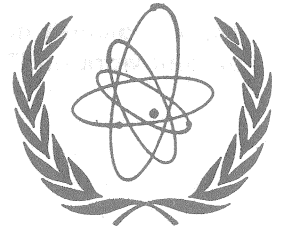




ITER NEWSLETTER

Vol.1, No.1

September 1988



INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

FOREWORD

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The task of unravelling the secrets of how to produce useful energy from nuclear fusion has engrossed the minds and directed the efforts of significant segments of the world's scientific community for nearly thirty-five years. Steady progress has been made, so that today we are approaching an exciting threshold. Scientists even now are experimentally investigating the properties of plasmas that are capable, in principle, of releasing as much energy as is required to produce those plasmas — the long sought-after point of plasma energy break-even. The great strides in understanding and accomplishments over the years have been due, in large measure, to the free and unselfish co-operation of scientists in all the nations that have been engaged in fusion research. This co-operation, so essential because of the magnitude of the scientific efforts involved, has been furthered in many notable cases by the special help that could be provided by international organizations such as the IAEA.

Although prospects for ultimate success are bright, much remains to be done before the promise of fusion energy becomes a reality. Further advances in scientific understanding and in the development of vital technologies will demand continuing commitment of scientific and engineering talent of the highest calibre. There must also be major investments in the facilities required to test and demonstrate all the elements of fusion power production. Recognizing the scope of the undertaking, leaders of many nations, including former Prime Minister Fukuda of Japan, President Mitterrand of France, General Secretary Gorbachev of the USSR and President Reagan of the USA, have publicly called for increased international co-operation in the development of fusion power. The IAEA, which from the earliest days of fusion research has actively promoted information exchanges, has responded to these calls.

After consultations with leaders of all major fusion programmes, in November 1987 the Director General of the IAEA, H. Blix, invited the European Community, Japan, the USSR and the USA to join efforts, under IAEA auspices, to prepare a conceptual design for the large scientific/engineering facility that is the next logical step and to initiate complementary programmes of supporting research and development. All four Parties responded by agreeing to jointly accomplish these tasks, working in accordance with specific Terms of Reference from 1988 through 1990.

The name for the facility, the International Thermonuclear Experimental Reactor, was chosen for two reasons. First, the words themselves are quite descriptive of the various facilities that the Parties had separately envisioned as the next large step in testing the science and technology of power from thermonuclear fusion. Second, the acronym ITER (pronounced "eater") is itself meaningful. ITER is the Latin word for "the way". In entering this agreement, all participants expressed their hopes and expectations that the ITER Conceptual Design Activities will open the way to even more effective international co-operation in energy development for the common good of mankind.

ABOUT THE ITER NEWSLETTER

IAEA publishes news of joint work on ITER

A primary responsibility of the IAEA towards its Member States is the dissemination of information relating to nuclear energy. In view of the potential of the co-operative efforts on ITER for worldwide benefits, the IAEA is publishing this Newsletter, which is being distributed to interested parties throughout the IAEA Member States. The purpose and the editorial policy of the Newsletter are as follows.

- Its purpose is dissemination of broad information and understanding only, and not to be an official record.
- It shall include information on not only the activities within the scope of the ITER agreement but also any other activities that materially affect ITER.
- Articles shall not be restricted to technical facts about ITER but shall also depict the personal and institutional involvements in this international co-operation.
- Material for inclusion in the Newsletter shall be solicited throughout all involved organizations.
- Responsibility for the Newsletter rests with the ITER Council, acting through its Chairman.
- The Newsletter shall be assembled by the ITER Secretariat, IAEA, and published monthly in Vienna.
- Items from the Newsletter may be extracted or reprinted, provided that acknowledgement of the source also appears.

