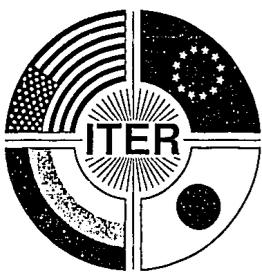


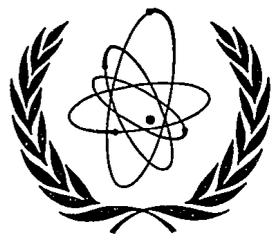
INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR



ITER EDA NEWSLETTER

VOL. 4, NO. 11

NOVEMBER 1995



INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

ISSN 1024-5642

NINTH MEETING OF THE ITER MANAGEMENT ADVISORY COMMITTEE
by Dr. M. Yoshikawa, MAC Chairman

The ninth meeting of the ITER Management Advisory Committee (MAC-9) was held at the Efremov Institute in St. Petersburg, Russia, on 3 November 1995.

MAC reviewed the Work Program, the plan for an Electronic Data Management System, an assignment of copyright for ITER publications, and some interface issues.

Work Program

MAC reviewed the ITER Task Status Summary and the complete list of R&D and Design Tasks approved by or reported to the previous meetings. Most of ITER EDA resources have been allocated to the Parties and also to Work Breakdown Structure elements by MAC-8 and there was no new task proposal to be reviewed at or to be reported to this meeting. The total ITER credit associated with the listed tasks amounts to 621,533.0 IUA for Technology R&D and 701.60 PPY for Design Tasks. 123 tasks out of 775 tasks have been completed following the acceptance of the Final Reports.

Plan for Electronic Data Management

MAC reviewed and supported the Director's proposal for the ITER Electronic Data Management System, noting that an electronic system for document and data management is substantially complete.

The ITER Process Management System (IPMS) was conceived at the beginning of the EDA to automate the management processes then under development. A decision was made that data management systems must



Participants in the Meeting

meet to support the new Project Management plan and to provide rapidly a working tool. Accordingly, electronic data management systems have been developed for the management of project documents (IDoMS) and CAD models (IMMS) based on elements previously encompassed in the original IPMS. These systems are now being used satisfactorily at the Joint Work Sites.

Assignment of Copyright for ITER Publications

MAC noted the four Parties' nomination of one person each, able to act as point of contact with the JCT and prospective publishers on copyright matters:

EU: Dr. E. Canobbio, JA: Dr. M. Seki, RF: Dr. L. Golubchikov, US: Ms. L. Howe

MAC recognized that the Director has told the JCT authors to sign the assignment documents under his responsibility in view of the urgency and with full reservation of the Intellectual Property Rights of the ITER Parties under the ITER Agreement.

MAC agreed to the Director's supplementary proposals regarding copyright matters that, in straightforward cases such as that the Intellectual Property Right interest of the ITER Parties under the ITER Agreement appear to be fully preserved, ITER JCT members may sign such a copyright assignment agreement under the authority of the ITER Director, subject to normal clearance of their draft papers through the ITER publications review process. MAC requested the Director to inform the points of contact after he makes authorizations.

Interface Issues

MAC has expressed high appreciation of the work performed by the Interface Sub Group (ISG) and agreed that the following actions be undertaken:

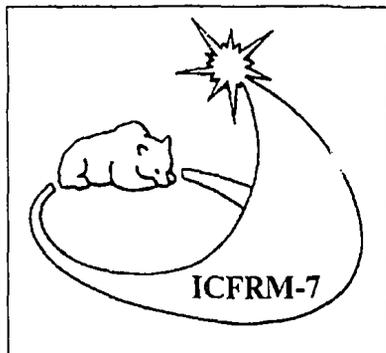
- (a) The Home Team Leaders (HTLs) will provide the ISG with a description of the commingle tasks related to the seven large R&D projects, in terms of anticipated transfer, timing, disposal, use after the EDA, etc.
- (b) The ISG will examine these specific issues and propose the options to solve them giving the consequences for each Party in terms of cost, liability, etc.
- (c) The ISG is asked to continue to work on the Cross Waiver Principle in order to determine the Parties' and related entities' responsibilities.

The HTLs will provide the information under (a) by mid-December 1995. MAC will appreciate an initial feedback from the ISG to the HTLs by the end of March 1996.

