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TWELFTH MEETING OF THE ITER MANAGEMENT ADVISORY COMMITTEE (MAC)

by Dr. M. Yoshikawa, MAC Chairman

The Twelfth Meeting of the ITER Management Advisory Committee (MAC) was held at the ITER Joint Work Site in Garching on 26 and 27 June 1997.

The ITER Director summarized the progress made in the ITER Engineering Design Activities in the period between IC-11 and May 1997. The overall focus of the Project is towards the next major milestone – the presentation of the Final Design Report to IC-13 in early 1998. The seven Large R&D projects are also progressing under their joint HT/JCT management arrangements; TAC-12 will review their status and plans and report to IC-12 (see article on TAC-12 in this issue). Where the Heads of the Parties' fusion laboratories have given a constructive response to request for input on the main issues for the ITER Physics assessment, the physics programmes are generating results oriented towards ITER's priority needs.

As requested at IC-11, the Director has assisted the Parties' Explorations and has been consulting with Home Team Leaders concerning the content and schedule of R&D programmes to July 1998 and on the activities and resources that could provide project continuity beyond the current EDA Work Programme.

Following the Director's status report, MAC reviewed Task Status Summary, Joint Fund and a schedule of ITER meetings.

Participants in the Meeting

Task Status Summary
The technology R&D programmes for the main ITER systems and components are aimed at validating the design choices, developing and testing the technologies involved and at establishing and qualifying the manufacturing techniques including Quality Assurance. In particular, the seven large R&D projects should demonstrate the manufacture of key components and have the components either in testing or immediately ready for testing so as to provide the technical information necessary to support a construction decision. The total value of the R&D tasks foreseen in the Work Programme reflected some reductions from previously approved totals arising from adjustments in content and distribution, and newly defined provisions for technology R&D on Heating and Current Drive systems.

About 400 Final Reports for both Design and Technology R&D Task Agreements have been submitted by the Home Teams for completion of tasks.

MAC took note of the ITER Task status summary and new Task Agreements the credits of which are less than 500 IUA or equivalent. MAC also reviewed and supported the modification of Task Agreements.

Joint Fund
During 1996 the Joint Fund operations reached a level of maturity and stability in scale and content, showing a reasonable uniformity between Agents relative to the differing conditions and circumstances of each.

The Joint Fund Agents at the three Joint Work Sites have continued to respond constructively to the needs and requests of the Project under the Joint Fund Rules and within the general framework of their normal financial procedures. The RF Agent has also respondeded well in implementing the new arrangements for design support contracts. The continuing efficient efforts of all the Agents are acknowledged and warmly appreciated.

MAC reviewed the consolidated accounts for the ITER Joint Fund Budget of 1996 and recommended to the ITER Council to approve it.

The Joint Fund budget proposals for 1998 have been developed on the basis of a flat budget for the year following established patterns for common expenditures, but limiting the formal request at this time to 55% of the estimated total for the year to reflect the 6 2/3-month period from 1 January to 20 July.

MAC reviewed the Director's proposals for the 1998 Joint Fund Budget and Allocations to Agents and main budget articles. MAC recommended to the ITER Council to approve the Director's proposals for the 1998.

Proposed Schedule of ITER Meetings
MAC reviewed and supported the schedule of Technical Meetings and Workshops proposed by the Director. The list of the supported Meetings for the remaining part of 1997 and early 1998 is given below.

