

The ZETA Generator

The ZETA (Zero Energy Thermonuclear Assembly) generator was built by Metropolitan-Vickers of Trafford Park. Metropolitan-Vickers specialised in heavy electrical engineering and was at the leading edge of electrical energy research and development in the 1950s. A model of the ZETA generator is on display in MOSI's Revolution Manchester Gallery. MOSI also holds the GEC (Trafford Park) Archive, which includes documents relating to ZETA.

What is nuclear fusion?

Nuclear fusion is a reaction produced when atoms are forced together, causing two atomic nuclei to fuse and form a heavier nucleus. This reaction releases a large amount of energy. In order for fusion to occur, plasma must be heated to over 100 million degrees, a temperature hotter than the centre of the sun. Plasma is ionised or 'charged' gas, which responds to electric and magnetic fields. It takes a huge amount of energy to achieve these temperatures. The problem with fusion is that it is very difficult to get more energy output than the input needed.

ZETA – a noble failure

In the 1950s British scientists saw nuclear fusion as a means of generating plentiful and cheap energy without harmful waste. ZETA was the UK's first major experiment in nuclear fusion. The aim of the ZETA project was to study the controlled release of energy from thermonuclear reactions. The ZETA generator was first operated on 12 August 1957 at the UK Atomic Energy Authority's research station in Harwell, Oxfordshire. ZETA's fuel was deuterium (heavy hydrogen).

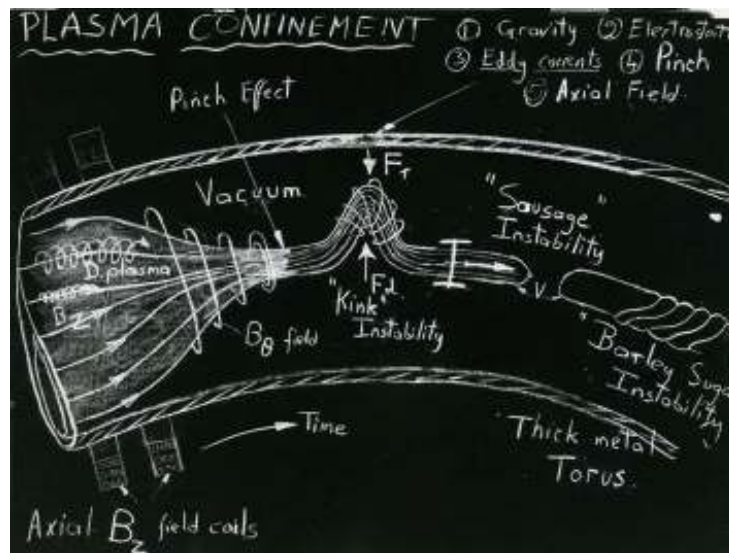


MOSI's ZETA model.

Using huge electromagnets, powered by a bank of capacitors, to squeeze or 'pinch' the plasma, ZETA achieved temperatures of 5 million degrees, a third of the temperature at the centre of the sun. The plasma can be thought of as many electric wires, all carrying current in the same direction, which are pulled towards each other by the force of the magnetic field. In the early ZETA experiments, researchers observed neutron spikes and speculated that these might be evidence of a thermonuclear reaction.

In January 1958 the Atomic Energy Authority decided to hold a press conference so that journalists could see ZETA. When Sir John Cockcroft, the Director of the Harwell research station and winner of the Nobel Prize for Physics in 1951, stated that he was 90% certain that ZETA had achieved thermonuclear fusion, his audience was enthralled. Newspapers ran front-page stories claiming that ZETA was as big a triumph as Sputnik, the world's first artificial satellite, which had been launched by the USSR three months earlier.

Unfortunately, further experiments proved that Sir John's confidence was misplaced. The ZETA researchers found that the plasma became unstable and 'broke up' before it was compressed sufficiently for nuclear fusion (see diagram below). The neutron spikes were products of this inherent stability. The findings seemed to suggest that the pinch concept was simply unworkable and the research ended in 1958. Having initially overstated the success of the project, the press bitterly condemned the project's failure.



Nuclear power was already being developed in another way: by fission (splitting atoms). Nevertheless, nuclear fusion research continued. ZETA was fundamental to the success of the Joint European Torus (JET) located at the UK's Culham Centre for Fusion Energy. The JET experiment is currently the largest fusion experiment in the world.

For more information:

- Read** Hance, Nick. *Harwell - The Enigma Revealed*. Oxon, UK: Enhance Publishing, 2006.
 McCracken, G. and P. Stott. *Fusion: The Energy of the Universe*. London, UK: Elsevier Academic Press, 2005.
 Maddox, John. *A Plain Man's Guide to ZETA*. Manchester, UK: Manchester Guardian and Evening News Ltd, 1958. (Copy available in MOSI Library.)
- Study** GEC (Trafford Park) Archive in MOSI's Collections Centre
- Visit** Dalton Institute website: www.manchester.ac.uk/dalton