

MEETING REPORT



SUMMARY OF THE SECOND INTERNATIONAL SYMPOSIUM ON FUSION NUCLEAR TECHNOLOGY, KARLSRUHE, FEDERAL REPUBLIC OF GERMANY, JUNE 2-7, 1991

The International Symposium on Fusion Nuclear Technology (ISFNT-2), the second in a series of topical meetings started in 1988 in Tokyo, Japan, was held on June 2-7, 1991, in Karlsruhe, Federal Republic of Germany. It was organized by Kernforschungszentrum Karlsruhe (KfK), one of the participants in the European fusion technology program.

The need for an independent forum for fusion technology in addition to the existing conferences on nuclear fusion arose from the increasing complexity of the great variety of technical systems for fusion even though ignition has not yet been attained. More than 300 experts from more than 15 countries gathered in Karlsruhe to present and discuss the latest results of their work. Apart from European, U.S., and Canadian experts, a number of Japanese colleagues and a group of scientists from the Soviet Union also attended the conference.

The meeting focused on the International Thermonuclear Experimental Reactor (ITER) initiative, which only recently completed its conceptual design phase and which is now about to start its engineering design phase. Another important topic of the meeting was the status of the Next European Torus (NET) project, which has more or less become a constituent of ITER except that a breeding blanket is not foreseen in the NET design. The meeting also demonstrated that the advanced status of both projects was made possible not only by the progress in the operational tokamak devices [e.g., the Joint European Torus (JET) and the Tokamak Fusion Test Reactor (TFTR)], but also in the research programs of the national laboratories, as well as by rigorous development and adaptation of analytical methods and calculation codes.

The crucial issues of fusion reactors are still the high heat loads to which the plasma-facing components, especially divertors, are exposed and the technical problems of remotely performing maintenance and repair at the complex structures.

The scope of the conference was not restricted to a review of the state of the art and applications of available know-how for next-generation fusion devices, but was also open to all questions relevant to future demonstration reactors (DEMOs).

In this respect, the areas of blanket technology, advanced low-activation structural materials, and neutronic optimization must be mentioned. Moreover, safety considerations and the problem of waste handling have already found a remarkable interest in this early stage of design. In this context, it also appears important to hint at the fact that the long-term developmental activities for a DEMO require the availability of ITER as a test bed for essential components and sub-systems of such a reactor.

The conference was structured in eight technical sessions with invited plenary talks and eight poster sessions that were each introduced by a summary lecture. These introductory papers were extremely useful in getting a comprehensive overview and identifying the problems still to be solved.

The topics of the technical sessions were as follows:

1. ITER, covering the overall concept, fuel cycle, plasma-facing components, safety aspects, lifetime evaluation, reliability, and availability
2. technology of breeding, covering blanket concepts for ITER, design options for a DEMO solid breeder blanket, and crucial issues for DEMO liquid-metal blankets
3. fusion-typical components and materials, covering divertors and wall protection, solid breeding materials, and neutron multipliers
4. tritium technology, covering experiments and calculation methods, shielding, and nuclear and design aspects in inertial fusion
5. maintenance, covering remote handling concepts and methods
6. forces and loads on structures, covering electromagnetic effects and high heat loads.

The topics of the poster sessions were largely the same as those of the technical sessions. The weight of certain topics, if measured by the number of contributions, however, was quite different. This was especially true for the areas of blanket technology, nuclear systems, and tritium technology. There were almost 200 contributions altogether.

The technical sessions were concluded by a lecture on guidelines for the design of fusion devices according to present knowledge in plasma physics. It has to be admitted

that the uncertainties in current technological approaches persist, and thus extrapolations toward a fusion power reactor are not possible in all areas. In spite of this restriction, it was possible to give a very positive resumé of this conference. In his concluding remarks, J. E. Vetter, Program Committee Chairman and head of the KfK Fusion Project, addressed the main subjects and the message of this meeting: Despite the considerable progress made, it remains a challenging task to find technical solutions for plasma-facing components, particularly divertors, that comply with all normal operation and accident scenarios. The hope lies in plasma physical approaches to favorably influence the boundary layer and to avoid plasma disruptions. Methods for calculating electromagnetic effects and design approaches to reduce their consequences could be improved considerably.

In one respect, the load conditions on the structures of a next-generation fusion device might be higher than for a future power reactor, namely, the stresses resulting from the pulsed operation mode.

Questions of the fabricability and the reliability of parts and joining techniques as well as of materials and tritium compatibility played an increasing role in the contributions to component design, particularly for blanket structures.

In tritium breeding and processing, there is confidence that even in real power systems, a breeding ratio above unity can be attained and that the inventory in the processing loops can be held sufficiently small. Uncertainties exist regarding

dead quantities of tritium in components and other structures near the plasma. The approaches for efficient, safety-optimized tritium purification methods and tritium- and helium-compatible pumping are promising. An optimistic prognosis can also be made for the technical feasibility of fusion reactors in terms of safe operation and accident management. However, large efforts seem necessary to develop suitable remote handling tools for the various maintenance and repair procedures.

All in all, the ISFNT-2 can be rated as a very good meeting, and this assessment was confirmed by the positive response of the participants. Moreover, a smooth and perfect organization, the generous premises, and a casual atmosphere brought about many contacts and good discussions.

M. Abdou, of the University of California-Los Angeles, invited the conference participants to California for ISFNT-3, which is likely to be held in the first half of 1994. In view of the new results to be expected from the current fusion facilities and of the evolution of the ITER project, one can look forward to this event with excitement.

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