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INSIDE

* Specialists' meetings in February
* Kurchatov Institute of Atomic Energy
* Princeton Plasma Physics Laboratory
* New ITER publications
* ITER Events Calendar

SPECIALISTS' MEETINGS IN FEBRUARY

1. MEETING ON ITER MATERIALS DATA BASE

by D. Smith

The primary objective of the specialists' meeting on ITER materials data base, held in Garching on 7 - 9 February 1990, was to develop a single set of recommended data for use in the current phase of the ITER design. This activity included a compilation and assessment of the available data for candidate ITER materials, and recommendations for design curves or correlations to be used by the designers. In order to more effectively complete the work, the effort was divided into three parallel areas:

- structural materials,
- tritium breeding materials, and
- plasma facing materials.

Significant new information presented in all three areas was combined with previously presented data (1988 Meeting on ITER materials data base and contributions to the ITER design activity).

Structural materials

The structural materials included Type 316 austenitic steel (solution annealed) as the first wall/blanket structure and copper, molybdenum, and niobium alloys as the candidate divertor structural materials. The unirradiated properties of Type 316 austenitic steel presented at the June 1988 ITER materials meeting were confirmed. New data were presented on the fracture toughness of irradiated steel, total and uniform elongation of irradiated weldments, and effects of helium on rewelding of steel. Available data for dispersion-strengthened copper, Mo-Re alloys and Nb-1% Zr alloy have been documented. Further investigations are required to provide a more comprehensive data base for all candidate divertor materials.

Tritium breeding materials

An assessment of the materials data base for candidate Li ceramic breeder materials, beryllium, and Pb-Li eutectic was completed. In addition, a relative comparison of important properties was made for the four candidate ceramic breeder materials, namely Li_2O, $LiAlO_2$, Li_4SiO_4 and Li_2ZrO_3. Additional data on radiation effects, and tritium transport/solubility are needed for the ceramics and beryllium.

Plasma facing materials

The activity on plasma facing material data base was focused primarily on graphite and carbon composites, with limited information presented on tungsten and beryllium. Information was presented in three areas: high heat flux testing and thermomechanical properties, neutron radiation effects on carbon materials, and erosion and tritium retention. Because the highly anisotropic pyrolytic graphite exhibits poor thermal shock characteristics, more emphasis on carbon composites is recommended. Tritium retention in carbon based materials is a concern. Additional data on tungsten is needed.

2. MEETING ON TRANSIENTELECTROMAGNETICS AND PLASMA CONTROL
by Y. Shimomura, Head, Poloidal Field System Design Unit

The ITER Poloidal Field (PF) Specialists' Meeting was held in Garching on 5 - 9 February 1990, with the major objectives to evaluate the new passive structure for vertical stability, and the loads due to disruptions and to initiate further work on plasma control in ITER. Twelve experts from four Parties and eleven permanent members of the ITER design team took part in this meeting.

New concept to ensure vertical stability

The first topic discussed was the vertical stability, which is one of the critical issues of the ITER design because of the highly elongated plasma and the large distance between the vacuum vessel and the plasma. A new twin loop concept was developed in 1989 by the ITER team, mainly by S. Sadakov. The concept consists of twin copper plates rolled on the top and bottom parts of an outboard blanket and a copper plate on the inner surface of the vacuum vessel. This concept was carefully analyzed by U. Gribov and S. Nishio and found to be a better one than the conventional saddle-loop concept. This is a very attractive concept because it provides sufficient stability margin and allows a large space for ports at the midplane because, unlike the saddle loop, it does not require a side plate.

Loads due to disruptions analyzed

The second topic was the loads due to disruptions. Large forces due to disruption develop in the inboard blanket, outboard blanket, divertor plate, vacuum vessel, etc. For the outboard blanket, a large space is available for support structure, but only a very small space is available for the inboard blanket and the divertor. The force can be reduced by increasing the number of electrical segmentation of the inboard blanket and the divertor plate. As for the vacuum vessel, improvement is required to cope with the large radial force of about 280 MN. The vertical force is about 50 MN without poloidal current. Based on DIII-D experiment, the poloidal current is estimated to be about 3 MA which induces about 40 MN or voltage of about 7 kV with electrical insulation. The voltage is too high for electrical insulation and in-vessel components are to be electrically connected to the vacuum vessel. The total weight of the vacuum vessel and in-vessel components is about 10,000 tons. Compared to the weight, the force due to disruption is small. Therefore, a careful study will be needed only on local effect due to the poloidal current.

A study on ITER plasma control was started by K. Kurihara and R. Yoshino from JT-60 and J. Leuer from DIII-D. Plasma control in the steady-state is essential in ITER. A delicate control of vertical position is required for an ideal double-null divertor operation. It is desirable to control the plasma position after thermal quench in order to avoid serious hard disruptions. This problem will become one of the major issues and will be studied not only in the PF group but also in the Physic Group.

3. NUCLEAR DATA AMONG TOPICS DISCUSSED AT ITER SHIELDING MEETING
by D.W. Muir, Nuclear Data Section, IAEA

Focus on design margins

The current status of the methods and data used in ITER shielding calculations was assessed at a specialists' meeting held at Garching, 12 - 14 February 1990. Special emphasis was placed on the establishment of safety factors, or design margins, and on the potential role of new integral experiments in reducing these margins. Representatives from the fields of neutronics, nuclear data, and sensitivity analysis discussed the reliability of current analytical methods. Specialists in neutronics integral experiments discussed the possibilities for new, accurate integral experiments, as well as the information contained in previous integral measurements.

