INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR

ITER EDA NEWSLETTER

VOL.3, NO. 2 FEBRUARY 1994

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

FIFTH ITER COUNCIL MEETING IN GARCHING, GERMANY

by Dr. V. Vlasenkov, ITER Council Secretary

The fifth meeting of the ITER Council took place in Garching, Germany, at the ITER Joint Work Site on 27-28 January 1994. It was attended by all members of the Council, and the total number of participants was 38.

The Council considered the Outline Design Report and the ITER EDA Milestones presented at this meeting by the Director according to his undertaking made at IC-4.

The Council took note of the TAC Report on the Outline Design and, by endorsing a recommendation made by TAC, considered that the Outline Design Report constitutes an acceptable basis for consideration by the Parties to proceed toward the conclusion of Protocol 2.

Following the recommendation by TAC, the Council requested the Director and the JCT to conduct a sensitivity analysis to determine the optimum way to achieve a reduction in cost while minimizing the impact on the performance margin. The Council requested TAC to assess the results of the sensitivity analysis to be carried out by the Director and the JCT. This assessment should be carried out as soon as the sensitivity study is completed, which is expected to be the case in about six months.

Participants in the Meeting

The Council took note of the MAC Report and Advice and agreed with most of the MAC recommendations. In particular, the Council

- accepted the MAC recommendation on the Director's prepared ITER EDA Milestones as revised on the basis of the TAC and MAC recommendations;

- recognized that the ITER Joint Fund became operational by approving the Director's proposed Financial Rules on the basis of the recommendation from SWG-2;
- endorsed the overall MAC recommendation on the Joint Fund Budget for 1994, but recommended that full use be made of the IAEA capability for supporting ITER publications;
- agreed that, for Task Assignment proposals submitted by the Directors, MAC's review and unanimous support should constitute Council approval;
- asked the Director to consult with appropriate persons from the Parties on the use of the Joint Fund for implementation of the ITER Process Management System (IPMS);

The Council asked SWG-2 to review the Director's proposed text on joint R&D between two Parties in addition to its ongoing tasks.

The Council took note of the RF Party's proposal to involve Kazakhstan in its participation in the EDA and its intention to provide the Council, for review by MAC, the relevant information of the conditions for Kazakhstan's involvement according to Article 19.2.

The next ITER Council meeting, IC-6, will be held in Moscow, RF, on 15-16 June 1994.

INTERNATIONAL GROUP OF HARVARD FELLOWS VISIT SAN DIEGO JOINT WORK SITE

by K.C. Knouse, Host Meeting Support Services Co-ordinator, San Diego Joint Work Site

On Friday, 28 January, a group of eleven distinguished visitors from the Harvard International Fellowship program visited the San Diego Joint Work Site. The group consisted of representatives from Canada, the EC, France, India, Spain, Sweden, Trinidad and Tobago, the UK and Venezuela.

The visitors were hosted by D. Gambier of the Director's Office, who presented an overview of ITER and the Development of Fusion as a Potential Energy Source. In a brief discussion that followed, the visitors showed keen interest in the international collaborative nature of ITER and the prospects of a progression towards a siting and construction decision.

Following the presentation, the group was given a tour of the CAD facility by Jim Mann, Deputy CAD Engineering Manager. The tour included a demonstration of the CATIA CAD system and a poster display of engineering concept design drawings of the ITER device. The visit ended with a luncheon hosted by SAIC and attended by Maurice Sabado from SAIC and André Poucet and Francis Perkins from the JCT.

The Harvard Fellows Program was created in 1958 to provide an environment for senior diplomats, international civil servants, government officials, private sector executives and military officers from thirteen countries and the United States to share and learn information on international policy issues.

