EFDA

Vol 2005 / 4
August 15, 2005

newsletter

EUROPEAN FUSION DEVELOPEMENT AGREEMENT

Issued by the EFDA Close Support Unit Garching

Contents

http://www.efda.org

News

IT ' S CADARACHE !

French President J.Chirac visits Cadarache

French President J.Chirac was accompanied by the French Minister for Education and Research, G.de Robien in his visit to the ITER construction site in Cadarache on 30th June. In his speech the French President underlined that ITER opens important perspectives for the new generations in France and Europe.

"This project is essential for our future and the future of the planet", he declared in front of more than 1500 Cadarache staff and regional representatives.

He also mentioned that the success in siting ITER in Cadarache is a sign that when Europe is united, it can be a leading force for progress and innovation.

The text of Chirac's speech is available at: http://www.elysee.fr/elysee/francais/interventions/discours_et_declarations/discours_et_declarations.14396.html

Excerpts from the Statement by EU Commissioner for Science and Research Janez Potočnik (Moscow, 28th June 2005)

Today we are making history in terms of international scientific cooperation. After long and difficult negotiations, the six parties to the international negotiations on the ITER fusion research project, meeting in Moscow, have decided that ITER should be located at the site proposed by the EU - Cadarache in southern France.

As a project of unprecedented complexity spanning more than a generation, ITER marks a major step forward in international science cooperation.

Now that we have reached consensus on the site for ITER, we will make all efforts to finalise the agreement on the project, so that construction can begin as soon as possible.

Commissioner Potočnik was accompanied in his visit to Cadarache on 3rd July by the French Minister for Research, F. Goulard, the former EU Commissioner for Research P. Busquin, former French Ministers for Research, F. d'Aubert and C. Haigneré, RTD Director General A. Mitsos, the Chief Administrator of CEA, A. Bugat and the High Commissioner for Atomic Energy, B. Bigot. They were welcomed by M. Chatelier, Head of the Fusion Department in Cadarache.

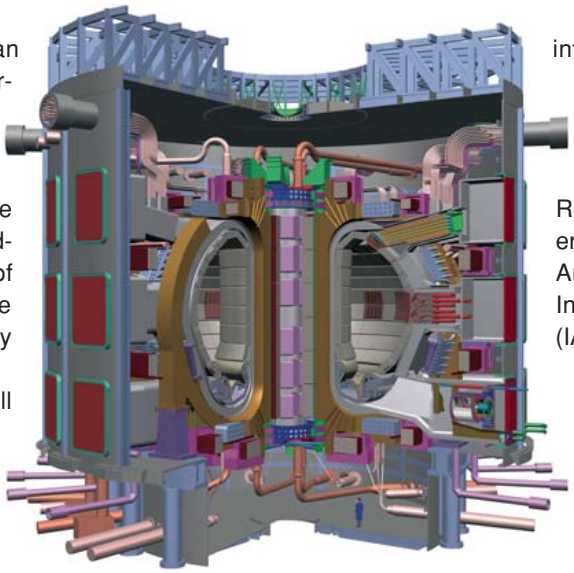
ITER

TF Model Coil

But, … what is ITER ?

ITER is the experimental step between today's studies of plasma physics and tomorrow's electricity-producing fusion power plants.

It is based around a plasma operating at about 100 million degrees producing a fusion power of about 500 MW. ITER will generate ten times the power that has to be provided to keep its plasma hot.



ITER is an international project involving six parties, The People's Republic of China, the European Union (represented by EURATOM), Japan, the Republic of Korea, the Russian Federation and the United States of America, under the auspices of the International Atomic Energy Authority (IAEA).

The overall programmatic objective of ITER is to demonstrate the scientific and technological feasibility of fusion as a safe energy source.

Divertor Mock-up

ITER has passed through a number of phases. Activities started with a Conceptual Design Phase (1988-1990), evolving to an Engineering Design Phase (1992 to 1998 and further extended to 2001). A design satisfying the wishes of the participating countries was completed in July 2001, to the extent necessary to establish its cost, schedule, safety, and licensing requirements.

After the site decision the following steps are expected:

1. A Joint Implementation Agreement has to be signed and ratified by the partners and the ITER organization will then be set up.
2. The construction phase starts. The hardware contracts are launched and, eventually, the systems are assembled and commissioned.
3. The estimated 20 years operation phase takes place.
4. The decommissioning phase takes place, when the plant is dismantled and disposed of.

