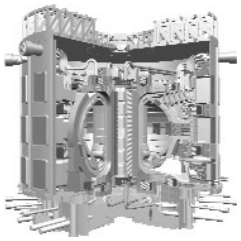

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TWELFTH ITER NEGOTIATION MEETING

Delegations from China, European Union, Japan, the Republic of Korea, the Russian Federation and the United States of America gathered on Jeju Island, Korea, on 6 December 2005, to complete their negotiations on an Agreement on the joint implementation of the ITER international fusion energy project (please see box on page 2).

This was the first time for Korea to host a Meeting of the ITER Negotiators.

At the start of the Meeting, the Delegations unanimously and enthusiastically welcomed India as a full Party to the ITER venture. A Delegation from India then joined the Meeting and participated fully in the discussions that followed. With this exciting new development, over half of the world's population is now represented in this global endeavour (please see in the box below the address of the Head of the Indian delegation to the ITER Negotiators).

Address by Head of Indian Delegation, Dr. V.P. Raja

Thank you very much Mr. Chairman for inviting me to say a few words. But for a very pressing engagement with the Prime Minister, the Chairman of the Atomic Energy Commission and Secretary of the Department of Atomic Energy, Dr Anil Kakodkar, would himself have been here on this august occasion. He has asked me to convey his good wishes for the success of all deliberations here.

Ladies and Gentlemen, on behalf of the people and Government of India and on behalf of our Chairman, it is my great pleasure and a privilege to accept this invitation for Participation in Negotiations and Partnership in ITER. As has already been remarked by others before, with our entry more than half of humanity has entered into a partnership to work towards the solution of one of the most pressing problems for mankind, viz. the energy problem. India has enormous energy needs. With an accelerating economy and growing expectations of our citizens for a better quality of life, energy has become a crucial commodity for us. Conventional sources of energy, like fossil fuels, cannot take us very far, both because of dwindling supplies and because of environmental constraints. We have great hopes in nuclear energy and have an ambitious nuclear fission energy program in which we are looking for significantly enhanced capacities in the coming decades. But our Government is also committed to a strong support for research on new energy sources. Fusion energy research is one such area and our Government has been strongly supporting it for the past couple of decades or more. The Government of India is thus fully committed to its obligations under the ITER partnership and also to a strong National program. Our scientists have already designed and fabricated two tokamak devices, ADITYA and the steady state superconducting tokamak SST 1. Many technologies of relevance to the forefront of fusion research have been developed by our scientists and engineers in collaboration with our industries. We thus bring to the table a combination of strong commitment from the Government and special scientific and technological skills, which are of relevance to ITER and to fusion research.

Ladies and Gentlemen, I would be failing in my duties if I did not put on record India's appreciation and gratitude to the ITER parties, who made special efforts to facilitate India's entry into the ITER partnership. Some of you made special efforts in initiating a process of consultations among the parties for India's entry. Others have made special efforts together with IT so that a significant and equitable package of allocations was made available to India. Yet others have made special efforts to see that even though we are the youngest ITER partners, we are made to feel welcome. On behalf of India I thank all of you for these considerations.

We now look forward to the task ahead: A successful conclusion of the negotiations, formation of the ILE and the technical task of actually starting construction of the ITER device. Our young scientists and engineers and our dynamic industries are waiting with great expectations for this unprecedented collaboration in human history, which is both a challenge and an opportunity!

I thank you very much, once again.

The seven ITER Delegations also welcomed to the Meeting the newly designated Nominee Director-General for the prospective ITER Organization, Ambassador Kaname Ikeda, who is to take up his duties as leader of the project.

Joint Implementation Agreement

The JIA is more formally known as the "Agreement on the Establishment of the International Fusion Energy Organisation for the Joint Implementation of the ITER Project". The JIA has Annexes which form an integral part of the agreement, and Attachments, which do not, and therefore which can be prepared separately and subsequently modified without renegotiating the Agreement.

