Fusion News

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Checking out Daddy's work: Ernesto Lerche, scientist at the Belgian Association ERM/KMS, makes good use of the opportunities afforded by the presence of Fusion Expo in Brussels and shows his children Gustavo and Julia around JET where he spends a few months each year. The exhibition presented for the first time a huge computer generated picture of the JET vessel. Almost 3 metres high, it shows every detail in overwhelming quality and gives a vivid image of what the machine will look like after the shutdown will be finished in 2011. See page 7 *(Photo ERM/KMS)*

EFDA sets up a Power Plant Physics & Technology Department

Fusion News talks to designated leader Gianfranco Federici

Gianfranco, you have been appointed leader of the new EFDA department for Power Plant Physics and Technology (PPP&T). For those of us who are used to the term 'power plant' in reference to DEMO, could you explain how the department is linked to DEMO?

My understanding is that PPP&T, or 3PT, as we tend to call it, will be looking at post-ITER-class fusion devices, i.e., those that enable fusion to be converted from the domain of experimentation and research into demonstrating fusion power production in possible future commercial exploitation. The emphasis of 3PT should be placed on the definition of a conceptual design for a Demonstration Power Fusion Reactor (DEMO).

Continued on page 2.

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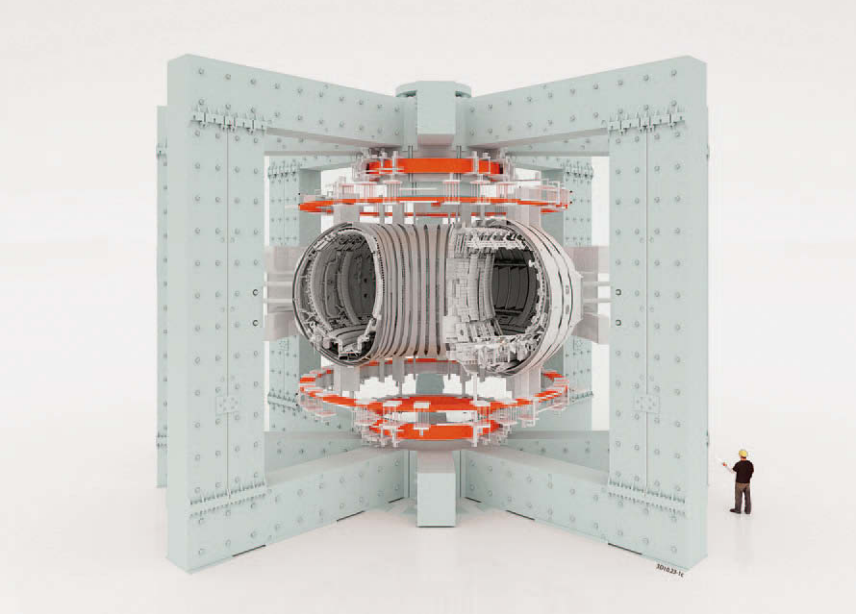
EUROPEAN FUSION DEVELOPMENT AGREEMENT



3D illustration of the JET vessel, showing the vertical stabilization coils in orange. *(Picture: JET)*

JET vertical stabilisation successfully upgraded

A team of researchers within the JET Plasma Control Upgrade Project (PCU) has successfully upgraded the JET Vertical Stabilisation System. The new system enables more sensitive control of the plasma geometry and can withstand larger perturbations, e.g. larger Edge Localised Modes (ELMs). It will also enable scientists to push the plasma performance to its limits without losing control. The project was closed out in summer 2010 and results were presented at the 26th Symposium of Fusion Technology.

The system upgrade became necessary as JET prepares for more powerful experiments with its new ITER-Like-Wall. Not only might there be larger ELMs, but, more importantly, the plasma must not touch the vessel wall at any time since this could result in the beryllium surface being melted at certain points. This requires the upgraded system to react extremely quickly to any vertical plasma movements.

The system's response time was improved by increasing the amplifier's maximum voltage. The hardware was replaced to reduce the signal to noise ratio. Processing capabilities have been increased to two gigaflops, allowing more complex control algorithms to determine the corrective magnetic field. Moreover, the system was upgraded giving the option of easily implementing different control algorithms which can be applied to the different phases of the plasma discharge. This allows for a more sensitive and instantaneous reaction to plasma movements. Enabling the system to work with different plasma models according to the actual plasma geometry has further enhanced its reaction time and precision. This feature will be exploited during the next experimental campaign. The software architecture also makes the system more flexible, because new features can be easily introduced by programming plug-ins.

The upgraded system was commissioned within an exceptionally short period of four experimental weeks in summer 2009. Up until the end of October 2009, it demonstrated its capabilities in large ELMs and ELMy H-mode operations at plasma currents up to 4.5 megaamperes. Additional testing with alternative adaptive controls showed that the current swing during the system's recovery from large ELMs could be reduced without compromising the vertical stabilisation capability.

Some features of the new software have been designed based on plasma models rather than on experimental tests. The successful commissioning proves that the design and implementation of major systems in tokamaks can be realised with a model-based approach.

The upgraded system contributes largely to the design of ITER which will reach different operating scenarios during its long pulses. Its Vertical Stabilisation System will thus need similar flexibility with regard to controllers or measurement algorithms.

Thanks to Gianmaria De Tommasi, Consorzio CREATE, Euratom-ENEA Association, for his input.

Vertical stabilisation

In order to increase the energy confinement time, a vital criterion for realising sustained fusion, modern tokamaks use D-shaped rather than circular plasmas. The downside of these elongated plasmas is their instability which, for instance, causes them to move vertically. The movement needs to be stopped by an active feedback system. Based on magnetic field measurements, the Vertical Stabilisation System estimates the vertical plasma velocity. Using plasma models, the magnetic field necessary to counteract this movement is calculated. A power amplifier feeds the electrical current into special radial coils. ELMs are a typical cause of these events and the vertical plasma velocity is correlated to their strength. Bigger ELMs require stronger counteracting magnetic fields and thus larger currents. At JET, the measurements are done every 50 microseconds (μs) and the system reacts within about 200 μs to vertical plasma movements.

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For more information see the websites:
http://www.efda.org
http://www.jet.efda.org
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