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newsletter

EUROPEAN FUSION DEVELOPEMENT AGREEMENT

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Close Support Unit
Garching

Contents

http://www.efda.org

News

ITER Competitiveness Council

Presenting a communication on the construction and operation of ITER to the Competitiveness Council on 13 May in Brussels (Belgium), EU Commissioner for Research Philippe Busquin outlined the ongoing negotiations concerning the selection of a candidate site in Europe. Two possible locations, Cadarache in France and Vandellós in Spain have been proposed as potential sites for ITER in Europe. Further sites have been proposed by Japan (Rokkasho-mura) and Canada (Clarington).

Full text of Presidency Summary on Page 2.

NSSG-8 Subgroup Meeting at IPP Garching (Germany)

During the 19th and 20th of May 2003 the Eighth Meeting of the Negotiators Standing Sub-Group (NSSG) took place at the Max-Planck-Institut für Plasmaphysik (Garching, Germany). The meeting was originally scheduled in Canada one month earlier but had to be rescheduled due to the SARS problem in Toronto. The meeting covered many different issues relating to the Negotiations, such as procurement allocation, procurement systems, management structure, staffing, intellectual property rights, decommissioning, financial regulations as well as the drafting of the Joint Implementation Agreement. Prior to the main two-day NSSG meeting, a number of technical discussions lasting several days took place within subgroups and progress was made in these areas.

IEA Meeting of the Governing Board at Ministerial Level

The energy ministers of IEA (International Energy Agency) Member countries met in Paris (France) on 28-29 April 2003 and agreed that Energy Security, Environmental Protection and Economic Growth remain the IEA's robust guiding principles for energy policy. They underlined their readiness to combat any disruption of oil supplies, while recognizing the fact that meeting the longer-term challenges of maintaining a secure, efficient and safe energy system will require near term actions. The Ministers promoted international co-operation in the world energy markets, and especially noted the increasing importance of IEA non-member countries. They also reaffirmed their commitment to promoting a sustainable energy future, and to meeting the social environmental and economic challenges this entails.

For the full text of the press release please see:
http://www.iea.org/new/releases/2003/commueng.htm

Fusion at IEA Energy Technology Fair on Page 6.

ITER

For the press release and the full document please see:

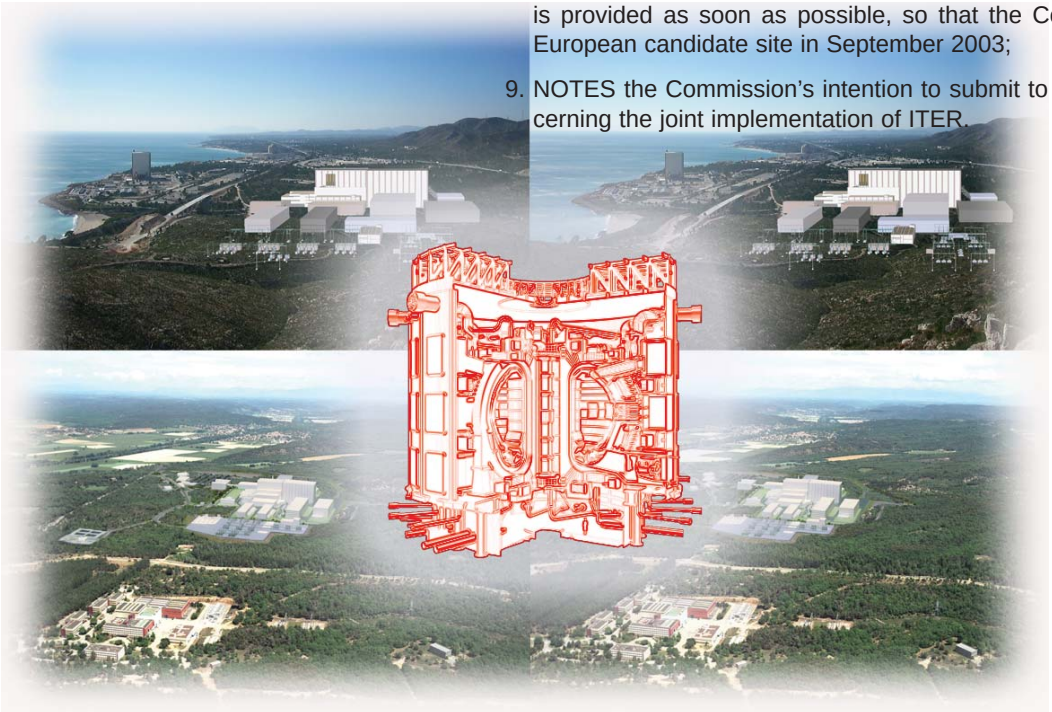
http://www.cordis.lu/greece/press33.htm

EU Competitiveness Council – Presidency Summary

(Continuation from Page 1)