Group of Harvard Fellows listening to presentation of Dr. Gambier

INAUGURATION CEREMONY OF THE EC-HOSTED ITER JOINT WORK SITE IN GARCHING

by Dr. E. Canobbio, EC Contact Person

The inauguration ceremony of the Joint Work Site Garching was held on 28 January 1994 on the occasion of the fifth meeting of the ITER Council (held in Garching from 27-28 January 1994), which was the first meeting of the Council on the territory of the European Union (EU). In the presence of well over 100 persons, including such distinguished guests as H.E. Mr. Kobayashi, Japanese Ambassador to the EU, and H.E. Mr. G.S. Smith, Canadian Ambassador to the EU, Professor A. Ruberti, the European Commissioner responsible for Science, Research and Development unveiled a plaque on the front of the ITER building. The ceremony included speeches by Professor K. Pinkau, Scientific Director of the Max Planck Institute for Plasma Physics, Dr. S. Machi, Deputy Director General of the IAEA, Dr. H. Zehetmair, Bavarian Minister for Eduction, Culture, Science and Arts, Dr. B. Neumann, Parliamentary State Secretary at the German Federal Ministry for Research and Technology, Professor A. Ruberti, Dr. R. Linkohr, Member of the European Parliament and Dr. D. Deniozos, Greek Deputy Secretary General for Research and Technology, representing the President of the Research Council of the European Union.

This series of speeches was introduced and concluded by movements of two Mozart string quartets beautifully played by members of the Garching institute's orchestra.

The unveiling of the plaque was accompanied by the speeches of Academician E.P. Velikhov, Chairman of the ITER Council, Mr. T. Okasaki, Dr. J. Decker and Prof. P. Fasella, ITER Council members, and by Dr. P.-H. Rebut, ITER Director. Professor R. Parker, Head of the Joint Work Site Garching, gave a talk during the lunch. Some of the statements and a congratulatory letter read to the audience are contained in the boxes accompanying this article.

Unveiling of the Plaque

The previous evening the participants had been invited to a state reception at the Staatskanzlei in Munich by Dr. E. Stoiber, the Minister President of Bavaria.

SPEECH BY PROFESSOR ANTONIO RUBERTI, MEMBER OF THE EUROPEAN COMMISSION

It is an honour for me, as a Member of the European Commission, to be present and to welcome all of you to the dedication ceremony of the ITER Joint Work Site at Garching on the occasion of the first ITER Council meeting in the European Union, since the beginning of the Engineering Design Activities for ITER.

Today's ceremony convenes representatives of the four ITER Parties: Japan, the Russian Federation, the United States of America and the European Atomic Energy Community; of two third countries associated with the European Community in fusion: Sweden and Switzerland; of a third country soon to be involved in ITER through the European Community: Canada; and of the International Atomic Energy Agency under the auspices of which the ITER co-operation was placed from the beginning. Yes, ITER proves how wide international co-operation in science and technology can indeed be and ITER becomes a paradigm for megaprojects in science and technology.

The ITER co-operation is led by the principle of equality of the Parties and this is a sound principle. As far as the European Community is concerned, such a partnership has been made possible by the fact that all magnetic fusion activities of the Member States and the ones of Sweden and Switzerland are integrated in one single entity, the Community Fusion Programme. This is indeed a striking example of how far European togetherness can lead.

ITER was set in a worldwide international frame from its very inception, in 1985. A broad similarity of the strategies of the four largest Fusion Programmes in the world already existed at that time as a result of the long tradition of international co-operation in fusion energy research. But ITER came to focus the fusion research efforts of the four Parties toward a common goal. This was felt as a necessity at the highest political level since 1985 as a consequence of the volume of resources required, of the scientific and technological challenge raised and of the long time scale of the endeavour. It is certainly true that when forces join the achievements add up, while sharing in the success does not diminish the individual benefit for each of the partners.

In 1988, the ITER co-operation formally began with the launching of its first phase, the Conceptual Design Activities for ITER which were successfully concluded at the end of 1990. At that time, the joint work was performed during quadripartite sessions of some fifty professionals regularly held in one single technical site, and it was here in Garching.

But, as the co-operation grew up, so grew its complexity and challenge. The permanent quadripartite Joint Central Team for the Engineering Design activities for ITER is hosted in the three comparable Joint Work Sites that three of the Parties have offered: at Naka, San Diego and Garching. The fourth Party has offered to host the ITER Council: in Moscow. It is the Parties' willingness to go ahead with the ITER co-operation which allowed the first siting problem to be overcome; but this draws our attention to the much more challenging problem in front of us: how to agree on the construction site for ITER if we decide to construct it together?

