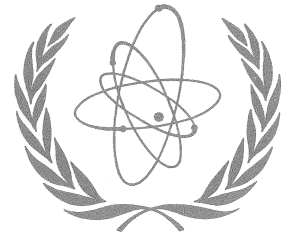


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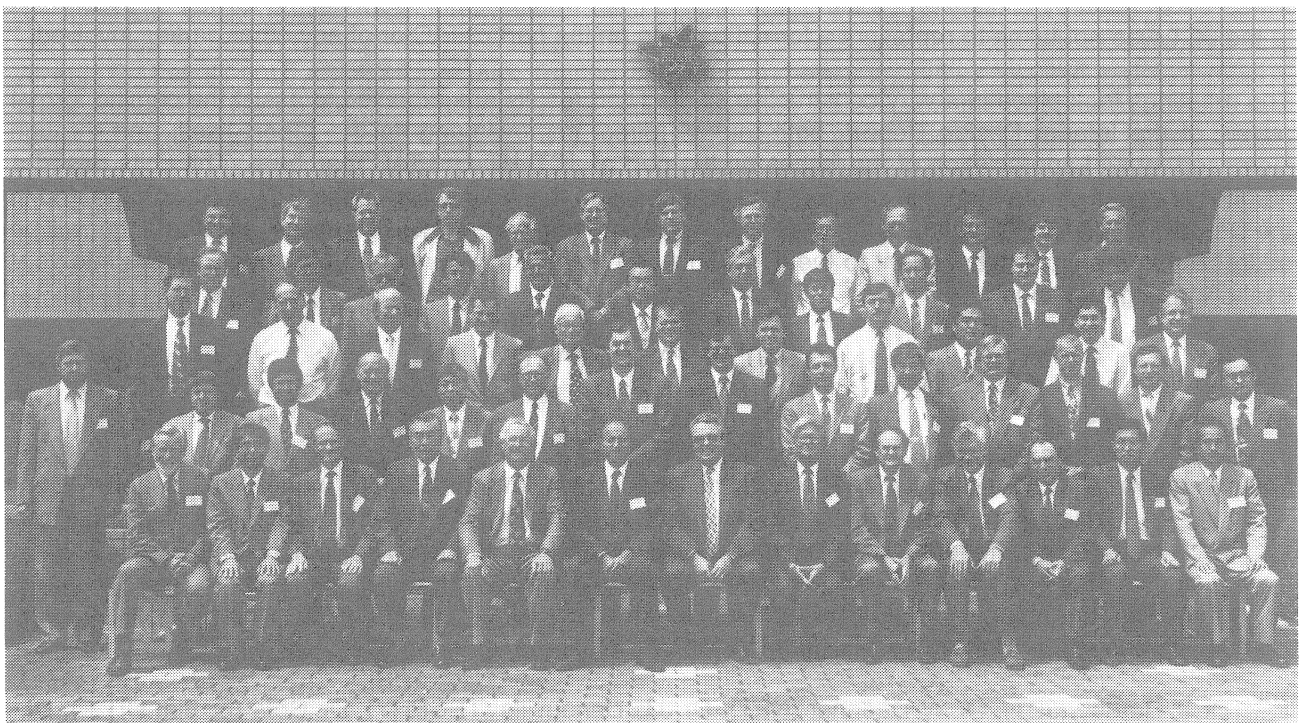
## TAC-JCT INFORMAL TECHNICAL REVIEWS

by Dr. R. Parker, Head, Garching Joint Work Site, and  
Dr. M. Huguet, Head, Naka Joint Work Site

As part of the preparations for the Interim Design Report informal technical reviews were held at the Garching and Naka Joint Work Sites (JWSs) involving the ITER Technical Advisory Committee (TAC), designated experts, the Joint Central Team (JCT) and some Home Team (HT) members, and the HT Leaders. The first meeting was held on 1–5 May 1995, at Garching. The second meeting was held on 10–13 May 1995, at Naka.

The purpose of these informal reviews was to provide an opportunity for the participants jointly to review the status of the ITER design and to provide technical input to the Project for use in preparing for the Interim Design and Cost Review to be held on 29 June – 7 July 1995, at the ITER San Diego JWS, and for the continuing work by the Project after that review.

