRs) which represent a real variety of next-generation technologies.

Beyond that, fusion power has to be where we are heading. The UK is a genuine world leader in fusion technology, and we need to maintain our national expertise as we step back from some of our international collaborations. In January, we were proud to host the first industry event on the Spherical Tokamak for Energy Production, an ambitious new programme led by UKAEA to design and ultimately build a compact fusion power station in the UK.

We need a diverse mix of nuclear technologies from a diverse range of vendors, to provide a more flexible source of baseload power to balance a growing share from renewables, and for other applications like hydrogen production and co-generation for industrial heat.

Reactor developers still see a great opportunity to develop their designs in the UK, but bringing new designs towards commercial reality will require government, industry and research institutions like ourselves to work together.

A large part of the mission for our new Midlands centre is to expand our capabilities in technology areas including instrumentation and control systems, equipment qualification and testing, simulation and digitalisation. Together with the mechanical engineering excellence of our Rotherham centre and our modularisation team in Birkenhead, we aim to offer a one-stop shop of innovation and expertise for nuclear and adjacent sectors. Being part of the High Value Manufacturing Catapult means we can also call on the specialist capabilities of the other centres in construction, forming, composites and more.

The nuclear sector deal launched last summer sets the framework to develop and deploy new reactor designs. SMRs, AMRs and fusion power present some great opportunity for the UK supply chain, and I am delighted to lead the "UK winning business" topic on behalf of the Nuclear Industry Council.

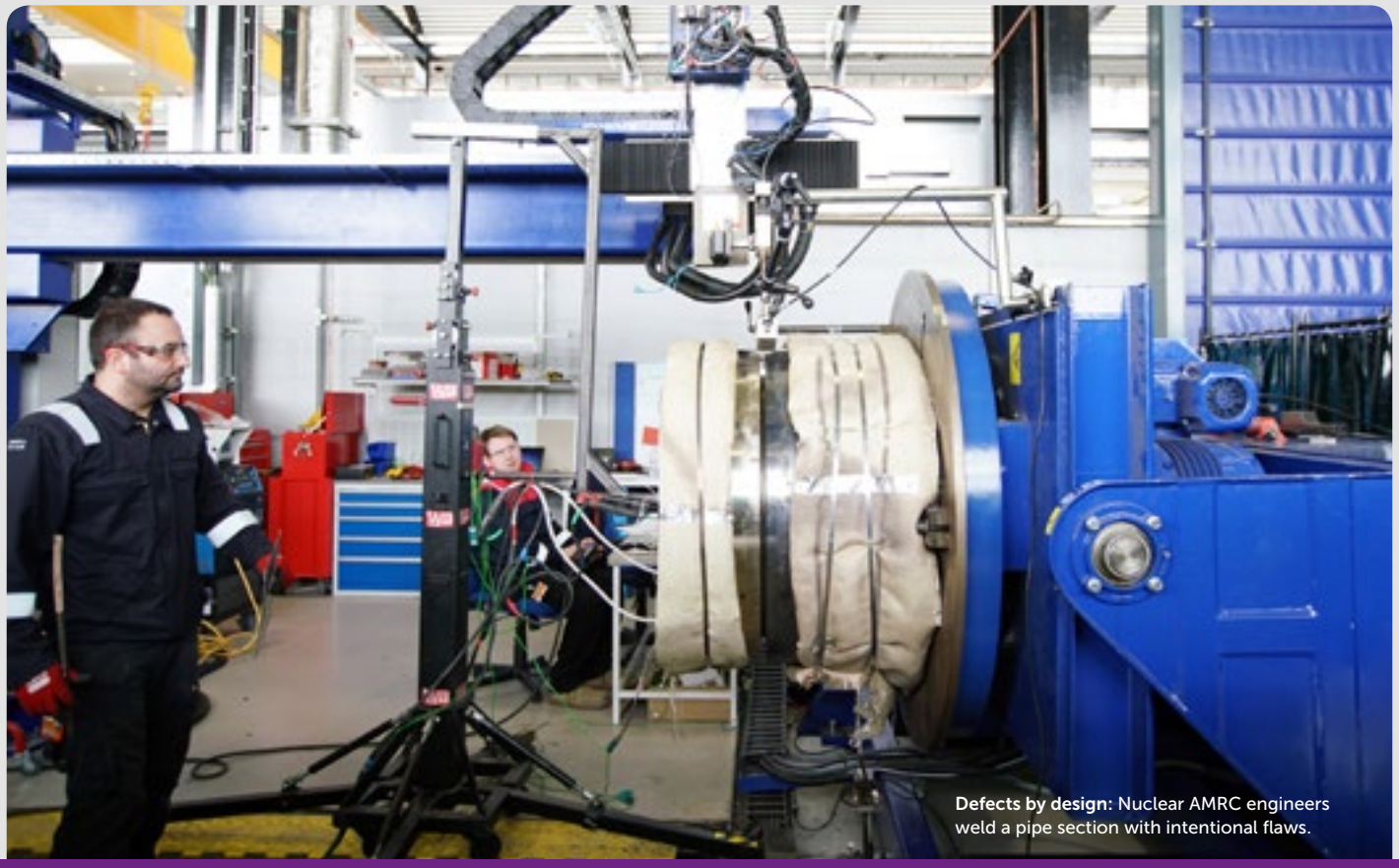
The sector deal also sets our industry some challenging targets on improving the diversity of the workforce, ensuring that talented people can contribute to the sector and drive commercial success. Now, only 22 per cent of the nuclear workforce is female. The challenge is to increase the proportion to 40 per cent by 2030, with half of all nuclear apprenticeships going to women within the next two years.