In the IAEA contribution, participants were informed about progress to date on the Agency's programme to create a modern and internationally available Fusion Evaluated Nuclear Data Library (FENDL), and advice was requested concerning the data requirements of the ITER project. In addition, the forthcoming consultants meeting on FENDL, to be held at IAEA Headquarters on 25 - 28 June 1990, was announced. It is expected that one or more of the participants in this shielding meeting will also attend the FENDL meeting and help finalize plans for processing of the data into the forms most useful for fusion applications.

Addition of specific elements to IAEA nuclear data library recommended

The participants agreed that the FENDL project, previously described in the June 1989 ITER Newsletter, will provide important input to future design calculations. To enhance this utility, participants recommended the addition of eight elements (Na, Mg, P, S, Cl, K, Ca and Ta) to the existing FENDL set of 25 elements. Highest priority was given to the two FENDL sub-tasks of preparing processed data libraries for neutron and photon transport codes and the development of an activation cross section library with a large number of target nuclei and reaction types. Data covariances (uncertainties) and partial transfer matrices will also be required, in order to assess the significance of any discrepancies between predictions and measurements in shielding experiments.

Vienna-Garching data-communications link

Following the meeting, arrangements were finalized for a new Vienna-Garching data-communications link. (See the article on data communications in the May 1989 ITER Newsletter.) The new link utilizes the DATEX-P X.25 protocol for error-free data communication. It gives the IAEA's Nuclear Data Section the possibility of running jobs remotely on the Garching VAX's and provides, through them, a more efficient connection with international networks, such as MFENET. This should accelerate progress on FENDL and assist in the timely dissemination of processed files to project personnel.

Editor's Note

The Newsletter continues the series on background information and ITER-related activities of the ITER Parties' major fusion research centres by presenting the I.V. Kurchatov Institute of Atomic Energy, USSR, and the Princeton University Plasma Physics Laboratory, U.S.A.

CONTROLLED NUCLEAR FUSION RESEARCH AT I.V. KURCHATOV INSTITUTE OF ATOMIC ENERGY

by N.E. Karulin

Founded in 1943

I.V. Kurchatov Institute of Atomic Energy (IAE) is the largest centre of nuclear science and technology in the Soviet Union. It was founded in 1943 with the primary mission of developing nuclear weapons. In 1946, under the leadership of I.V. Kurchatov, the first fission reactor Ø-1 was put into operation. Later, upon successful resolution of its primary task, which, at that time, was called "uranium problem", the institute focussed its activities on peaceful uses of atomic energy, including both nuclear power engineering and fundamental and applied studies. IAE played the leading role in design and made essential contribution to the construction of the world's first 5 MW nuclear power plant, which was commissioned in 1954 in the town of Obninsk, near Moscow. At present, the IAE carries out studies of nuclear and molecular physics, plasma physics, solid-state physics as well as the radiation damage studies and a number of other research activities.

Studies of controlled nuclear fusion (CNF) began in the institute in 1951, the work being headed by Acad. L.A. Artsimovich. The original concept of a tokamak was first suggested at the IAE and the first tokamak device was built there in 1955*. At present IAE is the leading CNF centre in the Soviet Union.

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* See historical details in the article by V. Pistunovich and V. Strelkov "Fragments of Tokamak History (1950-1968)", ITER Newsletter, Vol. 2, No. 9