Next Meeting

MAC decided that the MAC-10 meeting will be held in Garching on 20–21 June 1996.

Seventh International Conference
on
FUSION REACTOR
MATERIALS



FOCUSING ON MATERIALS FOR ITER DESIGN

by Dr. N. Cheverev, ITER Council Member, and Prof. V. Chernov,
Conference Co-ordinator

The Seventh International Conference on Fusion Reactor Materials (ICFRM-7) was held at Obninsk, Russia, on 25–29 September 1995.

The Conference was a forum for presentation and discussion of the most recent results on materials research for fusion reactor applications.

A total of 382 papers was presented at the Conference, including 17 invited papers. The number of participants exceeded 500; they represented 22 countries. It was the first time that this Conference took place in Russia. The previous conferences in the series were held in Japan (1984, 1989), USA (1986, 1991), Germany (1987) and Italy (1993).

It was not by chance that Obninsk had been proposed for the Conference. The city is one of the most interesting and well-situated "nuclear" towns in the former Soviet Union. One of the largest State Scientific Centres of the Russian Federation, the Institute of Physics and Power Engineering (IPPE), is located at Obninsk. Here the first nuclear power station to produce electricity (APS 1) was constructed and put into operation in 1954. Conveniently close to Moscow, it also has the necessary capacity in terms of hotels and guest houses. The large and modern conference centre can easily accommodate major conferences.

The distinguishing feature of ICFRM-7 was that it focused on materials issues for the design of ITER. Many interesting contributions were made by laboratories not directly involved in the ITER EDA, which were nevertheless pertinent to ITER. Participants from the ITER JCT, representing all three Joint Work Sites, were V. Barabash, V. Chuyanov, S. Fuess, W. Gauster, G. Kalinin, R. Matera, and S. Yamamoto. They presented five papers, three of which were invited overviews:

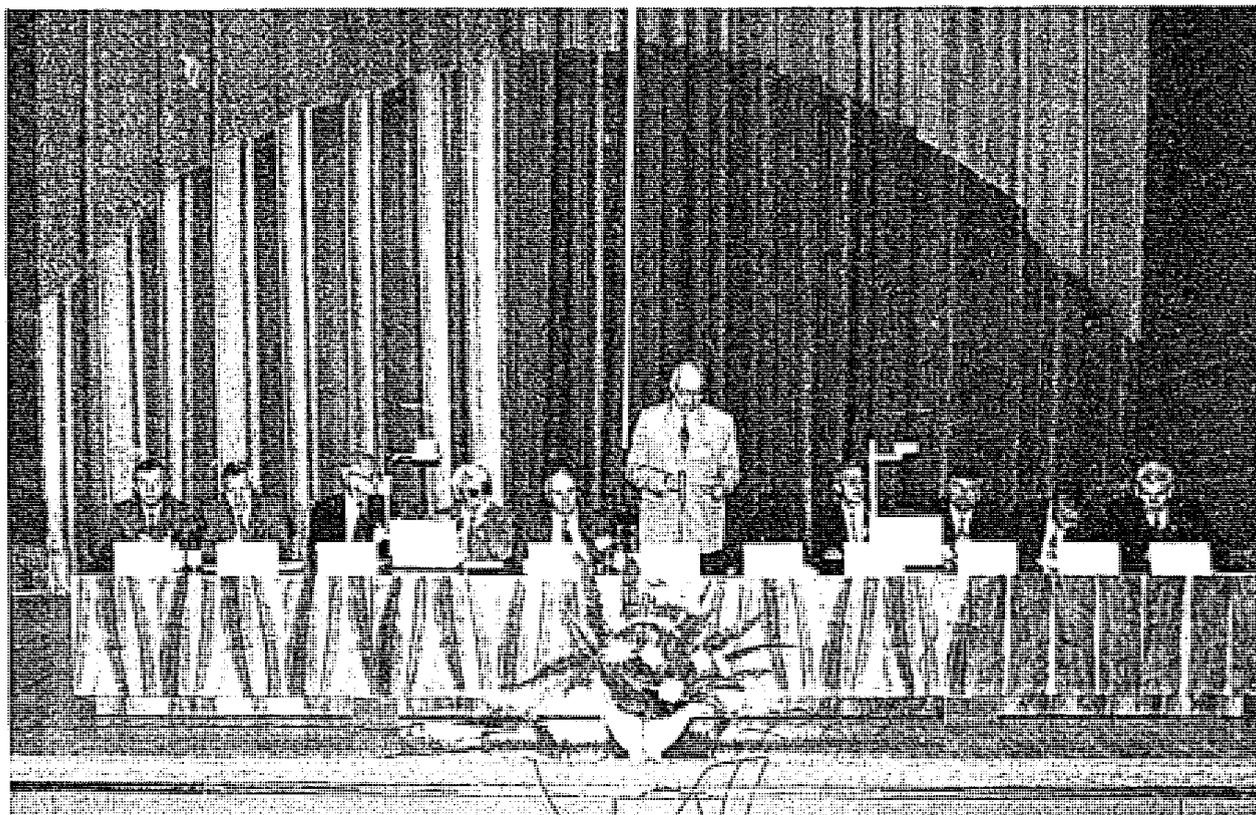
V. Chuyanov – "ITER EDA Project Status",
G. Kalinin – "Structural Materials for ITER In-Vessel Component Design",
R. Matera – "Design Requirements for Plasma Facing Materials in ITER".