GROUNDWORK FOR THE ITER PROJECT

ITER originated at high levels of government and was organized under the auspices of the IAEA

The Geneva Summit Meeting in November 1985 can be regarded as the starting point of intensive preparatory work that culminated in the current international co-operation on ITER Conceptual Design Activities. At this meeting Mr. Gorbachev suggested that this collaboration extend to joint design, construction and operation of a fusion reactor. There was formal recognition by the Heads of States that enhanced international collaboration in fusion development was highly desirable. Various bilateral discussions led to a preliminary proposal in October 1986 that the EC, Japan, the USSR and the USA prepare a single conceptual design of such a reactor. At the invitation of Dr. Blix, a Quadripartite Initiative Committee and an ITER Working Group, meeting periodically in Vienna, worked out Terms of Reference for co-operation on ITER Conceptual Design Activities. In November 1987 Dr. Blix invited the four Parties to participate in accordance with the Terms of Reference. By mid-March, all four had accepted this invitation. The Federal Republic of Germany prepared a site for the joint technical work which was dedicated on 23 April, and on 2 May joint work began there and at each of the Parties' home sites.



Support for the co-operative efforts in ITER Conceptual Design Activities extends to the highest levels of government. The Joint Statement of the June 1988 Moscow Summit Meeting of the leaders of the USSR and the USA included the following: "The President and the General Secretary noted with pleasure the commencement of work on a Conceptual Design of an International Thermonuclear Experimental Reactor (ITER) under the auspices of the IAEA, between scientists and experts from the USA, the USSR, the European Atomic Energy Community and Japan. The two leaders noted the significance of this step toward the development of fusion power as a cheap, environmentally sound and essentially inexhaustible energy source for the benefit of all mankind."

TERMS OF REFERENCE FOR CONCEPTUAL DESIGN ACTIVITIES

Four Parties work jointly in accordance with Terms of Reference for three years in definition and design phases

It was accepted by the four Parties that the Conceptual Design Activities be conducted in accordance with the Terms of Reference, which include a definition of the Parties and subject matter on co-operation, schedule and guidelines.

The subject matter on co-operation covers design activities and R&D activities with the objective of providing a design that will then be available for all Parties — the European Atomic Energy Community (Euratom), including countries associated with the Euratom Fusion Programme, Japan, the Union of Soviet Socialist Republics and the United States of America — to use either in their own national programme or as part of a large international collaborative programme.

The Conceptual Design Activities are conducted in two phases, a definition phase and a design phase. During the definition phase an ITER concept with a single set of technical characteristics will be documented in the Definition Phase Report, to be submitted to the ITER Council for approval by November this year. As part of the definition phase, a preliminary programme of work for design and R&D activities has to be developed.

