JET Insight

Quarterly News & Views of Europe's largest Fusion Device

December 2008

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Francesco Romanelli (second from left) with his collaborators in the Close Support Unit wish Merry Christmas.

Dear Reader

As this year comes to an end, I would like to share with you a few recollections together with thoughts on the future. At the beginning of 2008 a machine refurbishment and enhancement phase (shutdown) came to completion, mainly aimed at the in-vessel installation of the diagnostics and the ITER-like heating antenna all developed in the framework of the Enhancement Programme 1 (EP1). This shutdown brought to completion the effort launched at the very beginning of EFDA to substantially improve the JET technical and scientific capabilities.

The experimental campaigns have allowed a significant number of experiments to be carried out throughout the year, with many key results of direct relevance to ITER construction and exploitation. These outstanding results led to a substantial JET contribution to many international conferences in 2008.

It is important to stress that the JET achievements have only been possible thanks to the dedication of the Operator of the JET Facilities, the European Associations, and the many contributors from the non European countries collaborating with JET. I would like to express my sincere thanks to all and, in particular, to my close collaborators in the Close Support Unit at Culham.

> *"We are made wise not by the recollection of our past, but by the responsibility for our future."*
>
> *George Bernard Shaw (1856-1950)*

The year 2008 has also been crucial for the discussion about the future of JET. At the level of the EFDA Steering Committee a resolution was unanimously approved that implies running JET beyond 2010. Furthermore, the International Panel for the review of the facilities required in the European Fusion Programme has concluded that "JET needs to operate until 2014/15 at least."

Although much effort has been invested in 2008, the next year will require the best from all the people involved. In fact 2009 will see the start of the shutdown for the final implementation stage of the Enhancement Programme 2. So while congratulating the entire team for the outstanding achievements in 2008, I look forward to them committing with me to the success of 2009.

Wishing you and your family
a Merry Christmas and a new year
full of health and success.

Francesco Romanelli

Main article in this issue
"2008: **Outstanding** performance"

The excellent maintenance work performed by UKAEA leads to a **good performance** and availability of all systems. This has made it possible to investigate a wide range of **physics** and **technology** issues of relevance to **ITER**. For the longer term the operation of the **JET** Facilities **beyond 2014** is being considered.

2008: **Outstanding** performance

It is 8 pm on this cold November evening. In the control room of JET, where a number of physicists and engineers have been on duty since 3 pm, attention is high. No surprise, the next experiment is imminent. Maximos Tsalas, Leader of today's experimental session, is staring at his computer screen where, after the countdown, a video image of the running plasma discharge will soon be visible. Breaking the silence a loud voice starts narrowing down the time to the exciting moment: 8, 7, 6… and finally 0! A few seconds later Maximos's face is resplendent, his catching smile tells it all: the experiment was a success.

A day like this is not extraordinary at JET. In 2008 there has been a large number of successful experiments. One of the reasons for this success is the very good performance of the various systems forming part of the JET Facilities, such as the heating systems, the power supply systems and more than 80 different diagnostic systems. This level is the result of the excellent maintenance work performed by UKAEA, who operates the JET Facilities. The performance and availability of the systems have made it possible to investigate a wide range of physics and technology issues of relevance to ITER. Michael Watkins, Head of the Programme Department, summarizes the main aim of the scientific work: "The JET programme is devoted to the consolidation of ITER design choices and the qualification of the ITER regimes of operation."

A few examples might help to understand the close relationship between JET and ITER. In a tokamak fusion device the fuel is confined in the vessel by magnetic fields largely generated by purpose-built powerful coils. The coils are placed around the ring-shaped vacuum vessel, the torus, just like pearls on a necklace. For the field they generate to be constant along the torus direction and simultaneously allow access to the reaction chamber, their size would need to be much larger than the size of the plasma. In practice, the size of coils chosen for a particular device reflects a compromise between cost, scientific capability and access for heating, fuelling and diagnostic systems. However, the finite number of coils implies a certain modulation of the magnetic field, named ripple. Such a modulation has an adverse effect on the confinement of the alpha particles produced in fusion reactions. However, its effect on the confinement of thermal particles has not been fully appreciated until now.

