“Nuclear Fusion Potential & Present Status”
Mr Chris Warrick
UKAEA Culham Centre for Fusion energy

The Cirencester Science & Technology February lecture was given by Mr Chris Warrick from the Culham Centre for Fusion Research. Mr Warrick set the context for fusion research against a growing global demand for clean renewable energy.

Fusion power is obtained from the energy emitted when hydrogen atoms fuse to form helium. In the sun this is a very slow process and so for practical fusion power purposes, deuterium or tritium are used to bombard a lithium target and achieve fusion in seconds creating helium and a stream of neutrons that carry the majority of the energy. However using the heavier isotopes of hydrogen requires temperatures of 100 million degrees Celsius, some ten times those in the sun. These incredibly high temperatures reached by the resultant plasma can only be achieved using very powerful electromagnetic fields operating within a large magnetic chamber known as a Tokamak. Although the carbon lined torus in JET is 18 metres high, it uses only about one hundredth of a gram of plasma. The emitted neutrons are absorbed in a layer of lithium which heats up to around 500 ^{o}C and this is used to drive steam turbines.

Although the potential for fusion power has been acknowledged for decades the substantial combination of scientific and engineering skills needed to achieve a commercial breakthrough has required the collaboration of a number of countries. Much of the recent development work in this field has been achieved by the **J**oint **E**uropean **T**orus (JET) facility at Culham. This is the largest such facility in the world and is capable of yielding 16 MW of power, but is only a research tool as at this level more power is consumed than produced.

The lessons learned from developing JET at Culham have been used to design the next stage fusion facility which is the 500MW **T**okamak **E**ngineering/**R**esearch (ITER) facility in France. This is a €14bn global collaboration between the EU, Japan, China, India, South Korea and the US and is expected to be the first fusion facility to produce ten times more energy than it consumes when completed in 2020.

Fusion as a source of energy has several advantages: there is no environmental impact, no critical safety concerns, there is no long-lived waste and there are abundant sources of fuel.

More information is available on www.ccfe.ac.uk/introduction.aspx and www.iter.org .

Given on Wednesday 13th February 2013 at the Royal Agricultural College