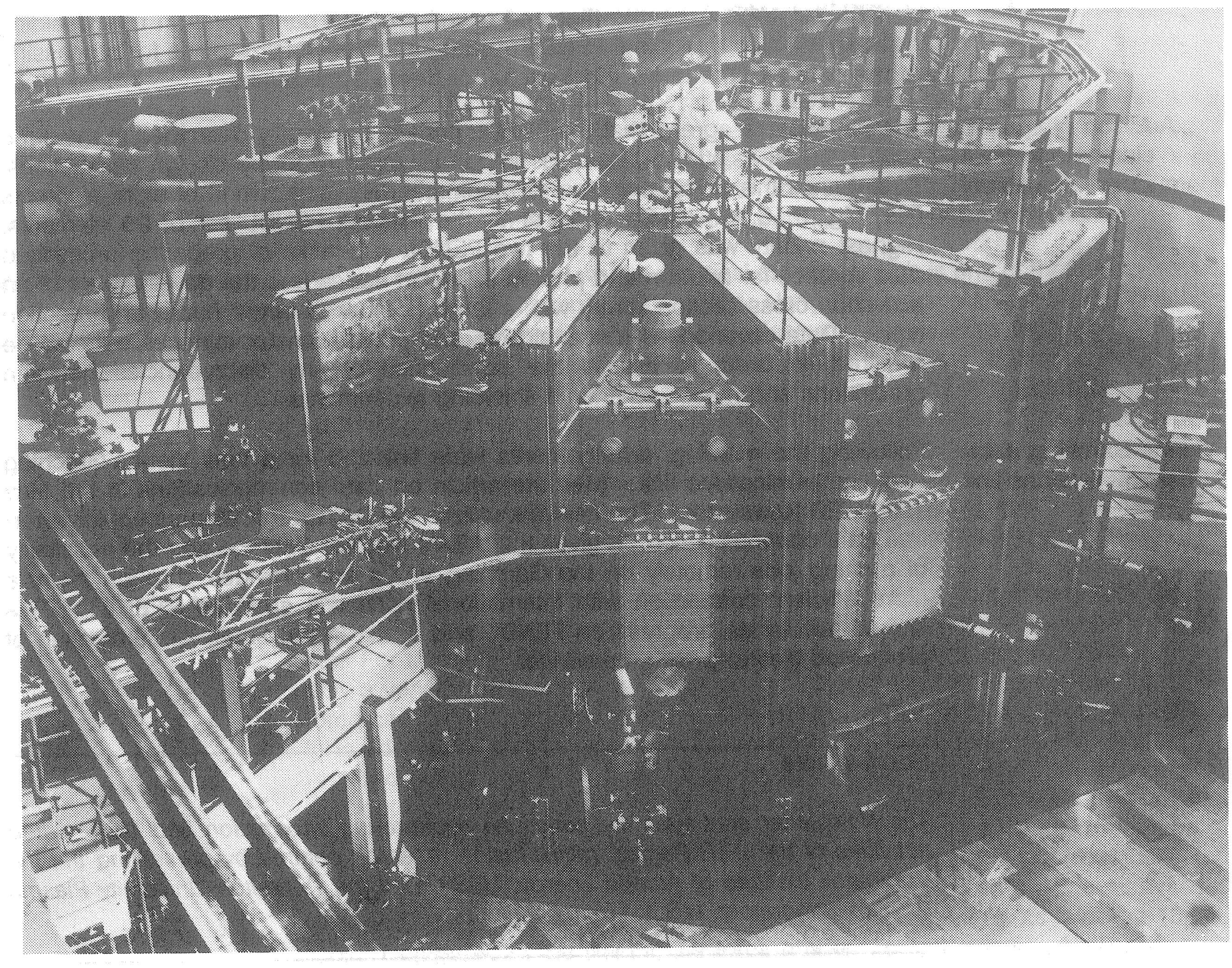


Fig. 1. Tokamak T-15

Beginning of the international co-operation

The speech by I.V. Kurchatov in Harwell, United Kingdom, in 1956, was the starting point of the broad international co-operation in the area of controlled fusion. Another major milestone in the East-West co-operation in this field was that, in 1969, British scientists took part in the experiments on the Soviet tokamak T-3 for the first time. Later, scientists from various countries participated in the experiments on T-10, T-7 and other devices of the Kurchatov Institute. The Soviet physicists and engineers played an active role in the well-known international project INTOR. Finally, following the proposal made at the Summit Meeting, the ITER activities were initiated, which required even more orientation of the IAE activities toward international co-operation.

Plasma Physics Department

The ITER-related activities were initiated at the IAE in 1988. They are mainly concentrated in one of the major IAE departments, the Plasma Physics Department (PPD), headed by Acad. B.B. Kadomtsev as Director. The PPD personnel are approximately 1400 scientists, engineers and technicians. The department has several tokamak experimental facilities, such as T-15, T-10, TO-2 and TVD. Along with the experiments on tokamaks, the PPD performs studies on open systems (OGRA-4 and PR-8), neutral beam injectors, nuclear technology, particle-surface interactions and others. A theoretical division of the PPD, headed by a Member-Correspondent of the USSR Academy of Sciences, Dr. V.D. Shafranov, is well known for its contribution in the development of a broad range of plasma physics and CNF issues.

Leading scientists and engineers directly involved in ITER activities

A number of leading IAE scientists and engineers are directly involved in the ITER activities. The Director of the Institute, Vice-President of the USSR Academy of Sciences, Acad. E.P. Velikhov, is an ITER Council Member. Acad. B.B. Kadomtsev and Dr. V.A. Chujanov are Members of the ITER Scientific and Technical Advisory Committee (ISTAC). The USSR ITER Managing Director, Dr. Yu.A. Sokolov is also from IAE. Several IAE specialists regularly take part in the extensive joint work sessions in Garching. Among them are Dr. G.E. Shatalov, Head of the Nuclear Engineering Project Unit, Dr. V.V. Parail, Head of the Current Drive and Heating Design Unit, and others. IAE representatives play key roles in the USSR national Executive Committee (OTR/ITER EC) providing management support to the USSR participation in the ITER activities (ITER Newsletter, Vol. 2, No. 4).

ITER-related works are also held in the Troitsk branch of IAE, near Moscow with two tokamaks there, TSP and T-11M, and in the Solid-State Physics Division at the IAE, where, for many years, super-conducting magnet systems have been developed.

Co-ordination of USSR-wide ITER-related works

In support of ITER, the institute carries out R&D in the field of high-temperature plasma physics, nuclear technology, current drive and plasma heating (CD&H), safety and environment, and system analysis. PPD co-ordinates participation of other Soviet research institutes in ITER-related R&D programme on:

- tokamak experiments,
- plasma diagnostics,
- gyrotron development,
- safety and environment,
- radiation-damage physics and liquid-metal divertor, and others.

Some important R&D tasks are described here below in more detail.

EC current drive and heating

The development of CD&H techniques with the help of electron-cyclotron waves (EC) is a considerable part of the T-10 experimental programme. Along with the EC experiments on T-10, headed by V.V. Alikaev, with a 3 MW (in plasma) gyrotron system, experiments with a 6 MW gyrotron system will be performed in the new super-conducting tokamak T-15. The development and testing of a stationary gyrotron with the high unit power (1 MW) for the ITER needs is being carried out by IAE in co-operation with the Institute of Applied Physics, Gorky, as one of the USSR contribution in the ITER R&D programme.

