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INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR

ITER EDA NEWSLETTER

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INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

ITER EDA PROTOCOL 1 IS COMPLETED

by Academician E. Velikhov, ITER Council Chair

Evgeni P. Velikhov graduated from Moscow State University in 1958. Since that time he has been working at the Kurchatov Institute of Atomic Energy in Moscow. At present, he is President of the Russian Research Centre "Kurchatov Institute".

He received his Doctor of Science degree in 1965, was elected Member-Correspondent of the USSR Academy of Sciences in 1968 and Academician in 1974. Since 1978 he has been Vice-President of the then USSR and now Russian Academy of Sciences. He is Head of the Russian National Fusion Programme. At the first ITER EDA Council Meeting, Academician Velikhov was elected by the Council as its Chair.

In accordance with the schedule agreed upon by the ITER Parties, Protocol 2 of the ITER EDA Agreement has been signed in Vienna on 21 March 1994. Protocol 1, which was the first step of the implementation of the Agreement ended the day before.

Looking back, one can say that the actual beginning of Protocol 1 was the first ITER Council meeting in September 1992, at which all principal project management personnel have been appointed and the Joint Central Team (JCT) structure was defined. The Home Teams were organized by that time. The Technical and Management Advisory Committees were set up to provide advice to the Council on current activities of the project. Two Special Working Groups (SWG) were established, SWG-1 was charged to review the detailed technical objectives of the project, and SWG-2, among other charges, to develop the draft of Protocol 2 and guidelines for the implementation of task assignments to the Home Teams.

The appointment of the Director initiated the staffing of the JCT according to the approved procedure for professional staff selection. Most important for the JCT was to start its work from the first days of its existence. I personally share the TAC members' opinion that the JCT is commendable for the substantial progress made in developing the Outline Design of ITER on a short time-scale, with the available resources and within the constraints set by the present arrangements, with its three Joint Work Sites.

Naturally, existence and activities of the JCT gave birth to accompanying problems such as: procedure of concluding secondment agreements, participation of other countries (and institutions from other countries), comparability of software used for documentation, visas, taxes, work permits, custom duties, accommodations, etc. Most of these problems have been successfully resolved by ad hoc Groups. The Contact Persons, who were identified by the ITER Parties at the first ITER Council meeting, have also significantly contributed to the EDA development.

Summarizing the main results of Protocol 1, we may state that:

- The ITER Outline Design developed by the JCT by the end of Protocol 1 constituted an acceptable basis for consideration by the Parties to proceed toward the conclusion of Protocol 2.
- The JCT has created the working basis of the Work Programme for the ITER EDA.
- A streamlined procedure of task assignments for the Home Teams has been developed and implemented by the Director, working with the Home Team Leaders.
- The ITER Joint Fund has become operational giving the JCT additional possibilities to conduct its work.

The conclusion is that ITER has become a central focusing element of the national magnetic fusion programmes in the participating countries. On the one hand, this inspires optimism as regards the success of the ITER project; on the other hand it makes us take our decisions very carefully. Another aspect of the Protocol 1 activities, which may attract the attention of the scientific community, is that ITER may serve as a model for future large-scale international scientific projects.

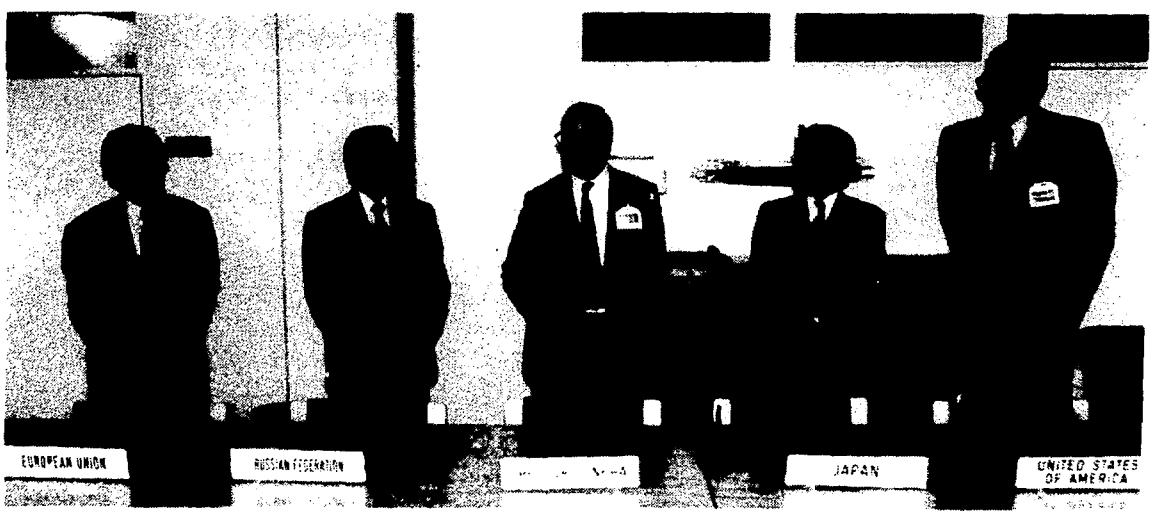
So, we have completed our first step in the ITER EDA, and one should not simply think that this was reached too easily, but with what once again has proved to be obvious: with good will, mutual understanding and the desire to reach together a common goal one can overcome many obstacles.

