

ELEVENTH ITER COUNCIL MEETING

by Dr. A. Kitsunezaki, ITER JA Contact Person

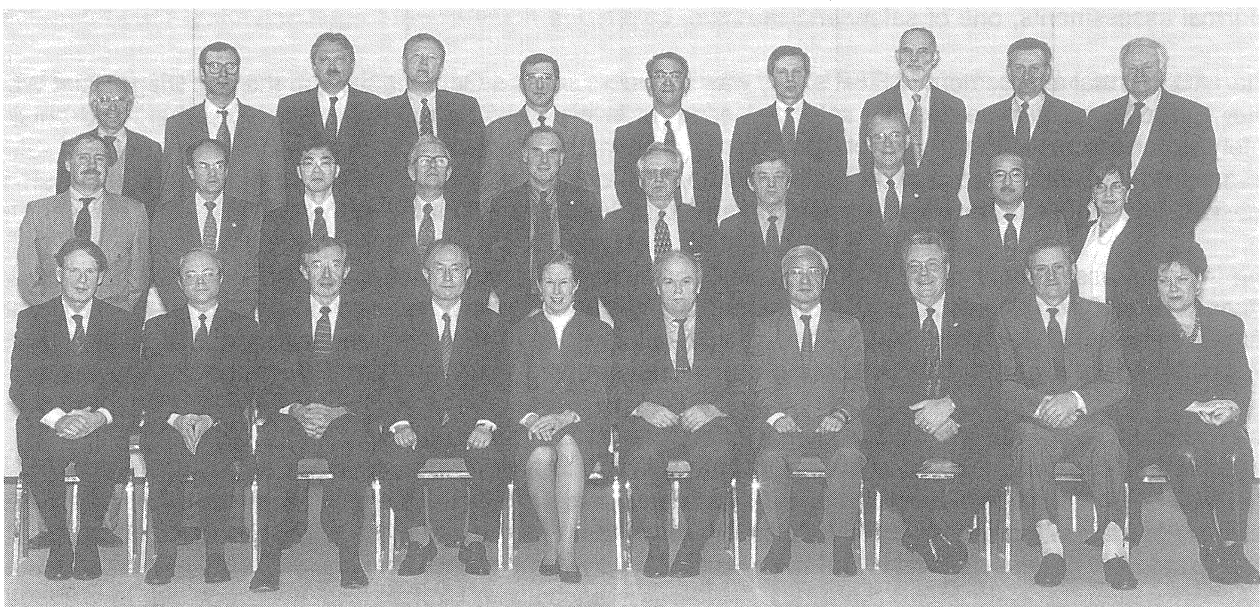
The Eleventh Meeting of the Council of the International Thermonuclear Experimental Reactor (ITER) Engineering Design Activities (EDA) was held on December 17 and 18, 1996 in Tokyo, Japan.

The four delegations that attended the meeting were headed, for the EU, by Prof. Jorma Routti, Director-General for Science, Research and Development of the European Commission; for Japan, by Mr. Naotaka Oki, Deputy Director-General of the Atomic Energy Bureau of the Science and Technology Agency; for the Russian Federation, by Academician Evgenij Velikhov, President of the RRC "Kurchatov Institute"; and, for the United States, by Dr. James Decker, Deputy Director of Energy Research of the Department of Energy.

The Council took note of the Director's Status Report. It is expected that a summary of this Report will be published in the January 1997 Newsletter issue.

The Council commended the JCT and the Home Teams for the quality of the ITER presentations to the 1996 IAEA Fusion Energy Conference, noting that the new experimental results have on the whole confirmed and strengthened the physics basis for the ITER design.

The Council endorsed the Director's request that due priority be given in the Parties' major fusion experiments to strengthening the physics databases for ITER listed in the Status Report and asked the Director to interact on this matter with IC members at Programme Director level to assure the timely transfer of these data to the ITER Project.



