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ORGANIZATIONAL STRUCTURE AND NATIONAL ACTIVITIES OF THE UNITED STATES IN SUPPORT OF THE ITER CONCEPTUAL DESIGN ACTIVITIES

by John R. Gilleland, U.S. Managing Director, ITER
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Efforts in the United States on ITER are nationwide. The institutions that are involved, listed in Table 1, include practically all that have ITER-relevant capabilities. These extensive activities are co-ordinated by a national organization that intentionally parallels the international organization of ITER joint activities.

Table 1. INSTITUTIONS PARTICIPATING IN U.S. WORK ON ITER

National Laboratories	**acronym**
Argonne National Laboratory	ANL
Idaho National Engineering Laboratory	INEL
Lawrence Berkeley Laboratory	LBL
Lawrence Livermore National Laboratory	LLNL
Los Alamos National Laboratory	LANL
Oak Ridge National Laboratory	ORNL
Princeton Plasma Physics Laboratory	PPPL
Sandia National Laboratories, Albuquerque	SNL-A
Sandia National Laboratories, Livermore	SNL-L
Fusion Engineering Design Center	FEDC
Universities	
Georgia Institute of Technology	GIT
Massachusetts Institute of Technology	MIT
Rensselaer Polytechnic Institute	RPI
University of California at Los Angeles	UCLA
University of Illinois	UI
University of New Mexico	UNM
University of Wisconsin	UW
Industries	
Bechtel	--
General Atomics	GA
Grumman Aerospace Company	GAC
TRW Corporation	TRW
Westinghouse Hanford Company	WHC

At the outset of formal international collaboration on ITER, the U.S. Department of Energy (DOE) assigned management responsibility for ITER technical activities in the United States to Lawrence Livermore National Laboratory. LLNL proposes U.S. ITER design and validation R&D activities to DOE for approval. LLNL then directly manages the approved design activities while the validating R&D is performed by various institutions, with approval and management by DOE's Office of Fusion Energy (OFE).

A nationwide organization co-ordinates and oversees ITER work in the U.S.A.

Although the office of the U.S. Managing Director is located at Livermore, the technical management organization is nationwide, as indicated in Fig. 1. The Deputy Managing Director, Carl Henning, acts in the United States for the Managing Director while he is abroad, as during periods of joint work. The co-ordinator of ITER Physics support in the United States is Douglass Post who is also head of the Physics Group in the ITER joint work organization. The various physics tasks that have been defined and the assigned task leader for each are shown in Table 2. James Doggett co-ordinates U.S. engineering support for ITER. Engineering tasks and leaders are listed in Table 3. Charles Baker is in charge of nuclear engineering for ITER in the U.S., which encompasses design work on plasma-facing components, blankets, shields, and tritium systems and the formulation of plans for the ITER test programme. Table 4 indicates the leaders in this area of U.S. ITER work.