ITER Meetings	12-14 September	ITER Diagnostics Technical Meeting	Varenna, Italy
	6-8 October	Test Blanket Working Group-5	Los Angeles, US
	13-17 October	5th Technical Meeting on Quality	San Diego, US
	27 Oct.-4 November	6th Technical Meeting on Safety and Environment - NSSR-2 Review Meeting	San Diego, US
	Late January 1998	Materials Workshop	Garching,Germany
ITER Physics Meetings	11-13 September	4th Energetic Particles, Heating & Current Drive EG Workshop (Energetic Particles Emphasis)	JET
	12-14 September	Diagnostics Expert Group Workshop	Varenna, Italy
	15-19 September	Disruption, Plasma Control & MHD Expert Group Workshop	Lausanne, Switzerland
	25-30 September	Confinement & Transport Expert Group and Confinement Modeling & Database Expert Group Combined Workshop	Garching,Germany
	13-17 October	7th Joint Divertor Physics and Divertor Modeling & Database Expert Group Workshop	Naka, Japan
	14-15 November	ITER Physics Committee	Pittsburgh, US
	16-18 February	5th Energetic Particles, Heating and Current Drive Expert Group Workshop	Naka, Japan

MAC decided that the MAC-13 meeting will be held on 16 and 17 January 1998 in San Diego.

TWELFTH MEETING OF THE ITER TECHNICAL ADVISORY COMMITTEE

by Dr. P. Rutherford, TAC Chair

The Twelfth Meeting of the ITER Technical Advisory Committee (TAC-12) took place from 30 June to 2 July at the ITER Garching Joint Work Site and was called to address the following charge from the ITER Council:

"The ITER Council requests the TAC to review, from a technical viewpoint, the status and plans of the ITER R&D program. The TAC is also requested to review progress on ITER diagnostics and the associated control system."

A previous TAC review of the ITER R&D program (TAC-9, November 1995) had focused on the "large-seven" R&D projects (L-1 to L-7), together with supporting R&D relating closely to these seven major projects. The scope of the TAC-12 review included updated assessments of the status and plans for the L-1 to L-7 projects and related R&D, but included also other R&D programs not addressed at TAC-9.

This was the first TAC review of ITER diagnostics and associated controls, although it is recognised that this effort has benefited from extensive interactions with the four Parties' programs through the ITER Physics Expert Group on Diagnostics.

ITER R&D Program

It was the TAC's general assessment that there have been major and important achievements in the R&D program and that the overall progress is impressive. In particular, the Large Seven Projects have retained almost their full initial scope, and many of them are on schedule for the completion of this scope within the time period of the EDA. This has been accomplished, despite substantially reduced overall resources, by reallocation of resources so as to retain the highest priority tasks and, in some cases, by transferring tasks or critical materials from one Party to another. In those cases where there have been unavoidable minor reductions in scope, there has been no compromise in the required performance on key tasks.

Despite heroic efforts to maintain schedule, a few of the major milestones of the R&D program will be delayed somewhat relative to the schedules indicated at the time of the TAC-9 review. In particular, on the present schedule, the industrial manufacture of the two CS-coil modules will still be completed during the EDA, but the cooldown of the CS Model Coil will now occur in the period just beyond the EDA, and the cooldown of the TF Model Coil will not occur until somewhat later. (In regard to the CS Model Coil, this possible delay was already recognized at the TAC-9 review; indeed, part of it arises from the JCT following the TAC recommendation to retain the full number of turns in the inner module of the CS Model Coil, even at the cost of a schedule slippage. In regard to the TF Model Coil, the delay has been mainly due to the change in the TF coil design approach.)

It was the TAC's view that successful initial cold tests with these two model coils would fully justify, from a technical viewpoint, the initiation of procurement of the materials needed for the ITER magnets. However, consideration should be given to earlier procurement of the superconducting strand, because of the limited world capacity to produce this critical material.

The TAC emphasized that the R&D program, as presently scoped and scheduled, bears the same relation to construction readiness as it did at the time of the TAC-9 review: completion of this program will provide the necessary technical information to support a construction decision and to begin procurement of time-critical materials and components.

The TAC further emphasized that, because of the nature of ITER as a nuclear facility, the level of design validation by R&D to be achieved by the time of a construction decision exceeds by far that which existed at the time of construction authorization for present-day large fusion facilities.

