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The Exhibit was organized and staffed by G. Saji and E. Golubchikova, supported by M. Araki, and S. Kosaka and the presenters noted above. Around 200 visitors signed the guest logbook and received packages of brochures on fusion and ITER. These packages included the following brochures produced and donated by various organizations:

International Thermonuclear Experimental Reactor, by ITER Joint Central Team
The Pervasive Plasma State, by the American Nuclear Society
Fusion Science - Harnessing the Energy of the Stars, by US DOE
Investment of an Energy Source for Tomorrow- FUSION Yields Important Benefits Today, by US DOE
Eight Reasons to Support Fusion Energy, by PPPL
DIII-D National Fusion Facility and GA Fusion Research, by DIII-D
Nuclear Fusion - Energy for Centuries to Come, by JET
Nuclear Fusion - Status and Perspectives, by IPP
Naka Fusion Research Establishment, by JAERI
National Institute for Fusion Science - The LHD Project, by NISC

The Exhibit and attendance was a useful way to inform a broader audience about the benefits of fusion and status of ITER. It should be noted that the 12th Annual Pacific Basin Nuclear Conference, to be held in Seoul, Korea in 2000, already includes nuclear fusion as one of its topic areas.

With successful completion of the ITER EDA and in the post-Kyoto world, fusion development has a unique opportunity to position itself for a challenging but rewarding phase. Success can only by achieved by mobilizing widespread support of the nuclear industry and of the general public for fusion as an environmentally attractive and sustainable source of energy. The Conference provided an opportunity to reach a wider audience. The strong interest expressed in ITER by a broad range of Conference participants demonstrated the potential to build such support.

SUMMARY OF DISCUSSION POINTS AND FURTHER DELIBERATIONS IN THE SPECIAL COMMITTEE ON THE ITER PROJECT IN THE ATOMIC ENERGY COMMISSION (unofficial translation)

by H. Nakamura, Director for Fusion Energy, Atomic Energy Bureau, Science and Technology Agency, Government of Japan

The Special Committee on the ITER Project was established in December 1996 as a forum for a broad investigation of how to deal with various aspects of the ITER Project, such as its role in the international community or its social and economic implications, assuming that the Engineering Design Activities (EDA) of the International Thermonuclear Experimental Reactor (ITER) would be completed by July 1998 and the project would proceed to the construction phase.

Meanwhile, the international discussion among the four ITER Parties (EU, Russia, US and Japan) has been progressing in a direction to extend the EDA for three other years; furthermore, the Government of Japan has decided to suspend new megaprojects in science and technology, such as inviting ITER to Japan, during the remaining years of this century because of an intensive fiscal structural reform intended. Under these circumstances, the decision on the Japanese stance on proceeding to the ITER construction phase has been postponed.

However, considering that the EDA would reach the end of an epoch in July 1998, it is necessary to summarize the points of discussion made so far and to specify the direction to further discussions and a way to come the final conclusions of the Committee. Furthermore, the final conclusions will be made at an appropriate time in the future, depending on the progress of the EDA.

Outline of "Discussion points and further deliberations in the Special Committee on the ITER Project"

Global environment problem and energy problem

The energy problem, as well as the global environment problem, are global issues that cannot be overcome by symptomatic policies or measures only, nor can they immediately be solved by the development of new technologies. Therefore, a new cooperation is necessary and should be initiated as soon as possible in order to share the understanding of these issues and to develop and utilize effective means through global collaboration.

Promotion of the fusion energy development

Fusion energy should be discussed in the context of various energy resources. Considering the uncertainty of various other energy resources in the future and the advantages and technological feasibility of fusion energy, it is one of the promising options. Additionally, in view of the responsibility the present generation holds for the next generations, fusion energy development is of utmost importance.

It is also important to clarify the methods of handling the safety of fusion and the relevant development issues in the future, on the basis of excellent characteristics of the fusion energy.

ITER Project

The Committee confirmed that it is of great importance to Japan to host ITER for the following reasons. Japan should:

1) play a leading role in the international community not by simply providing economical means but also by creating knowledge and intelligence and providing technical solutions to global issues.;
2) contribute to the international community by scientific and technical potential in the areas of research, education and industrial technology;
3) expose its public understanding and consciousness such as thinking on the future of humanity from the viewpoint of morals of the Japanese society in both the international and the domestic areas. In addition, Japan should not lose the international trust which it has by its history of promoting the peaceful use of atomic energy and by its effort to spread, publish and support advanced technologies and science in the areas of manufacturing technology, etc.;
4) invest into fusion energy research and development for the sake of humanity's existence and welfare and to assure freedom of selecting future energy sources the investment should be regarded as a sort of insurance fee.