Thanks to the flexible way JET's magnetic field coils can be powered, it has been possible to simulate in experiments the level of ripple expected in ITER, thereby investigating its impact on a number of issues such as energy and particle confinement. These studies have resulted in recommendations to the ITER Organisation regarding the level of magnetic field ripple that should be allowed in the ITER device.

A considerable fraction of the experimental time has been devoted to commissioning and exploiting the newly installed ITER-like Antenna (see October 2008 issue of JETInsight). This antenna features a similar degree of complexity as the one foreseen on ITER. It has been designed to deliver high power densities to the plasma under conditions of varying particle density in front of the antenna where conventional antennas typically fail.

Progress achieved so far places the ITER-like Antenna half way to its objective as moderate levels of heating power have been reliably delivered to plasmas independently of conditions at the front of the antenna.

Due to the expected large amount of energy stored in ITER plasmas and future fusion power plants, plasma scenarios must be compatible with power load limits imposed by first wall materials. Transient power loads are, for instance, induced on plasma facing components by a phenomenon which occurs at the edge of the plasma: Edge Localised Modes (ELM). In 2008 JET experiments have investigated different active techniques for reducing ELM induced power loads on plasma facing components. These techniques are based on applying a perturbation to the plasma, which results in an increase of the frequency of the ELM event and a decrease of the induced power loads on the plasma facing components.

Michael Watkins, Head of Programme Department.

> *"The JET programme is devoted to the consolidation of ITER design choices and the qualification of the ITER regimes of operation"*

Thanks to the flexible way in which JET was designed, the experiment can always be adapted to meet changing requirements. Michael Watkins comments: "JET continues to make major contributions to the development of fusion as a safe and environmentally benign energy option. Its programme of upgrades to 2014 and beyond will allow JET to help consolidate the design, define auxiliary systems and optimise operations for ITER. And this will be accomplished with a truly international environment which is prototypical of not only the European Research Area, but also ITER."

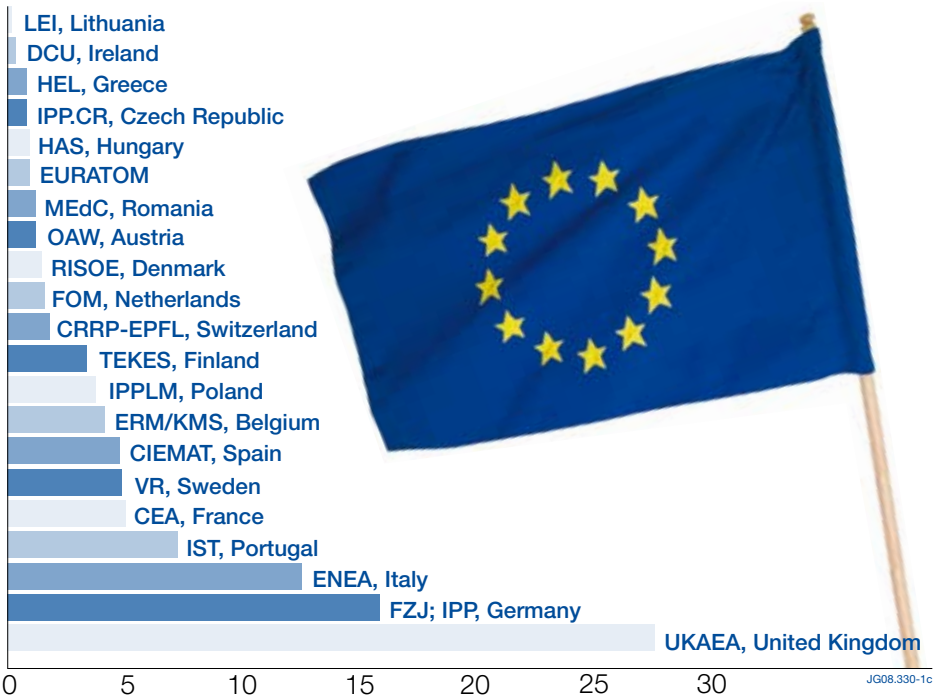
Richard Kamendje, Petra Nieckchen

A view into JET's control room. Maximos Tsalas is pictured leading the experimental session.

