



# **ELECTRON BEAM WELDING MANUFACTURE OF POWER GENERATION INFRASTRUCTURE**



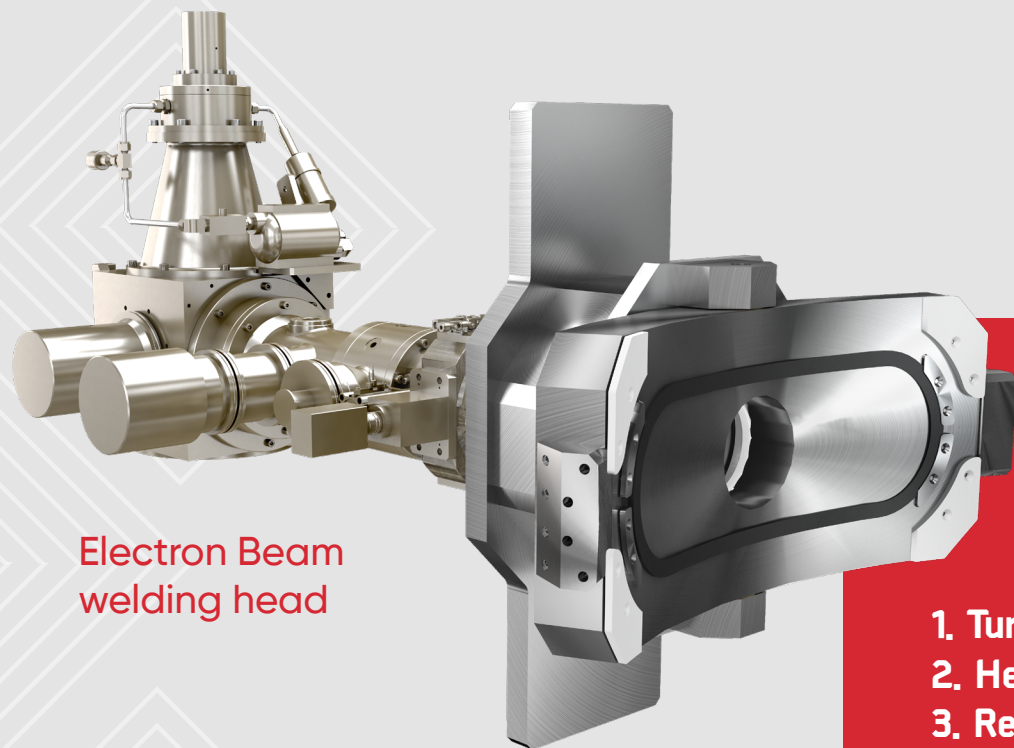
## Background to the emerging MMR market

Micro modular reactors (MMRs) are a type of nuclear fission reactor which are smaller than conventional reactors, and manufactured at a plant and then brought to site to be fully constructed.

Modular reactors allow for less on-site construction, increased containment efficiency, and heightened nuclear materials security. MMRs have been proposed as a less expensive alternative to conventional nuclear reactors.

U-Battery is a micro modular reactor (MMR) which will be able to produce local power and heat for a range of energy needs. The original challenge was to design an economically viable, modular nuclear power generation system which is intrinsically safe.