Having heard the views of delegations on the questions of ITER, the Presidency believes that the conclusions, as set out below, are supported by a very large majority of delegations. It notes that the approach on a single site is not shared by one delegation. The Commission is invited to ensure that the final report on this issue is provided as soon as possible so that the Council can achieve agreement on the candidate site in September 2003, and to submit to the Council proposals concerning the joint implementation of ITER by the end of 2003. In relation to the present negotiations on ITER, the Presidency

1. WELCOMES the Commission's communication *State of progress of the negotiations concerning the ITER international nuclear fusion energy research project.*
2. NOTES with satisfaction the fact that the United States and China have joined the negotiations and that other countries have expressed interest in the project.
3. UNDERLINES the importance of basing ITER in Europe, if and when a decision on its construction is taken, and stresses that every effort should be made to maximise the possibilities of ensuring that this takes place; and NOTES the need for an accompanying physics and technology programme, to take full advantage of international collaboration.
4. CONSIDERS, therefore, in order to strengthen the Community's position and to maximise the benefits for the European research activities, that the European candidate site should be identified through a consensual and well defined process.
5. SUPPORTS the Commission's view that this process should involve the establishment of objective criteria, including cost, it being understood that aspects other than purely technical ones should also be taken into account.
6. EMPHASISES that this process should be undertaken by the Commission in close cooperation with the authorities of the Member States, which have submitted site proposals.
7. RECOGNISES that it is essential in this process to call on the necessary expertise and to adopt a tight time schedule to ensure that the analyses are completed during the summer of 2003.
8. WELCOMES the intention of the Commission to ensure that the final report on this issue is provided as soon as possible, so that the Council can achieve agreement on the European candidate site in September 2003;
9. NOTES the Commission's intention to submit to it, by the end of 2003, proposals concerning the joint implementation of ITER.



Interview

"Let's keep all doors open to provide energy for our future"

EFDA Newsletter (E.N.): *You are an expert in the field of nuclear fission, but also chairman of EFET, which has participated in the engineering design activities for ITER. What are the main technology achievements associated with your work in nuclear fission which were of benefit for the ITER project?*

A.V.: EFET was created 10 years ago and there was strong motivation from the European Commission to develop knowledge and competence in industry for fusion. Initially just a few people in industry had experience in how to build a tokamak. Now in European industry we have the competence of about 60 engineers with rather a good knowledge in fusion. In addition, EFET provided valuable contributions. The main areas of benefit to the ITER project have been in the fields of independent cost evalutation and optimization of the manufacturing process for ITER components.

E.N.: *Safety measurements in nuclear fission and in fusion have to fulfill completely different demands as there is no possibility for a "melt down" in fusion. What influence do the technological achievements in fusion safety studies performed by EFET have on your projects in nuclear fission?*

A.V.: Indeed there is a certain safety culture from fission reactors influencing fusion, but there is no feedback for the safety approach from a fusion reactor like ITER. Safety is a matter of cultural behavior and also a matter of methodology. In the fission domain we are used to this approach and to these methodologies. As all four countries proposing an ITER site have nuclear fission reactors the licensing procedure for ITER will follow the approach for a fission reactor. So I think in this domain it's quite useful that fission industry is involved, because we are used to dealing with safety authorities. In a fusion power plant you have no melt down, that's clear, but with tritium you have slightly radioactive material that has to be considered and, in terms of methodology, both procedures are the same.

