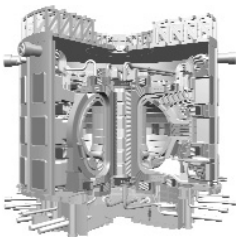

ITER CTA NEWSLETTER

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ITER BACKGROUNDER [1)]

- **ITER, which means "the way" in Latin, is an international fusion energy research and development project with the goal of taking the next major step in the development of fusion energy as a safe, clean and sustainable energy source for our planet.**

- **Fusion is the energy that powers the sun and the stars. Research into fusion has been conducted since the 1920s [2)], and recent advances have renewed interest in the technology. It is inherently safe and clean - any change in the process will result in an immediate shutdown and no fuel waste or greenhouse emissions are produced.**

- **ITER would be the world's largest international co-operative research and development project next to the International Space Station and would be constructed for approximately US $4 billion over 10 years and operated for about the same amount over 20 years.**

- **The ITER organization was launched in 1985 by Mikhail Gorbachev, Ronald Reagan and other world leaders. The design of ITER required an investment of US $1.5 billion and was completed in 2001. Negotiations began in November 2001 towards the implementation of the project - where it will be built, how the costs and procurement responsibilities will be shared, and how it will be managed and operated. The current ITER participants are Canada, the European Union, Japan and the Russian Federation.**

- **Four offers to host ITER have been submitted. The first was from Canada, with an offer to host ITER at its Clarington site near Toronto, submitted on 7 June 2001. On 5 June 2002, three additional site offers were submitted, -two from the European Union including one at Cadarache, France, and one at Vandellos, Spain, and one offer from Japan at Rokkasho-mura in Aomori Prefecture.**

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1) This backgrounder was approved as an official document by the participants in the Negotiations on the ITER Implementation Agreement at their fourth meeting, held in Cadarache on 4-6 June 2002.

2) Following the development of relativity and nuclear physics, it was conjectured in the early 1920s that the fusion of hydrogen atoms to form helium with a consequent small loss of mass

THIRD MEETING OF ITER PARTIES' DESIGNATED SAFETY REPRESENTATIVES

by Charles Gordon, Group Leader, Safety, Environment & Health, ITER International Team

The third meeting of the ITER Parties' Designated Safety Representatives took place in Cadarache on 6-7 June 2002. These meetings were agreed by the ITER Council and confirmed by the Negotiators on the ITER Joint Implementing Agreement to allow the Parties' Designated Safety Representatives, representatives of Parties' regulatory authorities and the International Team (IT) Leader to jointly consider potential issues for licensing ITER and to define the expected sequence of steps towards its fulfillment. Previous meetings were held in Garching in October 2000 (see Vol. 10, No. 3) and in Tokyo in May 2001 (see Vol. 10, No. 7).

Key points from the previous meetings include:

- At the time of the decision to sign the International Agreement, all Parties "should have confirmation that ITER can be licensed in the Host Country (and that the licensing process would not be unduly vulnerable to challenge)", as outlined in the ITER SWG-P2 Report.
- The Participants will need to rely on the Design Authority to give assurance of the ability of the design to fulfill the requirements for licensing based on the dialogue with the regulatory authority in each potential Host Country.
- Design Authority continuity is needed to integrate commitments into the design.
- The principles, criteria, and quality assurance to be applied to ITER have been generally agreed.

At this meeting, representatives from all four proposed sites (Canada, France, Japan, Spain) presented an update on their domestic activities. Discussions focused on progress related to the schedule for regulatory approval; regulations, design codes and standards to be applied and potential issues identified so far during informal discussions.

Good progress is being made towards regulatory approval: in Canada, a Letter of Intent has been submitted formally notifying the regulator of the possibility of building ITER, a licensing plan with a schedule of submissions has been provided, and the scope of the required environmental assessment has been approved by the Canadian Nuclear Safety Commission. Work is under way on technical studies for the environmental assessment and to prepare a preliminary safety report. In France, a Dossier d'Options de Sûreté (Safety Options Report) has been submitted to the safety authorities, first comments/questions have been received, and a formal letter from the French Nuclear Safety Authority is expected in late 2002. Work is under way on preparing the Rapport Préliminaire de Sûreté (Preliminary Safety Report). In Japan, technical standards to support ITER construction are being prepared in parallel with the drafting of the regulatory system to be applied to ITER following the previously agreed "Fundamental Approach for Ensuring ITER Safety" and statements of the Nuclear Safety Commission. In Spain, the existing regulatory environment can be applied to a fusion facility, and efforts are under way to provide a detailed regulatory process and prepare the necessary documentation.