Good marks for JET

The present framework of the JET exploitation within EFDA foresees the operation of JET until 2010. At the March EFDA Steering Committee meeting a resolution was unanimously approved that recognised "the scientific need for full exploitation of the JET Enhancement Programme 2 and for tritium operation" and requested the Commission "to investigate the possibility of making adequate resources available within the fusion programme budget".

Furthermore, the International Panel for the review of the facilities required in the European Fusion Programme recognised JET as "the most relevant device for support to ITER until new devices with improved capabilities become available" and concluded that "JET needs to operate until 2014/15 at least."



In this year the European Associations shown have been involved in running JET. The graph shows the percental contribution of scientists to the programme in terms of manpower between the end of the shutdown on 25 March and the 31 December.

Behind the scenes

Politicians, decision maker, journalists, school classes and members of the public are at any time very welcome to visit JET. The visits of school groups as well as private visitor groups are managed by UKAEA Culham's Public Relations department. The UKAEA team also supports the Close Support Unit (CSU) in organising visits of 'VIPs' wishing to see the JET experiment.

There is a high demand for visits, with over 2,500 people coming to see JET during 2008. So the organisation of these visits could easily be a full-time job! The last thoughts of the responsible persons are: Did we inform all needed colleagues for safety? Is the press release primed? Did we fly the flags? Do we need an interpreter? Which brochures are suitable as handouts? Did we have the number of guides we need? The data sheet of tasks seems sometimes endless. Luckily CSU and UKAEA can rely on the help of JET scientists and engineers in showing visitors around the facility. The staff understand the importance of publicizing JET and are happy to act as expert guides for visitors, explaining how fusion experiments are conducted and fielding questions on their work. Phil Morgan has been a JET guide for the past 25 years. After this long period he says: "I take great pleasure in showing people what we do, especially pre-university students. I try to demonstrate to them that a career in physics can be intellectually stimulating and rewarding, and that fusion research offers a gateway into many branches of the subject."

The work put into organising the visits is well worthwhile in helping the fusion community win new supporters, as you can see by the remarkable quotes by high level politicians who have recently visited JET. Fusion technology and research is a fascinating scientific field. The experiment JET – as Europe's largest fusion device – stands with its impressive dimensions of 12 metres height for the progress the fusion community has achieved.

Nick Holloway, Petra Nieckchen

Phil Willis
Member of UK Parliament, Chairman of the House of Commons Science and Technology Select Committee

He visited JET on 26th September as part of a parliamentary inquiry into engineering in the UK

"Remarkable, exciting and unbelievable are words to describe one of the most amazing scientific and engineering visits I have ever made."

John Howell
Local Member of UK Parliament for County Henley

He visited on 3rd October for a briefing on fusion and a tour of JET.

"Culham is a centre of world expertise in nuclear fusion technology. This is not only about cutting edge science; it's about cutting edge engineering too. I have always been a fan of fusion as the answer to our long term energy needs."

Liu Yandong
State Councillor of the People's Republic of China

She visited JET on 19th November during her tour of scientific facilities in the UK.

"In China we take large scientific and technical facilities very seriously for our future development. China is very interested in developing collaborations in new technology to find clean forms of energy, and nuclear fusion is one of the most promising energy options. JET, as the lead fusion experiment in the world, is very important for the future of mankind. I was impressed by the research and scientific capability. We hope to move our collaboration forward."

Come and see! → http://www.jet.efda.org → JET → Visiting JET

Imprint

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