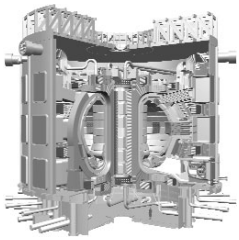

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ITER DELEGATION VISITS THE REPUBLIC OF KOREA

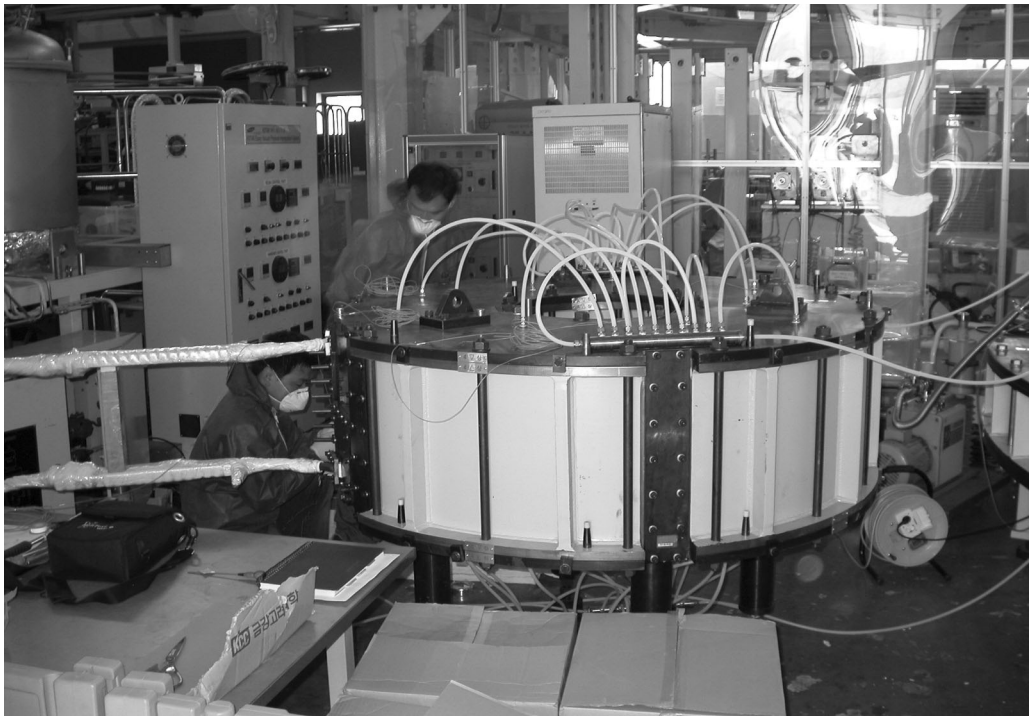
by Dr. R. Aymar, ITER International Team Leader

Following the expression of interest of the Republic of Korea in joining the ITER Negotiations, a technical delegation from the ITER International Team and the Participant Teams visited the country on 14 – 16 April 2003. The goal was to assess, through visits to laboratories and some relevant industries, the capability of the Republic of Korea to contribute – "in kind" – to ITER construction.

The Government and industries of the Republic of Korea support a large and permanent investment in research (at the level of 4% of GNP), as the primary source of future economic growth. Technical education and training are actively encouraged and supported by industry and the Government.

There is presently in the Republic of Korea a strong interest at Government and industry levels in supporting fusion research within the framework of the long term development of alternative energy supplies. The large investment in the Korean Superconducting Tokamak (KSTAR), a very ambitious project from a previously very limited programme, is a concrete demonstration of this interest and the expression of interest to participate in ITER follows the same line.

The ITER delegation, composed of R. Aymar, Y. Shimomura, V. Chuyanov, R. Haange, and K. Ioki from the IT, and M. Araki, and C. Sborchia as JA and EU Experts, visited the laboratories and industries listed on page 2.



