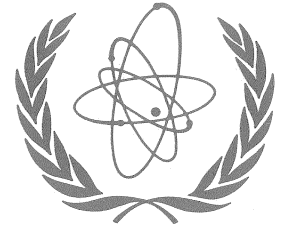


ITER EDA NEWSLETTER

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INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

ITER EDA STATUS REPORT

by J.M. Van Fleet, External Relations, ITER San Diego Co-Centre

The following is a summary of the progress in the ITER Engineering Design Activities as presented by the ITER Director, P.-H. Rebut, and noted by the ITER Council at its third meeting held 21-22 April 1993. Similar status reports are presented at each meeting of the IC.

The Director's report covered four areas: the status of the Design, the startup of R&D work, the Joint Central Team, and the Joint Work Sites (or Co-Centres).

Development of the Design

The Director reported on progress made in defining the essential features of the device. The preliminary Design of the ITER device was presented by the Director in the "ITER Project Outline Design Report" to the ITER Technical Advisory Committee (TAC) in March. The Council took note of the TAC report on the Design and concurred with their recommendations.

The main parameters of the Preliminary Design as presented by the Director are:

Parameter	Design Value
Toroidal field at nominal radius	6 T
Plasma current	25 MA
Nominal major radius	7.90 m
Minor radius	2.8 m
Elongation	1.6
Divertor configuration	Single null
Maximum toroidal field ripple at plasma edge	<2%
Burn time	1000 s at 25 MA
Fusion power;	
Normal operation	≈1500 MW
Extended operation	≈3000 MW

The Director commended the staff from the Parties who have been working with the JCT on the development of the design. This collaboration has demonstrated an encouraging model for co-operative design work at an informal level. The work to date has also helped to focus the R&D programme.

It will be essential to maintain the coherence of design as it develops at the three Joint Work Sites and in the Home Teams. The electronic management process system now under development will be an important tool in ensuring convergence.

The R&D Programme

The first statement of the Work Programme, which was presented to the ITER Management Advisory Committee (MAC), will be considered a preliminary statement and will evolve rapidly with the initial progress of the Technical Work.

Starting from the preliminary design work, the JCT is working with the Parties to define the R&D programme and to specify the Tasks. The main vector for this activity is technical meetings involving the JCT and Home Team staff and other experts, where preliminary aspects of the design are presented and possible lines of R&D are identified.

The subsequent formulation of specific Tasks in close interaction with the Home Teams is the priority activity for the JCT. Much detailed work is required to specify and draw up the Task Agreements. The JCT needs technical support at the three Sites and from the Home Teams for this purpose and to follow up on the progress on R&D tasks once allocated. A central aspect of the work to ensure coherence will be the definition of Quality Assurance (QA) standards and their integration into the R&D and Design work.

The Joint Central Team

At the first meeting of the ITER Council, it was agreed that a buildup of the Joint Central Team should be as rapid as possible and that the Parties should provide a total of 150 professionals to the JCT by the end of Protocol 1.

In assembling the Team, consideration has been given to the need both for balanced representation of the four Parties and for coherence in the startup of the work. The priority areas for assembling the Team at levels below group leader have been the Superconducting Coils and Structure, the Divertor, and the Vacuum Vessel. Given the need also to establish rapidly the Directorate and key Project Integration functions, this policy has been consistent with the objective to achieve a broad balance between the three Co-Centres.

As of mid-April 1993, some 540 nominations had been received. Of the 137 interviewed, 88 had been selected, 40 have arrived on site and 13 have completed their secondment procedures. For comparison, at the time of the second IC meeting, 34 JCT Members had been selected, 12 of whom had arrived on site.

Affecting this evolving situation is the large "pipeline" of secondment agreements and forms flowing through the system which require the collection of up to five geographically separated signatures.

While the ITER EDA has progressed through roughly 45% of the duration of Protocol 1, almost 60% of the total staffing agreed for the end of Protocol 1 had been selected. However, the number on site represented 26% of the agreed figure. It is important to increase the numbers arising on site in order to press forward with the technical work.

Once staff are selected, they are normally expected to be seconded and to arrive on site within three months of the date of selection. In some cases interim arrangements are made with the assigning Party to permit extended visits to the Joint Work Sites by the staff concerned pending their formal arrival.

The Joint Work Sites

Opening of the New ITER Building at Naka - The Director was pleased to report that the new ITER building for the ITER JCT at Naka had been completed and was now occupied.