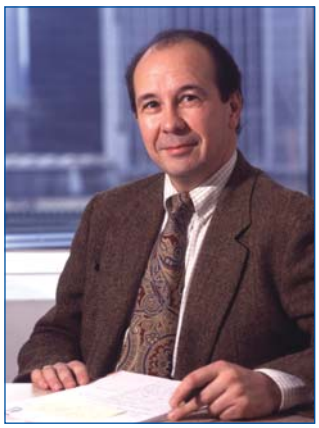
E.N.: *Framatome has also offered an advanced version of the CNP-1000 reactor, which is a Pressurized Water Reactor, for the Chinese Ling Ao and Daya Bay units. As you know, China has shown great interest in the ITER project. Have you also made contact with China via EFET with regard to ITER?*

A.V.: Not yet. China has joined the ITER project a few months ago. Its share of components and supply will be discussed during the ITER official negotiations. If the situation becomes clear, we propose starting the negotiations on an industrial level. But as Framatome has already built four nuclear fission reactors in China, we have already built up a very close relationship. We provided knowledge on component manufacturing and licensing. We will therefore also offer our experience in fusion to support them in the same way with ITER, of course, and transfer all necessary technology. If needed and if we win a contract to contribute to ITER construction, we would organize a partnership for the manufacturing of components in China with Chinese industry.

E.N.: *10 countries including France, Canada, Japan, the UK and the US have prepared an initiative to study systems for nuclear energy of generation IV, which could be available by 2030. Do you think there will be any consequences for the ITER project?*

A.V.: Not at all. The need in terms of energy demand for the future is rather high. The only answer to this demand will be an energy mix. Our Generation IV does not represent one concept of a reactor - six concepts have been chosen to be subject to research. There could really be a breakthrough based on any of these which might allow the development of a concept using more advanced technology which does not yet exist. This situation is very similar for ITER as an experimental reactor and for the next steps. We don't know today if the generation of fusion power plants following ITER will be competitive at that time. So let's see and let's keep all doors open.

Interview: D. Lutz-Lanzinger



Alain Vallée
is currently Senior Vice President, responsible for the Framatome ANP (Advanced Nuclear Power) overall R & D management and core process. He heads the Technical Center (2 sites in France, 2 in Germany) and is in charge of the implementation of the Intellectual Property Policy and also Chairman of the EFET (European Fusion Engineering and Technology) Organization.

For more information on Framatome ANP:

http://www.framatome-anp.com/servlet/ContentServer?pagename=Framatome-ANP/Accueil

EFET (consortium of European companies):

ANSALDO (Italy)
BELGATOM (Belgium)
FORTUM (Finland)
FRAMATOME ANP (France)
FRAMATOME ANP (Germany)
IBERTEF (Spain)
NNC (United Kingdom)

For more information:
http://www.efetgrouping.com

ITER

High priority R&D items to optimize the conductors for ITER:

- Quantifying the impact of transverse load on strand and on the conductor performance
- Control of strand cost

Options for the Development of Improved Conductors for the ITER Magnets

During May 6. - 9. 2003 a meeting to review the achievements in the ITER magnet research & development (R&D) programme over the last 10 years was held at EFDA CSU Garching (Germany). Representatives from the ITER-International Team (IT), and the Participating Teams from Europe, Japan, Russian Federation and the United States were welcomed. Dr. M. Huguet, head of the ITER site at Naka (Japan) and Dr. E. Salpietro from EFDA CSU Garching (Germany) co-chaired the sessions. The results from the ITER magnet R&D programme, including the manufacture and test of two model coils and three conductor inserts, have now been evaluated. The following subjects were covered during the meeting:

- The results from the model coil tests
- Improved design of the Toroidal Field and Central Solenoid conductor
- Advances in Nb_3Sn strand production and quality
- The Toroidal Field jacket material and conductor
- The Central Solenoid jacket material and conductor.

The primary goal of the meeting was to converge on the optimal conductor designs for the Toroidal Field and Central Solenoid coils. The main activity in the magnet R&D has been the manufacture and testing of the Central Solenoid and the Toroidal Field model coils.The Central Solenoid Model Coil was a joint effort between Japan, the European Union, the Russian Federation and the US, and was installed in the JAERI Naka facility (Japan). The Toroidal Field Model Coil was entirely built by the European Union and tested at Forschungszentrum Karlsruhe (Germany) with the participation of other ITER partners. Both projects (referred to as L1 for Central Solenoid and L2 for Toroidal Field) have demonstrated that the Nb_3Sn technology required to manufacture the coils for ITER has been successfully developed.