Energy confinement and plasma performance

The analysis of the experimental database, obtained from large tokamaks, contributes to the basis on which the energy confinement scaling for ITER is defined. The IAE physicists develop confinement theoretical models and work on the definition of the regimes with enhanced confinement as well as on the CD&H scenarios for ITER.

NB system for ITER

The development of a powerful neutral beam (NB) injector, 10 MW/unit, with energy of up to 1.3 MeV is in progress in the framework of the ITER R&D programme. It will be part of the preconceptual design of the NB CD&H system for ITER being under development. Energy beam absorption by plasma as well as heating scenario is being modelled and estimated by means of calculations.

Plasma equilibrium and stability

Various equilibrium calculations for the elongated plasma configurations are investigated, for both double-null and single-null options. These studies cover the issues of the stability of these configurations with regard to vertical displacements and MHD-modes, as well as the optimization of the volt-second consumption.

Power and particle control

Power and particle control is one of the critical issues of the ITER design. In this regard, the IAE specialists develop specific computer codes to be used for estimates of the loads on the ITER divertor plates and helium pumping capabilities. Efforts are also made in the area of periphery plasma physics with the aim to define the optimal operating regimes of the divertor.

Disruption control

Possibility of disruption control and prevention is studied experimentally on T-10 and TO-2 tokamaks. Included in these studies are disruption suppression by EC-waves, creation of periphery currents, analysis of the disruption precursors and disruption models.

Nuclear engineering and technology

Li-Pb eutectic being one of the options for the ITER breeding blanket, proposed by the USSR, its features and behaviour are under study at the IAE. Also, thermal and stress-strain analyses of the first wall and the divertor are being performed. The ion accelerator is used for testing of carbon based materials, which are possible candidates for the ITER divertor material. Also, tritium accumulation and sputtering under the particles flow influence are being analyzed.

Safety studies

Safety issues are studied for both routine and accidental operation conditions. The accumulation of radionuclides in the course of normal ITER operation is estimated. As to accidents, the consequences and scenarios of the LOCA- and LOFA-type accidents for the first wall, blanket and the divertor are being studied.

Bilateral international co-operation

Besides the multinational co-operation, IAE particpates in the joint experiments on tokamaks on the basis of the long-term bilateral agreements of the USSR with the USA, Great Britain, the Federal Republic of Germany, France and Italy. With Soviet technical assistance tokamaks were built in Hungary and Czechoslovakia. Also, there is co-operation with scientists of the German Democratic Republic in the field of plasma-wall interactions.

TABLE 1. KURCHATOV INSTITUTE MAIN TOKAMAKS

	T-10	T-15*	TSP**
Plasma major radius (m)	1.5	2.43	1.06 - 0.41
Plasma minor radius (m)	0.35	0.7	0.33 - 0.12
Elongation	1	1	1
Magnetic field on axis (T)	3.3	4.5 (3.5)	2 - 12.8
Plasma current (MA)	0.45	1.4 (0.7)	0.4 - 1.2
Plasma density ($10^{20}m^{-3}$)	0.7	1	0.7 - 10
Plasma temperature (KeV)	10 (T_e) 0.9 (T_i)	7	1 - 10
Heating power (MW)	3(EC)	6(EC)	1.7 (NB)

* Projected parameters (figures in brackets are the values obtained thus far)
** Right column corresponds to compressed phase

PRINCETON UNIVERSITY PLASMA PHYSICS LABORATORY

by Douglass E. Post

Princeton tokamak programme

The Princeton Plasma Physics Laboratory (PPPL), founded in 1953 by Lyman Spitzer, is operated as part of Princeton University with funding by the U.S. Department of Energy. The Laboratory, with 900 employees, is located near Princeton, New Jersey on the James Forrestal Campus of the University. The Laboratory's research programme has tokamak physics as its major emphasis and is centered around two large tokamak experiments -- the Tokamak Fusion Test Reactor (TFTR) and the Poloidal Beta Experiment (PBX/M) -- and a number of smaller experiments. Princeton also has programmes in theoretical plasma physics and computational modelling. The Laboratory plays the lead role in the Compact Ignition Tokamak (CIT) design effort. As part of the Astrophysical Sciences Department of Princeton University, the Plasma Physics Laboratory has a graduate programme in plasma physics with about 40 students.

Princeton ITER-related activities

The main focus of the Princeton participation in ITER is support of the physics of the ITER design in the areas of power and particle control, diagnostics, energy confinement and plasma performance analysis, MHD stability and poloidal field design, alpha particle physics and current drive and heating physics. TFTR and