The format of each meeting was similar. Formal presentations on the various systems and subsystems were made in plenary sessions by members of the JCT with some joint input from members of the HTs. Parallel subgroup sessions followed to review and discuss the material presented and to develop feedback to the project. To aid in this process, comment forms, "chits", were used at each meeting and all participants, including members of the JCT, were encouraged to write down their comments, concerns, and suggestions.



*Participants in the Naka Meeting*

Approximately 180 chits were generated at the Garching meeting and approximately 150 chits were generated at the Naka meeting. The subgroups were led by two co-chairs, one a member of the TAC and one a member of the JCT. Participants in each subgroup included members from the TAC, designated experts, and members from the JCT and HTs.

The subgroups and their co-chairs were:

<b>Garching Review</b>	Divertor and High-Heat-Flux Components	J. Sheffield (TAC) Y. Shimomura (JCT)
	First-Wall and Blanket/Shield	E. Adamov (TAC) R. Parker (JCT)
	Vacuum Vessel	K. Miya (TAC) V. Chuyanov (JCT)
<b>Naka Review</b>	Physics Related to Ex-Vessel Components	D. Robinson (TAC) Y. Shimomura (JCT)
	Magnets & Structures	K. Tomabechi (TAC) M. Huguet (JCT)
	Cryostat & Assembly	S. Itoh/V. Glukhikh (TAC) V. Chuyanov (JCT)

At the final plenary sessions of each meeting, the subgroups reported back on the basis of the JCT/HT inputs and on their discussions of the main issues and the points raised in the chits, providing:

1. An overall response to the design developments;
2. An identification of a limited number of issues which, it is hoped, can be addressed before the Interim Design and Cost Review; and
3. A compilation of issues to be addressed during the balance of the EDA and beyond.

It was understood by all concerned that these proceedings were entirely informal; the advice and feedback to the JCT was not taken to represent a formal position on the part of TAC or of any other parties involved.

The meetings took place in a very constructive spirit. Their results are expected to assist the coming formal review of the Interim Design Report, both through direct improvements to the report itself, and through increased mutual appreciation of the issues on the part of JCT, HT and TAC members. The chits raised a number of useful points, many of which will be addressed in the TAC review of the IDR in San Diego and in the Design Description Documents which are being prepared as part of the IDR, as well as others that will be addressed in the work subsequent to the IDR. This had the effect of turning the informal reviews into very useful working meetings.

#### LIST OF PARTICIPANTS

##### At Garching JWS:

TAC Members: Dr. E.O. Adamov, Dr. R. Andreani, Acad. V.A. Glukhikh, Prof. N. Inoue, Prof. S. Itoh, Dr. J. Jacquinet, Acad. B.B. Kadomtsev, Prof. K. Miya, Dr. D.O. Overskei, Dr. D.C. Robinson, Prof. P.H. Rutherford (TAC Chairman), Dr. J. Sheffield, Dr. M.I. Solonin, Dr. K. Tomabechi, Prof. F. Troyon; Mr. C.A. Flanagan (TAC Secretary).

##### Parties' Experts (E), HT Leaders (HTL) and Presenters

EC: Dr. J. Cordey (JET), Dr. W. Daenner (NET), Dr. J.L. Deneuille (TECPHY), Dr. Ghia (E, Fiat CITIF), Dr. M. Heller (E, Siemens), Dr. K. Lackner (E, IPP Garching), Dr. D. Maisonnier (E, JRC Ispra), Dr. A. Pizzuto (E, ENEA), Prof. R. Toschi (HTL, NET), Dr. G. Vieider (E, IPP Garching)