Three conductor insert coils have also been tested in Naka, using the Central Solenoid Model Coil to produce a background field, and a fourth insert is on its way. The first insert simulated the Central Solenoid conductor (Japan / US project), the second was a Nb_3Al conductor insert (Japan) and the third a Toroidal Field conductor in titanium jacket (Russian Federation). The fourth, for which tests are scheduled for 2004, will be a NbTi Poloidal Field conductor insert (European Union / Russian Federation project).

The successful tests of both Model Coils and inserts have confirmed the original design and given further insight on how to enhance the performance of the conductors towards higher operational margins. The ITER IT, taking advantage of the lessons learned from the R&D programme, presented a variety of options for the optimization of the performance of the conductors by using higher performance strands and different jacket materials.

After assessing the results, it was concluded that the preferred design solution for the conductors of both the Toroidal Field Coils and the Central Solenoid should be based on high performance strand with a stainless steel jacket.

JET

Third Track for Pellet Fuelling

For more information on JET please see:

http://www.jet.efda.org

The injection of frozen deuterium pellets at high speeds into tokamak discharges has the potential for more efficient fuelling than the puffing of deuterium gas. The JET programme is investigating the dependence of pellet penetration on three different injection geometries.

The first JET experimental campaign of 2003 benefited from the addition of a third pellet track (Fig. 1), together with improvements in the D_2 ice quality and a design of the switch which allows selection between the existing low field side (LFS), high field side (HFS) and new vertical high field side (VHFS) tracks (Fig. 2). The basic function of the new VHFS pellet track is to inject pellets towards the plasma core from the high field side. The previous HFS track is positioned too low to fuel directly the inner core and the LFS track cannot take advantage of outward drifts which are thought to improve fuelling efficiency. The VHFS guiding track is a 10 mm ID stainless steel tube capable of handling 4 mm and 5 mm (cube size) pellets. Diagnostics include a direct measurement of the pellet mass using a microwave cavity.

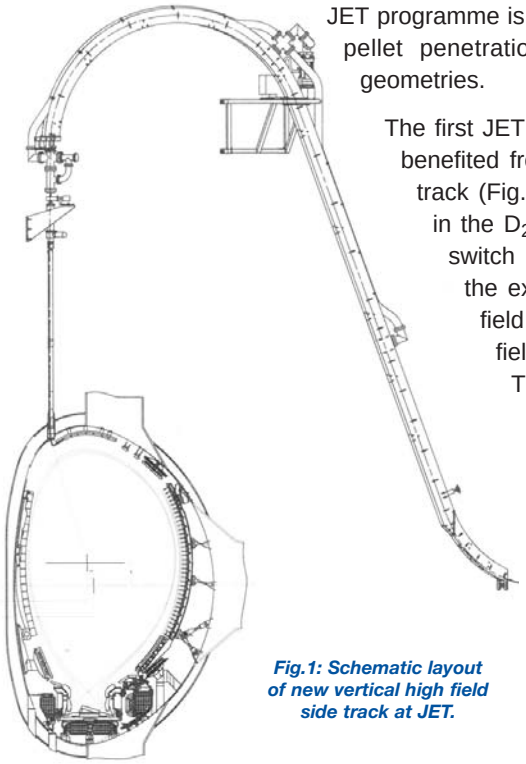


Fig.1: Schematic layout of new vertical high field side track at JET.

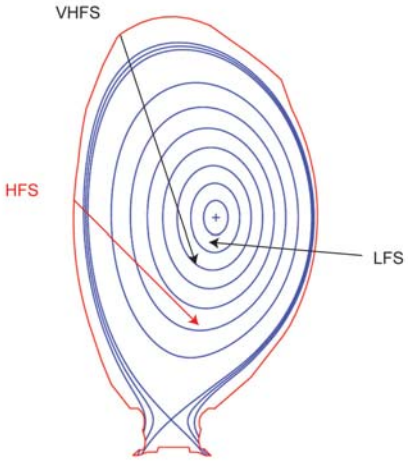


Fig. 2: Comparison between the three Pellet Injection geometries; low field side (LFS), high field side (HFS), and new vertical high field side (VHFS).