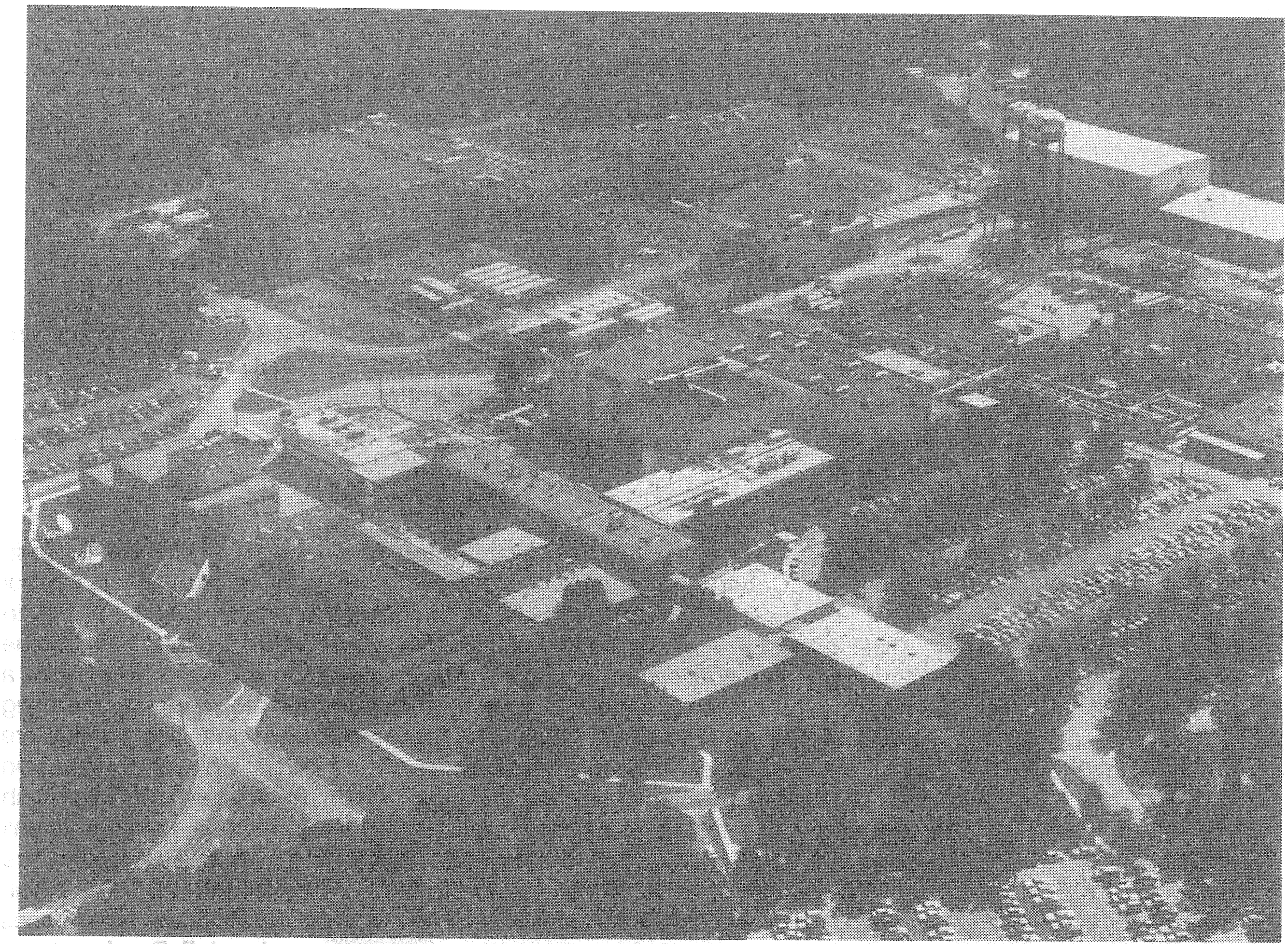


Fig. 1. Aerial view of the Princeton Plasma Physics Laboratory

PBX/M also contribute information useful for the ITER design as part of the ITER Physics R&D Programme and by participation in many of the ITER technical workshops. Two Princeton physicists, Douglass Post and Samuel Cohen, are part of the U.S. ITER team in Garching. Paul Rutherford, Associate Director of PPPL, is one of the three U.S. members of the ITER Scientific and Technical Advisory Committee. Melvin Gottlieb, the former Director of PPPL, is a member of the Ways and Means Working Party, which is charged by the ITER Council with "the CDA task of proposing those supporting elements needed for the possible conduct of the Engineering Design of ITER."

Princeton provides Head of International ITER Physics Group

Douglass Post from Princeton is Head of the ITER Physics Project Unit in Garching, which consists of about 25 physicists from the four ITER Parties. The responsibilities of the Physics Project Unit are to develop the physics guidelines for ITER, to work with the engineering groups to integrate the physics and engineering aspects of the design, and to manage the Physics R&D programme involving the fusion programmes of the four ITER Parties.

U.S. IPAG provides an interface between ITER and the U.S. function experiments

Dr. Post is also responsible for the U.S. physics support of ITER, which involves co-ordinated part-time and full-time participation of about 100 U.S. physicists from 16 institutions. Because the ITER design must be solidly based on the results of the world's tokamak research programmes, there must be a very close connection between the design team and the experimental and theoretical tokamak community of each ITER Party. To facilitate this interaction in the U.S., the U.S. Department of Energy has set up the ITER Physics Assessment Group (IPAG) to co-ordinate the contributions of the U.S. fusion experiments to the ITER Physics R&D programme and to provide an interface between the U.S. ITER physics team and U.S. fusion experiments. Membership is indicated in Table 1.