As was recognized at the time of the TAC-9 review, the TAC again noted that the main test facilities built or modified as part of the ITER R&D program will continue to be exploited after the EDA has been completed, so as to provide further essential and validating information, for example on the performance of components over many cycles, to test the margins available for some systems above the specified requirements, to provide for additional tests of interfaces between different components, and to define remote maintenance procedures.

ITER Diagnostics and Controls

In the TAC's view, excellent progress has been made in defining and designing the diagnostics equipment to meet the ITER requirements both for plasma control and for those measurements needed to satisfy the goals

of the scientific program. A comprehensive analysis has been made to determine the requirements for each measurement, based on the needs of proposed ITER operational scenarios. A selection of diagnostic methods has been made for the majority of the measurements. The descriptions of individual diagnostic systems are particularly helpful in identifying the status of each system. The proposed set of diagnostics takes into consideration the stringent requirements set by ITER's very-long-pulse burning plasmas.

The principal aim of the studies to date has been to define the diagnostics and to perform sufficient engineering design to ensure that there is adequate access and that the diagnostics are compatible with the other ITER components. While much of the preliminary engineering work has been done, some areas still need attention in the near term. However, the detailed design of many of the diagnostics can be done later.

Most of the needed diagnostics for ITER are in use today. Nevertheless, these diagnostics can require R&D to adapt them to ITER. In addition, there are newer or proposed diagnostics (some speculative) which will need substantial R&D.

The TAC recommended that emphasis in the continuing program should be given to the following areas:

- Showing that the time-scale for deployment of the diagnostics and controls, including commissioning times, is consistent with the proposed experimental schedule. In this regard, it would be useful, for comparison, to have information on the rate of build-up of diagnostics on existing tokamaks as a function of the state of operation of the device;
- Doing more analysis of the extent of back-up capability, redundancy and replaceability needed in regard to failures of control diagnostics, especially in areas where the absence of a diagnostic would have a serious impact on the continuous operation of ITER;
- Analysing priorities, with regard to engineering layouts and R&D, to meet the needs of the experimental program. This should include the allocation of resources, in the EDA and post-EDA period, to ensure that the engineering design and R&D is completed in a timely fashion for the most critical areas.

Participants in the Meeting

NSSR-2 AND FDR-SAFETY MEETING

by Drs. G. Saji and A. Poucet, ITER JCT

A working meeting to plan, together with the Home Teams (HTs), the activities for the Non Site Specific Safety Report 2 (NSSR-2) and the safety section of the Final Design Report (FDR-Safety) was held on April 21-25, 1997, at the ITER San Diego Joint Work Site.

The main objectives of the meeting were:

- To confirm the planned evolution and adjust the objectives in preparing NSSR-2;
- To agree on the analysis specifications for HTs that provide analysis results for NSSR-2;
- To hear comments from experts' review of the Detailed Design Report (DDR) package (including NSSR-1) in the safety area and to incorporate them in the NSSR-2 and FDR-Safety planning;
- To inform the safety experts about major safety-related design changes from DDR to FDR, to be included in the revised version of Safety Analysis Data List (SADL), and
- to adjust HT R&D tasks in support of NSSR-2 production.

Overall NSSR-2 Planning

The final version of NSSR-1 was issued in January 1997 and was well received by the Parties. Its review provided valuable guidance for the production of an updated version, NSSR-2, to be issued at the end of this year. NSSR-2 will be developed, by minimizing the changes in the basic configuration of NSSR-1, to implement the recommendations from TAC and Parties, to refine the NSSR-1, to fill the missing holes, to further improve credibility, and to be consistent with FDR design. The focus will be to provide comprehensive safety information at this stage of the project rather than trying to be strictly consistent with some of the still fluid detailed design data. The EDA final version of NSSR is being planned to be completed in 1998, which will further update the NSSR-2 to be consistent with the final design.