The ITER Parties' willingness to work together has made the co-operation go ahead fairly smoothly even amid turbulences such as major domestic transformations.

The first stage of the six-year ITER Engineering Design Activities is nearing completion as Protocol 1 terminates. The most substantive stage of the Activities, which will be covered by a single, second, Protocol, should be following without gap since, as I understand, this is the wish of the four Parties. By July 1998 the technical basis for making decisions on the construction of ITER should be produced satisfying the very first Article of the ITER EDA Agreement which stipulates that the design and technical data produced should then be available for each of the Parties to use either as part of an international collaborative programme or in its own domestic programme.

Thermonuclear fusion is one of the very few conceivable options, potentially acceptable from the environmental and safety points of view, to provide energy for the growing world demand of the centuries to come. Therefore, I am convinced that it is imperative to maintain the full capacity of the Parties to proceed further with fusion in general, and ITER in particular, in an effort commensurate with their responsibilities as highly developed countries in view of the long term potential energy benefit of fusion for mankind. The European Commission states once more its strong commitment to fusion and ITER and will do its best to ensure that sufficient resources are made available for this important purpose.

Of course, the human component is as instrumental as financial resources to the success of a joint venture like ours. At this point, I would like to acknowledge the dedication and commitment to the cause of ITER of all its actors: the ITER Council delegations, the Members of the Advisory Committees and of the Working Groups, the Director, his Deputies and the whole Joint Central Team, the Home Team Leaders and their Teams. Last but not least, we should thank all those in the German Government, in the Bavarian Government, and in the Max Planck Society who are providing support to the ITER Joint Work Site at Garching.

The challenges and complexities of ITER are so great that all interactions have to be optimized: we should maintain flexibility in the structure in order to ensure that at any time we have the right persons at the right places. It is a real satisfaction for all of us to see that so far the Parties have always managed to develop a general consensus before letting freeze the domestic negotiating positions. This is the result of the very efficient network of informal contacts that have been established in ITER among the various institutional structures of the Parties. The ITER co-operation is indeed generating a mentality that allows distances to be reduced, cultural differences to be overcome, so that, in a sense, we could, using Socrates' words, "live round a sea like frogs round a pond". Let us hope therefore that ITER will become one of the first megaprojects to be constructed in a worldwide international framework.

I wish the negotiators of the four Parties, who as I understand have got the necessary support both from the ITER Council and the respective domestic authorities, to successfully conclude here their work which should lead within a few weeks to the signature of Protocol 2 and will thereby ensure the basis for implementing the whole of the ITER Engineering Design Activities.

STATEMENT BY MR. OKAZAKI

Professor Ruberti, Commission of the European Communities, distinguished Guests. It is my pleasure to have been invited to attend this inauguration ceremony of the ITER Co-Centre here at Garching.

It is particularly impressive that the inauguration ceremony is held in Garching today, because this is the exact place where the ITER project started six years ago, by the name of CDA. Without the success of the CDA, we could have never started the EDA, for it is evident and clear that we are now proceeding this EDA, based on experiences we have gathered here in Garching, with the accumulation of all the scientific and technical results.

The challenge of ITER is the wisdom of science and technology pooled to harness inexhaustible energy. With the successful achievements of the ITER project, nuclear fusion energy will then be expected to satisfy the needs of future generations of mankind.

We must gather all skills and expertise of wide scientific and technical research areas among the four Parties. ITER EDA is indeed an unprecedented international co-operation which is the focus of the world's attention. Japan is proud of being a member of this international endeavour, and we are deeply committed to the success of ITER EDA.

We appreciate every effort of the Commission of the European Community, the Government of the Federal Republic of Germany, the Government of Bavaria, and, of course, the Max Planck Institute for Plasma Physics, to ensure successful operation of the Garching Co-Centre.

Finally, I would like to thank all people concerned for giving us such an excellent ceremony. Thank you.

REMARKS BY DR. P.-H. REBUT, ITER DIRECTOR

It is an honour for me to be here on the occasion of today's inauguration ceremony and I am especially pleased that all three of the ITER Joint Work sites are now "officially" open. But the work did not wait - it started here a long time ago with the ITER Conceptual Design Activities.