I have to admit that, at the Nuclear AMRC, we have a long way to go in hitting the sector deal target. We are striving to do better, and it's a particular pleasure to welcome Dr Emma Kelly as programme director for Nuclear AMRC Midlands. Emma joins us from the Midlands-based Energy Research Accelerator and brings a wealth of experience in major research collaborations.

I also want to thank Dr Iwona Zwierzak, Dr Rahul Mandal, Dr Kathryn Jackson and our other Stem Ambassadors and diversity champions, who are doing a fantastic job in engaging with schoolchildren at an age when they start thinking about their future, and keeping everyone focused on our ambition to achieve the next level of the Athena Swan award. We're also active in industry initiatives like Women in Nuclear and Women's Infrastructure Network, to support women who are already making a difference in our industry.

As someone with three daughters, I want them to have the same opportunities as their brother, whatever they decide to do. We all have a responsibility to deliver a rich and diverse future for the UK, for generations to come.

Andrew Storer, chief executive officer, Nuclear AMRC.



Defects by design: Nuclear AMRC engineers weld a pipe section with intentional flaws.

Flawed weld collaboration helps ensure Hinkley Point safety

Welding and inspection specialists from the Nuclear AMRC and Sonaspection have produced a series of intentionally flawed test pieces which will help ensure the quality of welded components for new nuclear plant.

Lancashire-based Sonaspection, part of the Institution of Mechanical Engineers, is the longest-established manufacturer of flawed test pieces in the non-destructive testing (NDT) industry.

The company was contracted to produce a series of test pieces by the Inspection Validation Centre (IVC) operated by global engineering group Wood, which is supplying inspection qualification services to the Hinkley Point C project.

Wood's role is to assess and qualify suppliers of NDT inspection services at Hinkley Point C. The test pieces will be used in practical trials to ensure that inspectors can identify the implanted defects before they are certified to inspect and validate real components and assemblies.

The test pieces needed to be produced using mechanised welding processes in a range of material combinations, featuring a variety of artificial defects and replicating various types of weld used in nuclear plant.

With limited experience in the required mechanised welding techniques, the Sonaspection team called on the Nuclear AMRC's welding specialists for support.

"The Nuclear AMRC has a wide range of skilled people, from operators to welding engineers, who are experienced in the specialist areas we were looking for when manufacturing these test pieces," says Neil Kelly, group operations manager for Sonaspection. "As the centre has a commitment to R&D work, they were very happy to work with us to perfect techniques and procedures where other suppliers would have classed this as not commercially viable. As an organisation, they can also handle the type of quality assurance requirements which are set out by Sonaspection and our customer Wood."

Sonaspection produced weld preparations with deliberate internal flaws, which the Nuclear AMRC team joined using the centre's mechanised narrow-groove welding facilities.

The project presented a number of welding challenges, says Stuart Park, arc welding technical lead for the Nuclear AMRC. For example, the first weld preps featured a block of material on the side of a narrow groove, which restricted the welding head's access to the joint. "We had to steer the head around this by doing some manual adjustment as we were operating, before we came up with procedures to get round that obstruction," Park says.