NSSR-2 is basically structured in the same way as NSSR-1 and is subdivided into 10 Volumes and an Appendix as follows:

- Volume I: ITER safety approach and functions
- Volume II: Safety design
- Volume III: Radiological and energy source terms
- Volume IV: Effluents and emissions
- Volume V: Waste management and decommissioning
- Volume VI: Occupational safety
- Volume VII: Analysis of reference events
- Volume VIII:Ultimate safety margins
- Volume IX: External hazards
- Volume X: Sequence analysis
- Appendix A:Safety Models and Codes

Appendix A is a JCT response to HT requests to include more information on safety methodologies being used in the NSSR accident analysis and on the status of code validation.
The planning and outline for each volume was reviewed and generally well received by the HTs. Specific improvements and questions were raised to be incorporated in NSSR-2.

NSSR-2 Production Schedule

April 21-25 1997	NSSR-2 planning meeting
end April 1997	Baseline safety analysis data fixed by SADL
mid June 1997	Final tuning of SADL and Accident Analysis Specification
early October 1997	FDR-Safety and NSSR-2 package for HT review
October-November 1997	6th Safety Meeting - NSSR-2 Review
December 1997	FDR package to TAC-13 for final review
February 1998	IC-13 consideration of FDR
end June 1998	EDA final deliverables, including the final NSSR

Recent Design Evolution Impacting NSSR-2
Many of the current design evolutions, although not necessarily affecting the overall safety of ITER, need to be assessed by safety analyses for NSSR-2. These include:

- Recent experimental confirmation that "saturation effects" of tritium implantation at the first wall will effectively limit tritium permeation and will significantly reduce tritium concentration in the primary coolant.
- The "flexible" design of the attachment of blanket modules to the backplates. The backplate will be improved into a new double wall configuration. The new design is intended to be more robust against VDE loads, to reduce thermal stress and to increase the residence time to allow decay of N^{16}. The separate backplate cooling system, which was relied on for decay heat removal in some of the accident sequences in NSSR-1, was eliminated. A part of the primary cooling systems will be hardened in safety design to maintain an equivalent level of defense for decay heat removal without relying on the backplate.
- The primary HT design is being revisited, including a reduction of the primary piping size, shell-side primary/tube-side secondary, change in pump coast down characteristics, consideration of control band in baking temperature control, increase in water hold up, etc.
- The heat transport system for the vacuum vessel was changed in accordance with the Russian HT recommendation to enhance natural circulation and to assure more uniform temperature distribution. The pressurizer concurrently acts as a steam separator for temperature control through pressure control, and as a natural circulation promoter.
- Significant design progress in integrating occupational safety consideration in design, especially in the hot cell design.

Status and Recent R&D Results Supporting NSSR-2
During the meeting, recent R&D results that provide a basis for ITER safety assessment were introduced by each HT:

- The EU HT presented the corrosion product modeling effort by using PACTITER, a code being developed by CEA, the status and plans for Cu corrosion testing. The current prediction of activated corrosion products is uncertain. Further R&D efforts are obviously needed to be able to address occupational radiation exposure issues quantitatively.
- The JA HT discussed results of the Loss of Vacuum/Ingress of Coolant Accident (LOVA/ICE) experiment, which revealed significant impingement heat transfer effects in overpressure. The results are being used for a validation effort of the accident analysis codes. JA HT also introduced the status of the dust removal task and the work being performed at the Fusion Neutron source (FNS) to measure decay the heat and to validate nuclear activation codes and nuclear data libraries.
- The RF HT introduced results of integrated tokamak seismic analysis, carbon and beryllium powder/air reactivity to simulate accidental behaviour of tokamak dust, and superconducting magnet accident experience in RF tokamaks T-7 and T-15.
- The US HT presented recent information on beryllium implantation and permeation, focusing on the "saturation effects". Further, information of the characterization of the DIII-D dust was presented. Based on these results and on those obtained in corresponding R&D in progress in the EU HT, particularly in the JET machine, the dust and the tritium codeposition issues are now recognized to be very crucial in the safety and design areas, calling for continuing vigorous R&D effort. The US HT also showed that good agreement with the LOVA/ICE tests by the JA HT can be reproduced by adequately considering flashing, condensation, jet impingement and backsplash effects. Finally, the US HT demonstrated that significant progress has been made in experimental techniques to measure chemical reactivity and volatility effects in the middle temperature region, which is more relevant to ITER's accident situation.