TABLE 1. MEMBERS OF THE U.S. ITER PHYSICS ASSESSMENT GROUP

James Luxon, Chairman	DIII-D (General Atomics)
Ken Young	TFTR (Princeton)
Ned Sauthoff	PBX/M (Princeton)
Steve Wolfe	Alcator C-Mod/Versator (Massachusetts Institute of Technology)
Ralph Isler	ATF (Oak Ridge)
Bick Hooper	MTX (Lawrence Livermore)
James Callen	Transport Task Force (University of Wisconsin)
Ron Bravenec	TEXT (University of Texas)
Erol Oktay	(Department of Energy)

Power and particle control

Samuel Cohen is the other person from Princeton on the ITER Physics Team in Garching. Dr. Cohen is responsible for the U.S. work in power and particle control for ITER. Power and Particle Control is among the most crucial physics issues in the ITER design. A major focus of the U.S. contribution in this area is the development and application of large scale computational models to design a divertor that will have acceptable operating conditions for the range of operating scenarios being considered for ITER. The results of these modelling studies are used to set the guidelines for the heat fluxes on the divertor plates, the erosion lifetime of the divertor plates, and the pumping system to exhaust the helium ash generated by the fusion reactions. Validation of the models using tokamak experimental data is a key part of this work. Many of the modelling studies are done at Princeton by Bas Braams, Martha Redi, Marijan Petravic, and Julian Cummings. Major parts of the studies are also carried out at many laboratories and universities in the U.S. including erosion analyses by Jeff Brooks at the Argonne National Laboratory and analysis of the divertor performance by Ken Werley at the Los Alamos National Laboratory.

Diagnostics

Ken Young, from Princeton, co-ordinates the U.S. efforts on the conceptual design of the plasma diagnostics systems for ITER. In some areas, new diagnostic techniques are required, either because new types of measurements are needed, such as alpha particle diagnostics, or because the techniques presently being used will not work in the ITER environment with high fluxes of neutrons and gamma rays. A diagnostics R&D programme to develop these new techniques is planned. In this regard, information from deuterium operation on TFTR has proved useful in calibrating the calculational tools used to analyze the sensitivity of diagnostic components to radiation. Princeton diagnosticians involved in these studies are Dennis Manos (edge plasma diagnostics), Robert Kaita (fast particles), and James Strachan (fusion products). Robin Snider of General Atomics and David Swain of ORNL are also part of the U.S. diagnostics group. The U.S. effort for the integration of the diagnostics into the machine layout is the responsibility of PPPL and the Fusion Engineering Design Center at Oak Ridge.

Energy Confinement and Plasma Performance

Stan Kaye at Princeton has collected energy confinement data supplied by the present generation of large tokamak experiments (primarily JET, TFTR and JT-60) to augment the existing database compiled earlier in 1983 with data from earlier (and smaller) experiments (ASDEX, PDX, PLT, ISX and DITE). The new ITER database was analyzed by Kaye and scientists from the other ITER Parties and the results were used to set the level of plasma current (22 MA) used for the ITER design. Analysis of the updated database has led to a new scaling for energy confinement and the identification of the source of part of the uncertainties of present tokamak scalings. A collection of data from H-mode experiments is now being co-ordinated by the JET group (Geoff Corday) and Stan Kaye is participating on behalf of the PBX and PDX/M experiments. Daren Stotler from Princeton has also carried out modelling studies to determine the validity of the density limit guidelines used for ITER.