Site Liaison - The development of the working environments between the JCT staff and the Host Organization staff at the three Joint Work Sites has progressed. Agreements have been reached with the three Host Parties on arrangements for liaison at each site between the JCT management, the Host Organization and the Host Party. Consultations between the Director and the Host Party of each site concerning the support and the conditions under which it is supplied continued.

Drawing Office Staffing - A crucial element of the support to the work of the Joint Central Team is the teams of CAD designers to be provided at each Joint Work Site to prepare and to modify drawings. The drawing office staff must be technically trained so that they can make basic mechanical assessments, exercise

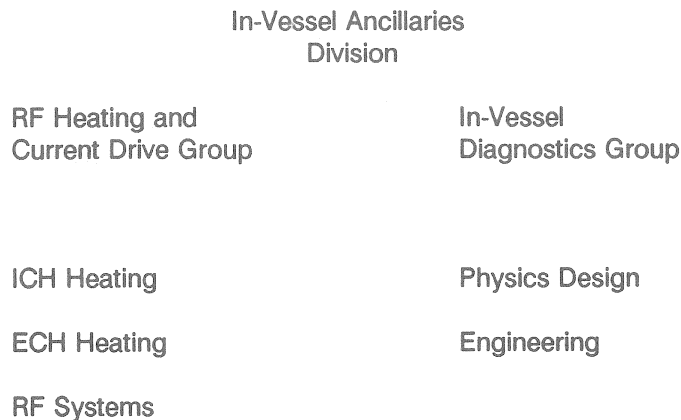
judgement on mechanical or interface problems and progress the work with limited supervision by the professional JCT Members. To date, each Host Party is committed to provide such support at a level of 7 CAD designers at each Joint Work Site.

The foundation has been laid, relationships have been constructed, and the Parties are prepared to deliver. The Director is pleased with the progress of the ITER EDA and confident that ITER will be built and fulfil its objective.

IN-VESSEL ANCILLARIES DIVISION

by Dr. T. Nagashima, Head, In-Vessel Ancillaries Division,
ITER Garching Co-Centre

The In-Vessel Ancillaries (IVA) Division at the ITER Garching Co-Centre at present consists of two units: the RF Heating and Current Drive Group and the In Vessel Diagnostics Group. Each of them has responsibility for the overall design of its respective system, as well as for the definition and monitoring of Research and Development (R&D) related to its area. The division structure is envisioned as shown in the figure below.



Organization Chart for the In-Vessel Ancillaries Division in Garching

The IVA Division Head, Dr. Takashi Nagashima, has been on site since mid November 1992. As of the first week of May 1993, seven members of the Division have been selected, including one group leader, out of approximately fourteen candidates interviewed to date. Dr. Shin Yamamoto, group leader of In-Vessel Diagnostics, has been on site since April 1993; and several of the selected staff members will begin to arrive in midsummer.

The first priority activity is to lay out work plans for the urgent R&D and design tasks that will be carried out by the Home Teams in support of the Joint Central Team (JCT). The key design task is to design Ion Cyclotron Range of Frequencies (ICRF) antennas suitable for heating plasmas in ITER to ignition temperatures and possibly driving current in ignited ITER plasmas with high efficiency. The designs must properly take into account new features of the proposed EDA design such as the integrated first-wall and blanket design under the intense radiation environment.

Electron cyclotron heating (ECH) is also foreseen to be useful for startup and possibly for heating and current drive. The most challenging engineering R&D is to develop reliable, high-efficiency gyrotrons at high power (≥ 1 MW), which is essential to the feasibility of ECRF systems. The required frequency is in the vicinity of 160 GHz, with higher frequencies required for current drive.

In-vessel diagnostics are required for plasma control and device integrity, and for plasma performance evaluation and optimization. The diagnostic components such as magnetic coils, reflector/mirrors, windows