JA: Prof. H. Horiike (E, Osaka Univ.), Dr. S. Matsuda (HTL, JAERI), Prof. Y. Ogawa (E, Univ. of Tokyo), Dr. M. Seki (E, JAERI), Dr. H. Takatsu (JAERI), Dr. S. Tanaka (E, Univ. of Tokyo), Dr. T. Tsunematsu (JAERI), Dr. R. Yoshino (JAERI)  
RF: Dr. O.G. Filatov (HTL, Efremov), Dr. I.V. Mazul (E, Efremov), Dr. Y.L. Outin (Efremov), Dr. Y.S. Strebkov (E, ENTEK)  
US: Dr. C.C. Baker (HTL, ORNL), Dr. D.E. Driemeyer (E, McDonnell Douglas Aerospace), Dr. D.V. Lee (E, McDonnell Douglas Aerospace), Dr. R. Mattas (E, ANL), Mr. B. Nelson (ORNL), Dr. N.R. Sauthoff (E, PPPL), Dr. R. Stambaugh (GA), Dr. J.H. Swanson (E, Princeton Univ.), Dr. M. Ulrickson (SNL), Dr. K.L. Wilson (E, SNL)

Joint Central Team: Dr. R. Aymar, Dr. G. Bosia, Dr. D. Boucher, Dr. A. Cardella, Dr. S. Chiocchio, Dr. V. Chuyanov, Dr. J. Dietz, Dr. W. Gauster, Dr. Y. Gohar, Dr. M. Huguet, Dr. K. Ioki, Dr. G. Janeschitz, Dr. G. Johnson, Dr. G. Kalinin, Ms. A. Lyraud, Dr. M. Makowski, Dr. E. Martin, Dr. R. Parker, Dr. F. Perkins, Dr. D. Post, Dr. S. Putvinski, Dr. Y. Shimomura.

#### At Naka JWS:

TAC Members: Acad. V.A. Glukhikh, Prof. N. Inoue, Prof. S. Itoh, Dr. J. Jacquinet, Prof. K. Miya, Dr. D.C. Robinson, Prof. P.H. Rutherford (TAC Chairman), Dr. J. Sheffield, Dr. K. Tomabechi; Mr. C.A. Flanagan (TAC Secretary)

Parties' Experts (E), HT Leaders (HTL) and Presenters

EC: Dr. R. Albanese (CREATE), Dr. O. Gruber (E, IPP), Dr. C. Jong (E, ECN), Dr. A. Laurenti (E, EFET), Dr. A. Salpietro (E, NET), Prof. R. Toschi (HTL, NET), Dr. B. Turck (E, CEA), Dr. A. Ulbricht (KfK), Dr. F. Vivaldi (E, EFET)

JA: Dr. T. Honda (E, Toshiba), Dr. Y. Ito (JAERI), Dr. S. Matsuda (HTL, JAERI), Dr. Y. Ogawa (E, TU), Dr. M. Sugimoto (JAERI), Dr. E. Tada (E, JAERI), Dr. H. Tsuji (E, JAERI), Dr. T. Tsunematsu (E, JAERI), Dr. J. Yamamoto (E, NIFS)

RF: Dr. V. Belyakov (E, Efremov), Dr. S. Egorov (E, Efremov), Dr. A. Malkov (E, Efremov), Dr. A. Shikov (E, Bochvar)

US: Dr. R. Bolmer (LLNL), Dr. D. Humphreys (GA), Dr. T. James (UCSD), Dr. D. Lang (E, LLNL), Dr. N. Martovetski (E, LLNL), Dr. D.B. Montgomery (E, MIT), Dr. W. Nevins (E, LLNL), Dr. P. Titus (MIT), Dr. R. Watson (E, PDMI)

Joint Central Team: Dr. R. Aymar, Dr. R. Bourque, Dr. V. Chuyanov, Dr. B. Green, Dr. Y. Gribov, Dr. R. Haange, Dr. J.-L. H elary, Dr. R. Hemsworth, Dr. M. Huguet, Dr. K. Ioki, Dr. G. Janeschitz, Dr. N. Mitchell, Dr. P.-L. Mondino, Dr. K. Okuno, Dr. R. Parker, Dr. Z. Piec, Dr. A. Portone, Dr. F. Perkins, Dr. C. Sborchia, Dr. Y. Shimomura, Dr. A. Tesini, Dr. R. Thome, Dr. J. Wesley, Dr. M. Wykes, Dr. K. Yoshida

## **THE STATE DUMA HEARINGS ON FUSION \*)**

**by Nikolai P. Kornev, MAC Member**

The Committee on Education, Culture and Science of the State Duma of the Russian Federation held the Parliamentary Hearings "On the Thermonuclear Problem" on 25 April 1995.