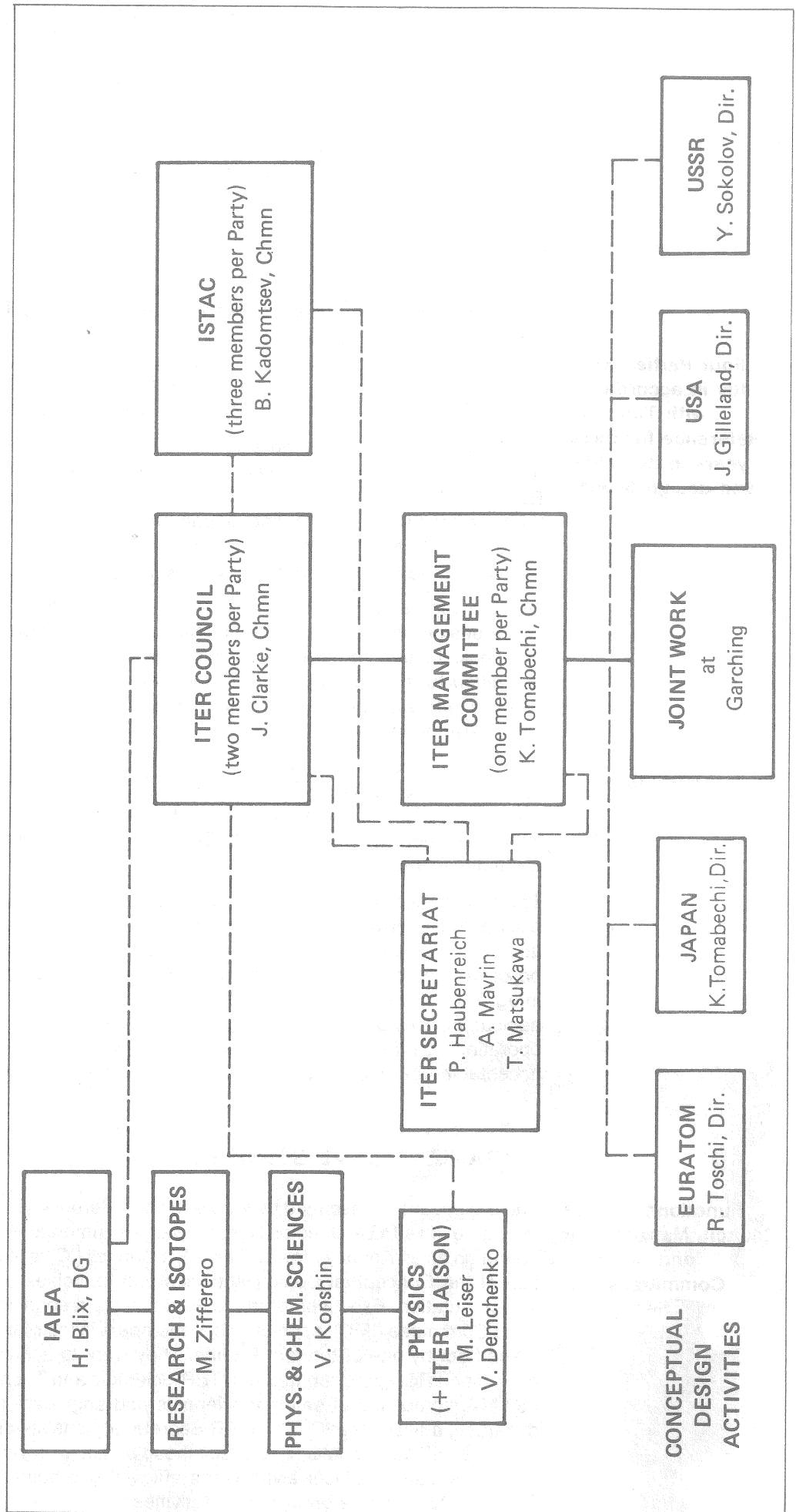
The design phase will begin as soon as the Definition Phase Report has been approved. The result of the design phase will be a Final Report, containing the conceptual design of ITER and describing all the work carried out for the implementation of the Conceptual Design Activities, which would be completed by December 1990.

The overall objective of ITER is to demonstrate the scientific and technological feasibility of fusion power. ITER will accomplish this by demonstrating controlled ignition and extended burn of a deuterium and tritium plasma with steady state as an ultimate objective. The experiment will demonstrate technologies essential to a reactor in an integrated system, and will include integrated testing of the high heat flux and nuclear components required to utilize fusion power for practical purposes. The operation of ITER should demonstrate the potential for safe and environmentally acceptable operation of a power-producing fusion reactor.

ORGANIZATIONAL STRUCTURE

Functions of ITER Council, Management and Advisory Committees and Secretariat

The organization prescribed by the Terms of Reference is outlined in the accompanying figure. The IAEA Director General was instrumental in establishing the ITER co-operation as an Agency project. The ITER Council (IC) is responsible for overall direction of the Conceptual Design Activities and exercises overall supervision of their implementation. Execution of the activities is the responsibility of the ITER Management Committee (IMC), each of whose members is the Managing Director of the work carried out by one of the four Parties. They work to achieve a coherent conceptual design and R&D programme. The ITER Scientific and Technical Advisory Committee (ISTAC), composed of eminent scientists and engineers from all required areas of expertise, advises the IC. The ITER Secretariat consists of the scientific secretaries of the IC, ISTAC and IMC, who assist those bodies in performance of their functions. The ITER Liaison Officer assures the efficient interaction of the ITER organization with the IAEA and its other fusion activities.