The JIA has a number of standard provisions like any other agreement about an international organisation:

— Establishment of the Organisation
— Purposes of the Organisation
— Functions of the Organisation
— Members of the Organisation
— Legal Personality
— Organs of the Organisation
— Council
— Director-General and Staff
— Intellectual Property
— Privileges and Immunities
— Audit
— International Cooperation
— Entry into Force
— Accession
— Settlement of Disputes
— Amendments
— Definitions
— Registration with the United Nations
— Authentic Texts and Certified Copies

In addition

— Resources
— Site Support
— Public Health and Safety
— Liability
— Decommissioning
— Peaceful Uses and Non-Proliferation
— Duration and Termination
— Withdrawal

The Annexes include:

— Intellectual Property Rights
— Site Support
— Privileges and Immunities—no final agreement has been reached on the form of this document

The Attachments include:

— Final Report of the ITER EDA
— Management and Procurement
— Total Cost Breakdown by phases
— Overall project schedules
— Cost sharing formulae
— Final Report of the ITER EDA
— Procurement Allocation
— Principles for Operation Programme

When it enters into force the JIA will have an initial duration of 35 years with the possibility of extension for up to 10 years without amending the Agreement.

Based on the results of intensive working level meetings held throughout the previous week, the Delegations have succeeded in clearing the remaining key issues such as decision-making, intellectual property and management within the prospective ITER Organization and adjustments to the sharing of resources as a result of India's participation, including in particular cost sharing and in-kind contributions, leaving only a few legal points requiring resolution during the final lawyers' meeting to review the text for coherence and internal consistency..

With this achievement, the Delegations are pleased to declare that their work is finished, opening the way towards concluding the negotiations at political level.

INAUGURATION OF ITER JOINT WORK SITE CADARACHE

The ITER Joint Work Site in Cadarache was inaugurated on Thursday, 15 December 2005 by a ribbon-cutting and olive-tree-planting ceremony, in the presence of regional politicians and representatives of the embassies and consulates of the ITER Parties.

Pascale Amenc-Antoni, Director of the CEA Cadarache Centre, welcomed the participants to the ceremony and gave an overview of the facilities put in place to host the ITER team. Didier Gambier, representing the European Commission, welcomed the representatives of the ITER Parties and assured ITER of continuing European support.

Kaname Ikeda, Director-General Nominee, made an immediate impression on the regional politicians by expressing, in French, his joy at the opportunity to start working at Cadarache on such an important project.

Dr. Werner Burkart, Deputy Director General of the IAEA, spoke of an historic event, in an historic year for the IAEA, and expressed his satisfaction at the progress in the ITER project.

Finally, Dr. Michel Chatelier, Head of the fusion department in Cadarache, said that he looked forward to hosting the ITER team and a fruitful cooperation.

The Joint Work Site offices will start to be occupied from January 2006 onwards.

D. Gambier cuts the ribbon held by K. Ikeda to open the ITER Joint Work Site in Cadarache in the presence of P. Amenc-Antoni, W. Burkart and regional politicians

NINTH MEETING OF THE ITPA TOPICAL GROUP ON DIAGNOSTICS

by Drs. A.J.H. Donné, FOM Institute for Plasma Physics Rijnhuizen, and A.E. Costley, ITER International Team

The Ninth Meeting of the ITPA Topical Group (TG) on Diagnostics was held at the National Fusion Research Centre (NFRC), Daejeon, Korea, from 10–14 October 2005. It was the first ITPA TG meeting to be held in Korea. The meeting was combined with a meeting on diagnostic developments on-going in Korea, which was held on 11 October. About 50 participants attended the meeting and all six ITPA partners were represented. Special sessions were devoted to the measurement requirements of ITER parameters and their justifications, to progress in the research on first mirrors, and to progress in the field of fusion product measurements.

The meeting was opened by Dr. Shin, president of the NFRC. Dr. Shin welcomed the delegates to Korea. He emphasized the need for fusion power and outlined the recent developments and plans for fusion research in Korea. This opening address formed an excellent introduction to the presentations and discussions of the TG.

During the meeting on diagnostic developments on-going in Korea, the Korean scientists presented their work on a variety of diagnostic systems. From the presentations and discussions it is clear that the interaction between the members of the TG and the Korean scientists working on diagnostics will be mutually beneficial: the Korean scientist can benefit from the knowledge base on diagnostics available within the ITPA TG, while much can be learnt from the engineering aspect of the KSTAR project which will be useful in the implementation of diagnostics on ITER (for example, the access to the plasma via the long cassettes).