The welding became more technically demanding as the project moved from plates to large-diameter thick-walled pipes, including some of the largest parts to be welded to date by the Nuclear AMRC arcs team. "It's been a good learning curve for our operators," Park notes. "It's been a valuable experience for us to demonstrate that the equipment we have works in a robust manner on these very challenging welds."

The welding team used narrow-groove gas tungsten arc welding cells provided by Nuclear AMRC member companies Polysoude, Arc Machines Inc and ITW Welding Products.

After welding, the centre's NDT engineers ensured that the testpieces did indeed feature the intended flaws and no unintended defects, using a variety of techniques including ultrasonic testing, visual inspection, dye penetrant and magnetic particle inspection.

The partnership between Sonaspection and the Nuclear AMRC was welcomed by Chris Curtis, technical manager at Wood's IVC. "The test pieces had to be representative of the site components in terms of base material and weld structure and also potential defect characteristics," he says. "Sonaspection had proved previously that they could manufacture defects to our specification, so the addition of the Nuclear AMRC to produce acceptable automated welds was a massive positive for the project."

The Nuclear AMRC team have now developed full mechanised processes for producing the flawed welds to a consistent quality in future test blocks, and transferred the associated intellectual property to Sonaspection.

"Throughout the work, we have gained valuable knowledge on the defecting of narrow gap welds with different welding processes which we can apply to projects for other customers in the future," says Kelly.

"Sonaspection has an excellent working relationship with the Nuclear AMRC – we find the staff to be constructive, knowledgeable and amenable to change," he adds. "These projects have required a real team effort to achieve the end goal, and the Nuclear AMRC has really bought into that ethos which made a sometimes difficult process much easier."

sonaspection.com

"Sonaspection has an excellent working relationship with the Nuclear AMRC – we find the staff to be constructive, knowledgeable and amenable to change"

Hinkley Point C: the test blocks will help ensure the quality of welds in the new power plant, now under construction.

F4N
Fit For Nuclear

New programme to support **energy supply chain**

The Nuclear AMRC is supporting a new initiative to help manufacturers grow their businesses in the oil, gas and energy supply chain.

Fit4Energy (F4E) has been developed by Robert Gordon University in Aberdeen, trade association the Energy Industries Council (EIC), and regional economic development body Opportunity North East (ONE).

Taking inspiration from the Nuclear AMRC's established Fit For Nuclear (F4N) programme, F4E offers specialist training to help companies develop sector-specific skills and knowledge and grow their businesses.

F4E offers a series of targeted training courses which combine presentations, case studies, projects and collaborative work. Two compulsory modules cover strategy and business planning, and skills development for scale-up, while optional courses cover topics such as diversification and new product development, process and cost optimisation, exports, and finance. Companies which complete eight or more courses can then apply to become "Fit4Energy approved".

The Nuclear AMRC is supporting the development of the course content, based on its experience with its F4N and Civil Nuclear Sharing in Growth programmes, and will help deliver the diversification module.

"After eight years of the Fit For Nuclear programme, we have developed a wealth of knowledge about how best to help manufacturers enhance their capabilities and diversify their businesses," says Ian Williams, Nuclear AMRC head of supply chain development. "We're delighted to work with Robert Gordon University and its partners to help even more companies achieve their ambitions in the wider energy sector."

The F4E programme is open to companies of all sizes across the UK, with courses delivered at Robert Gordon University. Each course includes one full day's "know how" workshop followed by two half-day "how to" implementation workshops tailored to a business's individual needs.

"We are delighted to offer this innovative programme to help the energy sector scale up their operations," says Professor Elizabeth Gammie, head of Aberdeen Business School. "The support we have received from ONE, the EIC and our collaborative partners such as the Nuclear AMRC has been invaluable, and we are looking forward to the first cohort of companies joining the programme in March."

In a separate initiative, the Nuclear AMRC is working with the Offshore Renewable Energy Catapult to take the F4N model into the offshore wind sector through the Fit 4 Offshore Renewables (F4OR) programme. In the pilot programme, backed by the Scottish Government, 20 Scottish companies are now going through an initial assessment and creating business improvement action plans.

www.rgu.ac.uk/business-innovation/business-services/fit4energy

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.