Participants in the Meeting

The Council received the Detailed Design Report, Cost Review and Safety Analysis (DDR) presented by the Director and transmitted it to the Parties for their consideration. The DDR will be the basis for the continued technical work leading to the Final Design Report in 1998. The Council noted with appreciation that the overall cost estimates were essentially unchanged from those previously presented. The Council accepted the TAC Review of the Technical Basis for the Detailed Design Report, noting that the review was based on the extensive technical documentation presented by the Director to TAC-11.

The Council was aware that each Party is making a significant move towards the realization of ITER. In the EU, the Fusion Programme Evaluation Board issued its Report which is strongly in favour of ITER construction. In Japan, a new Forum on the ITER Project is planned to be established very soon under the Japanese Atomic Energy Commission, where the ITER Project will be discussed from a wide range of view point. The RF Government approved the Federal Special Scientific and Technical Program "International Thermonuclear Reactor ITER and R&D Works to its support" for 1996-1998 and entrusted the Ministry of the Russian Federation for Atomic Energy and the Ministry of Foreign Affairs of the Russian Federation together to prepare for the negotiations. The US informed the Council of its plans to hold an in-depth review of the DDR and its technical basis by its Fusion Energy Sciences Advisory Committee.

The Council was informed that two meetings of non-committal, pre-Negotiation, exploratory discussions, called Explorations, were held at the end of last July and in December just before the IC-11 Meeting. Subsequent Negotiations would hopefully allow a start of construction activities without delay after the present EDA, which are planned to be concluded in July, 1998.

On the invitation of the EU delegation the IC-12 Meeting will be held in the European Union on 23-24 July 1997. The IC-13 Meeting is tentatively scheduled for January 1998 in San Diego.

ELEVENTH MEETING OF THE ITER TECHNICAL ADVISORY COMMITTEE (TAC-11) by Prof. P. Rutherford, Chair

TAC-11 was held on 3-7 December at the ITER Naka Joint Work Site.

The ITER Council had requested the TAC to conduct a thorough review of the technical documentation for the ITER Detailed Design Report (DDR). The TAC review was based on the draft, "Technical Basis for the ITER Detailed Design Report, Cost Review and Safety Analysis", which was issued by the Director on 12 November 1996.

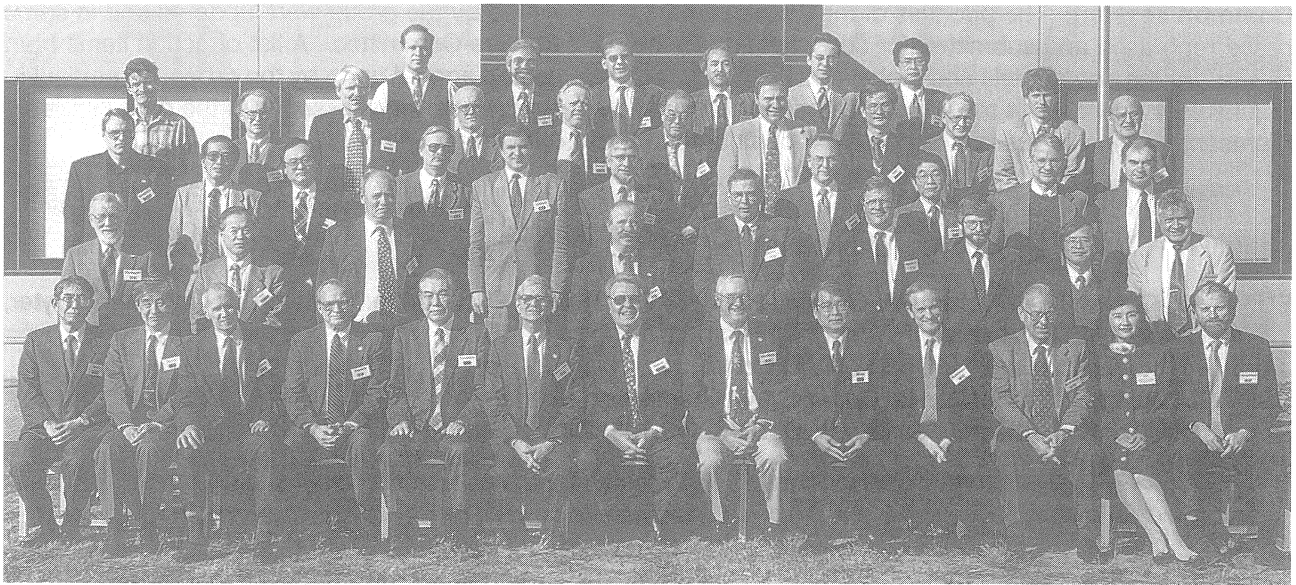
The TAC followed a plan in which the review of the draft DDR technical documentation was preceded by two informal assessments, one of safety and the other of physics.