Divertor Test Platform

For **more information** see:

http://www.iter.org

Associations

18th Association Day of the Association EURATOM-ÖAW

On 23rd June 2005 the Association EURATOM- ÖAW organized the annual Association Day on Plasma Physics at the Technical University in Graz. At this meeting Austrian research groups presented their current contributions to the physics programme and recent results. Guest lectures were given by Dr.B. Unterberg (FZ Jülich) on the dynamic ergodic divertor at Textor and Dr.M. Watkins (EFDA-JET) on present status and future plans at JET to help prepare for ITER. The Association was very pleased to welcome Dr.R. Giannella as a new member of the Association Steering Committee at this year's Association Day. The host of the meeting, the Institut für Theoretische Physik, has been cooperating for several years with IPP Garching and FZ Jülich on developing and benchmarking new numerical codes to study transport and heating in toroidal confinement devices. The lecture by Dr. Unterberg was complemented by a presentation of Dr.M. Heyn (TU Graz) on "the electromagnetic field of the dynamic ergodic divertor in the kinetic description of the tokamak plasma." The meeting was also attended by representatives of the EFDA Close Support Unit Garching and the Jožef Stefan Institute in Ljubljana (Slovenia).

For further information on the Physics and Technology workprogrammes of the Association EURATOM-ÖAW:

http://www.oeaw.ac.at/euratom

JET

Dr Fidel Castro Diaz Balart visits JET

Dr Fidel Castro Diaz Balart, the Scientific Adviser to the President of the Council of State of the Republic of Cuba visited JET, as part of his visit to the UK integrated in the Cuba Initiative with the aim of identifying ways in which to enhance UK/Cuban cooperation in scientific development.

Dr. Fidel Castro Diaz Balart, accompanied by a delegation from the Embassy of the Republic of Cuba, was welcomed to JET by Jérôme Paméla (EFDA Associate Leader for JET), Frank Briscoe (Operations Director), Chris Carpenter (Public Affairs Manager), Duarte Borba (Head of Publications) and Mike Watkins (Head of Programmes). During a working lunch, Jérôme Paméla gave a presentation on JET and its role in the overall fusion programme. Dr. Fidel Castro Diaz Balart showed a great interest in fusion research and asked specific questions related to the ITER scientific programme and the timescale for the demonstration of fusion energy. The visit was concluded with a tour of the JET facilities, which included the Control Room, Remote Handling, Assembly Hall and Torus Hall.

Fidel Castro Diaz-Balart is doctor in Sciences (Ph.D.) at the Institute of Atomic Energy I. V. Kurchatov of Moscow and graduated in Nuclear Physics by State University M. V. Lomonosov in Moscow and its branch of the Unified Institute of Nuclear Research (JINR) of Dubna (Russia). He is also doctor in Sciences (Dr Sc.) at the Higher Institute of Nuclear Sciences and Technology of Havana, where he is titular professor in his specialty.