Numerous presentations were given at the oral and poster sessions by members of the four HTs, highlighting results of the current R&D tasks.

Seven workshops were held in parallel to the Conference. Particularly relevant to ITER were the ones on "Ceramic Materials for ITER Diagnostics", "Interaction of Plasma with PFC Materials and Hydrogen Behaviour in Materials" (participants here included students from Japan and Russia), and "Physics of Radiation Damage".

An exhibit of Russian industrial capabilities and achievements in materials technology was presented during the Conference. About 10 organizations and institutes supplied displays, which included a model of ITER.

Participants of the Conference had the opportunity to visit the experimental laboratories of IPPE. After the Conference, numerous participants visited other scientific centres of the RF, such as the Kurchatov Institute, the Efremov Institute, the Institute of Atomic Reactors, and others, to acquaint themselves with the research going on and to participate in discussions on the various sites.



Opening Ceremony of the Conference

The strong government-level support provided by the Russian Federation contributed to the success of the conference, as did the involvement of a number of Russian and international sponsoring and participating organizations, including:

- Argonne National Laboratory,
- Bochvar Research Institute of Inorganic Materials,
- Efremov Scientific Research Institute of Electro-Physical Apparatus,
- International Atomic Energy Agency,
- International Science and Technology Centre,
- ITER Joint Central Team (Garching Joint Work Site),
- JSC "Prais Electronics",
- Kaluga Region Scientific Centre,
- Ministry of the Russian Federation of Atomic Energy (host organization),
- Ministry of the Russian Federation of Science and Technical Policy,
- Nuclear Materials Committee of TSM-AIME & ASM International,
- Oak Ridge National Laboratory,
- Russian Academy of Science,
- Russian Scientific Centre – Institute of Physics and Power Engineering (host organization),
- Russian Scientific Centre – Kurchatov Institute,
- State Committee of the Russian Federation for Higher Education,
- US Department of Energy.

Also the effective work of the Conference Chairman, Prof. L.D. Ryabev, First Deputy to the Minister of the Russian Federation of Atomic Energy, and of the Conference Co-Ordinator, Prof. V. Chernov (IPPE), contributed to the success of the Conference.

The organizers of the Conference and IPPE staff did their best to assure smooth running of the Conference. The participants appreciated the preparation by the organizers and the work of the many people who provided the Conference support.

ITER AT THE SYMPOSIUM ON FUSION ENERGY

**by Dr. F. Puhn, Head, Design Integration Division, JCT, and
N. Carroll, ITER San Diego JWS**

"Seeking a New Energy Era", the theme of this year's Symposium on Fusion Energy (SOFE), provided an appropriate forum for detailed discussions of the ITER project; and ITER Joint Central Team (JCT) members, along with their Home Team (HT) colleagues, were major contributors to the event. Under the sponsorship of the Institute of Electrical and Electronics Engineers (IEEE)/Nuclear and Plasma Sciences Society (NPSS), SOFE '95 was held at Champaign, Illinois, USA, October 1–5, with Dr. R. Aymar, Director of ITER, delivering one of the keynote addresses. 83 ITER JCT members contributed as authors, co-authors, and several of them acted at the Conference as session Chairs or presenters.