The TAC informal assessment of ITER safety was conducted on 4-5 October 1996, at the San Diego Joint Work Site, and followed a more detailed safety assessment involving JCT and Home Team members and outside safety experts from the Parties, which had taken place over the preceding two weeks. This more detailed safety assessment had addressed all of the material in the nine-volume draft Non-Site-Specific Safety Report (NSSR-1). The TAC informal assessment was based on an Executive Summary of the draft NSSR-1.

The informal assessment of ITER physics was conducted at a joint meeting of TAC and the ITER Physics Committee (IPC) on 14-15 October in Montreal, and took the form of a review of a first draft of the physics chapter for the DDR technical TAC/IPC assessment followed immediately after meetings of the seven Physics Expert Groups and after the IAEA Fusion Energy Conference.

The formal review of the technical documentation for the DDR formed the agenda for TAC-11.

The TAC commended the Director, the JCT, and the Home Teams on the good progress made in the ITER design since the Interim Design Report, Cost Review and Safety Analysis (IDR), was produced in 1995.



Participants in the Meeting

The TAC noted that essentially no change has occurred in the overall cost estimate presented in the IDR in 1995. Minor variations in the cost of individual systems have arisen only from modifications in the designs, keeping unit costs fixed, and have not involved obtaining updated cost estimates from industry. Accordingly, the TAC did not, as part of the present review, carry out any further assessment of the cost estimates.

In regard to the physics basis for ITER, the TAC noted that there is an international worldwide physics effort in support of ITER, encompassing seven Physics Expert Groups and involving many ITER-specific studies in the experimental and theoretical programs of the Parties. This effort was reflected in a large number of ITER-relevant papers presented at the recent IAEA Fusion Energy Conference. The new experimental results presented at the IAEA conference have, in general terms, confirmed and strengthened the physics basis for the ITER design. Remaining open issues are being resolved by focussed experimental effort in the tokamak programs of the Parties. The TAC also took note of the encouraging worldwide progress in the development of physics-based transport models for tokamaks and endorses the ongoing effort by the JCT and the Physics Expert Groups to include such models in projections of plasma performance in ITER. The TAC's overall assessment of the physics basis for ITER was that the present design parameters have been well-chosen for meeting ITER's technical objectives.

In regard to engineering systems, the TAC noted that approval of the IDR by the ITER Council in late 1995 has allowed the main features of the ITER design to be frozen and the detailed design of individual components and the associated issues of design integration to be addressed. It is evident from the technical documentation for the DDR that, for most components, the ITER design has now progressed to the level of detailed subsystem design and design integration, including incorporation of integrated safety and remote handling requirements. Since the IDR, considerable attention has been given to the tokamak building, so as to assure that safety and remote handling requirements will be met, that service lines will be incorporated in an efficient and functionally acceptable manner to result in a well-designed site layout, and that a range of seismic requirements can be satisfied. The TAC commended the JCT on the level of design integration that has been achieved in the DDR. The design is being evolved in strict observance of a design policy of maintaining the total cost within the cost estimate range developed at the IDR.

