



Fusion Business

tomorrow's technology for today

ITER SUCCESS HAS TECHNOLOGY TRANSFER BENEFITS

A company's successful development work on techniques for fusion's 'next step' ITER project has had beneficial spin offs in other areas of its business.

NNC has successfully developed low temperature Hot Iso-static Pressing (HIP) diffusion bonding techniques for ITER Plasma Facing Components.

After a significant R&D programme, two beryllium armoured plasma-facing baffle and limiter components have been manufactured and high heat flux tested for EFDA, the organisation leading European work towards ITER. The baffle prevents back diffusion of particles from the diverter region; the limiter defines the plasma boundary during start-up and shut down.



The baffle mock-up, shown here, endured 1000 cycles at 5MW/m² and 90 cycles at 7MW/m² during heat flux testing

The test results are the best so far achieved for HIP bonded beryllium components and demonstrate the feasibility of manufacturing beryllium plasma-facing components capable of withstanding the surface heat flux required in the ITER machine. Dr. Mario Merola of EFDA says, "This excellent result is the best reward of a long lasting and difficult R&D phase."

The components designed and manufactured by NNC Ltd. at its manufacturing facility at Birchwood Park, Warrington were high heat flux tested at Forschungszentrum Jülich, Germany.

The joining technology, specifically developed for these materials by NNC, was "low temperature" diffusion bonding, achieved through HIP. Dr. Merola adds, "This HIP'ing technology opens the way to the possible use of CuCrZr as heat sink material with the associated advantages in terms of fracture toughness, weldability, availability and cost, and with an adequate heat removal capability."

Through this R&D activity, NNC has developed a technique to determine optimum HIP parameters based on analysis and small-scale experiments. This technique, valid for a wide range of bonds, now offers the major benefit of selecting HIP parameters with added confidence.

The success is doubly important to NNC, which has seen the technology transfer from fusion to other areas. One such spin-off is the development of a copper bonded steam generator for use in a sodium cooled fast reactor. According to NNC Business Manager Alain Chevalier, "The success of the HIP bonding R&D for ITER gives increased confidence that the novel steam generator will provide significant safety and cost benefits."

Contact www.nnc.co.uk

STOP PRESS STOP PRESS STOP PRESS

Due to the very strong interest in the notice published in Fusion Business 17, concerning expressions of interest in work on the ITER project, the Fusion and Industry Programme has arranged a special 'ITER Awareness Event'. It will be held at: Baylis House Conference Centre, Slough, Berkshire on Tuesday 8th October 2002.

Details from deniese.willis@ukaea.org.uk, call 01235 466608

CULHAM EXHIBITORS REPORT BUSINESS BOOST

Companies that have taken advantage of the offer to stage an exhibition at the Culham Science Centre have reported significant benefits for their businesses.

Adrian Williams of Fluid Controls Ltd, who were at Culham in December 2001, said: "We have had a very good response recently from many new contacts, some of which we met at the exhibition, others hearing of us through word of mouth. We have seen a significant increase in business over the past couple of months directly related to the exhibition. Overall we think it was a great success and hope we can repeat the day sometime."

A similar view has been reported by other recent exhibitors, Pulsed Power and Measurement Ltd (PPM) and The Kurt J Lesker Company. Ian Dorman, Kurt J Lesker's European Sales Engineer, says: "We took the opportunity to raise our



profile within UKAEA by exhibiting a range of vacuum pumps and components. Also on show was the ACCUQUAD Residual Gas Analyser. This is a great way of getting to meet key vacuum users within the organisation. We were extremely impressed with the way that the exhibition was advertised and would gladly come back again in the future."



Dave Willford, Sales Manager for PPM's Power Product Division, reported significant interest in PPM's full range of power supplies as well as high voltage capacitors, voltage probes and wide band pulse current transformers. He says: "The facilities at Culham created a perfect environment for worthwhile technical and commercial exchange, and the show

was an outstanding success, with its benefits far outstripping those of any exhibition the company has taken part in over the last few years."

Contacts www.fluidcontrols.co.uk, www.ppm.co.uk, www.lesker.com

The Technology 2002 exhibition, which was held for the first time at the Culham Science Centre in April, has also been hailed a success. With a range of products and services on display, the 30 exhibiting companies, who included organisations such as Olympus Industrial, Siemens Environmental Systems, Canberra Harwell, Brokk (UK) Ltd and NNC, set up their stands in a purpose-built marquee for the occasion to promote engineering equipment and associated services.