*Preparation for testing of a superconducting coil for KSTAR *)*

– Pohang Accelerator Laboratory (PAL), Pohang
– Hyundai Heavy Industry (HHI), Ulsan
– Doosan, Changwon
– KSTAR Experimental Facility in the Korean Basic Science Institute (KBSI), Daejeon
– Magnet Laboratory of KBSI and the Korean Atomic Energy Research Institute (KAERI), Daejeon

The choice of the places visited was intended to show the delegation the development or the manufacture of KSTAR components.

- PAL is involved in the development of additional heating power supplies (lower hybrid and electron-cyclotron frequencies). Pohang Steel Company (POSCO), the owner of Pohang University which includes PAL, is in charge of the pulsed and steady state power supplies for KSTAR.

- HHI is presently manufacturing one prototype sector of the KSTAR vacuum vessel, one prototype of the TF coil case, and the KSTAR cryostat.

- Doosan is a large industrial company – which acts as a prime contractor – for most of the nuclear power plants in the Republic of Korea.

- KAERI, which has been involved previously in fusion research with two small tokamaks, is now responsible for the NBI and ICRH systems for KSTAR. Its dedicated Fusion Laboratory is presently conducting experiments with a prototype NBI system of 8 MW – and up to 120 kV, similar to the TFTR design, and a test stand for ICRH antennas, similar to the Tore Supra concept.

- The Magnet Laboratory has been set up by Samsung and transferred to KBSI. It is now used for the manufacture and testing of the Nb3Sn winding for the TF and some PF coils of KSTAR. The conductor is produced by Samsung at other facilities, with a square, longitudinally welded Incoloy jacket and strands drawn in-house following guidance by Outokumpu/IGC and Mitsubishi, which have supplied the base ingots.

- In KBSI, the new Fusion Laboratory, built for KSTAR, was inaugurated in November 2002. It includes all buildings and facilities around the torus hall, similar in concept and size to the NIFS laboratory in Japan.

*Members of the ITER delegation with staff of the Magnet Laboratory of KBSI in front of the lab building *)*

On the basis of information received during these visits to laboratories and industries, the ITER delegation came to the conclusion that:

- ❍ The collaboration between industrial companies and research institutes, the former sometimes being the owner of the latter, seems close and efficient.

- ❍ Companies in the Republic of Korea (at least those visited) are efficient and strongly competitive on the worldwide market.

- ❍ The industrial capabilities and expertise in the Republic of Korea are certainly adequate for the design and manufacture of "conventional" ITER components.

- ❍ As the commissioning in the Republic of Korea of a facility for tritium separation from the heavy water of the existing four CANDU reactor units is scheduled to start in 2004, with an expected annual tritium production of 0.8 kg, the possibility of using tritium from the Republic of Korea for ITER operation should be considered.

On the last day of the visit, the ITER delegation met with the Ministry of Science and Technology (MOST) Director General of Basic Science, Dr M.K. Lee, and several executives of MOST, KAERI, KBSI and Hyundai at the Government complex in Seoul/Gwacheon. This meeting offered the first opportunity to talk about the possible contribution of the Republic of Korea to ITER construction.

At that time, only the principle of the participation of the Republic of Korea in ITER was planned for a decision by the May meeting of the National Commission on Science and Technology (NCST) chaired by the President. Therefore, the Ministry was not yet in a position to discuss the possible technical content of its contribution.

Dr J.H. Shin, former president of KAERI, and now head of the Korean Nuclear Society and of the newly formed Korea Fusion Industry and Technology Association (KFITA), expressed the interest of industry and emphasized the fact that strong project management and engineering could be supplied by companies in the Republic of Korea. Dr. G.S. Lee of KSTAR/KBSI indicated that areas of interest for the Republic of Korea could be: project management and integration, and some contribution to the manufacture and testing of magnets, power supplies and controls (in Dr. Lee's opinion the balance of plant should be contributed by the Host Party), besides the future contributions of KSTAR in basic physics research.

Finally, the Director General concluded that the review of the ITER procurement packages and their costs, with a view to a possible contribution on the part of the Republic of Korea, will be conducted by MOST, in cooperation with industrial companies, soon after the approval by NCST.