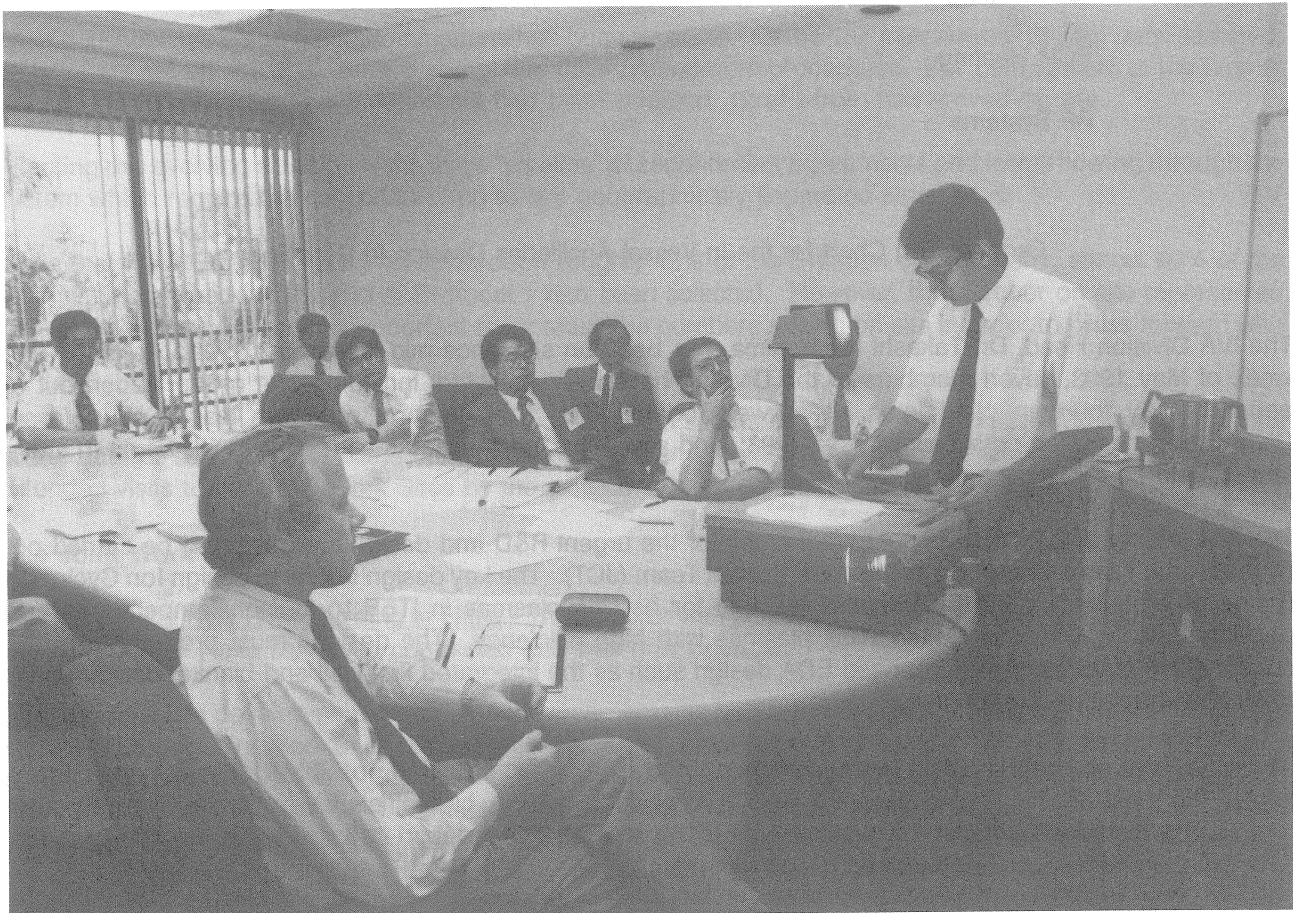
and fiber optics, ceramics, etc., will be subject to different levels of irradiation, as well as to different levels of thermal and mechanical cycling. The material selection and qualification process must take into account the expected operating environment. The design work for in-vessel diagnostics is performed in collaboration with other groups including the diagnostics and physics co-ordination groups in San Diego.

The task of continuing the selection of team members and assembling the Division is also a top priority of the division's activity. The staffing processes are: specification of posts by the JCT, nomination of candidates from the Parties, selection of team members by the Director, arrival and startup of work, and completion of secondment procedures. We continue to push the buildup of the Division as quickly as possible in order to fill the vacant positions.

TECHNICAL MEETING ON DESIGN STANDARDS AND REMOTE HANDLING **by F. Puhn, Head, Design Integration Division, ITER San Diego Co-Centre**

A technical meeting on design standards and remote handling was held at the San Diego Co-Centre from May 24 - 28, 1993. The meeting was chaired by F. Puhn, Head of the Design Integration Division in San Diego. The purpose of the meeting was to take the first step in establishing the basic design standards for ITER. Experts from the Home Teams were invited to present technical material bearing on the subject. About 40 visitors were present to participate, plus San Diego JCT staff. due to the large participation in the meeting, the group was the first to use the large, new conference room at the San Diego Co-Centre.

