Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

Extreme deep hole challenge for **Sandvik Coromant**

The Nuclear AMRC worked alongside member company Sandvik Coromant to develop a new tooling solution for extreme deep hole machining.

Sandvik Coromant, a leading manufacturer of tools for turning, milling and drilling, was challenged by a major customer in the oil and gas sector to produce a machining strategy for a particularly demanding component used in undersea exploration – a drill collar, which sits between the drilling rig and drill bit, and allows drilling fluid to flow through the system.

The very long cylindrical part is made of a difficult-to-machine stainless steel, with a precise bore and a number of concentric steps leading to a smaller diameter at the far end. The part also needed offset features to be machined at a length-to-diameter ratio of around 70:1.

"The customer was asking for some unbelievable features which were very hard to machine," recalls Ian Tromans, development engineer at Sandvik Coromant. The part had previously been produced for the client, but the Sandvik team showed that they hadn't actually been made to the specification.

"It's the most complex component that we've ever seen," adds development engineer Maurizio Minutolo.

Developing a machining strategy for the bore fell squarely into the capabilities of Sandvik Coromant's engineering competence centre for deep hole machining in Halesowen.

"What we class as deep hole drilling is anything with a length-to-diameter ratio of greater than 10:1," says Tromans. **"When we're talking about deep hole machining, we're talking about not only moving in the z-axis but moving in the x-axis as well. That's where it gets a bit more complicated."**

The hole was prepared in a sequence of steps, each requiring specialist tooling. Drilling the initial hole took almost five hours to remove around 400kg of metal. The hole was then expanded using pull boring, and skived with a high feed reaming head to finish the internal surface. The wider section was counterbored, and stepped diameters cut to precise chamfers.

The final stage of machining was the most challenging – cutting a number of scalloped features inside the bore at two to eight metres depth, with very tight tolerances on both size and relative position.

The Sandvik team identified that the features could be produced using a plunge milling technique, in which cutting is performed by feeding the tool axially rather than radially, but developing and proving the solution on a representative-sized part was beyond even the capabilities of the engineering competence centre.

"If we didn't have this centre of excellence as a capability, we'd often have to say no to these enquiries – that's why the Nuclear AMRC is important to us."

Sandvik Coromant called on the machine tool and fixturing expertise of the Nuclear AMRC, and the unique capabilities of its largest machining centre – the Soraluce FX12000.

"We knew the capabilities of the Nuclear AMRC, and it's fantastic to know that we have this sort of collaboration with some of the best machines and equipment anywhere in the world," says Wayne Mason, R&D and application solutions manager for deep hole machining at Sandvik Coromant.

To prove the process, the team made a demonstration piece of around two metres, and installed the full-scale plunge milling tool on the Soraluce.

The team had to overcome a range of milling challenges to achieve the required tolerances in a secure machining process, while avoiding vibration in the piece and evacuating chips without damaging the bore surface.

The team then used the Nuclear AMRC's large-scale metrology capabilities to record that the features met specification.

"Only the Nuclear AMRC had the equipment, expertise and collaborative approach to conduct the proof of concept manufacture and inspection of the plunge milled features," says Stuart Dawson, Nuclear AMRC operations director. **"It's an excellent example of working with a Tier One member to solve extreme technical challenges in an oil and gas component."**

The project could lead to new deep hole machining applications for oil and gas and other demanding sectors.

"We've proven we can mill two to eight metres deep on the inside of a bore," Mason says. **"Some of the feature requirements being put to us as a tooling supplier are incredibly difficult, but we like that because we are able to support that. But if we didn't have this centre of excellence as a capability, we'd often have to say no to these enquiries. That's why the Nuclear AMRC is important to us."**

www.sandvik.coromant.com
January 2016

The **Nuclear Advanced Manufacturing Research Centre** has the capabilities to address large-scale high-precision manufacturing challenges across the energy sector – especially for safety-critical parts which have to survive some of the toughest conditions on Earth.

Our workshop is home to an array of production-scale machining centres and welding facilities, many of which are the largest and most advanced of their kind available for collaborative R&D anywhere in the world.

For full details:
namrc.co.uk/capabilities/innovation

NUCLEAR **AMRC**

To find out how the Nuclear AMRC can help your business:

namrc.co.uk

enquiries@namrc.co.uk 0114 222 9900

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

Supported by the Regional Growth Fund

EUROPEAN UNION
Investing in Your Future
European Regional Development Fund 2007-13

CATAPULT High Value Manufacturing

The University Of Sheffield.

MANCHESTER 1824
The University of Manchester
Dalton Nuclear Institute