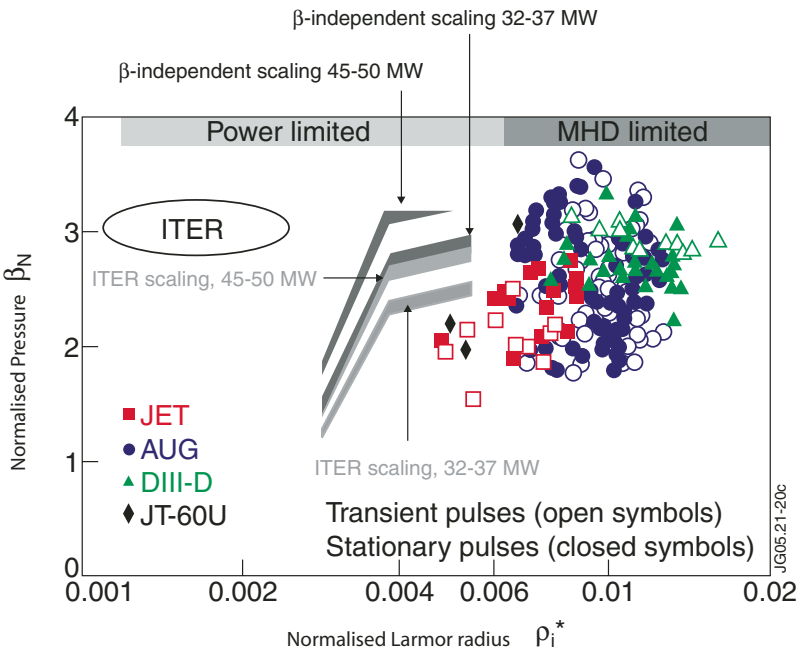
JET

The upgrade of the neutral beam system on JET, planned for installation in 2008, will deliver up to 35 MW of power for up to 20 seconds (compared with the 22MW available for 10 seconds at present), and up to half this power for up to 40 seconds.

Enhancements for a possible use of JET beyond 2006: the Neutral Beam Enhancement Project

The upgrade of the JET neutral beam system will allow significant advances in optimising ITER scenarios, such as the ELMy H-mode, the Improved H-mode and Advanced Scenarios. In particular, higher power operation in JET will also contribute to the development of high density scenarios compatible with a metallic wall as foreseen in ITER, and integrated in the overall JET enhancements which includes the installation of a metal wall [“The ITER-like Wall Project at JET”, EFDA Newsletter Vol 2005/3 page 6].

With the higher power installed on JET, the ELMy H-mode and Improved H-mode will be taken to higher normalised pressure (beta), allowing further refinement of the scalings for core confinement, ELM energy losses and divertor/wall interactions. In particular, it will be possible to determine the contribution of the pedestal energy to the total plasma energy and to refine the dependence of confinement on beta. At present, dedicated scans carried out on JET and DIII-D show a beta-independent scaling which is more favourable than the ITERH98(y,2) scaling, assumed for the ITER design. Regarding the study of Improved H-modes, it will be possible to obtain conditions significantly closer to ITER than those achievable today by operating JET at high beta and low normalised larmor radius, "rho-star" (see figure). The long pulse capability of the upgraded neutral beam system will be crucial to progress Advanced Scenarios with full current drive sustained for an entire current diffusion time at ITER- relevant normalised pressure.



Access to the Improved H-mode at low rho-star and high beta is limited by available power on JET. The NB power upgrade will allow studies of this sce-nario much closer to the ITER operating point, than is currently possible.

In addition, the higher power will allow Neo-classical Tearing Mode and Resistive Wall Mode control techniques to be optimised under conditions closer to ITER. This work will include sawtooth control and further studies of the effect of rotation on plasma stability. Greater demands will be placed on techniques for mitigation against large ELMs and disruptions. This is of particular importance in view of their potential to cause melt damage to the ITER-like first wall. JET will also be able to test mitigation techniques, such as pellet injection for ELM-pacemaking and fast, high pressure impurity injection for disruption mitigation, under edge plasma conditions similar to those expected in ITER.

The neutral beam power will be increased primarily by changing the magnetic configuration of the ion sources from the present “supercusp” configuration to a pure “chequerboard” configuration. The latter produces larger fractions of molecular ions (D2+ and D3+), which are slower after acceleration due to their higher mass, and hence neutralised more efficiently, resulting in a more powerful neutral beam.

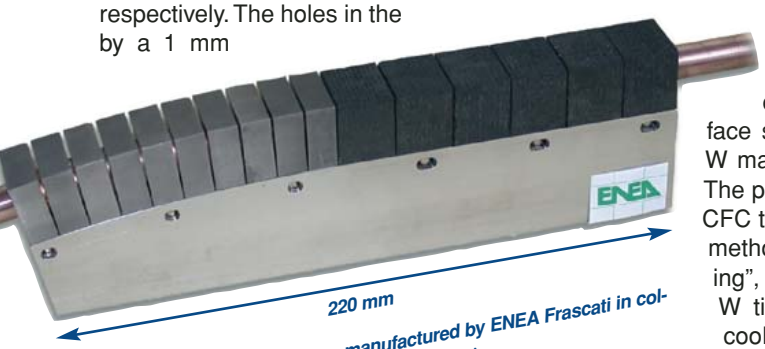
As part of the power upgrade several other changes will be made to the NB system: eight of the existing 80kV/60kA High Voltage Power Supply units will be replaced with four new 130kV/130A/20s units; critical components of each beamline, which presently rely on inter-pulse cooling, will be replaced with actively cooled components, extending the pulse duration from 10s to 20s; and all 16 ion-source/accelerators (PINIs) will be modified to allow a maximum beam current of 65A (at 125 kV acceleration voltage), instead of the current maximum of 60A.