The full system offers a doubling of the previous maximum fuelling rate and will allow the penetration and fuelling efficiency of pellets to be studied for a wide range of injection speeds, pellet sizes and injection geometry (which can be changed during a pulse). The pellet sizes currently available are 4x4 mm^2 strings, which can be cut to lengths of 2.2-4 mm, at repetition rates range in the range 2 - 10 Hz, respectively.

Initial experiments in 2003 demonstrated reliable operation of the new VHFS pellet track. In Fig. 3, a direct comparison of the density response to pellets injected along different tracks into the same plasma discharge is shown. Preliminary results indicate that the fuelling efficiency is similar for all three tracks at low speed (up to 250 m/s) and is better with the VHFS track at high speed (up to 400 m/s). The HFS track has allowed injection speeds of 310 m/s, much higher than previously achieved.

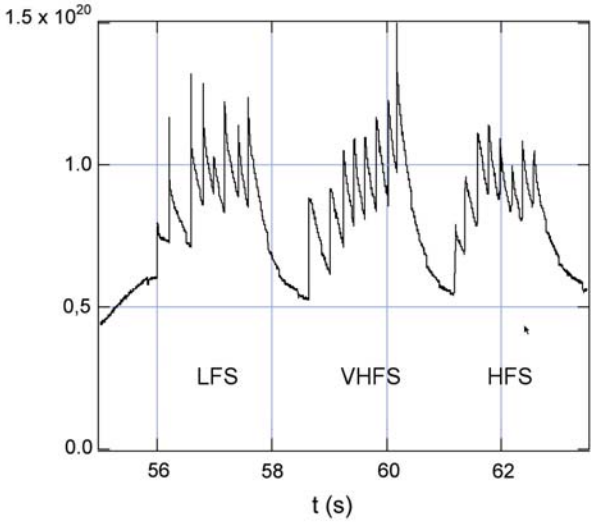


Fig.3: The line averaged electron density evolution for 4 mm pellets injected with 5 Hz repetition rate from the LFS, VHFS and HFS locations at 250 m/s into an L-mode plasma discharge (A. Geraud et al, to be submitted to the 30th EPS conference on CFPP, St. Petersburg, July 2003).

Associations

The design and fabrication of the new components and systems were carried out with involvement of primary European companies:

- **ASI Robicon**, Milan (Italy)
- **Siemens AG**, Erlangen (Germany)
- Passoni&Villa, Milan (Italy)
- **EEI S.p.A.**, Vicenza (Italy)
- **Tesla**, Storrington (UK)
- **Babcock Noell Nuclear**, Würzburg (Germany)
- **Man Turbomacchine De Pretto**, Schio (Italy)
- **Le Carbone Lorraine**, Parigi (France)
- **Plansee**, Reutte Tirol, (Austria)