Some of the potential licensing issues raised by one or more potential Hosts include:

- identification of safety-relevant systems and their requirements;
- coherence of licensing submissions with design and supporting assessments;
- demonstration of application of the ALARA (as low as reasonably achievable) principle;
- demonstration of feedback of lessons from similar facilities;
- human factors incorporation into the design and operation;
- justification of design codes and standards;
- justification of materials for safety-relevant components;
- information on operating organization, including structure and technical control over safety aspects;
- quality assurance and the management of quality.

To help define the work of the IT, the IT Leader requested each potential Host to provide the contents of required regulatory submissions in sufficient detail to identify where further work is required, so that common elements that are needed regardless of site can be prioritized.

The timing and objectives for further meetings depend strongly on the progress made and the needs of the Negotiators.

Participants in the Meeting

LIST OF PARTICIPANTS

CA PT
L. Colligan (Canadian Nuclear Safety Commission)
K. Moshonas (Iter Canada)
R. Hemmings (Canatom NPM Inc.)

EU PT
F. Alcala (CIEMAT, Spain)
J. Cahen (Autorité de sûreté nucléaire, France)
A. Gea Malpica (Nuclear Safety Council, Spain)
W.Gulden (EFDA)
G. Marbach (CEA, France)
M. Sanchez de Mora (CIEMAT, Spain)
B. Sevestre (CEA, France)

JA PT
S. Aoyama (Ministry of Education, Sports, Culture, Science and Technology)
M. Mori (JAERI)
E. Tada (JAERI)
T. Tsunematsu (JAERI)

RF PT
O. Filatov (Efremov)
S. Morozov (Federal Nuclear and Radiation Safety Authority)
B. Kolbasov (Kurchatov)

ITER International Team
R. Aymar
Y. Shimomura
C. Gordon

SECOND MEETING OF THE ITPA TOPICAL GROUP ON DIAGNOSTICS

by Drs. A.J.H. Donné (Group Chair), FOM Institute for Plasma Physics Rijnhuizen, and A.E. Costley (Group Co-Chair), ITER International Team

The second meeting of the International Tokamak Physic Activity (ITPA) Topical Group (TG) on Diagnostics was held at General Atomics, San Diego, USA, on 4-8 March 2002. The meeting was combined with a Progress Meeting on Burning Plasma Experiment (BPX) relevant diagnostic developments in progress in the USA, which was held in the same location on 4 - 6 March 2002. The meeting included joint sessions with the Divertor and Scrape-off Layer TG, and the Transport and Internal Transport Barrier TGs, devoted to the development of the requirements for measurements in the divertor region and for the evaluation and understanding of transport, respectively. In total 30 participants attended the meeting and all four ITPA partners were represented. This summary covers mainly the discussions at the TG meeting.

The key topics reviewed and discussed at the TG meeting were:

- the overall status of diagnostic development for ITER, FIRE and IGNITOR;
- the progress in the research on the designated high priority topics;
- the progress on some key BPX/ITER relevant diagnostic developments in the ITPA participant laboratories;
- the progress and plans for the work of the specialist working groups;
- the progress on the action items from the previous meeting of the ITPA TG on Diagnostics; and
- the conclusions of the meeting of the ITPA Co-ordinating Committee (CC) and the consequences for the work of the TG on Diagnostics.

A proposal for the third meeting of the TG was developed.

Participants in the Meeting

The requirements for measurements on ITER have now reached an advanced state of development and are tightly coupled to the programmatic objectives for the machine. Work at the detailed level of requirements for FIRE has now begun. Detailed measurement requirements have yet to be developed for IGNITOR. The situation is similar with the diagnostic designs and integration.