Although the investment can be considered as an inevitable insurance, the resources required for the project are estimated to approach one trillion yen in total in the Interim Design Report of EDA and hence are a major concern; it is thus important to maximize the positive outcome and to minimize the expense by balancing technical objectives, technical margin and cost.

Conclusion and further considerations

Even though it was recognized that hosting ITER is of great significance, the following studies are required for the final decision. The results of existing studies and/or new investigations, covering a broad range of options of related researchers, etc., with sufficient budget if necessary, are taken into consideration.

- Study of long term energy demand and supply;
- Feasibility study of alternative energy sources;
- Examination of technical feasibility of fusion energy;
- Investigation of future programs to support the project including supporting research studies, education and training of personnel;
- Study aiming at creating a philosophy of distributing the resources to various projects;
- Research on establishment of fundamental guidelines on responsibility sharing in international collaboration.

Additionally, the Committee will simultaneously discuss items such as:

- Comparison of siting ITER in Japan or abroad from various points of view such as the effect on technological innovations, and spin-off effects of enhancing economy;
- Fundamental criteria such as the responsibility and the financial allocation of the host country, including the operation phase;
- Issues to be prepared in Japan for conducting the ITER project such as organization and personnel assignment.

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According to the progress made with above mentioned studies, the Committee will again discuss these items, summarize the results in a report and make a recommendation for the decision on the Japanese attitude as a final conclusion of the ITER project.

Future plans

Specialized investigations on the above mentioned items will be made during a period of about one year.

Depending on the progress in studying these issues, international discussion and the progress of EDA, the Committee will resume its activities in summer 1999 and conduct its discussions aiming to reach a final conclusion before summer 2000.

ITER RADIO FREQUENCY SYSTEMS

by Dr. G. Bosia, ITER Joint Central Team, Garching Joint Work Site

In ITER, auxiliary heating and current drive functions are likely to be shared among at least two of several different methods. A (negative ion) Neutral Beam Injection system and three Radio Frequency Heating and Current Drive (RF H&CD) systems: Electron Cyclotron (EC), Ion Cyclotron (IC) and Lower Hybrid (LH) Systems, are being developed during the Engineering Design Activities (EDA).

ITER RF systems offer a range of complementary services satisfying all ITER operational requirements. They can be used i) to access the H-mode confinement in D-T plasmas and to subsequently increase the plasma temperature to ignition values; ii) to supplement alpha heating in finite-Q driven burn scenarios; iii) to assist plasma start-up and shut-down; iv) to maintain sufficient plasma rotation to avoid locked modes and to stabilize resistive instabilities. The above functions (to be applied to plasmas within the density range $n_{e0} \sim (0.3–1.5)\times10^{20} m^{-3}$ and the temperature range 3–20 keV) may require a total auxiliary power of at least 100 MW. In addition, RF heating systems have several supplemental roles in the optimization of ITER operation, ranging from wall conditioning to plasma-initiation assist.

On- and off-axis current drive capabilities are required for extending burn, for local control of the plasma current profile, for stabilization of resistive MHD instabilities and ultimately, for steady state operation. According to present modelling, non-inductive currents of few MA need to be generated and controlled on- and off-axis, in plasmas with densities in the range of $n_{e0} = (0.6 - 1.5) \times 10^{20} m^{-3}$, and plasma current $I_p = 12 - 21$ MA.

Plasma heating and current drive functions need to be co-ordinated and controllable: multiple functions must be provided under closed loop control, in order to maintain a quasi-stationary burning plasma.

DESIGN

Five ITER equatorial ports may be allocated to the RF H&CD systems, and each system is designed to provide 50 MW of output powers even if the actually implemented power will be smaller. The system designs are now converging to a modular approach, which favours standardization and interchangeability. The level of standardization is being further increased as the design progresses and common mechanical components, structures and auxiliaries are being designed for the three systems.

In all systems, the launcher design incorporates a monolithic port plug assembly (Fig.1) with ceramic windows located at the main flange of the vacuum vessel port, to provide the primary containment boundary, and similar mechanical interfaces with the vacuum vessel. All port plugs are composed of nuclear shielding and power transmission components together with the mechanical assemblies needed to support these structures. All plugs feature an all-metal construction, do not extend ITER vacuum boundaries, fit within a standard remote handling transport cask and are designed to be assembled and disassembled in the hot-cell.

Electron Cyclotron

Electron Cyclotron (EC) wave absorption and propagation lead directly to electron heating and on- and off-axis current drive. The EC wave, launched in vacuum, propagates into the plasma without attenuation or interaction with the plasma edge and is absorbed by the electron population at the resonant layer. Consequently, the launching structure does not have to be close to the plasma.