The joint work is carried out during several months of each year by about forty scientists and engineers, ten from each Party, at a site provided on behalf of the EC Party by the Federal Republic of Germany at the Max Planck Institute for Plasma Physics (IPP), Garching. During the remainder of the year, work continues on ITER in the home locations of ITER team members, with co-ordination through the IMC and a small staff at the joint work site.

Articles in future issues of the Newsletter will highlight individuals and how they are working together within the organization described above.

NEAR TERM MILESTONES

Definition phase results to be reported by end of 1988

An overall time schedule for the ITER Conceptual Design Activities has been developed and near term milestones have been set up. Those for 1988 are as follows:

- Joint work started on 2 May 1988 at Garching;
- An R&D plan was prepared by the IMC, reviewed by the ISTAC and approved by the IC in July;
- A Definition Phase Report should be reviewed by the ISTAC and submitted to the IC in October for consideration and approval in November;
- Results of the definition phase should be reported to the 12th IAEA Fusion Conference at Nice, France, in October.

FIRST MEETING OF THE ITER COUNCIL

Recognition of ITER's role in solving world energy problems

Delegations from the four Parties met in Vienna on 21–22 April 1988 to conduct the first formal meeting of the ITER Council. They were welcomed by the Acting Director General of the IAEA, Professor M. Zifferero, who spoke on the global nature of the energy problem and its relationship to growing world population. He submitted that the ITER activity is, at least potentially, the beginning of a concerted international effort to provide a long term solution to the global energy and environmental problems due to fossil fuels. The Ambassadors of the four Parties and the senior ITER Council members made brief remarks emphasizing the importance of this international activity, the supportive role of the IAEA and the strong support of each Party.

Council Chairman Clarke concluded the opening session with the observation that historians may see the ITER activities as having been as valuable for their advancement of international collaboration on a global challenge as for their contributions to science and technology.

The Council then proceeded with organizational matters. It established the ITER Secretariat, approved IMC procedures, and appointed the nominees of each of the Parties to membership on the ISTAC.

The IC responded appreciatively to a report by the host organization, on arrangements at Garching. The IC was informed of the interest of Canada in ITER participation through the EC team, as provided for by the Terms of Reference. The IMC described its organization and work plan for the definition phase, including specialists meetings and communications among teams at the joint work site and at home. The IC scheduled its meetings through 1990.

The first meeting concluded with the Council expressing appreciation for the dedication of the participants and satisfaction with the considerable progress.

JOINT WORK IN PROGRESS

Intensive work by four Party team at site in the Federal Republic of Germany

From its beginning on 2 May, the joint work at Garching has been intensive and productive. A notable feature has been the week-long meetings of specialists from the four fusion programmes, of which twelve had been held as of mid-August. The information and insights brought out by these meetings have been assimilated by the design team, which has proceeded towards the definition of the tokamak machine.

The ITER design team is being operated in a matrix form, by combining the activities of the Project Units and Design Units that have been formed in the design team. The Project Units have the role of co-ordination of the design activities, whereas the Design Units conduct detailed design.

Concurrently with the design work, the team has developed a co-ordinated R&D programme to meet ITER needs. The physics R&D tasks have been identified. Considering the extent of the world's existing physics programmes, a decision was taken to accomplish these tasks by soliciting voluntary contributions of physics data from the Parties. The technology R&D tasks have also been identified and the proposed contributions for the tasks from the Parties have been delineated within resources committed to ITER. Documentation of these tasks and the proposed contributions were submitted to the ITER Council.

ISTAC VIEW OF THE DESIGN ACTIVITIES

ISTAC endorsed the present design approach

Since its establishment in April the Committee has held two meetings.

An informal meeting, which was held from 8 to 10 June 1988 at Garching, allowed members of the Committee to get acquainted with the ITER Conceptual Design Activities and provided them with an opportunity to develop its working plan, to exchange opinions on the implementation of ISTAC charges and to consider informally the factors that might influence the project development and its progress.

The Committee discussed materials and presentations provided by the IMC and the joint design team members. The central point of the discussion was the assessment of availability of scientific and technological data in accordance with the requirements of the Terms of Reference for Conceptual Design Activities. The members of the Committee found that the goals of the ITER design could continue to be in line with the Terms of Reference and noted that both objectives, ignition and fusion technology development, were equally essential for the ITER machine.