The progress in the working tasks of the ITPA TG on Diagnostics, designated as high priority, was reviewed. Generally good progress has been made.

1. One of the outstanding topics in ITER diagnostics is the determination of the optimum way to measure the spatial emission profile of alpha particles and neutrons. Such measurements are typically made using neutron cameras. These are devices that measure the neutron emission along specific lines of sight, and views in two different directions, usually radial and vertical, are needed. Installation of a radial viewing camera is feasible on ITER but one viewing in the vertical direction looks especially difficult and current

work is focused on this problem. The most promising option has the collimators and detectors installed in a divertor port and the plasma is viewed through (enlarged) gaps between the divertor cassettes and the blanket modules. The integration issues are thought to be manageable although further detailed work is needed, for example an assessment of the neutron streaming. Work on the modelling of the neutron emission profile to be expected in plasmas heated by ion cyclotron resonance heating is in progress and is relevant to the motivation for the two dimensional neutron measurements. A new vertical viewing neutron camera has been implemented at JT-60U to study the potential asymmetries in the neutron emission profile and the impact of abrupt large amplitude plasma events on the neutron distribution. In combination with the measurements obtained on JET, this will provide valuable information on the need for, and benefits of, the two dimensional measurements.

2. The measurement of the confined and escaping alpha particles formed in the fusion reactions is another difficult area. The design of a microwave collective Thomson scattering (CTS) system for ITER, aimed specifically at measuring the confined alphas and other fast ions, has been further developed in Europe and most of the integration problems have now been solved. In parallel, the CO_2-laser system for CTS measurements at JT-60U is being upgraded to higher power. First measurements with this system are expected in 2006 and should give additional information on the value of such a system for ITER. New high efficiency bubble detectors have become available and may enhance the prospects for knock-on neutron measurements, which can be related to the confined alpha particles, with these rather compact devices.

3. All the optical diagnostics and many of the spectroscopic diagnostics have a mirror as their first optical element. The mirror faces the plasma and is subjected to high levels of radiation (both neutrons and electromagnetic) and potentially bombardment with energetic particles. It can suffer erosion and/or deposition. The lifetime of these mirrors is a critical aspect of the diagnostic design. A wide range of research on this problem is underway and a special session on the topic was held in the meeting.

   Very encouraging results have been achieved in dedicated (joint US/EU) experiments at DIII-D. Heated molybdenum mirrors (85-140ºC) have been positioned in the divertor and did not suffer from carbon deposition despite significant exposure in the deposition-dominated conditions. On the other hand, work in Japan with polycrystalline tungsten mirrors that have been exposed to bombardment with He^+ ions from a source showed that the reflectivity can be strongly reduced due to formation of bubbles, blisters and holes. It is still to be investigated what this implies for ITER. A direct comparative experiment in the TEXTOR tokamak has confirmed that single crystal molybdenum mirrors preserve their optical properties under erosion whereas a significant degradation of the reflectivity (increase of the diffuse component) is observed for polycrystalline mirrors.

   The first mirror work is generally gaining momentum and various machines are trying to set up well-controlled experiments. Development of models to simulate the processes involved, however, is urgently needed: a predictive capability is required in order to be able to design mirrors which will have a long lifetime in the ITER environment. Efforts are being made to interest specialists working on edge and first wall modelling in this problem. The First Mirror WG (working group) has drafted a proposal for a well-controlled experiment and submitted it for consideration in the ASDEX-Upgrade experimental programme. The proposal is supported by the TG. Furthermore, a proposal will be made to the ITPA/IEA meeting on joint experiments to include in them the testing of first mirrors.

4. The measurement of magnetic fields in ITER is not straightforward due to the long duration of the ITER pulses, combined with radiation-induced effects in the measurement coils. An extensive design task is on-going in the EU. Specific magnetic coil designs are studied in detail (mechanical deformation, thermal stresses, irradiation effects, etc.). New types of integrators for magnetic coils are being developed at JAEA, Japan. The integrators are designed such that saturation, caused by excessively high voltage during disruptions, is avoided. Also for KSTAR, new integrators are being developed that are compatible with long pulse operation.

