



NUCLEAR AMRC

NUCLEAR AMRC NEWS

THE NEWSLETTER OF THE NUCLEAR ADVANCED MANUFACTURING RESEARCH CENTRE

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Deep challenges for drilling research

The Nuclear AMRC is installing one of its largest machine tools to investigate new ways of drilling extremely deep holes.

The TBT ML700 is capable of drilling holes of 8m depth and between 5-110mm diameter through stainless steel.

At a length of 27m, it's one of the largest machines ever sold by TBT UK, and the largest in any university facility.

"The TBT ML700 machine is the very latest deep hole boring machine to be designed and developed by TBT Germany," says Mark Ramsay, managing director of TBT UK. ***"This particular machine has been specifically tailored around the requirements, both present and future, of the Nuclear AMRC."***

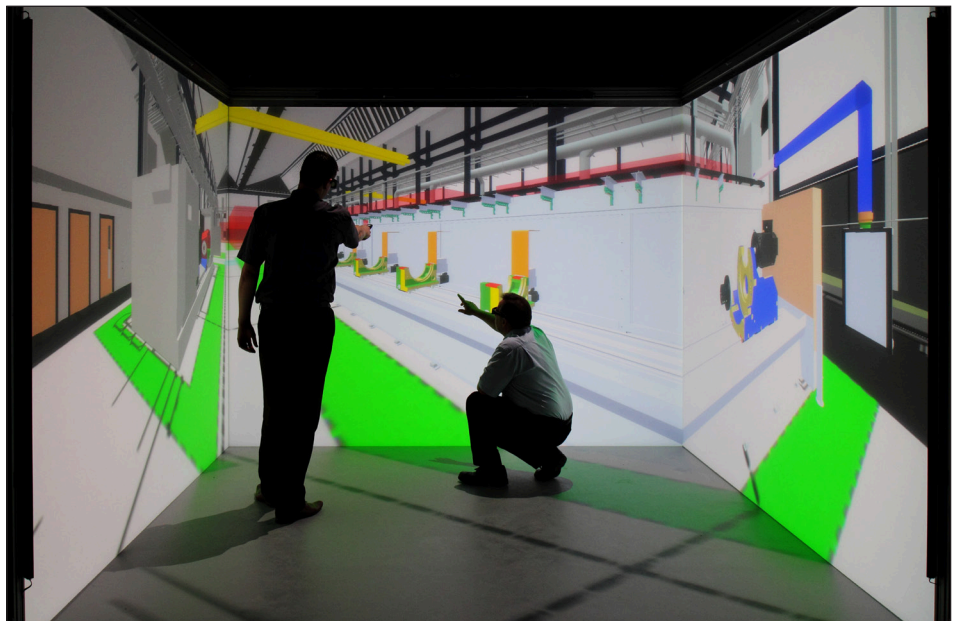
The machine is arriving at the Nuclear AMRC's South Yorkshire facility in February, and will take around a month to commission.

The Nuclear AMRC machining team and industrial partners will use the centre to investigate new techniques for drilling holes to depths of up to 500 times their diameter in a single process. Such extreme length to diameter (L/D) holes are required for key components of modern nuclear reactors, and in other industries such as oil and gas.

The current industry limit is a depth of around 300 times diameter. To produce the deeper holes required by nuclear, manufacturers currently drill holes from both ends which, if all goes well, meet up in the middle. The drilling process is frequently stopped and an ultrasonic probe used to determine the position of the drill tip by measuring the wall thickness. Scrap rates can be high.

Nuclear AMRC researchers are now investigating a new approach, with the aim of drilling holes of up to 8m depth with a single cut in a wholly automated process.

"We want to eliminate operator



A virtual approach to factory planning: Nuclear AMRC VR specialists Chris Freeman and Rab Scott study a model of the new TBT deep-drilling machine within a simulation of the centre's workshop. Virtual reality (VR) simulation is a powerful tool for optimising factory layout, and for component design and development. The Nuclear AMRC's South Yorkshire facility features state-of-the-art VR systems from Virtualis, including the fully immersive ActiveCube (above) with 3D projection on three walls and floor, and an ActiveWall for presentations to large groups.

intervention," says Stuart Dawson, head of the machining group at the Nuclear AMRC.

"We want a completely green button process with zero human intervention during the process. That means we need some kind of drill steering method so it can travel eight metres down this hole and arrive at the other end within a few millimetres of its target."

It's a challenging programme, for which the Nuclear AMRC will be tapping the talents of a new generation of engineers. Key parts of the research will be carried out by Nikki Hilton, a postgraduate mechanical engineer from the University of Sheffield who is starting a four-year engineering doctorate at the university's new Industrial

Doctoral Centre in Machining Science. With sponsorship from Rolls-Royce, Hilton will undertake a series of linked research projects addressing tool tip tracking and steering technology for extreme L/D holes.