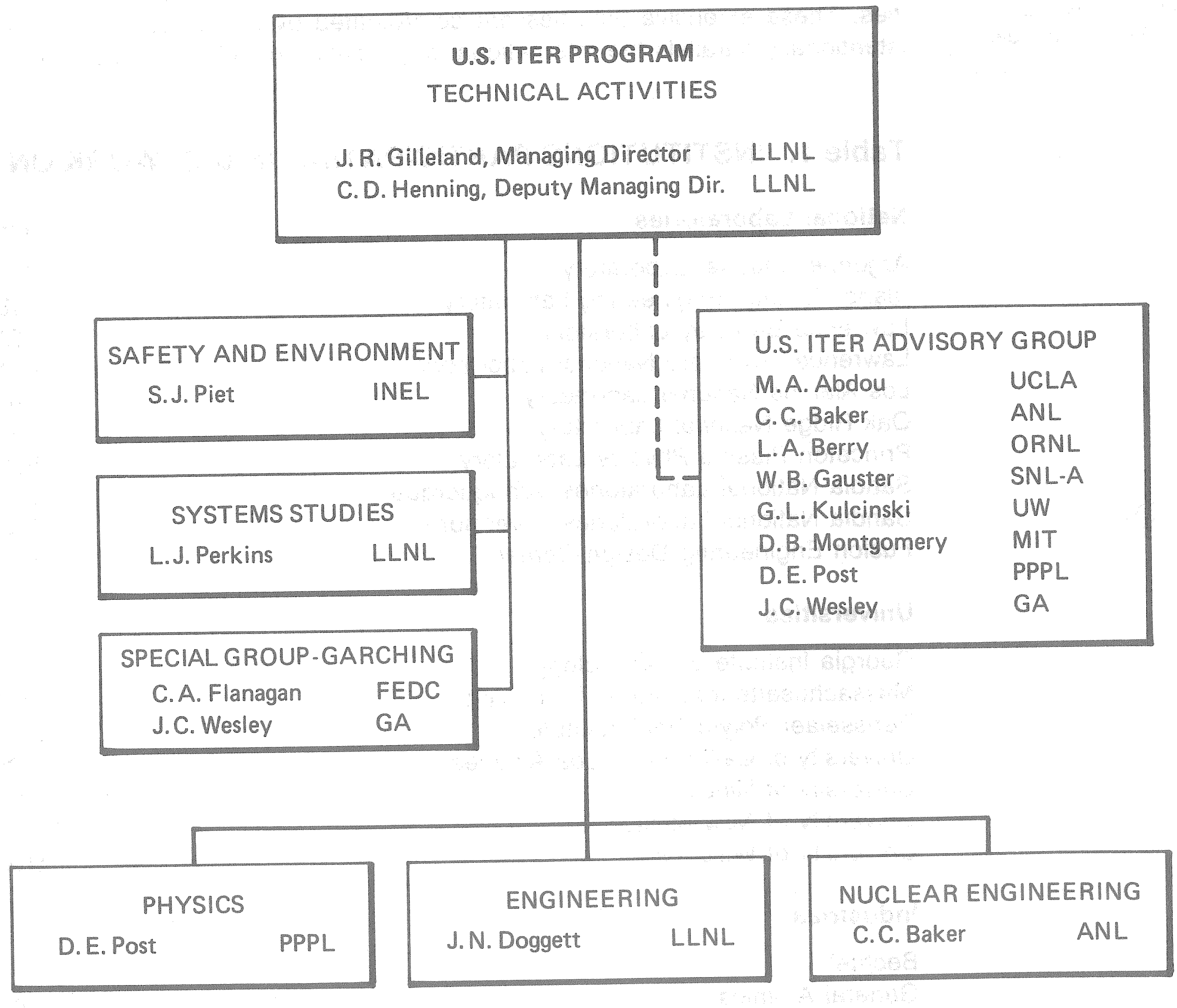

Fig. 1. U.S. ITER Technical Organization

Table 2. Leaders of ITER Physics Work in the United States

Co-ordinator:	Douglass E. Post	PPPL
Task Leaders:		
Confinement	James D. Callen	UW
	Nermin A. Uckan	ORNL
MHD Limits	John T. Hogan	ORNL
Power and Particle Control	Samuel A. Cohen	PPPL
Current Drive, Heating	William M. Nevins	LLNL
	R. Stephen Devoto	LLNL
Density Limits	Glenn Bateman	PPPL
Axisymmetric Magnetics	John C. Wesley	GA
	L. Donald Pearlstein	LLNL
Alpha-Particle Physics	Dieter Sigmar	MIT
	Roscoe B. White	PPPL
Diagnostics	Kenneth M. Young	PPPL
	Dennis M. Manos	PPPL

Table 3. Leaders of ITER Engineering in the United States

Co-ordinator:	James N. Doggett	LLNL
Task Leaders:		
Tokamak Engineering	David C. Lousteau	FEDC
Magnets	John R. Miller	LLNL
Current Drive and Heating	Walter B. Lindquist	LLNL
Plasma-Facing Components	V. Dennis Lee*	FEDC
Blanket and Shields	Brad E. Nelson*	FEDC
Fuel Cycle	Michael J. Gouge	ORNL
Maintenance and Facilities	Scott L. Thomson	FEDC

* Also functions as member of Nuclear Engineering team.

Table 4. Leaders of ITER Nuclear Engineering in the United States

Co-ordinator:	Charles C. Baker	ANL
Task Leaders:		
Divertor/First Wall Analysis	Dale L. Smith	ANL
Blanket/Shield Analysis	Yousry Gohar	ANL
	Mohamed E. Sawan	UW
Tritium Systems	James L. Anderson	LANL
Test Programme	Mohamed A. Abdou	UCLA

In addition to these activities, the co-ordinator of the U.S. ITER Safety and Environmental Studies, Steven Piet, INEL, reports directly to the Managing Director, showing the importance to the United States of the role of ITER in demonstrating fusion's potential advantages in safety and environment. John Perkins, Special Studies leader, co-ordinates studies on overall design rationale, systems studies, sensitivity analysis, and risk assessments. The ITER Special Group, sited in Garching for the duration of the Conceptual Design Activities, provides co-ordination and communication among the national teams. The Group includes representatives of each ITER Party. U.S. representatives are C.A. Flanagan, ORNL/FEDC, and J.C. Wesley, GA.

The U.S. ITER Advisory Group helps with co-ordination of resources within home institutions, reviews progress on home tasks and helps the Managing Director and DOE formulate U.S. R&D contributions. The U.S. fusion programme is broadly represented by this Group, as indicated by the affiliations shown in Fig. 1.

