



# Case study

## ITER neutral beam line component structural design and analysis

### BACKGROUND

Nuclear fusion research aims to deliver safe and sustainable energy for future generations by harnessing the reaction that powers our sun. The engineering challenge is to recreate and control this reaction on earth and make it commercially viable.

### THE CHALLENGE

The ITER Fusion reactor uses magnetic-confinement to maintain a high temperature plasma within a Tokamak. To energize the plasma, several energy sources are used including neutral beam injectors. In the ITER design, the neutral beams are produced by a set of beam-line components including the ERID shown in Figure 1 and the Calorimeter shown in Figure 2.

To ensure safety, it is imperative that these beam-line components are designed to withstand severe seismic and thermal shock events. They must also endure the hostile environment of the reactor, which includes high-vacuum conditions, sputter deposition of copper and neutron bombardment. The components must also be designed to be remote handled.

To address these challenges, Frazer-Nash was asked to undertake the full design and analysis of the support structures and alignment mechanisms for the Calorimeter and ERID Components.

### OUR SOLUTION

Frazer-Nash are experienced in designing for challenging and hostile environments at extremes of temperature and pressure; subsea, in space and within nuclear reactor cores.

Our expert engineers designed the support structures, subjecting them to worst-case loads and fault cases, using advanced computational modelling software codes, tailored to the client. The design was modelled in the CAD package CATIA V5, and the structural performance was analysed using ANSYS Workbench FEA (Finite Element Analysis) software.

This analysis enabled us to make iterative improvements to our design and deliver a fully compliant and structurally efficient solution that fitted within the restricted space envelope available in the reactor.

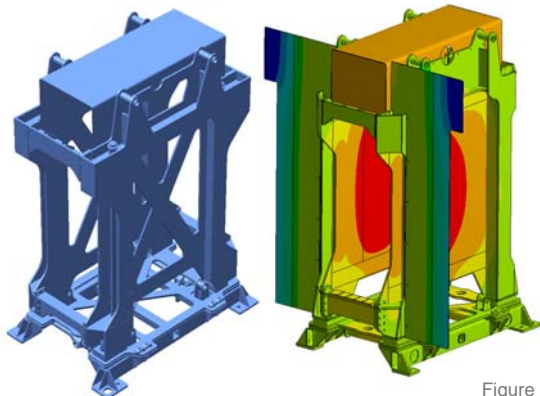


Figure 1: Electrostatic Residual Ion Dump

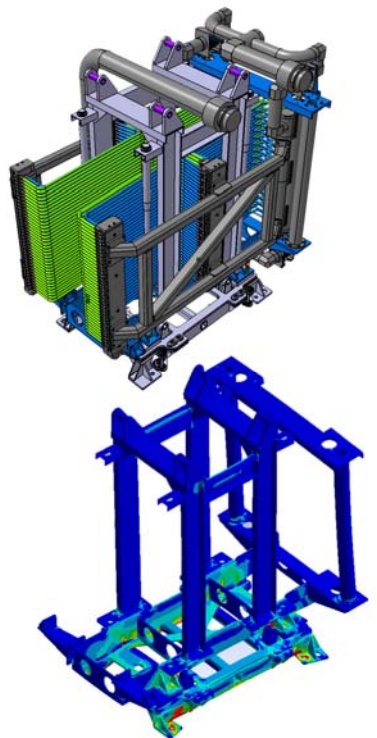


Figure 2: Calorimeter

### Client

Culham Centre for Fusion Energy (CCFE)

### Business need

Mechanical, structural and thermal design expertise

### Why Frazer-Nash?

Frazer-Nash has extensive nuclear expertise, including advanced design for structural and thermal performance.

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