"Nuclear manufacturing is a very exciting area at the moment, and it's good to be working with industry and creating a practical solution rather than doing some abstract bit of research," Hilton says. ***"The fact we have the Nuclear AMRC and Rolls-Royce and the academic support of the university means we can really push the technological limits."***

The TBT centre will also be available for Nuclear AMRC members and customers to use in their own research projects.

In this issue: EDF supply chain; welding research; Catapult latest; membership hits 30

EDF Energy focuses on supply opportunities

Nuclear new-build developer EDF Energy highlighted the role of the Nuclear AMRC at its national supplier day event in Westminster in December.

In his opening address to representatives from 350 companies, Vincent de Rivaz, chief executive of EDF Energy, referenced the work between government and industry to complete the Nuclear AMRC development.

“It is a tremendous contribution by the government, as well as others such as Rolls-Royce and Areva, in establishing an institution to support UK manufacturers and suppliers in the nuclear industry,” he said.

Alan Cumming, commercial director for nuclear new build at EDF Energy, also highlighted the Nuclear AMRC in his analysis of the UK supply chain.

“There are many companies working with the Nuclear AMRC,” he noted. **“All the key suppliers are there, and we are part of that. It is the key conduit for manufacturers and suppliers.”**

Alain-Pierre Raynaud, chief executive and chairman of Areva UK, said that through programmes such as *Fit For Nuclear*, the Nuclear AMRC was **“the front door to increasing UK manufacturing capabilities**

and taking market share”.

EDF Energy, with Centrica, is proposing to build new nuclear power stations based on Areva’s EPR technology at Hinkley Point, Somerset, and Sizewell, Suffolk. At the conference, EDF confirmed that Kier BAM was preferred bidder for the £100m+ contract for site preparation at Hinkley Point C, and announced a new agreement with Areva for early design work on the main reactor systems.

Around 190 UK companies have already benefited from EDF new-build contracts worth £170m, noted Humphrey Cadoux-Hudson, managing director of nuclear new build for EDF.

“This is an exciting time to be involved,” he told the conference. **“The opportunities for companies struggling through this difficult economic time are significant.”**

• *Fit For Nuclear (F4N)* is an online assessment and business support programme provided by the Nuclear AMRC. For businesses which can meet the high standards of the civil nuclear industry, F4N can provide a direct route into the supply chains of EDF Energy, Areva UK, and other industry leaders. To find out more, go to <http://namrc.co.uk/work-with-us/f4n/>

European research leaders visit Nuclear AMRC



International R&D: visit to the Nuclear AMRC workshop

Leading nuclear researchers from across Europe visited the Nuclear AMRC as part of a tour of key UK research facilities.

The UK Tour of Nuclear Research Facilities was organised by the UK Science and Innovation Network team from the British Embassy in Switzerland, with the aim of establishing contacts for international collaboration.

The group included senior figures from: CEA, France; NRG, Netherlands; SCK-CEN, Belgium, *Paul Scherrer Institute*, Switzerland; *VTT Technical Research Centre*, Finland; *Forschungszentrum Jülich*, Germany; *Nuclear Research Institute Rez*, Czech Republic; and the *European Commission Joint Research Centre*.

During their visit to the Nuclear AMRC, the group heard operations director Steve Court outline the centre’s work in manufacturing process R&D and business support for companies along the nuclear supply chain.

The Nuclear AMRC is focused on supporting the UK nuclear manufacturing sector, but works internationally on collaborative research projects.

The four-day tour also included a visit to the Nuclear AMRC Laboratory at the *Dalton Nuclear Institute*, plus The University of Manchester’s new *Dalton Cumbrian Facility*, the *National Nuclear Laboratory* at Sellafield, and *Imperial College London*.

Jaap van der Laan, business development manager at NRG, said: **“We were all impressed by the organisation of the Nuclear AMRC and the strong role of Rolls-Royce, and sense it clearly as an expression of the UK’s confidence and determination for the new-build programme.”**

Catapult for collaboration

The High Value Manufacturing Catapult is the new name for the UK’s technology and innovation centre for industry-focused research in advanced manufacturing.

The new branding is being applied across an elite network of research centres funded by the *Technology Strategy Board (TSB)*. Other Catapults under development cover cell therapy, offshore renewable energy, and satellite applications.

Opening for business in October 2011, the High Value Manufacturing Catapult is the first

of the new network. It incorporates seven established manufacturing research centres, including the *Nuclear AMRC*, to embrace all forms of manufacture using metals and composites, plus process manufacturing and bio-processing.