The ITER delegation stressed the urgency of this preparation for an efficient participation by the Republic of Korea in the ITER Negotiations, if so decided.

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*) Photos by courtesy of Masanori Araki

FOURTH 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 Fourth Meeting of the International Tokamak Physics Activity (ITPA) Topical Group (TG) on Diagnostics was held at ENEA-CNR, Padova, Italy, from 18 to 21 February 2003. The meeting was combined with a progress meeting on diagnostic developments in progress in Europe which are relevant to ITER and more generally to burning plasma experimental (BPX) devices. A special 1.5 day session was organized to discuss the need for alpha measurement requirements and to review possible alpha diagnostic techniques. In total 60 participants attended the ITPA and/or progress meetings and all four ITPA partners were well represented.

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

– the detailed measurement requirements for ITER along with their justifications;
– the overall status of diagnostic development for ITER and the US BPX device, FIRE;
– the progress in the research on the designated high priority topics;
– the progress with 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 status and plans for the International Diagnostic Database.

Good progress has been made in the tasks designated as high priority.

1. On ITER and BPX devices it is anticipated that it will be necessary to measure

   (a) the alpha source birth profile,
   (b) the number density and energy of the confined energetic alphas, and
   (c) the flux of escaping alphas.

   It will also be necessary to measure the alpha ash and to be able to study any instabilities stimulated by the presence of the alphas. The requirements for measurements and the candidate techniques are different in each case. In the preparations for the meeting the requirements for the measurements were further developed, and the revised requirements were discussed and agreed at the meeting. Discussions on techniques were concentrated on measurements (a), (b) and (c).

   The principal technique for measuring the alpha source profile is 2D neutron tomography. Conventionally this is carried out with a radial and vertical view neutron camera but on ITER severe interface difficulties will probably prevent the implementation of a camera viewing from above the machine. Alternatives were presented and discussed at the meeting. Considerable further work on these possibilities is necessary.

   Possibilities for diagnosing the confined alphas include collective Thomson scattering (CTS), knock-on-tail measurements, gamma ray spectrometry, and charge exchange recombination spectroscopy (CXRS). There are difficulties of implementation and interpretation in each case. A key question is whether it is necessary to distinguish the alpha particles from energetic deuterons from the heating beam, which have the same charge to mass ratio (q/m), and it was decided to raise this question with the other ITPA TGs. New measurement techniques have also been proposed. Possibilities for measuring the escaping alphas include IR camera imaging, Faraday cup detectors and scintillators. The latest developments in all these techniques were presented and discussed.

   Further development is necessary in almost all areas of this topic and for this reason the TG has strongly endorsed the planned alpha particle simulation experiments in JET in which several key diagnostic developments are expected.

2. New measurements with two prototype magnetic coils under irradiation have been carried out at the Japanese Material Test Reactor (JMTR). The latest data show a number of unexpected results. These include an initial high level of effective asymmetry for one of the coils and a marked increase of the induced voltage with fluence for both coils. In addition to the RIEMF mechanisms, it was suggested that generation of thermocouples due to local changes in the thermoelectric coefficient, caused by transmutation and/or defect generation, could also contribute particularly to the last observation. The effect, whatever the cause, is significant, and further tests are needed and are planned.

3. The measurement requirements and justifications for ITER have been reviewed by the other ITPA TGs, and many suggestions for changes and additions have been received. A procedure to review and adopt these has been agreed and liaison officers to carry the developments forward have been appointed.

4. Progress continues with the plasma facing mirrors. Several experiments are presently being set up or conducted, including a comprehensive set of mirror test modules that will be implemented in the JET divertor and at the low field side. Extensive testing of the effects of erosion, deposition and laser damage

of mirrors has been carried out in the RF. Mirror test samples have been exposed to the T-10 plasma and subsequently analyzed.

The parties reported steady progress for many diagnostic techniques that are relevant to a BPX. A very productive progress meeting on ITER/BPX relevant diagnostic developments in the EU was held, with many excellent contributions. The Specialist Working Groups reported on progress in their specific fields since the previous meeting. Because of the broadness of the field of spectroscopy diagnostics, it was decided to launch a new group on CXRS, Beam Emission Spectroscopy (BES) and NPA.