Associations and ITER

Divertor Vertical Target Prototype manufactured by Hot Radial Pressing

The Association EURATOM-ENEA (Frascati, Italy), in collaboration with the industrial company CSM S.p.A. (Rome, Italy), has recently completed the manufacturing of a medium scale prototype of the ITER divertor vertical target. This achievement culminates several years of R&D efforts aimed at developing alternative manufacturing technologies for the high heat flux components.

The prototype includes a high heat flux unit and a steel supporting structure. The high heat flux unit is based on the "monoblock" concept, which consists of tiles with a drilled hole. Then, a cooling tube is inserted into these holes and intimately joined to the tiles. The component has a straight and a curved part covered with carbon fibre reinforced carbon (CFC, grade NB31 supplied by SNECMA Propulsion Solide, France) and tungsten (W), respectively. The holes in the CFC and W tiles are lined by a 1 mm thick pure copper interlayer. The aim of this interlayer is to reduce the joint interface stress between the CFC or W material and the cooling tube. The pure copper is joined into the CFC tiles by an ENEA proprietary method named "Prebrazed Casting", whereas it is joined into the W tiles by simple casting. The cooling tube is made of copper alloy (grade CuCrZr). The high heat flux unit is mounted onto the supporting structure, made of 316L austenitic steel, by means of pins made of "aluminum-bronze". The pins are inserted in pads obtained in the rear side of the monoblocks and in grooves obtained in the supporting structure. The grooves allow the sliding of the CFC part thus alleviating the thermal stress during the operation under high heat flux loading. The joining of the cooling tube into the monoblock holes is obtained by means of the innovative technique named "hot radial pressing" (HRP). This technology consists in heating the small vacuum chamber that contains the high heat flux unit by an air furnace and then applying an internal pressure to the cooling tube at the prescribed temperature and time to get the joining between the tube and the pure copper interlayer.



Divertor Vertical Target prototype manufactured by ENEA Frascati in collaboration with CSM (Italy).

The basic feasibility of the HRP technique was already demonstrated in the past by the Fusion Technology Section of ENEA Frascati via the manufacturing of small-scale mock-ups with W and CFC armour, which have been successfully tested in excess of 20 MW/m^2. These encouraging results enabled the manufacturing of this component, which includes all the main features of the corresponding ITER divertor design. "This is a major achievement", said M. Merola, Divertor Responsible Officer at EFDA CSU Garching, "and demonstrates that EU has various technologies, which are available for the manufacturing of the ITER divertor". This prototype will be subject to an extensive high heat flux testing campaign at FE200 electron beam test facility located at Le Creusot, France, and operated by AREVA - Framatome ANP and CEA Cadarache.

A.Pizzuto (Head of Fusion Technology at ENEA Frascati, left) and E.Visca (Principal Investigator, right) discuss the manufacturing of the vertical target prototype

With respect to the well-known "Hot Isostatic Pressing " (HIP) technology, the "Hot Radial Pressing" (HRP) process has no need of a HIP can. This feature has the following advantages:

- The manufacturing of the can is avoided
- The machining of the can after the HIP process is avoided
- One of the most common failure mode of the HIP technology, that is the failure of the can, cannot occur
- The joining process is carried out in an active vacuum rather then in a sealed can. Therefore in case of outgassing of the material during the temperature cycle, the required vacuum conditions are kept
- The required ~0.5 mm gap between each armour tile can be obtained in a much easier way since no axial forces are applied
- The distortion of the component after the joining process is minimised

For **more information** see:

http://www.fusione.enea.it

http://www.c-s-m.it

Conferences

32nd EPS Conference on Plasma Physics and 8th International Workshop on Fast Ignition of Fusion Targets

From the 27th of June to the 1st of July, the Laboratorio Nacional de Fusión (Asociación EURATOM-CIEMAT para Fusión) and the Universitat Rovira i Virgili hosted the "32nd European Physical Society Conference on Plasma Physics and 8th International Workshop on Fast Ignition of Fusion Targets" in Tarragona, Spain. The meeting took place in Tarragona, an old Roman town by the Mediterranean Sea in the north-eastern region of Catalonia in Spain, which is a world heritage town due to its architectural/historical treasures. The conference venue, which is built in the place of an old quarry, was ideal to hold such a meeting with a spectacular main auditorium (where plenary sessions were held) and various smaller auditoriums and meeting rooms for parallel sessions and a spacious hall for the poster sessions.

