EFDA EUROPEAN FUSION DEVELOPMENT AGREEMENT

JET

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Message from the EFDA Associate Leader for JET

On the afternoon of the 31 May 2000 the first experiment on JET under the new EFDA framework started. Planned since the end of summer 1999, plasmas were produced on schedule, after several months of efforts of many technicians, engineers, physicists and managers from the operator (UKAEA), the EFDA Close Support Unit (EFDA-CSU) and from the EU laboratories involved in the EFDA activities. The opening of this first campaign was dedicated to radiation mode studies under the coordination of Jef Ongena, a Belgian Task Force Leader and Wolfgang Suttrop, his German deputy, with enthusiastic participation from tens of physicists from all over Europe, illustrating the co-operative scheme provided by EFDA.

This first issue of the EFDA-JET bulletin aims at celebrating this important event and illustrating the framework under which it was prepared. It opens a new series of bulletins which will provide at regular intervals information about the scientific results and the programme conducted on the JET facitlities under EFDA. The bulletin will, in particular, give the list of publications, reports etc. that will be available on the jet.efda.org web page.

A new wind blowing at JET

After months of intensive preparation, the first secondees arrive at JET on Monday 29 May. An enthusiastic group, eager to start experimenting with the biggest fusion device in the world, for several of them, for the first time in their life. Notwithstanding the bank holidays, our UKAEA colleagues join in and during intensive preparatory meetings, the experimental proposals for the first week are finalised.

Wednesday 31 May, a day long awaited by many. Ready to go, no time is lost in getting to the control room, where terminals are grabbed, and everybody waits eagerly for the first data to roll over the screen. Then finally, the countdown for the first shot, with all faces pointing anxiously to the plasma display and sighs of relief (and joy) at the successful execution of the shot. The news spreads around JET, the control room fills gradually with more and more colleagues, until a level is reached where it is difficult to find a seat. The control room is literally transformed into a buzzing beehive, with several groups in the different cubicles of the control room, poring over the data and holding intense discussions about impurity spectra, MHD modes, confinement, ways to improve the experiment, etc.

This is the new JET: a new organization with a new élan, offering to all fusion scientists in Europe a chance to participate in exciting and new experiments on the largest tokamak in the world!

by Jef Ongena, ERM-KMS Brussels, Task Force Leader S1

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Year 2000 work programme and first experimental campaign

The joint use of the JET facilities by the European fusion laboratories, signatories of EFDA, is strongly focused on the preparation of the next step: the planned fusion experimental reactor ITER. The experiments should provide a further consolidation of the scientific basis in plasma physics and engineering and the demonstration of operational modes leading to high performance in ITER.

The Work Programme 2000 gives strong priority to experiments which could influence detailed aspects of the still on-going ITER design : plasma shaping, operation near boundaries, further characterisation of the divertor, effect of neoclassical tearing modes. It includes joint experiments with specialised tokamaks to obtain important scaling information in several areas.

Priorities

The experimental proposals have been ranked according to the following criteria :

- their relevance for ITER issues,
- their importance in view of a possible campaign with a deuterium/tritium fuel mix,
- their role in improving JET's performance or to establish references in preparation for machine modifications,
- their link with the programme of Associations,
- their scientific impact on an improved understanding of tokamaks.

The first campaign covers the period from 31 May to 28 July 2000. During those 9 weeks 35.5 days of experiments are foreseen, together with a 20% contingency against machine unavailability and 2 days of scheduled maintenance mid-way through the campaign. In line with the ITER priorities, the programme focuses on the scenario Task Force S1 which deals with confinement physics and scaling near operational limits, with additional experiments from Task Forces E (exhaust), M (MHD) and H (heating) during the first six weeks. The second part is devoted mainly to Task Force S2 (shear optimised scenarios and internal transport barrier formation), with contributions from H, D (diagnostics) and M.

The experiments have been grouped in order to provide longer periods of work for visiting researchers but limiting the duration of stays at JET to about six weeks for most of them.

by Michael Watkins, Close Support Unit

Scientists involved

The scientific programme of JET under EFDA is organised in the form of Task Forces, with their Leaders being the main actors responsible for the preparation and execution of the campaigns, as well as the analysis and the publication of the results. They co-ordinate the staff seconded from all the European laboratories and have themselves been selected from amongst the most experienced staff by the Associations. Apart from the scenario Task Force S1 which deals with confinement physics and scaling near operational limits, and Task Force S2 dealing with shear optimised scenarios and threshold scaling for internal confinement barrier formation, six topical Task Forces have been established which are responsible for a wide range of specialised topics such as Heating, MHD, Exhaust, Diagnostics, Fusion technology and DT Operation.

The 3 campaigns during the year 2000 will bring a steady flow of visiting scientists, the so-called « secondees » to JET. The total of 170 for this year is unequally distributed with peaks of 50 to 70 participating scientists during the campaigns. This creates some specific logistics problems which have never been encountered at Culham before, such as office and computer facility allocation and accommodation and transport, to name just a few. A concerted effort involving the Associations, the operator and the EFDA-CSU has been initiated and is being put to the test at this moment. No major difficulties have been reported to date and all involved are confident that any problems will be mastered.

by Mark Siegrist, Close Support Unit

First secondees being welcomed at JET.