Since the third meeting of the TG on Diagnostics, many diagnostics have been added to the International Diagnostic Database (IDD). Especially the numerous new diagnostics added by the DIII-D and ASDEX-UG teams should be highlighted. The database presently contains information on 208 diagnostics. The addition of information on new diagnostics and information updates of diagnostics that are already in the database continues to be actively stimulated.

The fifth meeting of the ITPA TG on Diagnostics is scheduled to be held in St. Petersburg, Russian Federation, from 14 to 18 July 2003, immediately after the EPS conference. The meeting will be combined with a one-day joint session with all other ITPA TGs on control issues. The meeting will also be combined with a Progress Meeting on ITER/BPX relevant diagnostic developments in progress in the Russian Federation.

Both meetings held in Padova ran very smoothly, and the participants are grateful to ENEA-CNR for its hospitality and express their explicit gratitude to Dr. Per Nielsen and his colleagues for their care and attention to all the meeting arrangements.

Members of Topical Group on Diagnostics

Rejéan Boivin (GA, USA)
Alan Costley (ITER Int. Team, Naka, JA)
Tony Donné (FOM, Netherlands, EU)
Hans Hartfuss (IPP-MPG, Greifswald, EU)
David Johnson (PPPL, USA)
Yasunori Kawano (JAERI, JA)
Anatolij Krasilnikov (TRINITI, RF)
Yoshinori Kusama (JAERI, JA)
Francesco Orsitto (JET, EU)
Tony Peebles (UCLA, USA)
Mamiko Sasao (NIFS, JA)
Fernando Serra (IST, Portugal, EU)
Konstantin Vukolov (Kurchatov, RF)
Glen Wurden (LANL, USA)
Victor Zaveriaev (Kurchatov, RF)

Participants in the Topical Group Meeting

Guests at the Topical Group Meeting

Robin Barnsley (UKAEA, UK, EU)
Francis Berghmans (SKN/CEN, Belgium, EU)
Luciano Bertalot (ENEA-Frascati, Italy, EU)
Henrik Bindslev (Risø, Denmark, EU)
George Bonheure (ERM/KMS, Belgium, EU)
David Campbell (EFDA-CSU, EU)
Patrick Carolan (UKAEA, UK, EU)
Susana Clement-Lorenzo (EC, EU)
Ivan Duran (IPP-CSA, Czech Rep., EU)
Trevor Edlington (UKAEA, UK, EU)
Ray Fisher (GA, USA)
Giuseppe Gorini (ENEA-Milan, Italy, EU)
Manfred von Hellermann (FOM, Netherlands, EU)
Albrecht Herrmann (IPP-MPI, Germany, EU)
Eric Hodgson (CIEMAT, Spain, EU)
Christian Ingesson (EFDA-CSU, EU)
Kiyoshi Itami (ITER Int. Team, Naka, JA)
Jan Källne (VR, Sweden, EU)
Vasili Kiptily (UKAEA, UK, EU)
Takahi Kondoh (ITER Int. Team, Naka, JA)
Artur Malaquias (IST-Lisbon, Portugal, EU)
Andrea Murari (JET, EU)
Per Nielsen (ENEA-RFX, Italy, EU)
Rudi van Nieuwenhove (SKN/CEN, Belgium, EU)
Roberto Pasqualotto (ENEA-RFX, Italy, EU)
Joaquin Sanchez (CIEMAT, Spain, EU)
Dan Sporea (IFIN, Romania, EU)
Umberto Tartari (ENEA-Milan, Italy, EU)
George Vayakis (ITER Int. Team, Naka, JA)
Ludo Vermeeren (SKN/CEN, Belgium, EU)
Vladimir Voitsenya (KIPT, Kharkov, RF)
Chris Walker (ITER Int. Team, Garching, EU)
Ken Young (PPPL, USA)
Klaus Dieter Zastrow (UKAEA, UK, EU)

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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