A number of scientific and administrative leaders of the programmes, senior researchers and specialists were invited to take part in the hearings. Also invited were the senior managers of the fusion programmes of the European Union, Japan, and the USA: Dr. Maisonnier, Dr. Yoshikawa and Dr. Decker, respectively, and the ITER Director, Dr. Aymar, who was represented at the hearings by his Deputy, Dr. Shimomura. In Russia, thermonuclear research is under way within the frameworks of the State Programme "Controlled Thermonuclear Fusion and Plasma Processes" and the Federal Programme "ITER and Supporting R&D". A large part of the hearings was devoted to the ITER Project.

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\*) "State Duma" is the name of the Lower House of the Russian Parliament.

Statements made by Academicians Velikhov, Glukhikh, Kadomtsev, Dr. Adamov and others were very informative, clear-cut and well presented. The audience listened with great attention to the presentations done by the guest speakers Drs. Shimomura, Decker, Yoshikawa and Maisonnier. All the questions raised by the Duma Members were explicitly answered by the speakers.

#### **EXCERPTS FROM RECOMMENDATIONS OF THE PARLIAMENTARY HEARINGS ON NUCLEAR FUSION**

*The Parliamentary Hearings showed that the Russian Federation has remained one of the world leaders in this area of science and technology. The R&D activities in the main directions of thermonuclear fusion are being conducted on a very high scientific and technological level.*

*At present, ITER is the only known large international project in science and technology, according to broad international expertise, a project in which Russia can participate on equal footing with the EC, Japan and the US.*

*However, the participants in the Hearings have expressed their concern about the continuing reduction of Russia's scientists' contribution to fusion research and technology, in particular, during the last few years. Activities in many alternative studies of high-temperature plasma physics have stopped, and activities in the field of inertial fusion, including laser fusion, have been cut back. Significant budget cuts led to the termination of some promising R&D activities. This jeopardizes the participation of the Russian Federation in ITER. In the International Community, the ITER Project is considered to be an example of global scientific and technological agreements of the 21st century; it also serves as a test of Russia as a reliable and equal partner in international co-operation. A withdrawal of Russia from ITER could have very negative consequences for Russia's future in science, technology and political standing and economy.*

*The participants of the Hearings were in favour of the Russian fusion programme which was presented as a Federal programme "ITER and Supporting R&D" and as the State scientific and technological programme "Controlled Thermonuclear Fusion and Plasma Processes." They noted that the ITER financing for 1995 has been insufficient in not meeting the terms of intergovernmental agreements.*

*The participants in the Parliamentary Hearing agreed on the following recommendations:*

#### **1. To the Federal Assembly of the Russian Federation in respect to its 1996 Federal Budget**

- To maintain the Federal Programme "ITER and Supporting R&D" as a federal one and foresee the financing necessary to continue the fusion programme development and to fulfil the commitment of the Russian Federation to ITER.*

#### **2. To the Government of the Russian Federation**

- To fully finance the expenses of the federal programme "ITER and Supporting R&D" in accordance with the approved budget for 1995 and to seek any opportunity to cover the debt of 1994.*
- To prepare proposals to eliminate export and import tax, "Value Added Tax", as well as tax on services, materials, and equipment, which are being transferred to the Russian Federation by its foreign partners in the framework of the Intergovernmental Agreement on Contracts between the institutions of the Ministry of Atomic Energy of the Russian Federation and institutions of other ministries involved in the ITER Project activities and the International Directorate of the ITER Project.*

Along with emphasizing the progress achieved, the concern was stressed that in the last years research in some areas was cancelled and the input of the RF specialists into the international fusion co-operation was decreased due to inadequate financing.

