Issue Six May 1999

Fusion BUSINESS

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The EURATOM/UKAEA Fusion Industry Programme web site is being updated. If your company would like a link to the site, please email louise.ball@ukaea.org.uk

400% INCREASE IN UK INDUSTRY WORK FOR ITER

UK industry is working on contracts worth more than £600,000 for fusion's next step project, ITER (International Thermonuclear Experimental Reactor).

Funding of these design and development projects was approved after successful preparatory work by UKAEA Fusion. It represents a 400% increase in UK involvement in ITER technology tasks. UKAEA is subcontracting the bulk of the work on seven projects to UK companies (*see full project details on page 2*).

AEA Technology, The Welding Institute, NNC, The University of Sussex and QuoTec Ltd. are amongst the UK companies and organisations carrying out the work.

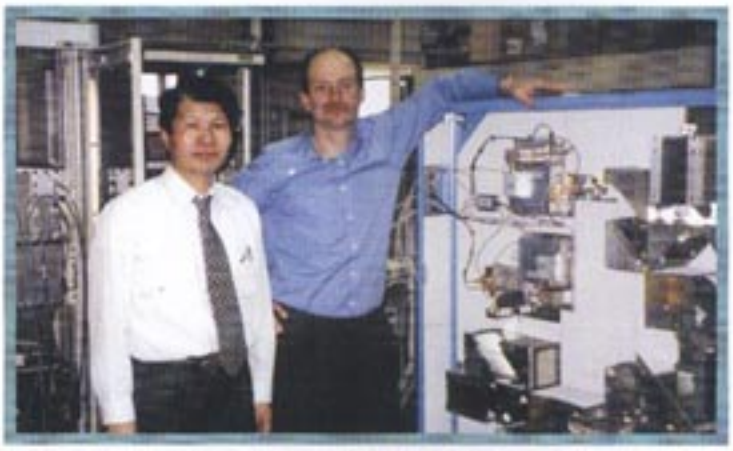
More details from Cleve Forty on 01235 463232 or email cleve.forty@ukaea.org.uk

KEY EUROPEAN FUSION AGREEMENT SIGNED

The European Fusion Development Agreement (EFDA), which covers all key technology and safety activities for fusion power research in Europe, is now in place.

This major agreement replaces the NET Agreement under which the technology R&D tasks for ITER were performed. It will ensure wider co-ordination of activities across Europe and will provide the main mechanism for industry involvement in fusion. EFDA also provides the formal framework for the use of the JET facilities after 1999 *(see page 4)*.

SUCCESS IN JAPAN



Professor Kawahata of NIFS with Dr. Richard Wylde

Thomas Keating Ltd., who featured in the first edition of Fusion Business, have successfully completed a contract with the National Institute for Fusion Science (NIFS) in Nagoya, Japan.

Thomas Keating designed and built a two colour interferometer to measure electron line density in the new Large Helical Device at NIFS. The system measured the first plasma within the LHD vessel, proving that the machine construction was completed on time.

> "The involvement of Thomas Keating Ltd in the JET interferometer project has assisted us in raising our business profile within the Fusion community and helped us develop the confidence to bid for the Japanese (National Institute for Fusion Studies) contract as the main contractor." Dr. Richard Wylde, Thomas Keating Ltd.

Flashback to Fusion Business One

Dr. Richard Wylde of Thomas Keating Ltd. says: "The success of the similar KG6D interferometer on JET, built in conjunction with UKAEA Fusion, confirmed to NIFS management that Thomas Keating Ltd. were the right people to build this LHD primary diagnostic."

Thomas Keating Ltd. and its sister company QMC Instruments are active in a whole range of GigaHz and TeraHz diagnostics for plasma fusion research and have systems and components in almost all the world's fusion laboratories.

Contact Dr. Richard Wylde on 01403 782045.

UKAEA

Fusion Working with Europe

GYROTRON MAGNETS ATTRACTING EUROPE-WIDE INTEREST

A Cryofree® 93 GHz superconducting gyrotron

Oxford Instruments, working with major microwave tube manufacturers including CPI, Thomson Tubes Electroniques and Gycom Ltd., has supplied around 50 magnet systems for gyrotrons (high power microwave sources) used in Electron Cyclotron Resonance Heating (ECRH), and plasma microwave diagnostics for several fusion experiments world-wide.

These include:

- over twenty 60 to 70 GHz systems, including ten at the UKAEA Culham Science Centre
- six 82.7 GHz tubes at CRPP-EPFL, Lausanne, Switzerland
- eleven 140 GHz tubes at MPI-IPP Garching, Germany and ENEA-EURATOM-CNR Association, Frascati, Italy.