A wide range of ITER-related R&D tasks are being actively pursued in U.S. laboratories and through bilateral arrangements between the U.S. and other countries. The subjects include the physics and the engineering technology required for the realization of ignition and also the development of a physics data-base, the auxiliary current drive technology and the nuclear technology required for the realization of steady-state operating and testing.

Plasma physics R&D help meet ITER needs.

Major contributions to the physics data-base and understanding necessary for efficient, confident design of ITER are coming from experiments with the two largest U.S. tokamaks. The Doublet III-D at La Jolla is addressing numerous ITER physics R&D tasks. In the near term, D III-D emphasis is on: transport in non-circular, high-beta-plasmas; divertor operations; H-mode physics, and current-drive methods. The Tokamak Fusion Test Reactor (TFTR) at Princeton is similarly employed for ITER physics R&D tasks. Emphasis is on experiments with plasmas having peaked density profiles and investigation of transport issues. Fusion experiments with deuterium-tritium plasmas in TFTR are now foreseen after 1990. Other devices whose programmes are contributing significantly to ITER physics R&D are the Texas Tokamak (TEXT) at Austin, the MTX at Livermore, the PBX-M at Princeton and the Advanced Toroidal Facility (ATF) at Oak Ridge.

Fusion technology R&D are part of ITER plan.

The U.S. proposed and accepted responsibility for 13 technology R&D tasks which were incorporated in the ITER R&D Plan. Work is being performed on: concepts, beryllium and structural materials for the ITER blanket; low-Z materials and first-wall and divertor tests; poloidal coils and insulation, with emphasis on radiation tolerance; plasma fuelling; and heating/current drive by rf waves and high-energy neutral beams.

ITER and other activities of special relevance.

Representatives of institutions involved in U.S. ITER efforts meet in a plenary session every month. These meetings, held in various parts of the country, enhance programme co-ordination and give people outside the project a chance to learn about ITER. There is also close co-ordination between the ITER organization and two other working groups in the U.S. fusion programme. One is the Transport Task Force, which has been formed in the U.S. to focus attention and efforts of leading experimentalists and theorists on the characterization, understanding and reduction of transport in tokamak plasmas. The other is the Advanced Reactor Innovations Evaluation Study (ARIES), led by the University of California at Los Angeles, that is developing advanced reactor concepts. This work can provide guidance to the overall fusion development programme.

Department of Energy responsibilities.

ITER Programme direction within OFE is provided by N. Anne Davies, Acting Associate Director for Fusion Energy of DOE's Office of Energy Research. Technical direction is provided by Robert J. Dowling, Director of the Division of Development and Technology; policy direction, by Michael Roberts, Director of International Programmes. Albert Opdenaker is the ITER Programme Manager and Chairperson of the ITER Co-ordinating Committee which involves representatives from each OFE programme element.

In the International ITER organization, the United States is represented in the Council by Dr. James F. Decker, Deputy Director, Office of Energy Research, DOE and Dr. John F. Clarke, now Senior Advisor, Office of Energy Research, DOE, who is serving as ITER Council Chairman. Dr. Michael Roberts, Director of International Programmes, Office of Fusion Energy, DOE, supports the U.S. members of the Council. Three eminent U.S. scientists and engineers are members of the ITER Scientific and Technical Advisory Committee. They are: Prof. Robert W. Conn, UCLA; Prof. T. Kenneth Fowler, UC-Berkeley; and Prof. Paul H. Rutherford, PPPL.

ITER perspective helps guide U.S. fusion programme.

Participation in the ITER Conceptual Design Activities is providing each Party with the broadest possible perspective on the scientific and technological tasks involved in realization of next-generation fusion devices such as ITER. The U.S. programme's priorities have been reassessed and its efforts are being focussed on critical issues that strongly affect performance and costs of ITER.

SECOND SESSION OF JOINT WORK

Substantial effort at Garching technical site.

The continuing four-party co-operation in ITER activities has benefitted from another period of intensive side-by-side work and personal interactions. More than 90 scientists and engineers spent at least one week at the ITER technical site at Garching during the second session of joint work from 20 February through 17 March. About 48 were present for the entire four weeks. As before, the international work force at Garching was rather evenly divided: 11, 12, 13, and 12 full-time professionals from Euratom, Japan, the USSR and the USA respectively. In addition, six members of the NET team at Garching were available full-time to respond to ITER requests.

The second session began, as planned, four months after the 1988 joint work session was completed. That first session, from May through September, had culminated in the ITER Definition Phase report and assignments of much work to be done by each ITER Party at home. The purposes of the second session were:

— to exchange information from home-work,
— to compare, evaluate and draw conclusions,
— to re-examine affected design choices,
— to narrow the range of options,
— to identify critical issues, and
— to plan further homework before the 1989 joint work session begins in June.