The participants in the Hearings supported both the State Thermonuclear Programme and the Federal ITER Programme and noted that the financing of the ITER activities provided by the 1995 budget was insufficient

and did not meet the requirements for the fulfilment of the intergovernmental agreement. The Duma Committee worked out the recommendations to the Federal Assembly \*\*) and the Government of the Russian Federation to adequately support the RF fusion programme and the ITER Project (excerpts from these recommendations are contained in the box on the previous page). The Deputies also recommended to include the research in the field of thermonuclear power production in the long-term energy programme of the country.

The Hearings were conducted at the conference hall of the Moskva Hotel situated in the centre of Moscow, and the weather greeted the participants of the Duma Hearings in a summerly warm and sunny manner.

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\*\*) "Federal Assembly" is the name of the Higher House of the Russian Parliament.

## **SUMMARY OF THE ITER DIVERTOR PHYSICS AND ITER DIVERTOR MODELLING AND DATABASE EXPERT GROUP WORKSHOPS**

by Drs. R. Stambaugh (GA), G. Janeschitz (JCT), M. Shimada (JAERI), D. Post (JCT)

The second meeting of the ITER Divertor Physics and ITER Divertor Modelling and Database Expert Groups was held at the ITER Garching Joint Work Site on February 6 - 11, 1995. The workshop participants (list shown overleaf) reviewed the ongoing experimental and theoretical programs in the Parties on divertor physics, updated and finalized the Physics R&D Program in divertors, developed design guidelines and requirements for the design of the power and particle control systems, provided ongoing co-ordination of the global and scalar databases for plasma edge parameters and reviewed the status of the validation and benchmarking of divertor models and planned the application of these models to assessing the performance of candidate ITER divertor designs.

The ITER divertor concept is based on spreading the power out over the first wall and divertor wall area with impurity radiation from intrinsic impurities such as beryllium and carbon and from injected impurities such as neon or krypton. Regimes in which much of the heating power was radiated to the walls were reported by groups from Alcator C-Mod, ASDEX-Upgrade, DIII-D, JET, JT-60U and TdeV. In these experiments, a high density, low temperature zone was formed in the plasma which radiated much of the heating power from the edge plasma to the walls resulting in a substantial reduction of the head loads on the divertor plates and "detachment" of the divertor plasma from the divertor plates. These detached plasmas have been obtained with intense hydrogen fuelling. In these cases the radiation was mostly due to carbon from the wall (e.g. Alcator C-Mod, JT-60U, ASDEX-Upgrade). Puffing with neon and other impurities resulted in detachment at lower densities. Ne puffing also increased the radiation losses from inside the separatrix. In ASDEX-Upgrade, neon puffing led to the formation of a "Completely Detached H-mode" (CDH) with large radiation losses from the plasma edge inside the separatrix and in the divertor region outside the separatrix, resulting in reduced power loads on the divertor plates with no loss of energy confinement. In most experiments the radiation zone formed at the divertor plate as the density or impurity level increased and then moved to the X-point. Continued puffing resulted in the radiation zone moving across the separatrix into the main plasma and finally to a disruption.

### LIST OF PARTICIPANTS

V.A. Abramov (KIAE), B. Braams (NYU), S. Cohen (US Home Team), M. Baelmans (KFA Jülich), K. Borass (JET), K.J. Dietz (JCT), R. Goldston (PPPL), N. Hosogane (JAERI), Y. Igitkhanov (JCT), K. Itami (JAERI), G. Janeschitz (JCT), C. Karney (PPPL), S. Krassheninnikov (MIT), A. Kukushkin (JCT), A. Loarte (JET), G. Mathews (JET), J. Neuhauser (IPP Garching), H. Pacher (NET), R. Parker (JCT), F.W. Perkins (JCT), G. Porter (LLNL), D. Post (JCT), V.A. Pozaharov (KIAE), D. Reiter (KFA Jülich), T. Ronglien (LLNL), M.N. Rosenbluth (JCT), J. Roth (IPP Garching), R. Schneider (IPP Garching), M. Shimada (JAERI), R. Stambaugh (GA), M. Sugihara (JCT), S. Takamura (NIFS), G. Vlases (JET), K. Würz (KFA Karlsruhe), J. Winter (KFA Jülich).

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