The experts were invited to bring to the meeting the design standards that are ready for use on ITER and to identify areas requiring more development. The meeting was divided into three sessions due to the large amount of subject matter being presented. R. Haange, Head of the Nuclear Technology Division at the Naka Co-Centre, was Chairman of Session 1. It addressed design standards for remote handling and focused on



At the meeting's Remote Handling session

components, tools and design rules. Session 2, which was chaired by P. Smith, from the Design Integration Division in San Diego, addressed the structural design criteria and analysis standards for ITER. Session 3, chaired by F. Puhn, covered standard materials, components and processes.

The meeting opened with a plenary session on Monday, May 24. After an introduction by F. Puhn, P.-H. Rebut, the ITER Director, gave a brief talk outlining the philosophy of the meeting and the importance of establishing design standards. Several presentations followed.

- Remote handling (Haange);
- Structural design criteria (Smith);
- Establishing design criteria for the JET tritium plant (Haange); and
- Standard materials, processes and components (Puhn).

The next two days were used by the Home Teams for their presentations during the three separate sessions. Each Home Team was allotted four hours to present their material. Due to the breadth of the subject matter, some of the material was not formally presented, but submitted in writing. Each session had multiple topics to address, and each topic was summarized by a member of the Home Teams. On Thursday the topic summaries were written on forms provided. These summaries were then used to create the overall meeting summary and minutes.

Friday morning consisted of talks by the three session Chairmen summarizing the material presented in each session. It was agreed that good progress was made in establishing initial design standards for ITER. However, a great amount of work remains to be done, and this will be accomplished by the JCT Members in the following months. The meeting minutes will reflect the summaries of each session and will reference the total package of written material submitted. The written material will be organized into notebooks for distribution to the three Co-Centres. It will also be available for reference.

LIST OF PARTICIPANTS

SESSION 1 - REMOTE HANDLING

EC: R. Haange S. Higson D. Maisonnier M. Selig	RF: S. Sadakov US: J. Doggett R. Hager J. Herndon	JCT: C. Ahlfeld T. Burgess D. Holland M. Kondoh T. Nagashima A. Oikawa K. Shibamura
JA: T. Munakata E. Tada S. Tsuzuki		

SESSION 2 - STRUCTURAL DESIGN CRITERIA

EC: D. Acker F. Schubert P. Turroni	RF: V. Korzhavin S. Sadakov US: S. Majumdar B. Nelson P. Smith R. Watson J. Zbasnik	JCT: C. Bushnell H. Yoshida
JA: K. Aoto Y. Muto T. Shoji H. Takatsu K. Yoshida		

SESSION 3 - STANDARD MATERIALS, COMPONENTS, PROCESSES

EC: F. Amelotti O. Kveton S. Paidassi	JA: S. Jitsukawa M. Shibui K. Yoshida	US: J. Davis D. Lousteau F. Puhn D. Reed	JCT: S. Yamamoto H. Yoshida
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PLASMA EQUILIBRIUM AND CONTROL TECHNICAL MEETING

by Dr. P.-L. Mondino, Head, Plasma and Field Control Division, ITER Naka Co-Centre;
and Dr. J. Wesley, Physics Integration Division, ITER San Diego Co-Centre

A Technical Meeting on ITER Plasma Equilibrium and Control was held at the Naka Co-Centre on April 26-29, 1993. The Meeting was the first on this subject for the ITER EDA and provided a useful opportunity for plasma and poloidal field (PF) system design experts from the Home Teams of the four ITER Parties and from the ITER Joint Central Team (JCT) to become acquainted with each other as well as with the plasma operations and PF analysis performed to date on the ITER EDA design concept. Information on analysis codes and capabilities of each of the Home Teams was exchanged and the Meeting participants developed technical conclusions about plasma startup, equilibrium control, vertical position control and plasma shutdown in the EDA design concept. Planning for homework studies by specialists in the four Home Teams and for transfer of selected plasma and PF system analysis codes from each of the four Home Teams to the Naka JCT were initiated.