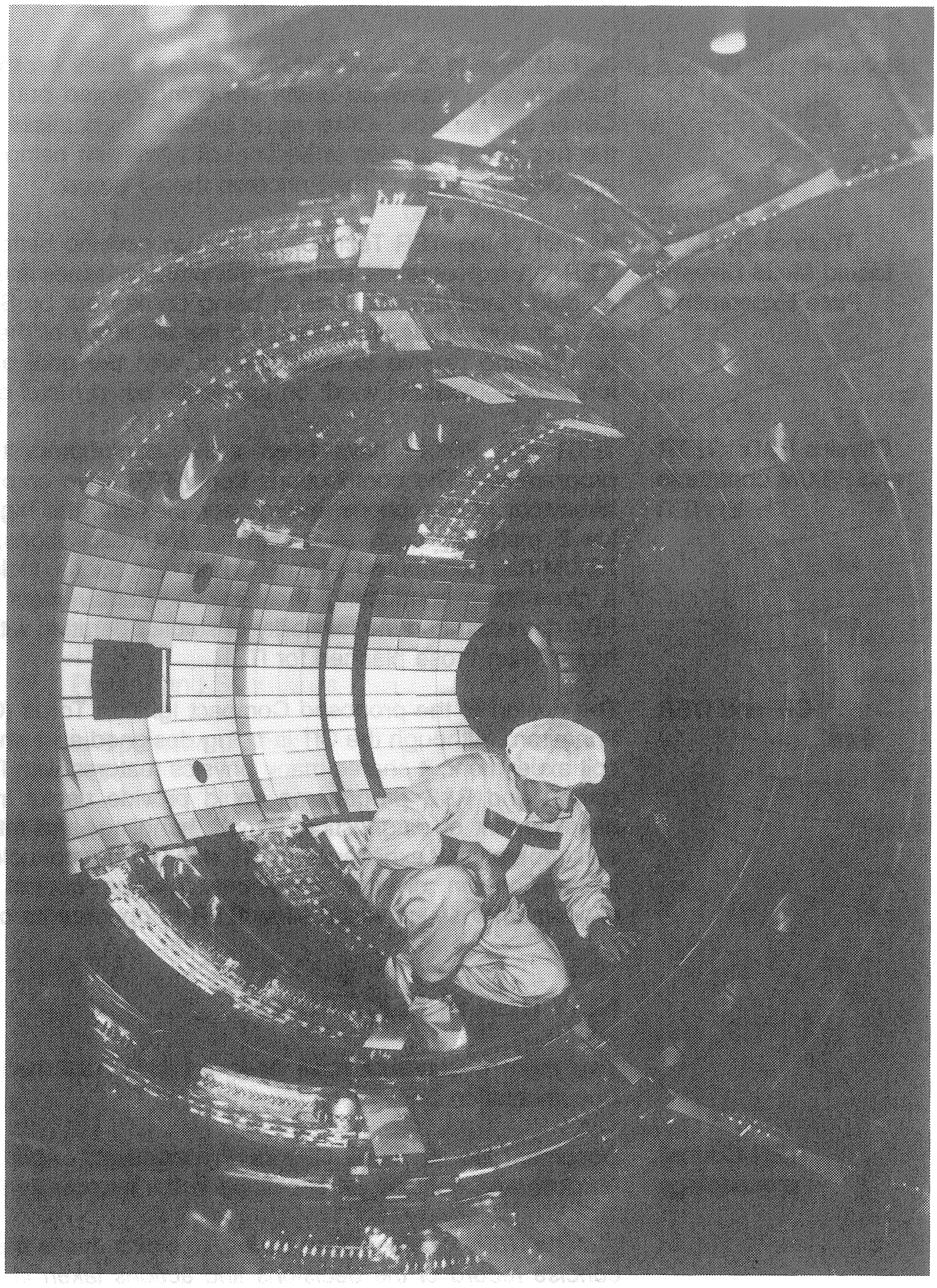


Fig. 2. Inside the vacuum vessel of the TFTR

Princeton codes used in the design of ITER

The Princeton Equilibrium, Stability, and Transport code (PEST) is being used by J. Manikam at Princeton and several other groups in the U.S. (e.g. John Hogan at Oak Ridge) to determine the MHD stability limits for candidate ITER plasma profiles and operating conditions. The Tokamak Simulation Code (TSC) developed by Steve Jardin and Niel Pomphrey at Princeton is being used by the U.S. ITER Poloidal Field Design Group led by John Wesley from General Atomics. Tom Kaiser at Livermore is using the code to study the time dependent interaction of the ITER plasma with the poloidal field system to set the plasma shaping and control, particularly with regard to vertical stability, for ITER. Royce Sayer at the Fusion Engineering Design Center is using the code to study the motion of plasmas during disruptions to allow the engineering groups to calculate the forces on the tokamak structure during disruptions. In addition, the ITER group in Japan (JAERI) has recently begun using the TSC code.

Alpha Particle Physics

Calculations to determine the peak heat fluxes on the first wall from fast alpha particles on unconfined orbits are being carried out by Roscoe White and Sam Cohen at Princeton. Other alpha particle physics issues including the coupling of the fast alpha particles to MHD oscillations are being assessed by Frank Cheng and Greg Rewoldt of the Princeton theory group.

Technology R&D: Liquid Metal Divertor Plate Experiments

As part of the ITER Technology R&D to develop better heat exhaust systems for ITER, an experimental study of the physics issues associated with the design of a liquid metal divertor plate is being carried out by Sam Cohen and co-workers at Princeton. They are measuring the efficiency of the transfer of the momentum of a flowing plasma to solid objects, with the goal of being able to predict the force of the "plasma wind" on candidate liquid metal divertor plates.

Physics R&D: TFTR and PBX/M contribute to ITER

TFTR and PBX/M have been active contributors to the ITER Physics R&D programme. The contributions from TFTR have emphasized information on the behaviour of disruptions, energy confinement, the high heat flux performance of low-Z materials such as graphite, MHD oscillations, and diagnostic systems. PBX/M has contributed information on disruptions, including the stabilizing role of a close-fitting conducting shell and the achievement of high plasma pressures. PBX demonstrated the feasibility of stable operation with plasmas with elongations higher than those planned for ITER.

CIT and ITER

The design of the proposed Compact Ignition Torus (CIT) is being carried out at Princeton. Although the CIT is being designed as a short pulse, high field copper coil experiment, it shares many physics features with ITER. In particular, the CIT design and R&D programme could provide useful information to ITER on the development of diagnostics, remote handling, and tritium systems. In addition, early operational experience in CIT with DT thermonuclear plasmas with additional information on divertor conditions, plasma control requirements, and other experimental issues would allow ITER to optimize its operational plan.

NEW ITER PUBLICATIONS

Two more documents have been recently published by the IAEA in the ITER Documentation Series.

ITER Council proceedings

Document No. 6, "ITER Council Proceedings: April 1988 - August 1989." Its purpose and content are explained in the Introduction Chapter as follows:

"*The ITER documentation series, of which this is the sixth report, began with a concise record of the decisions and actions taken in establishing ITER...The first report in the series also covered activities from the initial meeting of the ITER Quadripartite Initiative Committee in March 1987 through March 1988. The present report is intended to make available in convenient form the essential information on "landmark" events in the direction of the ITER activities from the first meeting of the ITER Council (IC), in April 1988, through the letter report by the Council following their fourth meeting in July 1989. This report therefore covers approximately the first half of the Conceptual Design Activities, which are to be concluded in December 1990.*"

ITER Physics Design Guidelines

Document No. 10, "ITER Physics Design Guidelines: 1989." This report, compiled by Dr. N.A. Uckan and ITER Physics Group, presents in detail the physics basis for ITER, which

