

UTILISING ELECTRON BEAMS TO FIND MATERIAL SOLUTIONS

Overview

Cambridge Vacuum Engineering (CVE) has commissioned a unique electron beam system for Tokamak Energy Ltd. They will use the machine to find design solutions for divertor components and progress their pioneering work towards making commercial fusion energy a reality.

Fusion Energy

Based in Oxfordshire, UK, Tokamak Energy is striving to deliver a new source of clean energy to the world by utilising the potential of fusion power.

Fusion power is harnessed from the joining of small atomic nuclei to form larger ones, resulting in a release of energy. This is the same process that fuels the Sun, and Tokamak Energy want to recreate it here on Earth in their compact spherical tokamaks. It is a scalable energy solution that is safe, clean, and plentiful.

Material Properties

As part of the manufacturing process, Tokamak Energy needs to find the best-suited material to use inside the divertor. The divertor is the exhaust system that extracts

unwanted particles from the plasma inside of the Tokamak.

To achieve this, they required a solution to test and find materials and coolant configurations which optimise performance under high heat fluxes.

Advanced Electron Beam Technology

CVE designed a unique electron beam system that could fit this requirement – a 60kV, 6kW machine able to produce 100mA of beam power.

The electron beam will rapidly deflect over a 30mm² target, simulating the heat loads on various components that Tokamak Energy will use in their tokamak. These prototype tests will then be analysed using thermocouples and an infrared camera.

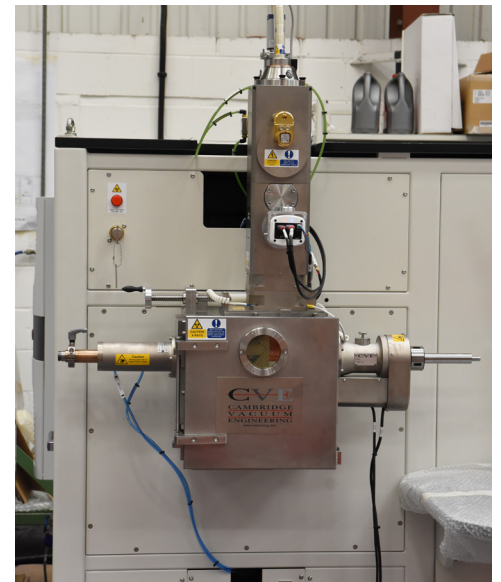
CVE's rapid deflection technology and custom pattern generator make this process easier, allowing the beam to fire over the target area in the user's defined pattern – at speeds of up to 10kHz. Including replicating

the quasi-gaussian profile of the heat flux on divertor targets.

Typically, CVE design and manufacture electron beam machines for welding applications, so working on this project provided an exciting opportunity for knowledge transfer and innovation in a new field.

Tokamak Energy hopes to use their spherical Tokamak to form the basis of the commercial module that will deliver electricity into the grid.

Figure 1. Custom-built electron beam system.



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