The report on the work of the Diagnostic TG in 2001 was well received at the ITPA CC meeting, and the charter of the Diagnostic TG, as well as the proposed high priority tasks for 2002, was approved. The chairmen of the MHD, Disruption and Control group and the Energetic Particles, Heating and Current Drive group committed their groups to working with the Diagnostic TG to further develop the requirements for measurements in their particular areas. It was suggested that there should be a cross-group working activity to develop the needs and capabilities for plasma control on a BPX, although no precise plans were made. The Diagnostic TG would be involved in this activity.

Since the last ITPA Diagnostic TG meeting, good progress has been made in the tasks designated as high priority.

1. The requirements for plasma and target measurements in the ITER divertor region have been further developed in collaboration with the ITPA TG on Divertor and Scrape-Off Layer (SOL) Physics. Some key issues have been resolved and for many parameters there is a now a reasonable match between the requirements for measurements and the anticipated measurement capability. However, some issues remain unresolved. In particular the measurement of electron temperature (Te) in the divertor looks very difficult even in the outer leg, and presently there are no measurements of Te and electron density (ne) in the inner leg. Measurements in the inner region are regarded as important, in particular for understanding and optimizing divertor performance. The interaction with the Divertor and SOL TG will be continued.

2. Recent measurements of Radiation Induced Electromotive Force (RIEMF) in plain cables made on the Japanese Fusion Neutronics Source (FNS) show a small steady current (5 pA) but a large transient peak (up to 100 pA) at turn-on and turn-off of the neutron source. Extrapolation of the steady current to ITER conditions would confirm that RIEMF would not be a serious problem in the magnetic measurements. The transient level cannot be extrapolated reliably so must be investigated in future work. The key repeat test in a reactor (neutrons and gammas with ITER-relevant flux/fluence levels) remains outstanding. This test is planned for December 2002.

3. Progress has been made in the implementation of systems for the measurement of the safety factor (q(r)) on ITER. Feasibility studies of the poloidal polarimeter have been carried out for a number of different ITER scenarios, with the principal conclusion that the signals and the signal variations are large enough at the chosen probing wavelength (118 microns) to make the measurement feasible. Some sight lines through an upper port have been considered but their benefit is yet to be fully determined. Detailed studies have been performed on the depolarization effects of the first mirror, utilized in the Motional Stark Effect (MSE) system, as well as on novel methods to account for these effects. A recent study of a combined Charge Exchange Recombination Spectroscopy/Beam Emission Spectroscopy/MSE system for ITER utilizing the Diagnostic Neutral Beam (DNB) has indicated that this system can also provide the internal magnetic field, provided the beam is observed from an adjacent top port.

4. A novel diagnostic to measure the magnetic pitch angle and, hence q(r), has been proposed. This technique is based on the observation of secondary charge exchange emission of neutral particles from the DNB and seems to be feasible from the physics point of view, but implementation on a BPX looks extremely difficult because of the requirement to measure particles escaping at various angles in an upward direction.

5. Progress has been made with the plasma-facing mirrors for optical systems. Based on the results of simulation experiments, recent calculations of the eroded layer thickness due to the flux of charge exchange atoms have indicated that first mirrors made of monocrystalline materials or thin metal films on a metal substrate will survive if sputtering is the dominant effect. The role of deposition on windows and mirrors for the core plasma is less clear and dedicated studies are needed at present day large-scale fusion devices. A mirror test will be implemented in the divertor and in a mid-plane port duct of JET. There

are no major problems expected with second mirrors fabricated as metal film on metal substrate except possible redeposition of eroded first wall or duct material. It was suggested that collaboration in the field of erosion/redeposition should be stimulated with the ITPA Boundary TG.

6. The proposal to raise the development of diagnostic techniques for the measurement of confined and escaping alpha particles to a high priority issue was accepted by the CC. The ITPA TG should take an active position in recommending specific pilot tests of potential alpha particle diagnostics on present day devices. It was pointed out in discussion that the presence of 1 MeV deuterium heating beams will cause a considerable background for both the knock-on tail alpha measurements and the collective Thomson scattering measurements, which will severely hamper measurements of the alpha population with these diagnostic techniques.

Progress has also been made in other areas. A considerable effort is under way to document the reasons behind the choice of parameters, resolutions, accuracies, etc. for the measurements on ITER and FIRE, and to connect this justification with the detailed measurement requirements. Initial work to set up a database including the typical time- and length scales of all types of plasma events has been carried out and the proposal is to connect this database to the list of measurement requirements via the justification. A wide involvement of all the other ITPA TGs is being sought in the development of the justifications and the specifications.