Beran Instruments provides condition monitoring systems and related tech for power, aerospace and other sectors.
www.beraninstruments.com

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standexetg.com

Ultra Electronics Energy applies electronic and software technologies to demanding environments and critical requirements.
www.ultra-electronics.com

Start your F4N journey today: **namrc.co.uk/services/f4n**

Made in Scotland: pressure vessels fabricated by McEvoy Engineering.

McEvoy Engineering proves credibility with F4N

McEvoy Engineering, an experienced supplier to operating nuclear power stations and the decommissioning market, has been granted Fit For Nuclear after joining the programme to benchmark its capabilities and win new work.

The family-run business is based in Stevenston, Ayrshire, a few miles down the coast from the gas-cooled reactors of Hunterston B and the older Magnox stations which shut down in 1990.

McEvoy Engineering started supplying the Hunterston sites in 1991, soon after the company's creation. It now supplies other nuclear sites including Heysham, Hinkley Point, Sellafield and Torness, providing high-integrity steel and pipework fabrication and integrated engineering solutions to site owners and contractors. Recent projects include a series of steel modules to allow controlled access to a reactor, and an aluminium platform for accessing waste flasks at Sellafield.

The firm also serves customers in a host of other demanding industries including oil and gas, renewables, defence and pharmaceuticals.

"All of our clients are in highly regulated sectors, but for the past 28 years between 40 and 60 per cent of our annual turnover year-on-year has been from the nuclear sector," says Alison McEvoy, financial and business development director. "We've worked very hard to tailor our service to meet the demands of that sector and deliver the high levels of quality, safety and competence that are expected."

While networking to secure further opportunities at Sellafield and for EDF's new build at Hinkley Point C, the firm's managers realised that many of the companies they were competing with were carrying the Fit For Nuclear badge. "To my mind, it was a recognised benchmark and carried a lot of brand equity. Given you are consistently trying to come up with factors to persuade a buyer that you're credible, to me the F4N brand cut to the chase and very much speaks to your credibility," McEvoy says.

When the team started their own F4N journey, their experience in the sector meant that the firm rated highly in the initial assessment. The biggest opportunities for improvement were in strategic leadership, particularly around communications with the 33-strong workforce to allow everyone to better understand their own role in contributing to the firm's development.

"In a family-run SME with managers who were first and foremost engineers at heart, having that external independent viewpoint and guidance to assist with the change of mindset was very useful," McEvoy says. "There was a deep-seated belief that culture change wasn't possible. With guidance, our managers came to realise that any initial resistance to change can be overcome and that it is worth the effort to persist with efforts to engage more with the wider workforce."

The company appointed change agents to lead workshop activity, and created a few simple channels for two-way communication including weekly production meetings and quarterly operational meetings where everyone can air suggestions about making improvements. Face-to-face meetings were complemented by an all-staff WhatsApp group to share news and updates, plus visual displays throughout the factory to emphasise the company's vision and continuous improvement plan.

"If you're consistent enough with your message and communicate openly with people on a regular basis – and that should be a two-way relationship – you realise that people do appreciate it," says McEvoy.

McEvoy Engineering was granted Fit For Nuclear in June 2018, and is now pursuing new opportunities in new build as well as growing its work in operations and decommissioning.

"As a Scottish company the nuclear sector is very important to us," McEvoy says. "We have worked hard to develop our strategic capability to suit the critical success factors for working in the nuclear sector, and we continue to promote our value proposition and track record in nuclear to expand our client base in the sector.

"We are currently doing work for Sellafield and Magnox in decommissioning, and EDF in power generation, and we strive to ensure that the key players in the nuclear new build sector are aware of our extensive nuclear sector experience. In five years, we hope to be supplying the new build nuclear programme with the same success as we currently supply decommissioning and power generating sites UK-wide."

The journey has also brought benefits to McEvoy Engineering's work in other demanding sectors, she notes: "The F4N programme is not just about nuclear – it's a process and business excellence model. It became very clear that it was a vehicle for closing out any gaps in all the good stuff we were doing, and it's very transferable to other sectors we work in."

www.mcevoyengineering.co.uk

F4N
Fit For Nuclear

Welsh manufacturers winning new work

The Nuclear AMRC is working with the Welsh government to provide extra support to 20 regional manufacturers working through the Fit For Nuclear programme.

The latest Welsh companies to be granted F4N are Bridgend-based pressure vessel manufacturer Vessco Engineering, and storage tank specialist Rhyal Engineering from Milford Haven. *Nuclear AMRC News* asked them both to talk about their journeys.