Three possible design modifications beyond the DDR were presented to the TAC for comment, namely the option of partially segmenting the central solenoid (CS), a new concept of mechanical attachment of the shield/blanket modules to the backplate, and the option of introducing ferritic inserts into the vacuum vessel to reduce the toroidal field ripple. The TAC was in agreement with the factors being taken into consideration by the JCT in deciding whether to incorporate these modifications. If decisions on the open issues can be made subsequent to this review, the detailed design and design integration process can be extended to essentially all components and systems, including integrated safety and remote handling requirements.

The Interim Design defined an R&D program to be carried out during the balance of the EDA. In many cases, the results of this R&D program are already confirming the technical validity of particular design choices. In the TAC's view, it is essential to provide resources so that the R&D program, at a level at least sufficient to confirm optimum and cost-effective manufacturing techniques, can be completed within the EDA.

As a result of its reviews of the draft NSSR-1 and the safety chapter in the DDR documentation, the TAC concluded that major progress has been made in defining the radiological and other hazards of ITER, both during normal operations and as a result of a broad range of reference off-normal events, and in providing appropriate safety features in the ITER design. The TAC commended the JCT and the four Home Teams on the safety analysis that is contained in the draft NSSR-1 and in the DDR documentation. A sound basis now exists for completing the comprehensive safety analysis of the ITER design that is an essential element of the EDA.

The TAC recommended to the ITER Council that the Detailed Design Report be accepted as a sound basis for proceeding to the Final Design.

FIFTH WORKSHOP OF THE CONFINEMENT MODELING AND DATABASE EXPERT GROUP

by Dr. D. Boucher, ITER JCT and Dr. J.G. Cordey, JET Joint Undertaking

The Fifth Workshop of the Confinement Modeling and Database Expert Group took place in Montréal, Canada, on October 13-16, 1996. The first day of the meeting was held together with the Confinement and Transport Expert Group (see report by Drs. Mukhovatov and Wakatani in the November 1996 ITER Newsletter). It was the opportunity for expert group members to assess the importance of confinement uncertainties on the projected ITER performances and to present their comments on the Detailed Design Report to the JCT.

During the following three days of the workshop, specific sessions covering the various Physics R&D needs under the responsibility of the group were organized to assess the status of the tasks, review progress from the last workshop and decide on the new set of action lists to be completed before the next workshop.

L-mode session (S. Kaye): After discussion, it was decided that the first version of the L-mode database, ITERLDB.1, should be frozen and released as soon as possible. The draft of the accompanying paper was discussed and suggestions for modifications for the final draft were made. It is expected that the paper will be submitted for publication within the next several weeks. The activity to update DB1 will start as soon as the paper is submitted. New data that will be contributed will come from Alcator C-MOD, JET, JT60-U, START, TCV, TdeV, TEXTOR and TFTR. Presentations of the new data from Alcator C-MOD and TdeV were made.

Modeling session (J. Connor): The modeling subgroup first reviewed the minutes of the previous workshop in Moscow for the benefit of those who had not been present there and in particular considered progress on the action list. J. Connor then presented the paper given at the IAEA meeting on behalf of the group for further comments. D. Boucher informed the subgroup of progress on the ITER Profile Database. A decision was made to maintain a table detailing the comments modelers have on the data and a table keeping track of the data each file was last changed. J. Connor led a discussion on issues for the modeling program such as new data and the improvement in modeling procedures that would help to discriminate between models, since most were performing similarly well against the present data. Y. Ogawa gave a very interesting presentation on his work on validating a number of models against JT60-U data.

There were valuable discussions and proposals for further bench marking of modeling codes and on how to use both theoretical considerations and comparisons with carefully selected experiments to reduce the number of contender models. The issue of how to model the edge temperature, which is crucial for the ITER predictions for some models, was considered by R. Waltz, and G. Porter of the Divertor Expert Group was invited to describe the effect of ELMs and the status of edge databases. A number of presentations on model predictions for the ignition capability of ITER were given. G. Hammett described the effect of various parameters on the performance of ITER according to the rather pessimistic IFS/PPPL model. G. Bateman presented his work using the more optimistic multi-mode model. W. Houlberg presented simulations with a number of different models. A lively discussion on reconciling the views of the group on the priorities for ITER R&D needs within the framework of categories proposed by JCT took place. There was a strong feeling that 1D modeling should strive to be competitive with global scaling laws during the following year and that particle transport was also an important issue. As a result of the various productive discussions at the workshop, a number of actions were agreed and requests for new data from the data providers were identified.