The exhibition at Culham was one of six similar events to be held at sites around the UK.

"ENORMOUS POTENTIAL" OF FUSION LINKS

The benefits to industry from its links with the European fusion programme have been highlighted at an international conference. Fusion and Industry Programme Manager, Dr Cleve Forty, presented a paper at the recent International Symposium on Fusion (ISFNT-6) in San Diego.

Dr Forty described those benefits as winning contracts to supply equipment and services to fusion laboratories, access to science data, opportunities for technology and knowledge transfer, and the use of facilities and availability of expert personnel.

In return, he argued, "Industry involvement in the European fusion scene is considered to be essential to the construction and operation of ITER" which offers "enormous potential opportunities" to industry from large engineering companies through to small and medium sized enterprises. Dr Forty says: "the fusion community is actively engaged in involving industry across Europe to an increasing extent in a way which will be of great benefit to both parties." The paper in full can be found on our website at:

www.fusion.org.uk/techdocs/isfnt6_forty.pdf

*We are now adding new pages and features to our website.
These will be unveiled in coming months.*

HIGH POWER LASER OPTICS

By Dr. Helmut Kessler, CVI Technical Optics Ltd.

Over recent years, high power lasers have gained more and more importance in scientific and industrial applications ranging from fusion research to laser cutting and welding. This development has stimulated an increasing demand for laser optics with high laser damage thresholds (LDT). These optics are used extensively at Culham Science Centre in fusion diagnostic Thomson scattering systems where very high performance, high energy and nanosecond pulse ruby and Nd:YAG lasers are deployed.



Inspection of laser optics

Most optics used in laser technology are coated optics, i.e. the substrate, usually Fused Silica or BK7 glass, is coated with a metal or a dielectric coating. Both substrate and coating play a vital part in achieving high laser damage thresholds. The substrate has to be of high optical quality to minimise absorption losses. Furthermore, it has to be polished to have a very smooth surface to maximise the LDT. For the coating it is important to use suitable coating materials and, as most optical coatings consist of a combination of different layers (up to 140), the coating design has to be carefully chosen. In the visible and near-IR light range, the most commonly used optical coating materials are oxide materials such as SiO_2 , HfO_2 , ZrO_2 and Al_2O_3 . In the UV/VUV range fluoride materials such as MgF_2 and LaF_3 are widely used.

CVI Technical Optics Ltd. and its parent company, the CVI Laser Corporation, are one of the world's leading suppliers of laser optics with a database containing more than 2500 coating designs.

Contact: **CVI Technical Optics Ltd.** on **01624 647000** or visit **www.cvilaser.com**

FUSION'S ANTENNA INSIGHT

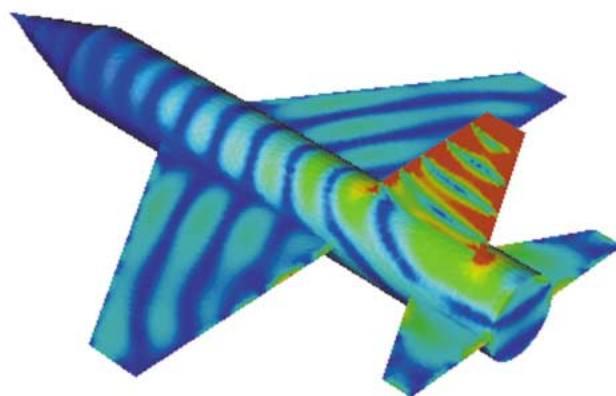
A casual remark over lunch to a fusion researcher has given one UK company a unique insight into the problem of how to accurately predict the performance of the many antennae on modern aircraft.

Culham Electromagnetics and Lightning Ltd (CEL) are experts in electromagnetics and have written a range of state-of-the-art numerical codes for applications including antennae, radar signature and high power microwave. One such code is numerical method of moments (MoM). Widely used in the aerospace industry, MoM is used to characterise the performance of installed antennae. However, extending its application to tackle high frequency multi-antennae configurations using conventional computers can lead to processing times of up to six months, "totally impractical for our purposes," said one CEL modeller.