A number of new applications are emerging for high frequency microwaves, for example, ECRH for ceramic sintering, and high resolution radar with improved atmospheric penetration. The cryogenic options offered by Oxford Instruments' magnet systems allow these to be explored with realistic commercial goals.

Oxford Instruments' superconducting magnets may use any of a range of cryogenic cooling systems (some with high temperature superconductor current leads), including magnets with effectively zero liquid helium consumption and even some which are Cryofree® (cooled solely by a mechanical cryocooler).

More information from Dr. John W Burgoyne. Tel. (01865) 393200.

Oxford Instruments' gyrotron magnets at the UKAEA Culham Science Centre

UK INDUSTRY WORK FOR ITER

(continued from page 1)

The tasks include:

- Fatigue and creep-fatigue testing of two different copper alloys (copper chrome zirconium and copper aluminium 25)
- Examining the feasibility of performing electron beam welds for the ITER stainless steel vacuum vessel and backplate welds (60mm thick)
- A number of contracts connected with the detection and removal of tritium and dust (such as carbon and tungsten)
- Testing of ceramic prototype windows for ITER diagnostics
- Analysis of dust and flakes from the interior of JET
- Depth profiles of co-deposited deuterium/tritium in carbon layers formed on JET plasma-facing components
- Studies of aqueous corrosion and erosion of various steel and copper alloys in the presence of a radiation field.

1999 Fusion and Industry Conference & Events Diary

June 14-18 - 26th EPS Conference on Controlled Fusion and Plasma Physics, Maastricht, Netherlands.

June 21-25 - Frontiers of Science and Measurement, NPL, Teddington, Middlesex.

July 15-17 - Applications of Physics in Financial Analysis, Trinity College, Dublin, Ireland.

September 19-24 - ISFNT (5th International Symposium on Fusion Nuclear Technology), Rome, Italy.*

October 5-7 - French Physical Society Exhibition, Paris, France.

October 11-15 - 18th Symposium of Fusion Engineering, Albuquerque, NM, USA.

November 2-4 - National Measurement Conference '99, Brighton.*

*The Fusion Industry Programme will be exhibiting at this event.

Email deniese.willis@ukaea.org.uk or call 01235 463296 for more information.

Please note details may be subject to change.

ERODEX

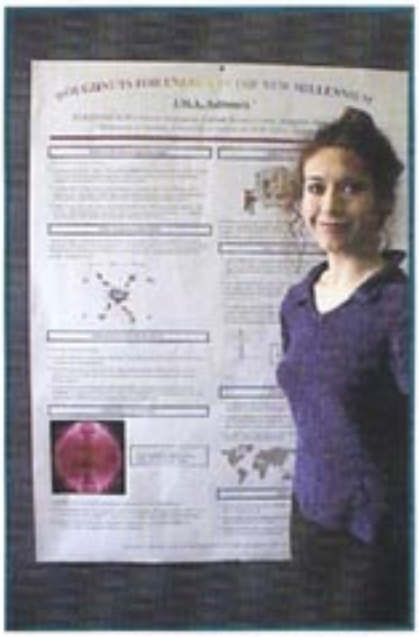
Erodex (UK) Limited is the only independent company in the UK marketing carbons and graphites, and offering a full C.N.C. machine shop service. The company started in 1974, and in 25 years of trading has established a firm position as a leading supplier of these products. It has successfully supplied components and services, including both graphite and carbon fibre inner wall protection tiles, to JET and UKAEA since 1993.

The company is a major player in a number of industries, and is the leading supplier of carbons and graphites in more than one. Electro Discharge Machining, particularly in aerospace applications, continuous casting of metals, semi-conductor and electrical industries, vacuum furnace applications, mechanical carbons, glass making and metal sintering are all areas where Erodex has been long established.

Heavy investment has created a "state-of-the-art" machining facility that is widely accepted as being in the very vanguard of graphite machine shop technology.

Contact Ian Rolinson on 01384 892011.

JOANNA SET FOR THE COMMONS



Culham scientist Dr. Joanna Ashbourn was one of 300 young scientists selected to exhibit their posters in the House of Commons in March, as part of the National Week of Science Engineering and Technology (SET '99).

Joanna's poster 'Doughnuts for Energy in the New Millennium' highlighted the need for energy as the world's population grows, and reviewed why fusion is such an important possibility. It considered the important contribution of the COMPASS-D tokamak at Culham, and in particular the Helios Diagnostic (spectroscopy of injected helium gas) that Joanna is working on.

Another successful exhibitor was one of Culham's former PhD. students, Dr. Ruth Bamford, of the Rutherford Appleton Laboratory, who won an Office of Science & Technology award for her poster on tracking ionospheric changes during solar eclipses.