SIGNING OF ITER EDA PROTOCOL 2

Representatives of the four ITER Parties, the European Community, Japan, the Russian Federation and the United States of America, met on 21 March 1994 in Vienna to sign the second ITER EDA implementing protocol.

The Signatories were Ambassador Corrado Pirzio-Biroli, Head of the Commission of the European Communities' Delegation in Vienna, Ambassador Kunisada Kume, Resident Representative of Japan to the International Organizations in Vienna, Dr. Nicolai S. Cheverev, Deputy Head, Main Department of Fundamental Nuclear Physics Research and Thermonuclear Fusion, MINATOM of the Russian Federation, Ambassador John B. Ritch III, Resident Representative of the United States of America to the IAEA.

Dr. Hans Blix, Director General of the International Atomic Energy Agency, under whose auspices the quadripartite ITER collaboration is taking place, conducted the ceremony.



Director General H. Blix addressing Representatives of ITER Parties

OPENING REMARKS BY DIRECTOR GENERAL HANS BLIX

Ambassadors,

I am pleased to welcome you here this afternoon for the signing of Protocol 2 for the International Thermonuclear Experimental Reactor Engineering Design Activities.

On July 21 of 1992 I had the pleasure of presiding in Washington, D.C. over the signing of Protocol 1, which was the first implementing protocol for the ITER EDA. Since that time, I know that the ITER EDA is moving ahead vigorously with many dedicated personnel around the globe working on this challenging, important task. The IAEA is pleased to provide the overall auspices for the collaboration between the ITER Parties and to provide some specific services, as we do, for example, in maintaining the ITER Office here in Vienna, managing the ITER Trust Fund, and publishing the results of the ITER EDA, including the monthly ITER EDA Newsletter.

Protocol 1 is now expiring, and we are pleased that you are gathered here at IAEA Headquarters today, to sign the second implementing protocol, Protocol 2, so that the remaining work on the ITER EDA can be completed. With this brief introduction, I invite each of you to sign the four copies of the document.

Thank you.

Under Protocol 2, which will cover the Parties' efforts through the end of the Agreement on July 20, 1998, the Parties will complete an engineering design of ITER. Protocol 2 specifically covers the detailed technical work up to the end of the Agreement while Protocol 1, which was signed on 21 July 1992 in Washington D.C. and had been in effect till 20 March 1994, covered the preparatory work from the beginning of the Agreement to this point.

Representatives of ITER Parties signing Protocol 2

TECHNICAL MEETING ON PUMPING AND FUELLING

by K.J. Dietz, Chairman, Garching Joint Work Site

The meeting was held 19-25 January 1994 at the ITER Garching Joint Work Site.

Objectives

- To assist the JCT in the definition and layout of the ITER Pumping and Fuelling System under consideration of the constraints (technical, financial and time);
- to define pumping and fuelling requirements (exhaust pressure, He burn-up fraction, accumulation, transport and removal, type(s) of fuelling) as well as conditioning requirements;
- to identify technical solutions and to highlight uncertainties in their realization;
- to distribute homework to identify critical areas and to propose methods for their solution to be presented at the next meeting;
- to recommend *one solution* for the ITER pumping and fuelling system with one possible backup;
- to propose research and development programmes to be carried out in order to support the proposed solution.

Open Questions

In addition, the meeting was asked to address open questions, such as

- DT burn-up fraction;
- helium transport and accumulation in core plasma;
- helium transport in SOL plasma, helium retention in the divertor, recycling coefficient;
- fuelling efficiency and its relation to divertor density, comparison of gas fuelling with pellet fuelling for different pellet speeds;
- compatibility of pellet fuelling with ITER divertor;
- divertor pressure and He fraction

Agenda

The agenda contained the following main items:
- Fuelling and Exhaust Scenarios
- ITER Pumping System
- Pumping and Fuelling R&D
- Wall Conditioning
- Summary session with recommendations for hardware and R&D required

In order to allow the Home Teams to prepare themselves for the meeting, the JCT issued a list of topics and questions concerning the pumping and fuelling system and enclosed a list of boundary conditions.

Participation

The response of the Home Teams was good. A list of participants and observers is shown overleaf. The Home Teams provided the session chairmen (heads of delegation) and prepared minutes and recommendations.