The measurement requirements for transport and ITB physics were discussed in the joint session with the Transport and ITB TG. It was recommended that the target spatial resolution for the measurements of the profiles of q, Ti and the impurity profiles should be raised to a/30, where a is the plasma minor radius. Measurements of fluctuating parameters are thought to be indispensable for a better understanding of alpha-driven instabilities that might have a negative effect on the confinement, but the requirements need better definition. It was agreed that the Transport and ITB TG will critically assess the existing measurement requirements and report back to the Diagnostic TG.

Since the previous meeting of the Diagnostic TG, a number of diagnostics have been added to the International Diagnostic Database (IDD), including some from machines which were not previously represented (LHD, DIII-D, Alcator C-Mod). Moreover, the information on many diagnostics has been updated. The database presently contains information on 116 diagnostics from 15 different machines. Addition of information on new diagnostics and information updates of diagnostics that are already in the database are actively stimulated. Responsible Officers will be appointed for the various institutes.

The Parties reported steady progress for many diagnostic systems that are relevant to a BPX, for example the development of a rotation probe for stationary magnetic field measurement on LHD; the development of a reflective system for plasma viewing on JET; the above-cited first mirror test, which is part of a programme of development of ITER-relevant diagnostics on JET; LiF-enhanced MSE at NSTX; and time-of-flight refractometry in Troitsk.

The Specialist Working Groups reported on progress in their specific fields since the previous meeting. The charter for a new Specialists Working Group on Radiation Effects was discussed and adopted, and it was agreed that the Parties will put forward nominations for members to this working group.

A very productive progress meeting on BPX-relevant diagnostic developments in the USA was held as a break-out session of the TG Meeting. Much highly relevant diagnostic work was presented.

It is proposed to hold the third Meeting of the ITPA TG on Diagnostics in Toki from 17 to 21 September 2002. The meeting will be combined with a Progress Meeting on BPX-relevant diagnostic developments in Japan.

Both meetings held in San Diego ran smoothly, and the participants are grateful to General Atomics for its hospitality and express their gratitude to Dr. Réjean Boivin and Mrs. Lupe Cerda and their colleagues for their care and attention to all the meeting arrangements.

Attendees at the Second ITPA Topical Group Meeting on Diagnostics

Members of the Expert Group

Rejean Boivin (GA, USA)
Alan Costley (ITER Int. Team, EU)
Tony Donné (FOM, Netherlands, EU)
David Johnson (PPPL, USA)
Anatolij Krasilnikov (TRINITI, RF)
Yoshinori Kusama (JAERI, JA)
George McKee (GA, USA)
Francesco Orsitto (EFDA JET-CSU, EU)
Tony Peebles (UCLA, USA)
Richard Pitts (EPFL, Switzerland, EU)
Mamiko Sasao (NIFS, JA)
Fernando Serra (IST, Portugal, EU)
Vyacheslav Strelkov (Kurchatov, RF)
Tatsuo Sugie (ITER Int. Team, JA)
Konstantin Vukolov (Kurchatov, RF)
Glen Wurden (LANL, USA)

Guests and Attendees at the Topical Group Meeting

David Brower (UCLA, USA)
Tom Carlstrom (GA, USA)
Ed Cecil (Colorado School of Mines, USA)
Ray Fisher (GA, USA)
Ruggero Giannella (CEA, France, EU)
Manfred von Hellermann (FOM, EU)
Tony Leonard (GA, USA)
Artur Malaquias (ITER Int. Team, EU)
Per Nielsen (RFX, Italy, EU)
Takeo Nishitani (JAERI, JA)
Joaquin Sánchez (CIEMAT, EU)
Tatsuo Shikama (Tohoku Univ., JA)
Dan Thomas (GA, USA)
George Vayakis (ITER Int. Team, EU)
Chris Walker (ITER Int. Team, EU)
Ken Young (PPPL, USA)

Items to be considered for inclusion in the ITER CTA Newsletter should be submitted to B. Kuvshinnikov, ITER Office, IAEA, Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: +43 1 2633832, or e-mail: c.basaldella@iaea.org (phone +43 1 260026392).

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