Other centres in the Catapult are the *AMRC with Boeing*, Sheffield; *Manufacturing Technology Centre*, Coventry; *Advanced Forming Research Centre*, Strathclyde; *National Composites Centre*, Bristol; *Centre for Process Innovation*, Teesside; and *Warwick Manufacturing Group*.

The TSB is investing £140 million over six years in the High Value Manufacturing Catapult. Businesses can access Catapult support through the Nuclear AMRC or any of the other participating centres.

CATAPULT
High-Value Manufacturing



New welding cells tailored for industrial research

New welding equipment being installed at the Nuclear AMRC will be used to address some of the most complex problems in nuclear manufacturing.

Many key components in a nuclear power plant are produced by joining very large sub-components. The joins must resist corrosion while maintaining material integrity and withstanding extreme pressures, over a lifetime of 60 years or more.

Welding on this scale can be a complex task – a single joint between thick-walled nuclear components can require over 100 weld passes using standard techniques. The repeated heating and cooling can have significant effects on the material properties around the join, potentially harming the long-term performance of the component.

To minimise the risk of such problems, the Nuclear AMRC is developing advanced welding techniques tailored to the needs of the nuclear industry.

“This new state-of-the-art equipment marks a significant increase in the overall welding capability at the Nuclear AMRC,” says Keith Bridger, head of welding engineering.

The first cell to be installed features a multi-wire submerged arc welding (SAW) head mounted on a 6m by 6m column and boom. The welding head can feed up to five wires, powered by eight 1000 amp power sources. The cell can also be used for strip cladding using the electroslag process.

“This cell is principally targeted at providing very high deposition weld joints and cladding for components outside the immediate nuclear island, and for future renewable energy applications,” Bridger says.

A second cell targets groove welding for components within the nuclear island. The cell features a 7.5 tonne manipulator on a 6m by 4m column and boom, and can deploy a variety of gas tungsten arc welding (GTAW) end effectors on a tractor unit with three axes of movement. The equipment, provided by Polysoude, has a modular design which allows it to be customised for different tasks. For example, a planetary narrow groove welding head allows the cell to be used for joining set-in nozzles and bosses.

Polysoude has also provided an open tube/tubesheet welding head which forms the core of an orbital welding cell. ***“The driver for this cell is to produce very robust welding procedures to enable thousands of tube/tubesheet welds to be made with minuscule rejection rates,”*** notes Bridger.

The fourth cell focuses on high quality groove SAW and electroslag strip cladding. ***“This cell offers the opportunity to take a conventional welding process and make it fit for nuclear by optimising the weld,”*** Bridger explains. It is based around a 15 tonne manipulator under a 5m by 5m

column and boom provided by ITW Miller.

Further welding centres, including a large chamber electron beam facility, will be added over the next 18 months.

The large-scale welding facilities in South Yorkshire are complemented by the resources of the Nuclear AMRC Laboratory at The University of Manchester’s Dalton Nuclear Institute. The new laboratory houses some of the most advanced welding equipment found at any UK university.

Key facilities include an industrial-scale SAW and cladding system, narrow gap GTAW systems, and fully automated high power laser systems.



New face of manufacturing: Nuclear AMRC welding apprentice Sam Biddleston, pictured with the multi-wire submerged arc welding cell, stars in publicity for the second Global Manufacturing Festival. Held in Sheffield in March 2012, the Festival celebrates and promotes the UK’s world-leading manufacturing industry. Conference speakers include Nuclear AMRC programme director Keith Ridgway, Rolls-Royce R&D director Ric Parker, and EDF Energy’s Alan Cumming. For more information, see <http://www.globalmanufacturingfestival.com/>



Manufacturing specialists bring membership to 30

The latest companies to join the Nuclear AMRC have brought the centre's membership to 30.

The new members include *Hermle*, a leading provider of 5-axis machine tools,

and *Hexagon Metrology*, who both join as Tier One members with a seat on the Nuclear AMRC board.

New Tier Two members are specialist materials supplier *Böhler Welding Group*,

and manufacturing software group *IMS*.

Nikon Metrology, who provided the Nuclear AMRC's robotic machining cell, has increased its commitment to the centre by upgrading its membership from Tier Two to One.



NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

About the Nuclear AMRC

The Nuclear Advanced Manufacturing Research Centre is a collaborative initiative led by The University of Sheffield, The University of Manchester, and a consortium of industrial partners.

The Nuclear AMRC aims to be the focal point for the civil nuclear manufacturing industry in the UK. It works with members to develop new manufacturing technologies which meet the needs of the new generation of nuclear power stations, to help companies join the nuclear supply chain, and to provide support in skills and quality. For more information call 0114 222 9900 or visit <http://namrc.co.uk>

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