The fusion researcher suggested CEL try the MoM code on the Fusion parallel computer, in return for the latest version of CEL's GHOST graphical output system. Adapting the code and then fine tuning it for parallel processing led to an increase in computational speed by an impressive factor of 25, reducing advanced electromagnetic modelling analyses times from six months to one week.

CEL Commercial Manager, Kevin Ward welcomed the collaboration with UKAEA Fusion: "Implementing MoM on parallel systems has resulted in an enhanced capability for modelling complex problems. More importantly, it has given us a greater insight into the issues involved in predicting high frequency multi-antennae performance on modern aircraft," he said.

CEL are part of the Chelton Group.



The computed electric currents generated by an antenna on the tail fin.

Your view Are there topics you would like to see covered in *Fusion Business*; do you have comments on this edition? If so, please contact *Fusion Business* co-ordinator deniese.willis@ukaea.org.uk or call 01235 466608.

MARKING A YEAR OF INNOVATION AT CULHAM

Occupiers and staff in the Culham Innovation Centre have marked its first anniversary, after a busy and productive year for those involved. The Centre is now home to 15 companies* employing 74 staff between them. A number are already taking advantage of UKAEA's Technical Support Package, which is available to suitably qualified occupiers and, as reported in Fusion Business 18, two of the companies, Oxford Scientific and Reaction Engines Ltd., have won DTI SMART awards to help further their work.



Centre Manager Barbara Allsworth says: "The Centre has had a great first year. We now have a mix of companies covering technical, commercial and business services who are able to benefit from the support and flexible lettings policy at Culham."

*Acro Aeronautical Services, Agenda PR & Marketing, Business Link, Eclipse Learner Systems,

Oxford Scientific Ltd, N2N Neutronics, Packaging Products Direct, Reaction Engines, RemoteSec Ltd, The Target Practice, Total Audio Visual Solutions, Toumaz Technology Ltd, Laplacian, Mgenie, Richard Butcher.

PEOPLE SPIN OFF:

Part Six: Dr Keith Hopcraft

Profiling people who started their careers in fusion and are now using the skills they developed in other areas.



Dr Hopcraft took his doctorate in plasma physics as a Culham CASE student in 1982/83. His field was theory of MHD and the understanding of instabilities in fusion plasmas. Postdoctoral work at Culham followed in 1984/85 before he went to Kings College,

London and his interest moved to optics and scattering. This was followed, in 1990, by a post at Nottingham University where he teaches and researches the statistical mechanics of highly complex interconnected systems relevant equally to fusion plasmas and international financial markets.

Dr Hopcraft's view of his experience in fusion research was that fusion people could always make a significant contribution in other fields. This was, he says, because of the multi-disciplinary nature of fusion at the leading edge of science, its highly sophisticated instrumentation and its involvement with highly complex systems. He says: "I valued my training there enormously. Culham presented real practical problems that had to be dealt with both rigorously and effectively. This was allied to experience of managing and administering expensive and substantial scientific equipment."

Institute of Physics Business Partners

UKAEA is one of 50 partners in a networking forum supported by The Institute of Physics.

The Business Partners Network enables business and industry to influence the focus of the activities and workings of the Institute, and to take part in initiatives promoting the contribution that physics and physicists make to innovation, wealth creation and quality of life.

Dr Sue Fryer, Business Manager at the Institute, says: "Association with the Institute can raise awareness for a company and its support for physics and physics education, particularly amongst the scientists and engineers who are their customers and employees. Network membership can give them competitive advantage, and brings complimentary invitations and discounts for the company and nominated staff."

An SME Club operates within the Network to allow smaller, technology-based companies to benefit from the technical and professional support provided by the Institute of Physics and to network with each other. SMEs are also offered a complimentary web page, set up and maintained by the Institute.

Details at <http://physics.iop.org/bi.html>, e-mail business.partners@iop.org or call 020 7470 4800.

Views expressed herein do not necessarily reflect those of EURATOM/UKAEA Fusion Association. No liability is accepted whatsoever for errors or omissions in Fusion Business. This work is funded by EURATOM and the UK Office of Science and Technology. Our website is www.fusion.org.uk/industry.