VESSCO ENGINEERING LTD

We had been targeting the civil nuclear sector since 2011. Early connections with Rolls-Royce, Alstom Power Systems and EDF resulted in bidding opportunities for pressure vessel packages for Hinkley Point C.

We decided to enter the F4N programme to ensure that, as a business, we were as ready as we could be to accept any work packages that we might be successful with.

We required considerable work with regard to internal communication – particularly regarding major strategic plans such as targeting the nuclear sector. Management systems throughout the business needed to be strengthened and deepened. Some areas were already strong, whereas others were well short of the standard expected for suppliers to the nuclear sector.

We undertook a gap analysis and developed a plan to address all the perceived weaknesses. Basically, we picked off the targets one by one, using our own resources and assisted by our F4N industrial advisor.

We have won a significant contract with GE Power Systems for two very large pressure vessels, with manufacturing to commence March 2019, and we have won two projects with Balfour Beatty for super duplex fabrications.

We are currently bidding for packages with other tier one contractors, and also bidding for a tier one contract directly for EDF NNB.

We expect the civil nuclear industry to account for 40 per cent of our business over the next 10 years and probably beyond. We have started to seek contracts in France and Finland, and support these aspirations with visits to the countries whenever an opportunity arises.

Julian Vance-Daniel, managing director

www.vesscoengineering.co.uk

RHYAL ENGINEERING
"Technical, Professional & Practical Solutions"

Although Rhyal Engineering has previously undertaken work for the nuclear industry, we entered the F4N programme to enable us to legitimise our experience and further develop our skillset in this market sector.

We were extremely critical in our initial self assessment. This was highlighted in our on-site verification, and as a result our scores improved following benchmarking. What was interesting was that although our scores improved, the ratios remained similar.

We scored highly in quality and health and safety culture, no doubt due to our traditional market sector which expects performance in these areas. We scored poorly in process excellence, people excellence, and strategy and leadership. Although this did not really come as a surprise, it was useful to take a step back and consider this.

To close the gaps, we identified the level we wanted to perform at, and set realistic time-based targets. We identified a lead for each discrete activity and, where possible, used internal resources supported by external specialists. An example of this was the introduction of 5S, which was particularly well received with the benefits felt immediately.

Although we have not yet secured new work as a result of F4N, it has provided us with leads which we are currently working to develop. The work we have undertaken has allowed us to improve the business in other areas including waste reduction and improving the use of our facilities.

We see the opportunities for our business in the nuclear industry to expand in the next few years. F4N has given us the relevant tools to better understand the sector and potential clients' requirements. F4N shows that we are serious about our commitment to the sector.

Hywel Dyer, engineering manager

www.rhyalengineering.com

Penny Nuclear lifts its fortunes with F4N

Penny Nuclear, a specialist designer and manufacturer of lifting and mechanical handling systems, is winning new work in decommissioning and targeting new build opportunities after being granted Fit For Nuclear.

Penny Nuclear's parent company, Penny Hydraulics, was founded in 1978 in the coalfields of north-east Derbyshire to repair mining equipment. The company diversified into hydraulic lifting equipment for commercial vehicles and the beer trade, and has continued to expand into new applications and markets – one recent challenge was to design, manufacture and install a lifting system for Europe's tallest chandelier.

Specialist handling: general manager Simon Pykett.

"We've always undertaken bespoke projects," says Simon Pykett, general manager for Penny Nuclear. "We designed and manufactured a radioactive waste retrieval system for Dungeness in 2004 as a special project. That went extremely well, so we quickly realised we could offer something to the nuclear industry."

As head of the new Nuclear division, Pykett soon secured a direct contract with Sellafield Ltd for three lifting beams. Sellafield and Magnox are now among the group's largest customers for its lifting and mechanical handling solutions and high-end fabrication work.

The company entered the Fit For Nuclear programme in 2015, to gain additional support as it pursued opportunities in the new build programme at Hinkley Point.

The initial F4N assessment identified some areas for development – ironically, Pykett recalls, the report came in within days of a significant purchase order from Sellafield. "Some of the gaps on our assessment, such as visual communication on the shopfloor, seemed to be requisites for tier two customers, but not necessarily the tier ones," he says. "Since then, we've ticked all the boxes, and now have the in-house capabilities and tools to tackle the other areas. The process has taken longer than we expected, because we were busy delivering nuclear projects."