The Restart of JET

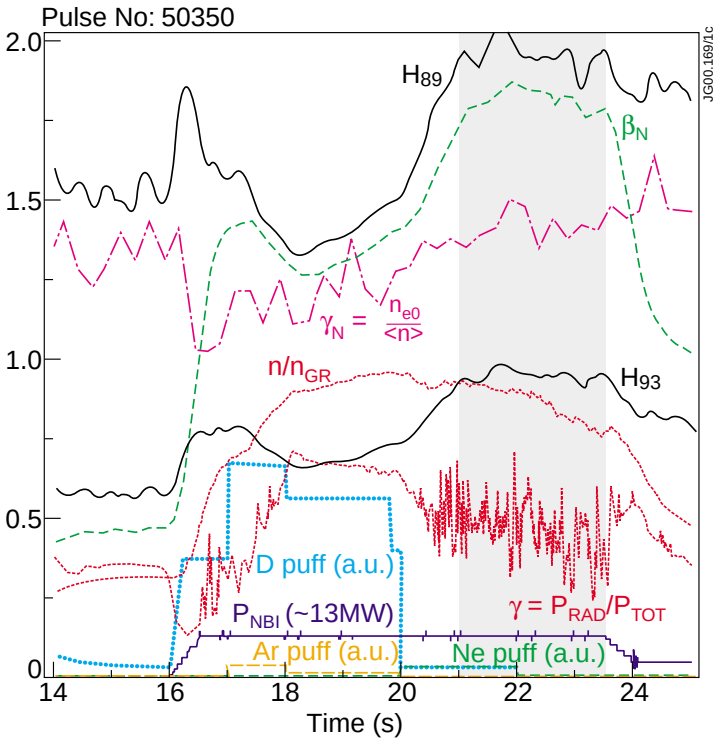
The very first event of the year 2000, in preparation for the use of the JET facilities under EFDA, was their hand-over to the UKAEA. This occurred on 1 January in accordance with the statutes of the former JET Joint Undertaking. They were put in a passively safe state prior to hand-over to minimise safety risks, particularly given the (small) risk presented by the Millennium computer bug. This involved almost all equipment being switched off. Since then there has been a programme of work under the JET Operation Contract to make the facilities ready for the experimental campaigns. Work on maintenance and replacement of some components was started in February following the re-instatement of a normal 'shut-down' state for the facilities during January. The main items of work were:

- the installation of two new sources (PINIs) in the neutral beam systems;
- the replacement of two windows which had failed (one in the FIR interferometer and one in the Lower Hybrid launcher);
- the mechanical installation of a sliding impedance matching system (SLIMP) on a second ICRF antenna;
- the replacement of seals in the Freon system that cools the toroidal field and divertor coils.

Restart of the JET facilities began on 16 March with the pump-down of the torus. Following this there has been an 11-week project to re-commission all of the JET systems ready for hand-over to the EFDA Task Forces on 31 May. This has been extremely successful and has met all of the agreed Restart Targets with the exception of the commissioning of the LH system, which was not completed because of problems with the power supplies and arc detection system. Nevertheless 2.4MW of LH power has already been coupled to plasma for 4s. The performance of the Neutral Beam and ICRF systems has been excellent. Neutral beam powers of up to 13.5MW have been produced for 5s and a peak of 17MW was achieved in another pulse. The ICRF system has produced up to 9.4MW for 10s at 42 MHz and up to 11MW for 6s at 51MHz. The system has also been commissioned up to 5.5MW at 33 and 37MHz. The diagnostic systems have been re-commissioned with the exception of KY6 (the Lithium beam diagnostic) which has a vacuum problem. The plasma configuration and control requirements of the EFDA Task Forces have also been demonstrated. Achieving these challenging Restart Targets has demonstrated a tremendously high level of dedication and commitment from the whole team, which augurs well for the effective operation of the JET facilities.

The mechanisms for providing the necessary flow of information between the EFDA Close Support Unit, the UKAEA and Task Forces have been established and are working well. The constructive approach of all involved gives confidence that the new EFDA arrangements will be an effective way of co-ordinating the work on JET.

by Martin Cox, UKAEA



Example of a discharge obtained on the third day of the first campaign on JET under EFDA, as part of the radiative mantle experiments The discharge was heated by ~13MW of neutral beam during 8 seconds and impurity seeding was applied. The grey shaded area in the figure shows the simultaneous realisation of high confinement ($H_{93} \cong 0.90 - 1.0$, $H_{89} \cong 1.8 - 2.0$, $\beta_N \cong 1.7–1.8$), high density close to Greenwald limit ($n/n_{GR} \cong 0.80–0/.95$). and high radiation ($P_{rad}/P_{tot} \cong 0.5$).

JET Launch into Cyberspace

With the advent of the new organization, the virtual Site boundary has been enlarged by thousands of kilometres (miles for some Europeans). Under the EFDA umbrella, the teams involved in experimentation on JET include participants in all 23 of the European Euratom Associations laboratories, and "work-at-distance" through "Cyberspace", even on a very complex machine like JET, has become a reality.

Two major steps have been introduced to make this possible.

First, the Remote Data Access (RDA) software has been developed in recent years and is now implemented in most of the European Associations, allowing staff to access the JET data directly within their own data treatment packages on computers in their home laboratories. In addition, the internal web pages have been made accessible remotely for authorized users.

Second, several access computers allowing remote login to JET systems (Remote Computer Access - RCA) have been installed. The security implications have been studied in depth. All users must have an electronic "SecurID" card, and all access is controlled and logged. Users now can login into the IBM mainframe, the JET Analysis Cluster, the JET PC Network, and, if required, to the development cluster of control computers to view information from the control room. The Real-Time Display of signals, and all control room information can be seen almost immediately and physicists can feel part of the experimental team even from their home laboratory.

Remote data and computer access to JET systems is only one part of an overall approach to create the necessary "Remote Participation" infrastructure in the European Fusion community. "Communication" is high on the list of priorities, with an effort to increase dialogue and to decrease mission expenses. Internet-based teleconferencing tools, including tools to share active computer applications on remote screens are under evaluation. Finally, the question of support and documentation are of prime importance and is being actively worked on, so that no laboratory is left out in the cold.

by John How, CEA, Deputy Coordinator for Remote Participation

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