H-Mode session (J. DeBoo): Further discussion was held by the Database Group on the H-mode confinement projection to ITER and its uncertainty. Based on the ITER93H scaling expression the ITER projection is 6 sec, $\pm 30\%$ where the uncertainty represents 2σ for a power law functional form. O. Kardaun formulated a 95% interval estimate of 3.5 - 9 sec which included effects such as projections using different functional forms for the scaling expression and estimates of systematic measurement errors. A detailed review of the IAEA paper from the Database Group produced many useful suggestions for corrections and improvements. Previously collected contributions to the H-mode database from ASDEXU, CMOD, COMPASS-D, DIII-D, JET, JT60U, and TEXTOR were discussed and a new set of criteria for choosing data to be included in scaling studies was identified, with the most significant change from previous studies being the inclusion of all types of heating power, particularly ICRF. Further work is required to try and understand the reasons behind a strong beta degradation found in the ITER93H scaling expression and the β^0 dependence found from recent JET and DIII-D non-dimensional scaling studies. Additional H-mode data to be added to the database includes some ASDEX-U data showing up to a 40% improvement in confinement with a reduction in neutral pressure in the divertor and DIII-D data with boronized vessel walls indicating no significant differences in confinement compared to unboronized walls.

H-mode power threshold session (F. Ryter): Based on considerations made with dimensionless variables, a formula including the uncertainties has been developed. The size dependence is close to R^2 . It clearly shows that the large uncertainty on the prediction for ITER (50 to 200 MW) is caused by the calculated uncertainty of 0.5 on the R exponent. Other analyses using regression techniques while imposing the dimension condition were made. These studies also found a threshold dependence close to R^2 . Analyses taking into account the radiated power inside the separatrix, which at present shows a strong inverse dependence on R, obviously require a better understanding of the variation of radiated power with size.

Discriminant analysis is also being carried out using a non-linear model which is able to take into account the non-linear behaviour of the power threshold on density and to determine the minimum threshold density.

It has been again pointed out that the large scatter in the experimental data, which is not yet understood, strongly limits the possibilities to reduce the uncertainty on the predictions. Further windowing of the data and effort in understanding the physical reasons are proposed to improve the situation.

First attempts to obtain scaling expressions using edge data (physics-based approach) yields unreasonable results and a valid prediction requires more edge data (already existing for some devices) which will be included into the database soon. It is still unclear whether such an approach will be able to reduce the uncertainty on the power necessary to obtain the H-mode in ITER.

New experiments at the same value of magnetic field and density are not meaningful because of the lack of overlap between the density ranges. It is, therefore, proposed to normalize the density by the density limit. The database will be analyzed from the point of view of identifying the necessary experiments. The dimensionlessly similar experiments for confinement will also be used for threshold analyses to determine the capability of this approach for threshold predictions.

Common session: The priorities of the Physics R&D tasks covered by the group were updated and in some cases rephrased and submitted for consideration to the ITER Physics Committee. A list of action items from all sub-groups - on models and global databases - was presented and agreed upon by the group. In particular, requests for new data in the various databases covered by the group were discussed with the data providers representing the various laboratories that contribute to these databases.

LIST OF PARTICIPANTS

EU: J.W. Connor, J.G. Cordey, A. Coté, E. Haddad, G.T. Hoang, O. Kardaun, Y. Martin, J. Ongena, F. Ryter, A. Taroni, K. Thomsen, M. Turner, J. Weiland
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US: G. Bateman, J. DeBoo, B. Dorland, M. Greenwald, G. Hammett, W. Houlberg, S. Kaye, J. Kinsey, M. Kotschenreuther, D. Mikkelsen, D. Schissel, J. Snipes, R. Waltz
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