With support from F4N industrial advisor Kevin Ross, Pykett focused on formalising the firm's continuous improvement and lean manufacturing processes. "We always embraced continuous improvement, but it was never truly structured or formalised," he notes.

"We enrolled everyone on a half-day introductory course, then seven of us went through yellow belt training on six sigma and lean. When we first proposed it, there was a bit of resistance from the shopfloor but, after the half-day training, they started to actually appreciate how small improvements can make a big difference."

Penny Nuclear was granted F4N status in December, and is already reaping the benefits of the journey. "After formalising and completing the initial action plan, we were subjected to quite a major audit by a large tier two contractor," Pykett says. "Because of the process we'd been through with F4N we were able to pass that with flying colours. That led to a contract which we're delivering at the moment. It has opened the doors, and we are looking at more work in new build and in defence."

Penny Nuclear now has around £2 million turnover, and a growing team of 15 full-time employees. The wider Penny Hydraulics business has also invested in growth, opening a new £2 million facility on its site in Clowne in October 2017 – and, more recently, building a new storage facility to mitigate the risks posed by Brexit. Around a tenth of the group's 87-strong workforce are apprentices working through the AMRC Training Centre. "We've got a really good level of apprentices coming through now," Pykett notes.

Decommissioning remains the biggest opportunity for growth, and the company is increasingly working with major tier two suppliers including Cavendish Nuclear, Graham Engineering and Nuvia as well as the site licence companies.

"That's where we can offer something to the marketplace that perhaps others can't – we pride ourselves on being a one-stop-shop, including in-house design and manufacturing," Pykett says. "We've always been a bit under the radar because of working directly with Sellafield and Magnox, but as more framework arrangements come through to market we want to work more with the larger tier twos to offer them the solutions we have."

www.pennynuclear.com

Lost Horizon: a 2014 vision of the proposed new reactors at Wylfa Newydd.

Horizon suspends new build plans

The UK's nuclear new build programme suffered a second setback in January as Horizon Nuclear Power confirmed that it is suspending its projects at Wylfa in North Wales and Oldbury in Gloucestershire.

Horizon's parent company Hitachi Ltd made the decision after being unable to agree financing and commercial arrangements for Wylfa with the UK government. Hitachi proposed to build two of its 1.3GW advanced boiling water reactor (ABWR) plants at Wylfa, at an estimated cost of £16 billion, followed by two at Oldbury.

"I am very sorry to say that despite the best efforts of everyone involved we've not been able to reach an agreement to the satisfaction of all concerned," Duncan Hawthorne, chief executive officer of Horizon Nuclear Power, said in a statement. "As a result we will be suspending the development of the Wylfa Newydd project, as well as work related to Oldbury, until a solution can be found. In the meantime we will take steps to reduce our presence but keep the option to resume development in future."

Nuclear AMRC chief executive Andrew Storer said that Hitachi's decision was disappointing, and very concerning for the companies which had prepared to win work in Horizon's supply chain.

"We hope that the conversations with the UK government can conclude in a satisfactory manner to see the project progress as planned," he said. "This really illustrates the financial challenges of investing in the current generation of gigawatt-scale reactors. Hitachi's ABWR technology has satisfied the regulatory process in the UK, and has already been built to schedule previously, but it represents a huge upfront investment with a long period until a financial return."

Horizon says it will continue to engage with the UK government and stakeholders regarding future options for development.

In a statement to Parliament, business and energy secretary Greg Clark confirmed that the government had agreed to consider taking a one-third equity stake in Wylfa Newydd, providing all required debt financing for construction, and providing a strike price of up to £75 per megawatt hour.

The UK government is currently reviewing the viability of a regulated asset base (RAB) model for financing new nuclear projects, and plans to publish its assessment by the summer. The RAB model is currently used to finance major infrastructure projects such as the Thames Tideway sewer project.

Hitachi's decision came two months after Toshiba announced it was liquidating its UK venture NuGeneration, which proposed to build up to 3.8GW of new capacity at the Moorside site in Cumbria.

The financial challenges facing gigawatt-scale reactors have led to renewed calls for investment in advanced modular reactors which could meet the UK's needs for low-carbon baseline generation in a more affordable way.