"*...has been developed from an assessment of the results of the last twenty-five years of tokamak research and from detailed analysis of important physics issues specifically for the ITER design....While a strong emphasis has been placed on the physics credibility of the design, the guidelines also take into account that ITER should be designed to be able to take advantage of potential improvements in tokamak physics that may occur before and during the operation of ITER.*"

ITER EVENTS CALENDAR - 1990

Joint Work Session	Garching	22 Jan - 23 March
Meeting of Working Party on Ways and Means	Vienna	13 - 16 March
ISTAC Meeting	Garching	21 - 23 March
ITER Council Meeting	Vienna	26 - 27 Apr
Joint Work Session	Garching	2 July - 16 Nov
ITER Council Meeting	Washington	8 - 9 Oct
ISTAC Meeting	Vienna	28 - 30 Nov
ITER Council Meeting	Vienna	13 - 14 Dec

Specialists' Meetings at Garching in support of joint design work:

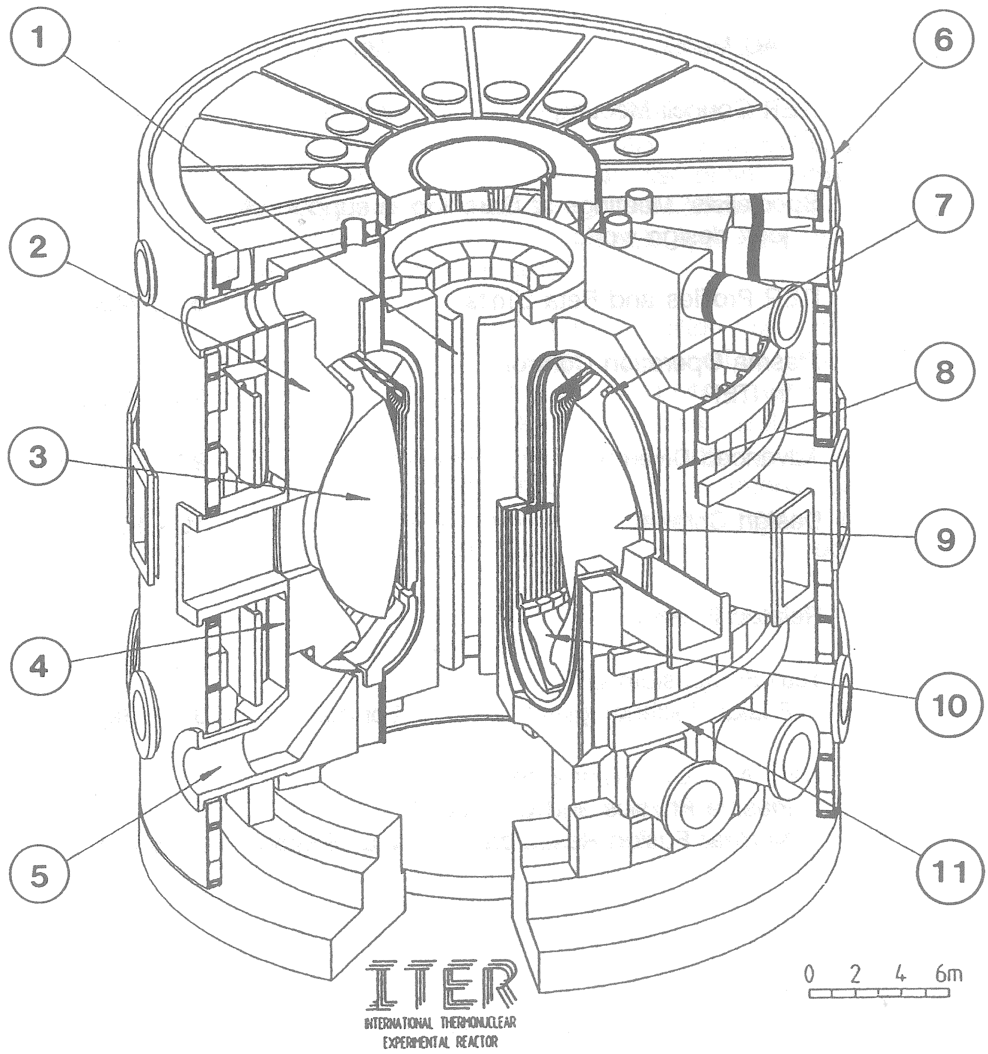
ITER Profiles and Beta Limits	5 - 7 March
Plasma Operation Control in ITER	23 - 27 July
Advanced Divertor	20 - 24 Aug
Design Criteria	10 - 14 Sep

Related Events:

16th Symposium on Fusion Technology	London	3 - 7 Sep
13th IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research	Washington	1 - 6 Oct

ITER REFERENCE PARAMETERS

Plasma major radius, R (m)	6.0
Plasma half-width at midplane, a (m)	2.15
Elongation, 95% flux surface	1.98
Toroidal field on axis, B_o (T)	4.85
Nominal maximum plasma current, I_p (MA)	22
Nominal fusion power, P_f (MW)	1000



1- CENTRAL SOLENOID
2- SHIELD/BLANKET
3- PLASMA
4- VACUUM VESSEL-SHIELD
5- PLASMA EXHAUST
6- CRYOSTAT
7- ACTIVE CONTROL COILS
8- TOROIDAL FIELD COILS
9- FIRST WALL
10- DIVERTOR PLATES
11- POLOIDAL FIELD COILS

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