Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

Safety-critical design support for **Plexus Ocean Systems**

The Nuclear AMRC's machining experts provided vital design support for a new subsea wellhead produced by Plexus Ocean Systems.

Aberdeen-based Plexus is a leader in the design and supply of wellhead products for the global oil and gas industry. The firm's patented POS-GRIP technology significantly improves the reliability and safety of high-pressure high-temperature wellhead systems, and has been widely adopted for surface wellheads.

In 2012, Plexus decided to expand the market for POS-GRIP technology by designing and developing an innovative subsea wellhead – the Python.

The firm produced concept designs during 2013. While working with its supply chain to plan production of the new wellhead, Plexus identified the potential for help from the Nuclear AMRC on design for manufacture.

"Design for manufacture can significantly reduce the cost and risk of bringing innovative new products to market," explains Jay Shaw, the Nuclear AMRC's lead engineer on the project.

"Because our engineers have a deep understanding of how large, complex components can be machined and fabricated, we can help make sure that new designs can actually be manufactured efficiently while meeting all the quality requirements and the design intent."

Three full-size housings for the Python wellhead had to be designed and manufactured for qualification testing. The test housings were designed to qualify various aspects of the wellhead design, and relied on new and novel components never before manufactured by Plexus.

"Plexus has no in-house machining capability, and relies on a robust supply chain of machining suppliers in the UK," says supply chain manager Matthew Thorpe. **"The need to get the best design for manufacture is essential to ensure that the most economic solution is found that meets the design requirement but is also able to be manufactured successfully."**

Plexus and the Nuclear AMRC began working together in 2014, using the centre's machining expertise to help review critical components in terms of the manufacturing process and supply chain capability.

A series of design-for-manufacture reviews with the Nuclear AMRC looked at the design and machining requirements of critical items. The team identified risks in terms of machining tolerance, surface finish and potential distortion issues, and proposed how to maintain the design integrity while allowing economic manufacture.

"The need to get the best design for manufacture is essential to ensure that the most economic solution is found."

Suppliers were also included in the review meetings so that their capabilities could be considered. The Nuclear AMRC engineers visited a number of companies to assess their machining capability for the new Python design.

The team found that one of the Python components would be particularly challenging to machine – a large two-piece clamp which mechanically locks the wellhead when in operation. The clamp was manufactured from a single forged ring of over two metres diameter which had to be split, and featured complex end profiles for the closing mechanism.

"The net result was a clamp with a complex geometry obtained by the removal of a significant amount of metal," Thorpe says. **"The potential risk of distortion in terms of the clamp twisting was identified, and a recommended machining method including stress relieving, sequence of milling and turning and splitting was developed.**

"I am pleased to say that the manufacturing strategy developed worked very well, and the split clamp was produced with no issues."

A fully operational Python wellhead was designed and manufactured using the knowledge gained during the test housing project, and unveiled at the SPE Offshore Europe exhibition in Aberdeen in September 2015.

www.plexus.co.uk
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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.

Our workshop capabilities include:

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- Horizontal boring.
- Five-axis machining.
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enquiries@namrc.co.uk 0114 222 9900

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

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