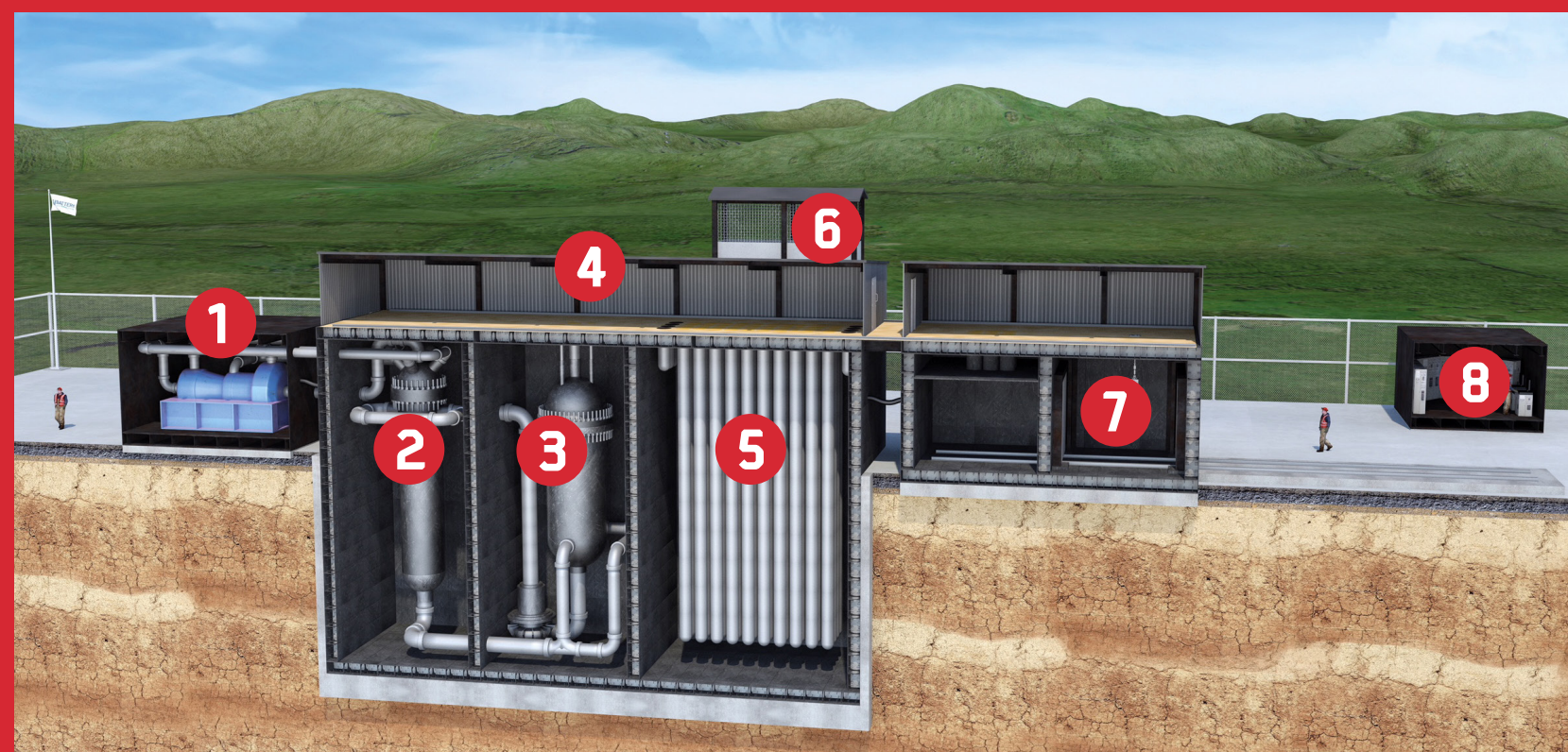
Putting this into context, large scale nuclear reactors require high capital investment and heavily rely on the infrastructure of nuclear sites. Designers were therefore motivated to develop smaller scale reactors, especially for developing countries and remote areas off main power grids. The development of micro modular reactors presents a host of economic, industrial and environmental opportunities, contributing to the solution of what is known as the "energy trilemma" (low carbon, secure and affordable energy) and enabling a low carbon economy.



Electron Beam welding head

### KEY

1. Turbine Generator
2. Heat Exchanger
3. Reactor
4. Maintenance Floor
5. Used Fuel Cartridge Store
6. Fuel Store Ventilation
7. Fuel Handling Facility
8. Control Room



Innovate UK  
This project is co-funded by the UK's innovation agency, Innovate UK

## The Welding Challenge

Globally 79% of electricity is generated by thermal processes, in which conventional power plants provide over 62% of global electricity supply and the remaining 17% is by nuclear fission processes and this is expected to increase further (IEA, 2015).

Thermal power plants make use of a large number of thick section (greater than 20mm) components for many parts of the primary circuit; pump and valve bodies, ancillary systems and other safety critical components. Furthermore, offshore wind demand in the UK requires more than one thousand structures (towers and foundations) or 1 million tonnes of steel to be cost-effectively fabricated on an annual basis.

The demand for "thick section" steel structures in power generation is already strong and continues to grow. The ability to fabricate these thick section structures cost-effectively is in part limited by the welding time and associated cost; to produce a typical 40-metre long monopile (60mm thick) can take more than six thousand hours of 'arc-on' welding time. The long term benefits of this partnership will be increased revenues and exports as well as the securing of high value jobs in manufacturing and low-carbon energy sectors.



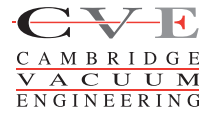
The UK requires more than **1 million tonnes** of steel to be cost-effectively fabricated on an annual basis.



Globally **79%** of electricity is generated by thermal processes,



This project is a joint collaboration between



## The EBManPower Solution

To reduce cost the manufacturing time needs to be significantly reduced.

Cambridge Vacuum Engineering (CVE) has developed the "EBFlow" system, based on high productivity Electron Beam Welding which can reduce the welding time involved to less than 200 hours, equivalent to a reduction in cost of over 85%. The EBManPower project will implement and validate the first EBFlow system within a large-scale fabrication facility in order to enable cost-effective manufacture of large scale power generation infrastructure.

Cammell Laird is one of the UK's heavy fabrication shipbuilders and is the manufacturing partner for the U-Battery MMR system. The EBManPower project is due to complete in 2021, and is valued at £1.5 million. The EBflow system will be deployed at the Cammell Laird site in Birkenhead to fabricate a demonstration pressure vessel for the U-Battery, and other related energy products in a cost-effective manner. This practical demonstration will be critical in driving widespread deployment of the new cost-effective solutions to meet low carbon needs across the energy sector in the UK and overseas.