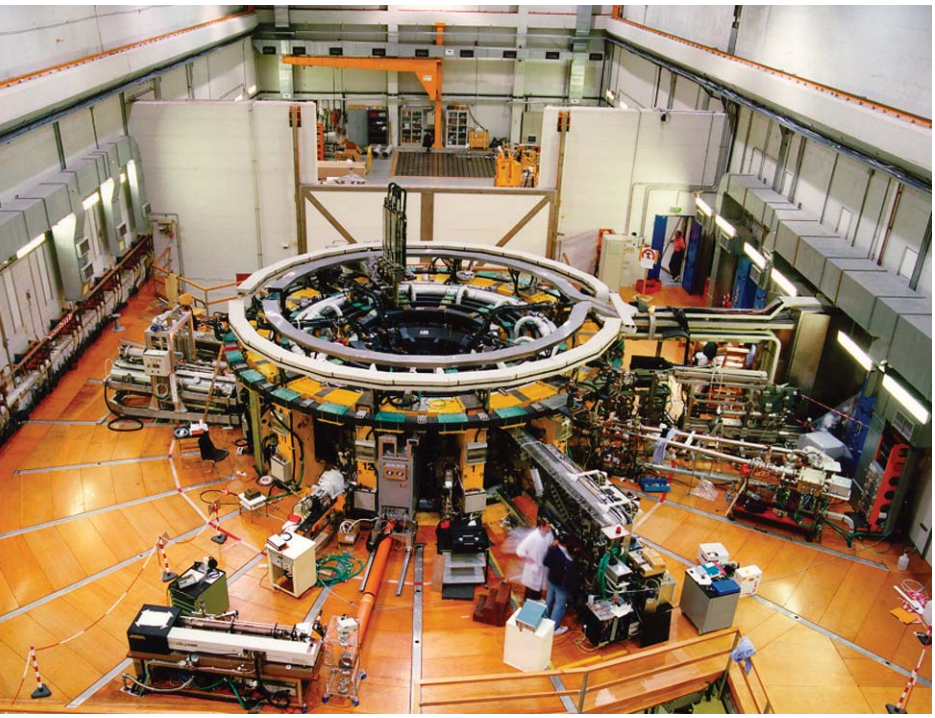
Consorzio RFX Padova – Fusion in Italy

The RFX (Reversed Field Experiment) device entered into operation in 1992. Since then, it has produced more than 10.000 pulses of ~100 ms with toroidal plasma currents of ~1.1 MA, with significant results in the fields of MHD physics, transport mechanisms and turbulence control. The substantial progress obtained in the understanding of the Reversed Field Pinch (RFP) plasma physics has led to significantly new knowledge and to design improvements of the machine for further research development.

In December 1999, a fire developed in a capacitor bank of the RFX device, destroying or damaging part of the power supplies. Euratom, CNR and ENEA, the organizations financially supporting RFX in agreement with Padova University, confirmed the importance of the RFX research programme and, thanks to the fact that the insurance company covered most of the cost of restoration, the RFX reconstruction and improvement plan became a reality.
Now the power supplies of RFX have been restored and modifications are being introduced:

- to improve the capability for active MHD control, via an array of 192 saddle coils outside the vacuum vessel;
- to improve the axysymmetric equilibrium control, by means of a thinner and closer shell;
- to widen the toroidal field control scenarios by a modified power supply system.

The utilisation of the most recent technologies in power semiconductors has allowed an expansion in the toroidal field power supply flexibility, which is particularly useful for MHD mode studies. The total energy stored in capacitors has been decreased and the bank has been divided into 12 separate modules to improve the current control in each coil sector and to facititate fault protection.



Industry has been centrally involved in the technological developments necessary to meet these requirements. Two examples of significant results are related to the new switching power supplies that use IGCT - a power semiconductor recently introduced in the market – and to the fast make switches based on Light Triggered Thyristor - instead of ignitrons – for capacitor bank discharge and for protective crowbars.

The poloidal field power supply and control system is presently being used to test the performance of new switches for ITER Fast Discharge and Protection Units.

It is now expected that RFX will return to operation in spring 2004 and the first physics experiments are planned for summer 2004. The scientific programme for the exploitation of the machine, which is in preparation, will be oriented towards obtaining a better understanding of confinement processes and, thanks to the better definition of the structure of the magnetic field, towards the reduction of the plasma-wall interactions and the possibility of actively influencing the transport. It will allow a deeper understanding of basic non-linear MHD phenomena such as magnetic reconnection, self-organisation and mode-mode interaction relevant to a large variety of plasmas. The modifications introduced will also provide continuity with the past research program, but, at the same time, will strongly improve the capability of addressing key issues relating to active MHD control.

The scientific programme of RFX will include important studies which are relevant not only to the RFP line, but to the entire magnetic fusion programme and in particular to tokamaks and ITER.

More information on Consorzio RFX:

http://www.igi.cnr.it/

Events

IEA Ministerial Governing Board Meeting Fair

The IEA (International Energy Agency) Ministerial Governing Board Meeting took place in Paris on April 28 and 29, 2003, attracting high level representatives from all IEA member states. In parallel with the meeting an Energy Technology Collaboration Fair was organised to show the activities which are being promoted by various member countries in the fields of renewables (including hydrogen), fossil fuels, end use technologies and fusion. Fusion was also mentioned in the input document presented at the Ministerial Governing Board meeting.

M. Roberts (US DoE, left), J. Pamela (acting EFDA leader, middle) and L. de Palacio (Vice President of the EU Commission and Commissioner for Energy and Transport, right) at the Fusion stand

The aim of the fair was to present to the visitors the state of art in these fields, in which co-operative research is pursued through the Implementing Agreements which are established by the member countries in the framework of the IEA.