Meeting Results

The main meeting results can be summarized as follows:

<u>Pumping System</u>

Cryopumps shall be used (with helium cryotrapping) as primary pump for the base system. Location inside or outside the ITER cryostat. Secondary pumps can be cryopumps or mechanical pumps. A throughput of 1000 mbar.s^{-1} can be obtained at a pressure of 5x10^{-3} mbar. R&D requirements are mainly related to regeneration valves, primary cryopumps, impurity separation mechanical pumps and instrumentation.

Fuelling System

Gas puffing and pellet injection, 3-6 pellets, speed up to 1.5 km.s^{-1} as base system. Recommended R&D shall concentrate on pellet feed, tritium pellet fabrication, qualification of injector and gas puffing equipment to nuclear environment and construction and testing of prototype injector.

Wall conditioning

Conditioning at elevated wall temperature $\geq$300°C, glow discharge and RF methods. R&D requirements not already covered by other activities are, among others, to develop an ITER compatible RGA, a plasma assisted chemical vapour deposition method, and a high speed impurity pump.

Physics R&D

During the discussion it became clear that a large amount of voluntary physics R&D would be of benefit for the development of the pumping, fuelling and conditioning hardware.

Summary

The meeting was very useful and the JCT will carefully consider the recommendations for hardware and research and development. Generally, the recommendations are in line with the JCT concept, so that a large part of them will be taken into account and implemented into hardware design.

LIST OF PARTICIPANTS

EC
M. Chatelier, CEA
D. Murdoch, NET
D. Perinic, KfK Karlsruhe
J. Winter, KFA Julich

JA
Y. Murakami, JAERI
T. Abe, JAERI
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S.L. Milora, ORNL
D. Ravenscroft, LLNL
D. Cowgill, SNL

EC Observers
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G. Pacher, NET
J. Hemmerich, JET
L. Lengyel, IPP Garching
V. Metrens, IPP Garching

Garching JCT
J. Dietz
H. Nakamura
P. Ladd
G. Janeschitz
R. Matera
M. Sugihara

Naka JCT
H. Yoshida
O. Kveton
D. Holland

ITER TRITIUM PLANT TECHNICAL MEETING

by R. Haange, ITER Joint Work Site Naka

The first (EDA) Tritium Plant Technical Meeting was held 14-18 March 1994 at the ITER Naka JWS.

The main objectives of the meeting were:

- to discuss design options and select design of subsystems of the Tritium Plant;
- to discuss additional T-Plant requirements for blanket test modules (preliminary);
- to review T-extraction from liquid lithium (JCT option for breeding blanket);
- to establish R&D requirements.

The participants in the meeting noted with regret that the RF delegation could not attend due to visa problems. The Home Team Delegations as well as the JCT members expressed their dissatisfaction with the non-attendance of the RF Home Team and requested that this be handled appropriately by the Council to try to avoid future recurrence.

Participants in the Meeting

The first two days of the meeting were scheduled for presentations by members of the JWS Naka to introduce the pre-selection of process options for subsystems, to describe the present operation conditions and give information on additional design parameters. The next two days were reserved for HT presentations which were requested to include preliminary information on T-Plant implication of test blanket module processing and review of the status of T-extraction from liquid lithium. The last day of the meeting was used to compile summaries for the four main subsystems discussed during the meeting, i.e.

fuel cleanup system (FCU),
hydrogen storage and supply,
water detritiation and isotope separation,
atmosphere detritiation.

The following main conclusions can be drawn from the meeting. The HTs agreed that the process concept for FCU pre-selected by the JCT, i.e. the catalyst/permeator process including a palladium membrane reactor, should be developed in the R&D programme. The likely requirement for 20 bar overpressure for the primary

FCU component was considered to be too restrictive as other means of overpressure protection were deemed to be feasible. The proposed detritiation factor by the JCT (in the order of 10^3) was considered to be low and further optimization was recommended. The once-through processing concept proposed by JCT was viewed as an important target.

With respect to hydrogen storage, the HTs agreed that uranium is the consensus choice for the storage bed and recommended that the option to use other (intermetallic) materials should be kept open. Intermetallic beds are seen to be the proper choice for shipping beds.

The JCT pre-selected water detritiation process (distillation, vapour phase catalytic isotope exchange in combination with cryogenic distillation) was fully supported by the HTs. One HT suggested to incorporate also thermal diffusion columns in the ITER designs for added flexibility in a highly integrated JCT design. As for the atmosphere detritiation designs presented by the JCT, the HTs agreed with the basic design approach and recommended some additional measures to reduce the amount of tritiated water adsorbed on dryer beds.

In the detailed technical presentations by members of the HTs, a considerable amount of important work relevant to the design of the ITER T-Plant was presented. These include reports on self-assaying storage beds, development of FCU systems and recent operation results with cryogenic distillation columns.