This conference is the main annual meeting for fusion physics research in Europe and always attracts significant non-European participation. This year, 751 delegates attended the meeting, most of them coming from the six ITER partners: EU (65%), USA (12%), Japan (9%), Russian Federation (8%), Korea (2%) and China (2%).

The Conference proceedings were opened by a welcome speech of Dr. Carlos Alejaldre (former Head of the Asociación EURATOM-CIEMAT para Fusión) Director General of Technological Policy of the Spanish Ministry of Science and Education. In his speech, Dr. Alejaldre reviewed the research planning and policies of the Spanish Government with emphasis on fusion research and, in particular, ITER. This was followed by the award ceremony of the Hannes Alfvén prize for 2005 and the first plenary session of the conference.

The highlight of the conference was the signature of the ITER site agreement in Moscow on the 28th of June, which was celebrated in an extraordinary evening session. In this session, there were interventions by Dr. Jacquinot (former Head of the Association EURATOM-CEA), Dr. S. Clement (DG-RTD-Fusion EU Commission) and Dr. L. Rodríguez (CIEMAT, member of the European ITER Site Study Group), where both the signed site-agreement and the technical/socio-economic characteristics of the ITER Cadarache site were presented.

Finally, the conference was adjourned with the presentation of the venue for the 33rd EPS Conference on Plasma Physics in 2006, which will be held in Rome, June 19 - 23, and will be hosted by the Associazione EURATOM-ENEA sulla Fusione.

The 2005 Hannes Alfvén prize winners were: Prof. M. G. Haines, Dr. T.W.L. Sanford and Ac. V.P. Smirnov. The EPS Plasma Physics Division acknowledges with this prize their contributions to the development of the wire-array Z-pinch as X-ray source for inertial confinement fusion.

Public Opinion

Europeans support more money for EU research

Two Eurobarometer reports were published early June by the European Commission. . According to them, 71% of EU citizens agree that collaborative research at EU level is growing in importance and 59% consider that the EU should spend more money on scientific research. 64% of Europeans agree that our economy can become more competitive only by applying the most advanced technologies. The same proportion acknowledges the role science and technology play today in industrial development. The survey supports the perception that US is more advanced than Europe in research, with only 12% of those questioned thinking that Europe is ahead of the US.

Research at EU level is widely seen as creative and effective, and a large majority consider that European countries should cooperate more with each other. Regarding science and technology decision-making, 73% of EU citizens want politicians to rely more on the advice of expert scientists. European citizens show great trust in science and technology. 87% agree that science and technology have improved their quality of life and 77% believe they will continue to do so for future generations.

Some critical messages also come out of the surveys:

- 54% of Europeans consider that food made from genetically modified organisms is dangerous;
- People see also negative impacts, e.g. on environment and employment.
- Europeans feel badly informed and not very involved in science and technology issues.
- There is also some criticism of the way scientists' explain their achievements and handle information towards the public.

The reports contain the results of a survey carried out in 32 European countries (EU-25 plus Bulgaria, Romania, Croatia, Turkey, Iceland, Norway and Switzerland)

Full study available at: http://europa.eu.int/comm/public_opinion

Events

Fusion-Industry Workshop (Madrid, Spain, 1-2 June 2005)

A two day workshop took place in Madrid on 1-2 June, bringing together representatives from the Fusion Programme including Associations and industry. The event was an initiative of the European Commission, hosted by the EURATOM-CIEMAT Fusion Association. This workshop was an important element in the process conducted by the Commission to review the EU industrial policy for fusion.

The opening plenary session was devoted to seven presentations addressing:

- Industrial policy at CERN
- Role of Industry in the Ariane Programme
- Role of industry in the construction of Super Phénix
- Role of industry in the construction of Wendelstein-7X
- ITER challenges & readiness of ITER design for licensing and construction
- Know-how and industrial base developed during ITER-EDA
- Legal issues, IPR & European Legal Entity (ELE) Statutes.