Conclusion
In this meeting, the approach proposed by the JCT was discussed in detail. It was concluded that the overall structure and contents proposed for NSSR-2 respond well to the Parties' needs and provides the technical information necessary to initiate licensing procedures.

Major areas of improvement from NSSR-1 include:

- The justification of safety in the design, demonstration of defense-in-depth;
- Expansion of the accident analysis to include hot cell operations, test and breeder blanket systems;
- More systematic assessment of effluents and emissions;
- Improved analysis of magnet systems safety and of hydrogen hazards in tritium plant;
- systematic modeling of sequences and justification of reference accidents;
- background information on validity of codes and models used in the analysis.

The issue of occupational exposure was discussed many times; the uncertainty in the collective dose estimate could be very large at this stage. This results from uncertainties in dose rates and in actual person-hours necessary for the maintenance of a first-of-a-kind experimental facility. The uncertainties in dose rates are due to neutron streaming in complex three dimensional geometry in shielding, and to activated corrosion products, which result from a very complex nuclear-chemical-metallurgical process that is extremely difficult to predict without precedence. Extensive efforts are being made in ITER to make progress in occupational safety issues.

LIST OF PARTICIPANTS

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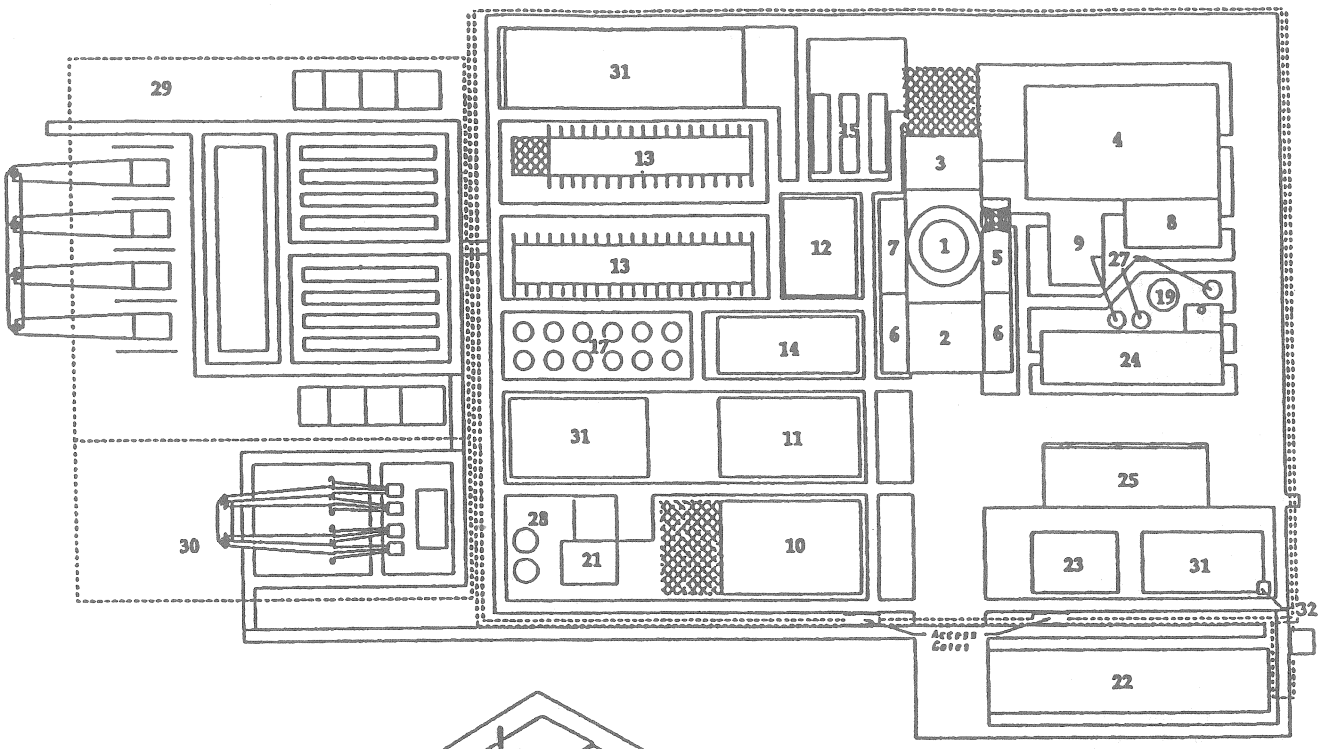
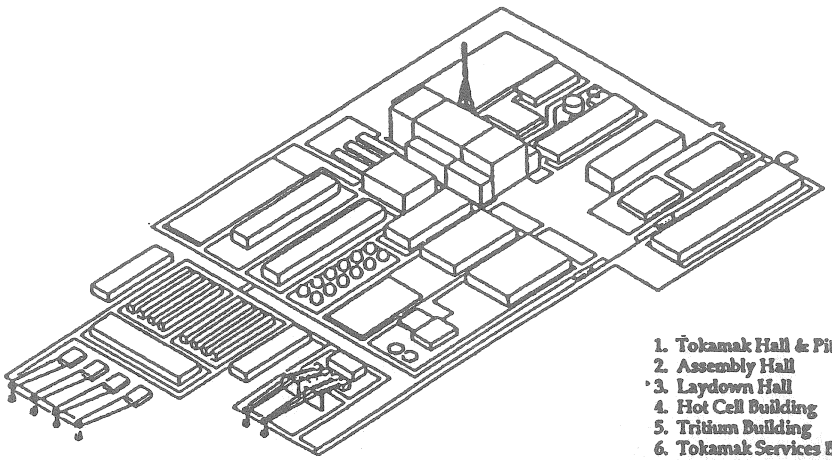
Participants in the Meeting





Key to Tokamak Buildings

1. Tokamak Hall & Pit
2. Assembly Hall
3. Laydown Hall
4. Hot Cell Building
5. Tritium Building
6. Tokamak Services Building
7. Electrical Termination Building
8. Radwaste Building
9. Personnel Building
10. Cryoplant Compressor Building
11. Cryoplant Cold Box/Dewar Building
12. Magnet Power Supply Switching Network Building
13. Magnet Power Conversion Building
14. RF heating Power Supply Building
15. NBI power supply yards
17. Gas storage yard
18. Cooling Tower Hot Basin
19. Steam Plant Fuel Tank
20. Cooling Towers (not shown)
21. Emergency Power Supply Building
22. Laboratory Office Building
23. Control Building
24. Site Services Building
25. RF Coil Fabrication Building
27. Outdoor Water Storage Tanks
28. Fuel Storage Tanks
29. Pulsed Power Switchyard
30. Steady State Switchyard
31. Outdoor Storage Areas
32. Sewage Holdup Tank

THE ITER SITE GENERAL LAYOUT AS CONTAINED IN THE ITER DETAILED DESIGN REPORT, COST REVIEW AND SAFETY ANALYSIS (DDR)

At its 12th Meeting (July 1997) the ITER Council approved the DDR as the basis on which to continue the technical work for the remainder of the EDA

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, or e-mail: basaldel@ripo1.iaea.or.at (phone +43 1 206026392).

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