Your comments on this edition of Fusion Business are welcome, along with suggestions for articles. Contact Louise Ball on 01235 464104 or email louise.ball@ukaea.org.uk

TENDER & CONTRACT NEWS UPDATE

The Fusion Industry Programme has nominated 20 UK companies to tender for work on four major European fusion projects so far in 1999.

- Design, manufacture and assembly of the W7-X Cryostat at IPP Greifswald, Germany, and design, manufacture and supply of regulated high voltage power supplies for the W7-X plasma heating system.
- Design, procurement and installation of pressurised water loop pipework for CEA, Cadarache, France.
- Manufacture and supply of a superconducting magnet for FOM, Holland.

In all, more than 40 UK companies were asked if they were interested in being nominated.

Under European Fusion Programme rules, each Fusion Association is asked to nominate suitable companies to tender for any European fusion contract worth more than 300,000. The EURATOM/UKAEA Fusion Industry Programme will nominate UK companies with the necessary capabilities. We can also help during bid preparation, and use our contacts to link UK companies as industrial partners to bid for large or complex international projects.

If your company would like to be included on our database, contact Louise Ball on 01235 464104 or email louise.ball@ukaea.org.uk.

STOP PRESS STOP PRESS STOP PRESS

UK firms are being offered the chance to exhibit their promotional material on the UKAEA Fusion stand at two events this year (*see Diary page 2*). Exhibiting at these events gives you an opportunity to influence leading fusion engineers, scientists and decision-makers. Details on 01235 463296 or email deniese.willis@ukaea.org.uk

A Guide to Fusion – Part 4
The First Wall

A segment of the COMPASS-D graphite 'divertor tiles', fitted with an array of probes to measure heat flux and local plasma properties.

The "first wall" in a tokamak has to withstand large fluxes of electromagnetic radiation, neutrons (possibly) and energetic particles. Radiation and neutron emissions in present-day tokamaks create heat loadings of up to 0.5MW/m^2, which the stainless steel or inconel vacuum vessel surface can withstand. However, the charged particle efflux, which in a power plant would include alpha particle ash from fusion reactions, has to be 'diverted' onto surfaces fitted with tiles of refractory material mounted on substrates (which may be water-cooled). These must be able to take heat loadings averaging 5MW/m^2 and surface temperatures above 1000°C.

Graphite is widely used because of its excellent thermal shock properties. However, when hot, it reacts chemically with hydrogen isotopes and produces large amounts of dust. Beryllium, molybdenum and tungsten have also been used but are not ideal. The energetic particle bombardment results in material from these surfaces entering the plasma, increasing radiative losses and cooling the plasma. This puts additional constraints on the materials that can be considered. The energetic particles can also penetrate into the tiles, producing reservoirs of gas that can re-emerge if the tiles are subsequently heated further, influencing plasma density stability.

These complex physics and technological issues mean that first wall design for a power producing tokamak is still very much a developmental issue.

Steve Fielding

JET FUELLING TESTS

A very busy period of research is under way at JET, before the Joint Undertaking, under which it is currently run, terminates on 31 December 1999. Negotiations are in progress to allow JET to be operated under new arrangements in support of ITER and fusion in general.

During the spring and summer of 1999, JET's remote handling facility (*see Fusion Business Two*) will be used to install a guide tube inside the JET vessel. This tube will allow a tiny pellet of frozen deuterium to be launched into the hot plasma from the inboard side of the vessel, typically at speeds of 250m/s. Novel fuelling experiments using this pellet launcher will begin in the autumn.

The remainder of the programme features alternative options: new studies for ITER, including regimes that might allow steady state operation of a tokamak, and a second deuterium-tritium campaign aimed at generating record fusion powers and sustained fusion reactions, again to provide new data for ITER.

The choice depends on how the JET facilities will be operated after 1999. In the proposed arrangements, UKAEA would have a contract to operate the facilities for a collective European programme of experiments. European "task forces" would be set up for science and technology work using these diverse and powerful facilities. Suggestions for industry involvement in the work at JET post-99 will be welcomed.

ITER LATEST

Three of the four ITER partners, Japan, Europe and the Russian Federation are continuing to study a reduced-cost, reduced objectives, design for the project. The fourth partner, the USA, will probably continue to collaborate on physics issues and complete its allocated R&D tasks. Dr. Anne Davis, Associate Director for Fusion Energy, told a US Department of Energy Advisory Board Meeting: "The US plans to contribute to ITER physics on a voluntary basis and complete its commitments to build the 40 tonne central solenoid magnet model and the divertor cassette, and participate in their occasional tests." Importantly she added: "If other parties proceed in the ITER construction, the US would want to reconsider its involvement."