5. The IT study group, which is attempting to develop a strategy for dealing with the potential problems arising from dust, has developed preliminary requirements for dust measurements. Although further development of the requirements is needed, and will be done by the TG interaction with the study group, the requirements should enable a first selection and conceptual design of candidate devices for the dust measurements.

The design of an optical laser radar system for erosion measurements has been further improved. It is important that the system is tested under ITER-relevant (erosion) conditions. Also the mechanical adjustment requirements in the ITER environment should be assessed.

In the special session on measurement requirements, a detailed presentation was given of all the recommendations for changes in the requirements that have been suggested in the wide-ranging review that has been carried out involving all the ITPA TGs. The areas have been identified where there may be significant shortfalls between what is requested and what can potentially be measured. These have been defined as 'potential issues' and will be worked on in the next steps.

The requirements and justifications for fast-particle measurements have been further developed in close collaboration with the ITPA TG on Steady State Operation and Energetic Particles. Also the requirements for pressure measurements by means of a residual gas analyzer (RGA) have been developed and detailed.

Representatives from the ITER Parties' Participant Teams (PTs) reported steady progress for many diagnostic techniques that are ITER-relevant. Only three months after the decision on the ITER site, it is evident that many scientists working on diagnostics in the various PTs are becoming more aware of the problems and challenges of implementing diagnostics on ITER although thus far the dedicated development of systems for ITER is limited. Some examples of recent work presented at the meeting are: mitigation of deposition on mirrors and windows (CN), core plasma charge exchange recombination spectroscopy on the ITER diagnostic neutral beam (EU), divertor impurity flux monitor (JA), X-ray crystal spectrometer (KO), laser-induced fluorescence for the ITER divertor plasma (RF), and deposition effects on heated mirrors (US/EU collaboration).

The Chinese HL-2A group has joined the International Diagnostic Database (IDD). The TEXTOR team has been particularly active in adding information on new diagnostics. The IDD now contains information on 309 diagnostics from 21 different machines.

The possible location and date of the 10th Meeting of the ITPA TG on Diagnostics was discussed. It is provisionally proposed to hold the meeting in Moscow, Russian Federation from 10th–14th April 2006. A special session on fusion-product diagnostics will be organized (which will be focussed on an assessment of the measurement capability for confined alpha particles and for the neutron emission profile, as well as on the calibration strategy). The meeting will be combined with a one-day progress meeting on ITER-relevant diagnostic developments on-going in the Russian Federation. Also a proposal was made for the location of the 11th Meeting of the TG. This meeting is provisionally planned to be held in Sendai, Japan in the fall of 2006.

The meeting ran smoothly due to the excellent organisation of the host, and all participants are grateful to the NFRC in Daejeon for its hospitality and they express their explicit gratitude to Drs S.J. Yoo and H.G. Lee, and Mrs. J.Y. Chung for their care and attention to all the meeting arrangements.

Participants at the Ninth Meeting of the ITPA Topical Group on Diagnostics

Members of Topical Group on Diagnostics

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Tony Donné (FOM, Netherlands, EU)
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Kazuo Kawahata (NIFS, JA)
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Anatoli Krasilnikov (TRINITI, RF)
Yoshinori Kusama (JAEA, JA)
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Mamiko Sasao (NIFS, JA)
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Suk Jae Yoo (NFRC, KO)
Qingwei Yang (SWIP, CN)
Victor Zaveryaev (Kurchatov, RF)
Yan Zhou (SWIP, CN)
Wonho Choe (KAIST, KO)

Guests and Attendees at the Topical Group Meeting

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Joo Shik Bak (NFRC, KO)
Nick Balshaw (UKAEA, UK, EU)
Robin Barnsley (ITER IT, Garching)
Claude Boucher (INRS, Canada – via FZJ, EU)
Marco Cecconello (EFDA, Germany, EU)
Mun-Seong Cheon (SNU, KO)
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Participants at the Ninth Meeting of the ITPA Topical Group on Diagnostics

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