"Smaller reactor units can reduce the financial challenges, while modular construction in factories using advanced manufacturing techniques can significantly reduce the overall costs of a new fleet of reactors," Storer noted. "This is further evidence that as a country, we need to seize the opportunities of new advanced reactors, to meet our energy needs and to allow UK manufacturers to take a global lead in these game-changing technologies.

"However, we do have a low carbon electricity challenge today, and Wylfa Newydd represents a significant contribution to our energy mix and our UK renaissance of nuclear new build. Let's hope a way forward can be established quickly."

Ultra Electronics provides **NuScale safety system**

Ultra Electronics Energy has unveiled a new safety display and indication system for US-based SMR developer NuScale Power.

The system is the first to use field programmable gate array (FPGA) technology for real time display and monitoring in the US commercial nuclear industry. It shows critical safety plant data for each of a NuScale plant's 12 reactors, with dedicated graphic displays for each.

"NuScale's plant design brings superior safety features that are revolutionising nuclear safety, and we're proud to pioneer the use of FPGA technology in a ground-breaking application for our safety display system," said NuScale chief technology officer José Reyes.

NuScale is developing a new modular nuclear power plant based around the factory-fabricated 60MW Power Module, which is designed to be deployed in clusters of up to 12 per plant.

Ultra Electronics, a tier one member of the Nuclear AMRC, worked with NuScale through a Texas-based subsidiary to develop the new safety display and indication system. Thanks to FPGA technology, the system displays plant data without using microprocessors, operating systems or software in the runtime environment, and is less susceptible to cyber attack.

"These exceptional new safety displays show what is possible when two innovative companies come together and reimagine what the future of nuclear instrumentation and control systems can be," said Mark Ealing, vice president of strategy at Ultra.

www.ultra-electronics.com

End of life: the Dounreay Materials Test Reactor.

New Dounreay contract for Cavendish Nuclear

Cavendish Nuclear will dismantle and demolish Scotland's oldest nuclear reactor under a new contract with Dounreay Site Restoration Ltd.

The Dounreay Materials Test Reactor (DMTR) began operations in 1958, and was used for irradiation tests on materials until 1969. Fuel, coolant and redundant plant have already been removed, leaving the reactor vessel, supports and containment shell ready for final decommissioning – a process that will take around three years.

"I am delighted our innovative and collaborative approach to reactor dismantling, using proven and cost-effective technology in conjunction with the local supply chain, will deliver the greatest skyline change seen at Dounreay for many years," says Cavendish Nuclear director Natalie Nisbet.

A tier one member of the Nuclear AMRC, Cavendish will work with key suppliers JGC Engineering and Technical Services, Veolia/KDC, and Frazer-Nash Consultancy.

Cavendish will combine proven, off-the-shelf technology with tight controls on radiological exposure and radioactive contamination to safely remove the remaining structures from the inside out. Expected low dose rates will remove the need for complex remotely-operated tooling, and allow different waste materials to be separated at source.

www.cavendishnuclear.com

Infrastructure network tackles **diversity challenges**

Improving diversity is key to improving productivity, nuclear expert Dr Fiona Rayment told a new networking group for women working in the infrastructure sector.

Rayment was speaking at the launch event for the new North of England branch of the Women's Infrastructure Network (WIN). Around 45 women from across the energy, utilities, transport and environmental industries attended the meeting, hosted by the Nuclear AMRC.

A director at NNL and chair of the Nuclear Skills Strategy Group, Rayment discussed the challenge of the nuclear sector deal to improve diversity across the sector. Just 22 per cent of people currently working in the nuclear industry are women, but the sector deal sets ambitious targets to increase that to 40 per cent by 2030, with half of all nuclear apprenticeships going to women by 2021.

Achieving the aims of the nuclear sector deal, and the wider industrial strategy, is all about people, Rayment emphasised. "You're not going to raise productivity unless you have the right people, right skills and right capabilities to drive that forward," she said.

Only eight per cent of nuclear boards currently include women, Rayment noted, so the sector as a whole is not benefiting from the diversity of thought which numerous studies have linked to higher performance.

Power network: Victoria Bradley welcomes delegates.

"It really is incumbent on anybody in senior roles to think about diversity and what you can do about it," Rayment concluded.

