Project FORCE: Advanced Manufacturing and Materials

BENEFITS – Confidence in the ability of novel techniques to bring down the cost of nuclear builds

Funded as part of the BEIS **Nuclear Innovation Programme** funding this work helps to reduce an important blocker for the wide-scale use of power beam welding techniques in the nuclear industry.

The adoption of power beam welding by the nuclear industry could significantly cut manufacturing costs, particularly with the move to modularisation where systems are assembled within a factory environment.

A greater understanding of the effects of power beam welding techniques could also reduce through-life costs, as welds are generally the regions within components that require the most onerous inspection and assessment regimes, potentially limiting the life of a component, and ultimately the reactor.

THE CHALLENGE – The ability to justify the safety of welds to nuclear regulators

Welding metallic components is a core technology across all nuclear reactor designs. There are a range of welding techniques and each results in complex microstructures in the vicinity of the weld. Understanding the effect of welding parameters on material properties and residual stresses is of paramount importance for structural integrity in the design and operation of nuclear plant.

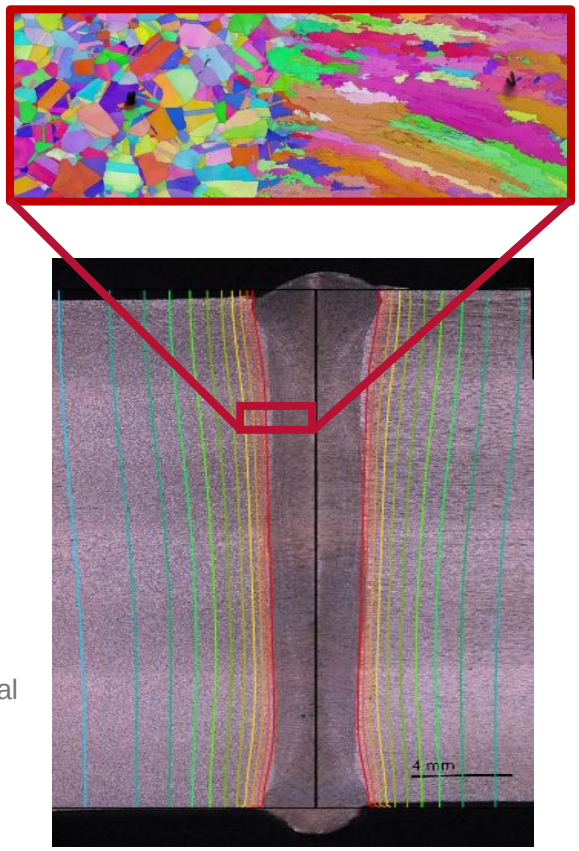
Electron beam (EB) and laser beam (LB) welding techniques have great potential for future nuclear reactors. Benefits over contemporary techniques include: faster process time, smaller heat affected zone, and potentially favourable welding residual stresses. A greater understanding of power beam techniques is required for their wide-scale adoption, which includes developing validated modelling approaches that allow complex materials effects to be predicted and optimised.

OUR SOLUTION – Bringing together existing skills to provide validation of novel techniques

Frazer-Nash Consultancy and our partners, **University of Bristol, Nuclear Advanced Manufacturing Research Centre (NAMRC), Cammell Laird and VEQTER**, have developed a programme of work to further the understanding of power beam welding. The work programme focusses on three key areas:

- The detailed characterisation of EB and LB welds, and the development of a modelling approach to predict the weld residual stresses accurately and efficiently.
- Prediction of the fracture behaviour of power beam welds in the presence of residual stresses and the effects of component thickness and ageing.
- The development of a framework for how variations in material properties and residual stresses can be accounted for in structural integrity assessments.

Our work is focussed on 316L stainless steel and considers typical component geometries such as plates and cylinders. The validated modelling approaches we are developing will be implemented in industry standard codes to maximise applicability to the nuclear new build.



Find out more
To find out more about our work and how we can add value to your business visit our website.

FRAZER-NASH CONSULTANCY