As a result of HT presentations on the current status of T-extraction from liquid lithium and of the preliminary presentations on T-extraction from test blankets it was agreed that at this stage adequate space should be reserved in the T-Plant building to allow the installation of the associated extraction systems. Further action could only be taken after the policy on test blanket sections has become clear and the decision on the type of breeding blanket has been made.

Practical proposals were made on the basis of relevant experience in operating tritium systems (including TFTR) leading to component designs that have maintenance considerations incorporated from the onset as well as to a documented decision making process as required for regulatory approval.

The only subsystem within the T-Plant for the Basic Performance Phase that cannot be based on sufficiently proven technology and requires substantial further R&D effort is the FCU. The outcome of the meeting indicates that design data allowing a firm decision to be taken on the final selection of FCU would be available towards the end of 1995 by means of the proposed R&D packages.

LIST OF PARTICIPANTS

EC Home Team	JA Home Team	US Home Team
J.L. Hemmerich	K. Okuno	J. Anderson
S.K. Sood	M. Enoeda	J. Bartlit
D. Murdoch	S. Konishi	G. Nardella
R.-D. Penzhorn	T. Hayashi	D.-K. Sze
G. Vassallo	T. Yamanishi	S. Willms

Joint Central Team: V. Chuyanov, D. Dilling, H. Nakamura, M. Huguet, D. Holland, H. Yoshida, H. Horikiri, J. Koonce, O. Kveton, R. Haange

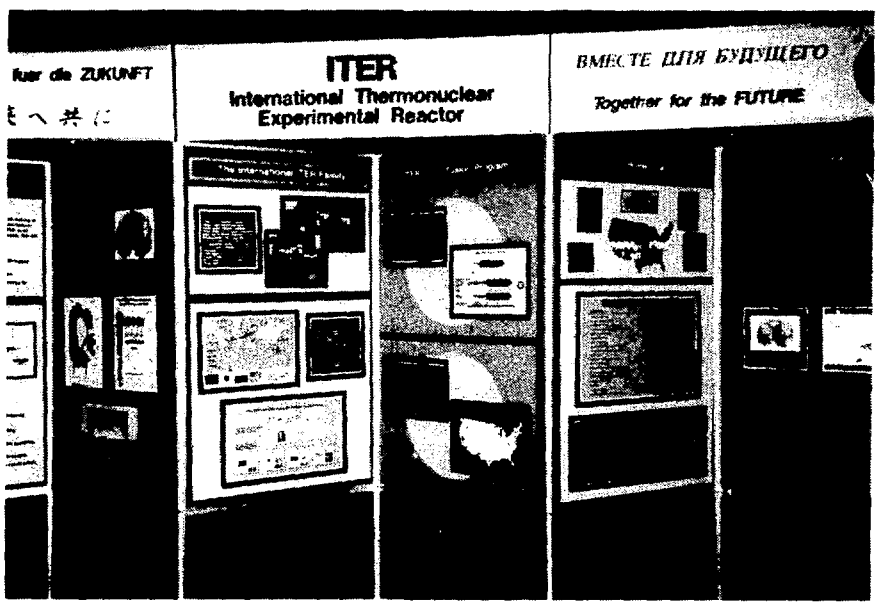
NEWS IN BRIEF

Fusion Forum, 3 March 1994

Industry, universities, and Department of Energy laboratories involved in the U.S. fusion program converged on Washington, D.C. to meet with Members of Congress and congressional staff to discuss program progress and need for fusion. There was a breakfast meeting at which congressional staff members provided feedback on fusion funding prospects to the fusion participants. The fusion participants spent the day visiting Members of Congress and officials of the Administration.

The Fusion Forum evening reception was held in the Montpellier Room of the Library of Congress. Over thirty displays filled the room. DOE's display provided an overview of the U.S. magnetic fusion program including U.S. participation in ITER as a focal point. Dr. C.C. Baker and Mr. C. Flanagan prepared and manned the U.S. ITER Home Team display. Displays by the participating organizations described how their activities contributed to the national and international programs.

Approximately ten Members of Congress and nearly 100 congressional staff were in attendance. The Fusion Forum was well received and plans for another event next year are being discussed.



U.S. ITER Display at the Fusion Forum

FORTHCOMING EVENTS *)

- Technical Meeting on Power Supply, Naka, Japan, 10-13 May
- MAC-6, St. Petersburg, Russia, 1-2 June
- IC-6, Moscow, Russia, 15-16 June
- TAC-6, St. Petersburg, Russia, 12-14 July

*) Attendance at all ITER Meetings by invitation only.

Items to be considered for inclusion in the ITER Newsletter should be submitted to B. Kouvchinnikov, ITER Office, IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: 43 1 237762 (phone 23606392).

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