Victoria Bradley, director, energy, infrastructure and government at law firm Walker Morris and co-founder of the new Northern branch of WIN UK, also highlighted the benefits of diversity. "It is now recognised that more diverse businesses and teams are more innovative and more financially successful – gender diverse companies are 15 per cent more likely to out-perform their peers financially," she said.

WIN UK launched in London in 2011 to provide networking and support for women in the infrastructure sector. The new Northern branch will hold further events over the year for women – and men – who want to share best practice for evolving equality of opportunity and career advancement.

www.womens-infra-uk.org

Positive approach to gender equality

The UK's Women in Nuclear network held its fifth annual conference in January. Cara Saungsomboon, an engineering student on a year's placement with the Nuclear AMRC as assistant research engineer, reports.

The conference centred on the positive approach to unconscious bias – by making the effort to consciously incorporate good practices within the workplace, we can improve the attraction and retention of women to achieve the nuclear dector deal target.

The event was a great way to highlight some of the equality, diversity and inclusion problems the industry is facing. I haven't experienced these myself, but it was important for me as a woman starting in an engineering career to see that there were other men and women who are ready to keep the goal of gender equality firmly in the spotlight, and to see the number of major companies who are committed to these ideals.

There was a definite sense of community from the delegates and the Women in Nuclear executive board. The message of support was echoed by the conference's keynote speaker, Richard Harrington MP. He reiterated the point that supporting one another is the most effective way to achieve equality in the workplace and, although there was much work still to be done, the industry is on the right track.

As Gwen Parry-Jones, executive director of Horizon Nuclear Power, said: "We tackle some of the largest, most complex, engineering infrastructure projects in the world – if we could apply the same level of attention to the problems of equality, diversity and inclusion within the industry, then there's no telling how quickly they could be solved."

www.womeninnuclear.org.uk

Sharrow girls given a taste of engineering

Nuclear AMRC staff helped girls from Sharrow School in Sheffield develop a taste for engineering, with a hands-on challenge involving chocolate welding.

Twenty girls aged from nine to 11 visited the centre as part of the Stem Ambassador programme to encourage young people to study science, technology, engineering and maths-based subjects and consider related careers.

After presentations from some of the centre's female engineers, the students faced a practical challenge. The Nuclear AMRC's volunteer Stem Ambassadors, including assistant research engineer Cara Saungsomboon and research associate Dr Rahul Mandal (pictured), helped the girls manufacture boxes from chocolate, and then test them to destruction.

The highest praise came in a thank-you letter from Nadia in year six: "My favourite part was when we got chocolate. I also really like how you inspired me and who knows in future I could be an engineer!"

Some of the events that the Nuclear AMRC will be attending or supporting in the coming months – see us to find out more about how we can help your business.

Diary namrc.co.uk/news/events

Insphere Baseline launch

21 March, Rotherham

The Nuclear AMRC hosts innovative metrology company Insphere for the launch of its rapid machine tool verification system Baseline.

namrc.co.uk/events/insphere-baseline-launch

Total Decom

30 April – 1 May, Manchester

Conferences, workshops, one-to-ones and a supply chain exhibition covering decommissioning in nuclear, oil & gas, renewables and more.

www.totaldecom.co.uk

Nuclear Innovation UK

2–3 July, Sheffield

The Nuclear AMRC presents a major conference covering research supported by the government-funded Nuclear Innovation Programme.

Register your interest:
register@nuclearinnovation.co.uk

Engineering & Technology Solutions Exhibition

25 September, Birchwood

The UK's biggest independent nuclear suppliers' exhibition returns to Birchwood Park for networking, tech demonstrations and more.

www.nuclearexhibitions.com/BirchwoodEvent

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 your business, contact Jay Shaw, Nuclear AMRC programme director: jay.shaw@namrc.co.uk

NUCLEAR **AMRC**
ADVANCED MANUFACTURING RESEARCH CENTRE

The University of Sheffield

MANCHESTER 1824
The University of Manchester
Dalton Nuclear Institute

Contact us:

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

tel: +44 (0)114 222 9900
email: enquiries@namrc.co.uk
online: namrc.co.uk
twitter: @NuclearAMRC

Nuclear AMRC Midlands
iHub, Infinity Park, Derby, DE24 9FU

Nuclear AMRC Birkenhead facility
Cammell Laird, Campbeltown Road
Birkenhead, Merseyside, CH41 9BP

Manufacturing Technology Research Laboratory
The University of Manchester
Sackville Street, Manchester, M13 9PL

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