SOFE is an international symposium covering the broad range of fusion engineering topics with a variety of presentations on specialized subjects. Supporting this year's theme, the Symposium was organized on a machine-oriented basis, with posters presented simultaneously with oral presentations on the same topic. The JCT participation and contributions reflected the broad scope of ITER, and are detailed in the boxed insert. In addition, HTs, especially from the US, made many contributions so that, overall, ITER design and R&D work were the focus of about 30% of the papers and presentations.

The JCT and the HTs reported good progress for both design and preliminary R&D results and attendees noted an overall firm commitment to the project. The keynote speakers, W. Marton of the US Department of Energy, discussing the fusion program in the US, and Dr. R. Aymar, specifically focusing on ITER, set the tone by affirming their confidence in the project.

Dr. Aymar, in his discussion of ITER strategies and technical issues, reiterated the positive conclusions of the last ITER Council. He emphasized the Council position that the strategy is sound and should not be changed and that the international co-operation is proving to be an efficient framework. He confirmed his confidence in the project, saying that both he and the Technical Advisory Committee are happy with the objectives, parameters and designs at the Interim Design Report stage and it is their opinion and that of the ITER Council

that these should not be changed. He noted that the performance margins are small, but still positive to achieve the objectives, and reassured the participants in the Conference that the project is moving in the right direction.

ITER JCT PARTICIPATION IN SOFE '95

Session Co-Chairs:

- ◆ *ITER Overview, Session Co-Chair: J. Dietz*
- ◆ *Magnet Technology, Session Co-Chair: R. Vieira*
- ◆ *DIII-D; Disruptions, Session Co-Chair: G. Federici*
- ◆ *Tokamaks/Spherical Tokamaks, Session Co-Chair: K. Ioki*

Plenary Speaker:

- ◆ *The ITER Magnet System Program – Design and R&D, M. Huguet and R.J. Thome*

Oral Presentations and Posters (OP and P)

- ◆ *Development of the ITER Divertor, OP: J. Dietz, et al*
- ◆ *ITER Shield Blanket and Vacuum Vessel, OP: K. Ioki, et al*
- ◆ *Nuclear Analyses in Support of the ITER Design, OP: R. Santoro, et al*
- ◆ *ITER Coils Insulation R&D Program, OP: R. Vieira, et al*
- ◆ *ITER Coil Power Supply, P: A. Roshal, et al*
- ◆ *Tooling Concepts for ITER Tokamak Assembly and Remote Disassembly, P: A. Oikawa, et al*
- ◆ *Neutral Beams for ITER, P: R. Hemsworth, et al*
- ◆ *Gas and Power Flow in the ITER Neutral Beam Injectors, P: M. Hanada, et al*
- ◆ *Overview of ITER Remote Handling, P: K. Shibamura, et al*
- ◆ *ITER Principal Safety Functions: Radiological Confinement, Heat Removal, and Shutdown, P: S. Piet, et al*
- ◆ *Key Results in ITER Safety Analysis, P: H. Bartels, et al*
- ◆ *Plasma Position and Shape Control for ITER, P: A. Portone*
- ◆ *The ITER Cryostat, P: R. Bourque and M. Wykes*
- ◆ *ITER Magnet and Structure Assembly Plan, P: Z. Piec, et al*
- ◆ *ITER Breeding Blanket Design, OP: Y. Gohar, et al*
- ◆ *Preliminary Assessment of the Tritium Inventory and Permeation in the PFCs of ITER, OP: G. Federici, et al*
- ◆ *The ITER Poloidal Field Configuration and Operation Scenario, P: Y. Gribov, et al*
- ◆ *Analysis of the Transition End Regions of the ITER Central Solenoid, P: J. Stoner and F. Wong*
- ◆ *Analysis of Heat Transfer and Erosion Effects on ITER Divertor PFCs Induced by Slow High-Power Transients, P: G. Federici, et al*
- ◆ *AC/DC Converters for the ITER Poloidal Field System, P: I. Benfatto, et al*

Several of the JCT attendees provided comments about the Symposium, many of them noting work of immediate interest to the ITER EDA being done by the HT members and on other fusion devices, as illustrated below.

Z. Piec: "...The great amount of work related to the ITER components and diagnostic design, present and future R&D programs, manufacturing study, and assembly. ...the TPX R&D results were widely presented and they may be greatly used in the present and future ITER R&D program. Many conclusions from the TPX superconducting PF Coil manufacturing and insulation R&D were presented and they should be studied for the ITER PF Coil system. ...The great interest in Fusion shown by the Asian and European countries that are not involved in the ITER EDA was shown. Several papers from China, Republic of Korea, India, and Spain showing the currently constructed small-scale fusion devices were presented."