The fusion stand was organised by the IEA Fusion Power Co-ordinating Committee and EFDA played a key role in its implementation. The stand consisted of three different areas: a generic description of fusion, an overview of the ITER project and a display covering the Implementing Agreements. The ITER model and a model showing the building layout at the ITER site were also presented. A Power Point presentation and films on fusion (The Starmakers, JET, ITER [courtesy of ITER Canada], IFMIF [courtesy of JAERI]) were shown on a large computer-driven plasma screen at the entrance to the stand.

The Ministers and delegations visited the fair in the afternoon of the first day. They spent a substantial time at our stand and were given information about fusion, with special emphasis on the ITER project. In particular, most of the Ministers representing governments involved in the ITER Negotiations visited the stand and they were therefore very well informed about the current situation. All were very supportive of fusion research activities and, more specifically, of the ITER project. On the following day, the press was allowed to visit the fair before the final press conference, given by Mr. B. Wilson (UK), Chairman of the Ministerial Board, together with the IEA Executive Director, Mr. C. Mandil, closed the event.

The presence of fusion at the fair allowed the fusion community to convey to this high level audience the progress achieved, the present state of research and the developments towards the construction of ITER, which is the necessary next step in the world fusion programme.

Main topics of the meeting:

- **Technology options to reduce greenhouse gas emissions in the long term**
- **Security of energy supply**

For the IEA press release please see:

http://www.iea.org/new/releases/2003/commueng.htm

VIPs visiting the fusion stand:

Mr. S. Abraham (USA - Energy Secretary)
Mr. H. Dhaliwal (Canada - Minister of Natural Resources)
Mr. J. Folgado Blanco (Spain - State Secretary Energy and Industrial Development)
Mr. H. Gueler (Turkey - Minister of Natural Resources)
Mr. T. Hiranuma (Japan - Minister of Economy)
Mr. F. Lamoreux (EU - Director General Energy and Transport)
Mr. D. Maillard (France -Director General Energy and Raw Materials)
Mr. C. Mandil (IEA - Executive Director)
Ms. L. de Palacio (EU - Vice President of the EU Commission and Commissioner for Energy and Transport)
Mr. B. Wilson (UK - Energy Minister)
Mr. I. Yusufov (Russian Federation - Minister of Energy)

A model in Paris:
ITER at the fusion stand

Events

EFDA at the World SUSTAINable Energy Exhibition & Conference 2003

Technical Innovations, environmental aspects, financial issues and policy matters – SUSTAIN is a biannual international conference and tradeshow where trends in the area of sustainable energy, particularly industrial aspects, and energy efficiency are brought together. Supported by the European Commission, the 4th event of this kind took place on May 13-15, 2003 in Amsterdam (The Netherlands). 83 exhibitors from eleven countries exhibited their latest products and services to international visitors to the fair, which merged both sustainable and ecological issues (Sustain and Ecotech fair).

Supported by the Association Euratom-FOM (Foundation for Fundamental Research on Matter) Rijnhuizen (The Netherlands), EFDA presented posters on fusion, JET and ITER and explained to visitors the aims and targets of fusion research in the EU. The ITER model and the films shown at the stand provided a broader spectrum of information. The large number of visitors - representatives of national and international industries, conference delegates, energy experts, as well as university professors from other fields - were well informed about fusion in general. Constructive discussions were carried out with members of Non-Governmental Organisations visiting the fair and a useful exchange of experience and opinions was also possible with experts working for other sustainable energy projects. Most of the visitors were supportive of research in fusion energy and wished to be informed more regularly on the progress in the research. The fair allowed EFDA to establish many new contacts with opinion makers and representatives from different energy sectors.

A two-day conference was held in conjunction with the fair reviewing the latest strategic and technical developments in the international renewable energy markets. Prof. N.J. Lopes Cardozo, Head of the Plasma Physics Division at FOM, presented the strategic development and the potential of fusion as a clean energy source of the future. He explained the state of the ongoing ITER negotiations between the partners and discussed the possible contribution of fusion to a sustainable supply of energy in the second half of this century.

For more information please see:

http://www.sustain2003.com/

http://rep3.raishows.com/sustain2003/bez_overig139/bez_overig139.asp

For more information see our EFDA website:

http://www.efda.org

and additionally

http://www.jet.efda.org

http://www.iter.org

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