The main topic on the agenda of the first official ISTAC meeting, held at the IAEA Headquarters in Vienna from 13 to 15 July, was to review the R&D Plan for Conceptual Design Activities, developed by the IMC, and to summarize its findings in a report to the IC. The ISTAC members discussed and assessed the R&D Plan with regard to the directions of development of specific tasks, approved by the ITER Council. The Committee supported the IMC assumption that a great deal of information essential to ITER, generated from other R&D activities that are being carried out in the national programmes of each Party, would be provided for the ITER Conceptual Design Activities either as direct input through Conceptual Design Activities or by other, indirect means. It pointed out the importance for ITER activities that the current national R&D programmes of the Parties would be carried out vigorously and with an appropriate orientation. The ISTAC agreed with the IMC approach that the major physics R&D would come from the national programmes and proposed that the R&D Plan focus on critical ITER machine technology requirements.

The ISTAC endorsed the present design approach, which sought sufficient flexibility to meet both of the objectives, ignition and steady state mode of operation, specified in the Terms of Reference.

Specifically, in the present design a larger, higher current plasma can be accommodated within the same vacuum vessel by introducing a higher performance shield and limiting the number of pulses, thereby providing increased confinement capability. The design can also allow a modest reduction in plasma density and fusion power, thereby providing a steady state operating mode with acceptable current-drive efficiency. Although the present design emphasizes negative ion based neutral beams for heating and current drive, because of their capability for driving current in the central core of the plasma, consideration has also been given to the use of lower hybrid waves for current drive in the outer part of the plasma, as well as to the use of electron cyclotron waves for special profile control purposes — or even as the primary current drive technique.

After a detailed discussion, the Committee prepared its report to the ITER Council on the R&D Plan and came to the conclusion that the ITER design team had made substantial progress towards the definition of the ITER machine concept and the R&D Plan, which, with suggested modifications, corresponds to critical feasibility issues, as stated in the Terms of Reference.

SECOND MEETING OF THE ITER COUNCIL

IC approved the R&D Plan

This meeting was conducted at Vienna on 26-27 July. The IC first heard status reports from the IMC, ISTAC and IPP. The Council concurred with the ISTAC endorsement of the present design approach of seeking flexibility to meet goals of both ignition experiments and steady state operation.

A major item of business was review of the R&D Plan prepared by the IMC and endorsed by the ISTAC. The importance of voluntary supplements in critical areas, especially tokamak physics, was recognized. The IC requested that the IMC complete the list of R&D needs so that the Parties could arrange the appropriate voluntary support of specific items and ensure timely completion of more general R&D supportive of ITER. The discussion concluded with IC approval of the plan.

The IC accepted the IMC recommendation for Canadian participation within the EC contribution to ITER. The IC was informed that China had expressed interest in participation through the US Party.

The consensus of the Council on design related issues of cost, safety and environment was established. ITER must be designed to meet the goals stated in the Terms of Reference while keeping costs reasonable in the broadest context. Ways to reduce costs in fusion plants after this one of a kind research facility should be developed. Finally, criteria and design guidelines shall be developed to assure safety and environmental acceptability for ITER under all conditions.

The general feeling of the IC at the conclusion of its second meeting was pleasure at the effective co-operation and technical progress up to that time and confidence that the definition phase would be successfully completed as planned.

COMING EVENTS

ISTAC meets on 20-22 October 1988 in Vienna.

ITER Council meets on 1 and 2 November 1988 in Vienna.

In August this year the IMC held two specialists meetings on Tritium Recovery/Fuel Cycle and Nuclear Materials at Garching. It is expected that a useful outcome of the ITER development will appear from a specialists meeting on Superconducting Magnets in San Francisco, held from 21 to 25 August 1988.

Items to be considered for inclusion in the ITER Newsletter should be submitted to A. Mavrin, ITER Secretariat, IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: 43 222 230184, or Telex: 1-12645, or Cable: INATOM VIENNA.