LIST OF PARTICIPANTS

EC: L. Bottura
O. De Barbieri
O. Gruber
P. Lomas
N. Mitchell

JA: N. Fujisawa
M. Matsukawa
S. Nishio
K. Shinya
T. Tsunematsu
R. Yoshino

RF: V. Belyakov
V. Korshakov
V. Vasil'ev

US: R. Bulmer
A. Kellman
D. Pearlstein

JCT: P. Barabaschi A. Portone
K. Dietz Y. Shimomura
M. Huguet M. Sugihara
P. Mondino R. Thome
K. Odajima J. Wesley

The Technical Meeting marked the first use of the newly opened ITER Naka Co-Centre building located on the Japan Atomic Energy Research Institute (JAERI) site at Naka. Meeting participants were treated to the luxury of individual offices, each furnished with a computer system. A JAERI-sponsored reception for the participants following the second day of the Meeting provided a welcome opportunity for socializing and sampling the local cuisine.

In the Meeting, three different subjects - Codes, Scenario and Equilibrium - were discussed, first in a one and one-half day Plenary session chaired by M. Huguet, and then in one-day subgroup sessions on each subject respectively chaired by Toshihide Tsunematsu, Peter Lomas and John Wesley. The Meeting reconvened for a final half-day Plenary session where the conclusions of the subgroup sessions were summarized and plans for future work were finalized.

The Codes sessions focused on the plasma and PF system analysis computer codes available from each of the four Parties and on the feasibility of making some of these codes available to the JCT for the EDA design. Comparison of the information developed in this session showed that all four Parties could provide similar basic analysis capabilities for plasma equilibrium, vertical stability and eddy current modelling, and also showed that certain codes were likely more suitable for use by the JCT, while other more specialized or complex codes might better be left to be used by the Home Teams to conduct analysis at the request of the JCT. A provisional selection of codes, approximately two from each Party, was identified for transfer to the Naka Co-Centre; this transfer will involve visits by the respective code developers to Naka for installation and user training.

The Scenario sessions focused on the technical topics of plasma startup and shutdown, and equilibrium evolution during the ITER plasma operations sequence (PF scenario) as well as plasma flux (volt-second) requirements and PF system capabilities. Here, after comparison of the results, the participants agreed that Townsend avalanche plasma breakdown and initial current formation with Ohmic heating will be possible, but

marginal, with a 20 V/turn in-vessel loop voltage capability and careful attention to the initial programming of the PF coil currents to obtain low in-vessel error fields. The option of providing radio-frequency assist (probably by electron cyclotron heating) to make breakdown more robust and provide additional power for impurity ionization and recombination loss was judged highly desirable. The required powers were estimated to be in the 2-20 MW range; future work is needed to refine this estimate. The participants also agreed on the general adequacy of the capability of the ITER PF coil system to provide the plasma equilibrium sequence needed for ITER operations with plasma currents of up to 25 MA and fusion powers of 3 GW. The volt-second capability of the PF system was generally judged to be slightly lower than necessary for the design fusion burn duration of 1000 s; however, this conclusion is rather critically dependent on the central solenoid magnet dimensions and performance, subjects that are still being examined by the ITER Design Integration and Superconducting Coils & Structures Divisions.

The Equilibrium sessions focused on the subjects of the effects of plasma current profile variations on static equilibrium and PF coil currents as well as on axisymmetric stability and control of the plasma configuration. Here the participants agreed on the importance of providing sufficient PF coil current capability to accommodate the range of plasma current and pressure profiles expected during ITER operations and plasma experiments. Detailed evaluation of these requirements will require careful co-ordination of work in the plasma physics, equilibrium modelling and magnet design areas. The participants also agreed upon the basic feasibility of axisymmetric control using control coils external to the ITER vacuum vessel; the selection of an optimum control coil concept (main PF coils versus separate superconducting or resistive control coils) and power supply approach requires further study by the JCT.

The participants and JCT staff agreed that the first Meeting was very successful and that the informal discussions were particularly constructive and fruitful. Written conclusions were sent to each Home Team Leader on May 14 and further requests for a Design Task on Plasma Vertical Position Control were sent on June 4. The first results were already notable on some Design Task proposals presented under the title Emergency 1993. The next few months will allow the results of the studies in progress to be obtained. The conclusions from this work are expected to be available before the end of 1993.

COMING EVENTS *

- TAC-3 Meeting, Naka, Japan, 9-11 September (date changed)
- MAC-3 Meeting, Naka, Japan, 16-17 September (date changed)
- IC-4 Meeting, San Diego, USA, 29 September - 1 October (date changed)

* 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: 43 222 237762 (phone 23606392).

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