Progress was made in design and R&D plans.

Reports by the Parties reflected significant efforts in various areas of ITER design. Progress was made in quantifying requirements and defining viable options. In some instances, results indicated that changes in certain design features may be desirable or necessary, but no drastic change in the ITER concept was foreseen.

Concurrently with the design work, participants worked on R&D evaluations and plans. Each party had prepared a progress report on technology R&D and a proposal for the 23 ITER-related physics R&D tasks previously identified. Using these proposals as a basis, participants jointly drafted a comprehensive plan for physics R&D by all four ITER parties. On March 14–15 this draft was critically reviewed in a meeting of people with responsibilities for performing the physics R&D in each country.

In summary, the second joint work session provided useful contacts among ITER parties, producing guidance for further work in preparation for the next session, scheduled for June–October, 1989.

Participants of the Second Joint Work Session, Garching, 20 February 1989

USSR: PHYSICAL STARTUP OF TOKAMAK-15

by A.S. Mavrin, USSR State Committee on the Utilization of Atomic Energy

Major milestone has been achieved in the USSR fusion programme.

A major milestone has been achieved in a programme that has great significance for the conceptual design of ITER. The startup and experimental operation of Tokamak-15 reached, in December 1988, the stage of producing plasma for the first time. T-15, located at the Kurchatov Institute of Atomic Energy in Moscow, is one of the world's most advanced, large tokamaks. It is expected both to produce new data on long-pulse confinement of plasmas and to provide a valuable demonstration of technologies vital to practical, power-producing fusion reactors.

The history of plasma physics and fusion technology development has shown that, as expected, the harnessing of thermonuclear fusion energy for production of useful power is probably the most challenging scientific and technological venture of the 20th century. Most of T-15's main components incorporate recent physics and technology achievements on an impressive scale — total weight of the machine is 1500 tons. Its startup is therefore viewed as a significant step toward the ultimate goal. As such, the first creation of plasma in T-15 was the occasion of a gathering at the facility on December 28, attended by scientists and specialists responsible for its design, fabrication and testing of components, assembly and startup.

Valuable operation experience will be gained using sophisticated superconducting magnetic system.

The toroidal field in T-15 is produced by a set of large (2-m diameter) superconducting coils. The steady toroidal field will enable T-15 experimenters to study plasma heating, confinement, and impurity control in prolonged tokamak pulses. The superconducting material (Nb_3Sn) and the mode of helium cooling (forced flow) are the same as have been chosen for the ITER design. Operation of the toroidal magnet and its supporting cryogenic, electrical and instrumentation systems in the tokamak environment will therefore be an experience with value comparable to that of the physics experiments. This is, in fact, one of the important goals of the T-15 project.

Among the superconducting materials that could be produced on a large scale in the foreseeable future, niobium-tin is favoured because it has higher critical values of magnetic field, temperature, and current density than another candidate material NbTi. On the other hand, the critical current, field and temperature are very sensitive to conductor strain. This requires special care in design and manufacture of the conductor and magnet coils. (See article on superconducting magnets for ITER in January issue of the Newsletter.) For T-15, the conductor of which the coil is wound includes flat cable with two copper tubes for the circulation attached to the cable by electroplating process. Each cable strand contains ~15.000 Nb_3Sn filaments imbedded in a bronze matrix. When T-15 reaches design-point conditions, the superconductor will be at a temperature of 4.5 K, the cable will carry 3.0 kA, resulting in a toroidal field of 3.5 T at the plasma centerline.

Experiments in support of ITER activities are planned.

The new tokamak design includes about 60 main systems and components to be tested. The initial stage of the main system testing has been mostly accomplished by this moment. The toroidal magnetic field coils were cooled down to the temperature of 11.5 K and the superconductivity was reached at 100 A current. Plasma with electron density of 3.10^{18} m^{-3} and life time 0.1 sec was created in the course of the experiments performed. When T-15 achieves the design parameters, the facility will be able to provide important plasma physics and technology research both for the Soviet national fusion programme and in support of the ITER project.

ITER EVENTS CALENDAR — 1989

Joint Design Review	Garching	20 Feb – 17 Mar
Joint Work Session	Garching	2 June – 20 Oct
ISTAC Meeting	Garching	26 – 28 June
ITER Council Meeting	Vienna	12 – 13 July
Symposium on Fusion Engineering	Knoxville	2 – 6 Oct
ISTAC Meeting	Vienna	15 – 17 Nov
ITER Council Meeting	Vienna	30 Nov – 1 Dec

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