F. Puhn: "The SOFE Conference contained many interesting papers showing the progress of the ITER EDA at approximately its midpoint. Of particular interest to me was the paper by R.G. Castro et al, LANL, ("Structure, Properties and Performance of Plasma-Sprayed Beryllium for Fusion Applications"), showing the results of ITER R&D on development of plasma-sprayed beryllium. The progress made so far with a new technique has demonstrated the spraying of thick beryllium layers with good micro-structure and thermal conductivity. Sprayed-on beryllium in thick layers did not exist at the start of the EDA. This new development allows potentially useful design concepts for in-situ plasma spraying which were previously considered impossible."

A. Roshal: "In the field of power supplies I would pick out two papers as having potential impact upon the ITER design. The first ("Quench protection for superconducting magnets", C. Neumeyer, et al, PPPL) deals with concepts and design options of a scheme and DC switches for superconducting coil quench protection. On the poster, Dr. C. Neumeyer presented the results of testing of the explosively actuated circuit-breakers which had been performed in the framework of the TPX R&D program. In the second paper ("Converter control strategies for reactive power reduction and compensation in ITER", R. Piovan, et al) prepared at the "Istituto Gas Ionizzati" in Padova, Italy, a new method for reactive power compensation was proposed based on the permanent connection of a compensating capacitor and on a converter control strategy which zeroes the reactive power delivered from the grid in any converter load condition. This method was specially developed for ITER application."

C. Walker: "In general, there was a firm commitment to ITER with a lot of sensible work towards its design...On the Diagnostic Engineering side it is noticeable that many machines have now acknowledged the fact that the engineering of the diagnostic equipment, especially at the machine interface, is important. The extent of the diagnostic equipment was clearly demonstrated for most machines. The meeting serviced to exchange workable solutions to similar problems that were not appreciated beforehand...The DIII-D work on Magnetic Diagnostics showed some of the analysis and prototype manufacture for ITER. There is general agreement on the durability requirements and method of construction of In-Vessel diagnostic equipment. ...The JET MkII Divertor Diagnostics at present being installed at JET gives useful comparisons with ITER because of the cassette nature of the Divertor target. ...For DIII-D radiative Divertor and the TPX, good overviews were presented with some of their engineering problems and solutions. They showed for the first time the integration of diagnostics on a Tokamak while it is still under design, showing how ubiquitous they are and how it is possible (and often necessary) to integrate diagnostics in every port. ...On specific diagnostic systems and components, there were several good ideas worth following up: a proposed fibre optic vacuum feed through for TPX, and ITER In-Vessel viewing system (EU HT) that is less invasive than present proposals, a strain gauge probe for stationary magnetic field measurement..."

A proceedings of the 16th IEEE/NPSS Symposium on Fusion Engineering will be published and sent to all registered participants in January 1996.

ITER DIAGNOSTIC MEETINGS

by Dr. A.E. Costley, ITER JCT, Dr. P.E. Stott, JET, and Dr. K.M. Young, PPPL

An International Workshop on "Diagnostics for ITER" was held in Varenna, Italy, 28 August – 1 September 1995. The Workshop was organized by the International School of Plasma Physics "Piero Caldirola", Milan. The Workshop was followed by the Third Diagnostics Expert Group Workshop which was held jointly with a Technical Meeting on Diagnostics on 4 and 5 September.

The International Workshop was an outstanding success. It was attended by 84 participants drawn from all four Parties. There were 45 oral presentations, 34 posters and lively discussion sessions on all aspects of ITER diagnostics. It is obvious and very encouraging that the diagnostic community is responding to the problems and challenges of measuring the plasma behaviour in ITER.

The Workshop highlighted several "pivotal" questions for ITER diagnostics. Depending on the outcome of these questions there will be substantial consequences for ITER diagnostics. Examples of the many important questions are:

- How will vertical access be provided for the neutron camera and other important diagnostics?
- Can tangential access be provided for the measurement of n_p/n_t by neutron spectrometry? Will the signal/noise in this measurement be adequate even with good tangential access?
- Can the heating beams be used for the motional Stark effect measurements?
- Can inside, i.e. high field side access be provided for reflectometry?
- Can extensions of the vacuum boundary be provided for VUV and x-ray spectroscopy?