These provided excellent background material and acted as a stimulus to the following working group sessions focussing on fusion specific issues. Topics addressed by the four working groups were:

- Industrial Policy Issues
- Legal and Contractual Framework for ITER
- Preserving/Developing Know-How & Developing Human Resources for the Medium Term
- Role of Engineering and Service Companies.

The Workshop was a great success in promoting the interaction between the Associations and industry and material produced during the event will be used in:

- The finalisation by the Commission Services of the ELE Statutes and the associated Pro curement System for ITER construction.
- The promotion of industry-Association partnerships for the development of key technologies for fusion energy.

The principal aim of the workshop was to give an opportunity for the key players to contribute to the review, by expressing their views and exchanging ideas on issues of concern. A further aim was to promote the interaction between the Associations and industry, which will be crucial to ensure transfer of essential know-how during the period of ITER construction and beyond. Of the 120 participants, there were around 50 from the Fusion Programme and the Associates and around 70 from industry. They included a wide representation from all over the EU, 16 of them from the new member countries.

The material will also be a valuable contribution to the preparation for the Awareness Workshop for European Industry on ITER. Date and venue of the event will be announced on the EFDA website.

Events

Yves Poitevin receives Miya-Abdou Fusion Nuclear Technology (FNT) Award

At the ISFNT-07 conference (Tokyo, 22-27 May 2005), Y. Poitevin (EFDA-CSU Garching), P. Barabaschi (ITER) and T. Hirai (Forschungszentrum Jülich-Germany) received the Miya-Abdou FNT Award 2005 for their special achievements in advancing fusion nuclear technology.

Yves Poitevin was given the award in recognition of his outstanding technical contributions to the design of high-heat flux components and blanket systems, especially for ITER.

Y. Poitevin graduated from the Ecole Centrale de Paris, joined CEA Saclay (France) in 1994 and started immediately to contribute to the design of high heat flux components, spallation targets, hybrid and advanced nuclear systems and the blanket technology for fusion reactors.

In 2001 he was appointed Project Leader of the Helium Cooled Lithium Lead (HCLL) breeding blanket concept. This concept is one of the two most favoured EU candidates for being used in future fusion reactors.

In 2004 Y.Poitevin joined the EFDA CSU Garching (Germany), where he is now responsible for the implementation and management of activities and contracts with Associations and industry in the 'Breeding Blanket' area.

For more information see our EFDA website:

http://www.efda.org

and additionally

http://www.jet.efda.org
http://www.iter.org

Preparing the future: the Carolus Magnus Summer School on Plasma and Fusion Energy Physics

In September 2005 about 50 participants will gather in the Mechelerhof (Mechelen, The Netherlands) for the seventh edition of the Carolus Magnus Summer School (CMSS) on Plasma and Fusion Energy Physics, a 2-week training event.

Typically 60 lectures are given, the didactic material of which is subsequently published in a special issue of Fusion Science and Technology as well as on the Internet, with a 6 months delay to respect copyright restrictions.

The biennial CMSS teaching initiative of the partners of the Trilateral Euregio Cluster or TEC (the Institut für Plasmaphysik of the Forschungszentrum Jülich in Germany, the FOM-Instituut “Rijnhuizen” near Utrecht in The Netherlands and the Laboratory for Plasma Physics housed in the Belgian Royal Military School in Brussels) had already been organized at several locations. The last one was Brussels (Belgium) in 2003.

Most of the speakers are from one of the TEC partners, but external specialists treat subjects falling outside the main focus of the cluster's expertise.
This year one of the evening lectures will be devoted to ITER. There will also be a talk on space weather, governed by 3-D MHD phenomena.
The summer school is not a pure one-way teaching initiative. The students themselves are invited to present their own work in two poster sessions, and the evenings and coffee breaks allow for lively discussions.

More information at: http://www.carolusmagnus.net

Treated subjects range from basic principles of magnetic confinement, heating, equilibrium and instabilities, classical and neo-classical transport as well as kinetic theory, clear up to leading-edge and occasionally far from fully understood fusion physics topics such as anomalous transport and internal transport barriers. The curriculum of the school is continuously adapted to keep in pace with recent developments and even future needs.

EFDA Close Support Unit - Garching
Boltzmannstr. 2
D-85748 Garching / Munich - Germany

phone: +49-89-3299-4237
fax: +49-89-3299-4197
e-mail: federico.casci@efda.org
editor: Federico Casci
graphic design: Karen Jens