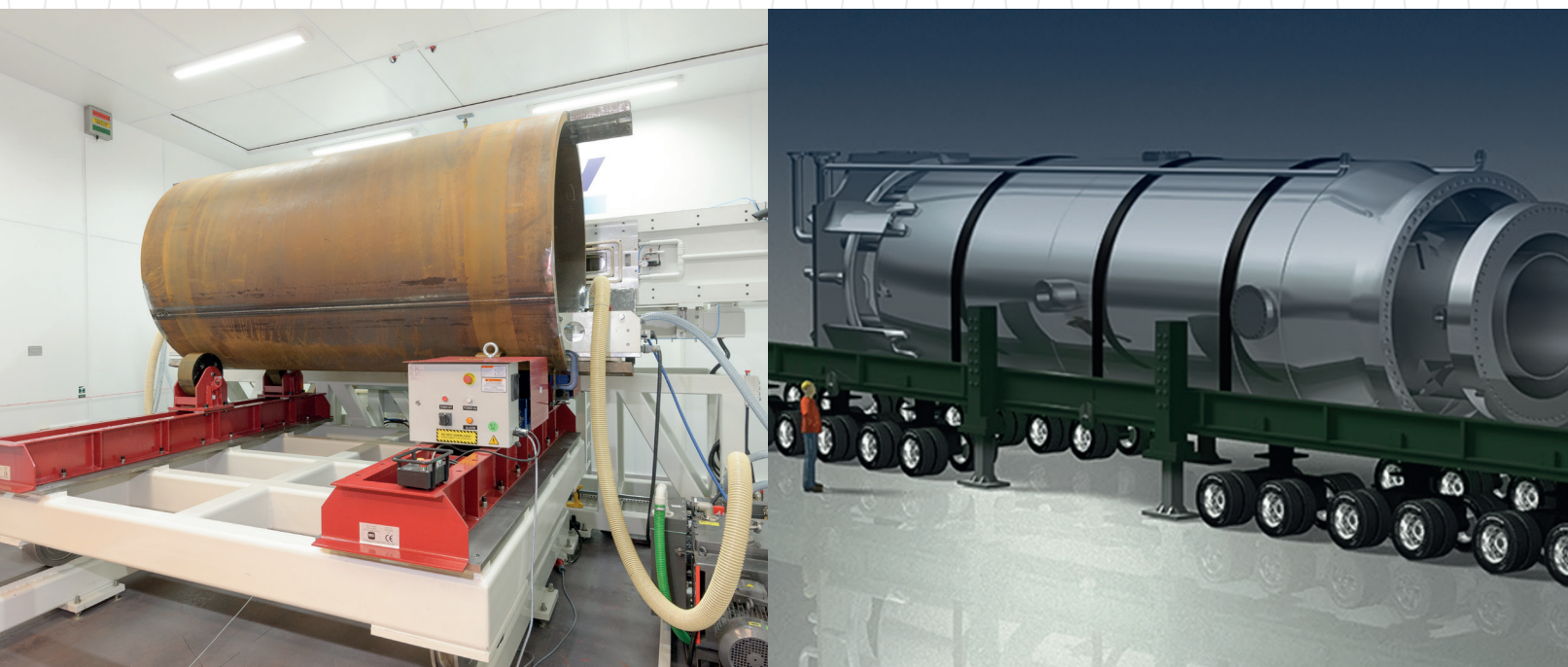
## Wider project benefits

In the longer term a key objective of EBManPower is to stimulate the development of a flexible and efficient advanced manufacturing technology (Electron Beam Welding) for the manufacture of components for Nuclear power plant. Similar processes have been successfully applied in other industrial sectors, but this is the first time this approach has been applied within the power sector.

The project is at its heart focused on reducing the cost of "thick section" steel structures applicable for both nuclear and off-shore wind structures. EBManPower will exploit CVE's revolutionary EBFlow system and will innovate, demonstrate and provide a near to market result; validation in a real world environment is the ultimate aim. The project will take a technology concept, the feasibility of which has already been proven, and make the final push to reach the marketplace. The results will be used to enable its UK based consortium to enter and compete in the power industry plant component supply chain as well as bringing opportunities for other sectors and clients.



Micro modular reactors are perfect for developing countries and remote areas



**“ Our revolutionary EBFlow technology, fully developed and pioneered in Britain, will transform the productivity of fabrication processes throughout the world of heavy engineering. In many cases the speed of welding can be 30 times faster than current methods ”**

**Bob Nicolson, Managing Director at Cambridge Vacuum Engineering**





**[www.ebflow.com](http://www.ebflow.com)**

**01223 800861    [info@ebflow.com](mailto:info@ebflow.com)**

Cambridge Vacuum Engineering, 43 Pembroke Avenue,  
Denny Industrial Centre, Waterbeach, Cambridge, CB25 9QX United Kingdom