The answer to these questions will be an important part of future work on ITER Diagnostics. The provision of the relatively low energy diagnostic neutral beam is also a key point on which much, including the capability for measuring the helium ash, depends.

The proceedings of the Workshop will be published by the International School of Plasma Physics early in 1996 and will be a valuable compilation of much of the work on ITER Diagnostics that has been carried out to date.

The Third Diagnostics Expert Group Workshop and the Technical Meeting on Diagnostics were attended by almost all members of the Expert Group. In addition, several diagnostic specialists attended by special invitation. The principal conclusions of the meetings are as follows:

- ◆ To assure that the Diagnostics meet the physics needs, the Diagnostics Expert Group recommends that each of the other Expert Groups should appoint a liaison person for Diagnostics and should have an Agenda Item on Diagnostics at their next meeting. The Diagnostics Expert Group will invite each of the other Expert Groups to send a representative to its next meeting in February 1996.
- ◆ Members of other Expert Groups should be asked to review the Diagnostic sections in the Physics Design Description Document (DDD) and the initial definition and specification of the diagnostic system detailed in the Diagnostic DDD, as a focus for communication.
- ◆ A number of important access issues for diagnostics were identified in the International Workshop (above).
- ◆ The Diagnostics R&D activity in Radiation Effects studies is of very high priority. Its resources should be used carefully, and directed now more to specific component testing.
- ◆ The definition of the plasma operational scenarios needs to be further developed for optimum diagnostic design. The startup scenarios and scope of operation in H/D may require different sightlines and measurement specification.
- ◆ The Expert Group recommends that the Control Task Force defines the control requirements based on plasma measurements as quickly as possible so that the class (i) measurement set can be revised as soon as practicable. A clear identification of the parameters that have to be measured is required. The requirements and proposed diagnostics will again be reviewed at the next Expert Group Meeting.
- ◆ New Diagnostic Design Task Agreements are in the process of being signed, the tasks being scheduled for completion early next year. The Expert Group will ensure that the physics aspects of the associated Progress Meetings are properly reviewed.
- ◆ The JCT agreed to develop ways of improving communication with the Group members, including providing instructions for obtaining documents from the ITER server. Electronic communication unfortunately does not fulfill all requirements at the moment because of difficulties with drawings.
- ◆ Many options exist for reflectometry on ITER and there is much experience in the HTs. It was decided to set up a Working Group on Reflectometry as a subcommittee of the Diagnostics Expert Group to advise and guide the JCT on the choices for this technique. The group will normally work by E-mail, telephone or mail, but opportunities will be taken for occasional meetings attached to relevant physics or diagnostics conferences or other meetings.

It was decided to hold the fourth meeting of the Diagnostics Expert Group in Moscow, RF, on 22–23 February 1996.

All the participants thought that the meetings were extremely productive and useful. The organization and hosting of the meetings were excellent and the participants would like to thank Prof. E. Sindoni and Dr. G. Gorini for their careful arrangements and The International School of Plasma Physics "Piero Caldirola" for hosting the meetings.

**EXPERT GROUP WORKSHOP
PARTICIPANTS**

EU: R. Bartiromo, P. Stott

JA: A. Nagashima, T. Nishitani,
M. Sasao

RF: A. Krasilnikov, M. Petrov

US: E. Marmor, R. Snider,
K. Young (Chairman)

JCT: A. Costley (Co-Chairman),
V. Chuyanov, L. Johnson,
L. deKock, V. Mukhovatov,
T. Sugie (JA-JCT),
C. Walker



Participants in the Expert Group Workshop

ITER EVENTS *)

ITER Physics Committee Meeting, Garching, EU, 30 November – 1 December

Tritium Plant Technical Meeting combined with Fuelling & Pumping Meeting, Naka, Japan, 4–8 December

IC-9, Garching, EU, 12–13 December

Second Meeting of the Test Blanket Working Group (TBWG-2), San Diego, US, 17–19 January

*) Attendance at all ITER Meetings by invitation only.

Items to be considered for inclusion in the ITER Newsletter should be submitted to B. Kouvcinnikov, ITER Office, IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: (+43 1) 237762; phone (+43 1) 2060 26392.

Printed by the IAEA in Austria
January 1996