I want to take this opportunity to thank the European Union for providing us with the ITER Joint Work Site in Garching. The JCT benefits from being located at the Max Planck Institute for Plasma Physics, which is one of the most distinguished research centres in the areas of plasma physics and fusion technology. IPP is a member of the Max Planck Society and has an impressive record for research achievements.

This IPP location provides a suitable base for communication with all the elements of the European fusion programme and the other Parties' programmes. There is a positive side of our three-site-structure - we are closer to the four Parties.

We have made a lot of progress in fusion research and I would like to mention, in particular, the tritium experiments at JET and the Tokamak Fusion Test Reactor (TFTR). ITER is the next step in fusion research; it is an experimental reactor that will operate at high power. Unfortunately, the physics in this domain does not allow us to continue only with small experiments. ITER is the first global science and technology project of this kind, and it must be a success.

An international project means more than pooling financial resources. It is also bringing together different cultures, different points of view, and different skills. This gives us a very rich base from which ITER will evolve.

I can assure you that all those who are working on this project are dedicated and determined to bring the ITER Engineering Design Activities to construction and successful operation. The Joint Central Team at the site in Garching, under the direction of Ron Parker, has a major role to play - they are responsible for designing the inside of the ITER machine.

With a team which is distributed among three sites, we need to maintain cohesion and unity. The difference of eight hours between each of the sites does not ease communications. but, modern communications technology and efficient project management tools allow us to compensate for these difficulties. All the team members are eager to proceed and they are working all around the clock.

The Joint Central Team is a small part of the ITER project. It is vital to bring the expertise and eagerness of the Home Teams as well as all the world fusion laboratories and industry into a coherent project. The road to fusion is long and challenging.

So, I also want to thank the talented and dedicated members of our team here, as well as the JCT members at the other two sites, for their hard work during the start-up of this project. With all the talents who are assembled, I am confident that we will be successful.

And, again, I would like to thank the European Union, Japan, Russian and the United States for their support of ITER. And more specifically, I would like to thank our hosts - Germany and the Max Planck Institute for Plasma Physics - for providing these good accommodations and support to the Joint Central Team. Thank you.

The Secretary of Energy
Washington, DC 20585

January 26, 1994

Dear Council Members and Distinguished Guests:

The United States Department of Energy offers its congratulations to the European Community, the State of Bavaria, and the Max Planck Institute of Plasma Physics on the inauguration of the International Thermonuclear Experimental Reactor Joint Work Site at Garching.

The work that engineers and scientists from the many nations participating in this project are doing, at Garching and the other Joint Work Sites, represents a significant step forward in the development of fusion reactor design and technology. It also signals great progress in a new approach to international collaboration, founded on the principle of equal sharing of benefits and costs.

In spite of this progress, we must remain aware of the challenges that still face us. Creativity, innovation, and teamwork will be necessary to resolve the technical and managerial issues that will inevitably arise, as they have in earlier phases of our cooperation. The Department of Energy is confident that both the parties and the individuals involved in this venture will continue in the tradition of technical excellence and mutual cooperation that has allowed us to reach this point.

Completion of a successful engineering design of the International Thermonuclear Experimental Reactor is an essential step in the development of fusion energy as a viable commercial energy source. The Department of Energy is proud to be a member of this team and is committed to its success.

Sincerely,

Hazel R. O'Leary

ITER EDA STATUS REPORT

by J.M. Van Fleet, External Relations
Office of the ITER Director, ITER San Diego Joint Work Site

The following is a summary of progress made to the end of 1993 in the ITER Engineering Design Activities as presented by the ITER Director, Dr. P.-H. Rebut, and noted by the ITER Council (IC) at its fifth meeting held 27-28 January 1994 at the Max Planck Institute for Plasma Physics, the host location for the ITER Garching Joint Work Site.

Development of the Outline Design and Work Programme

Since the fourth IC Meeting, the work achieved within the Joint Central Team (JCT) has incorporated the priorities of the Council. In preparing the work for TAC-4 and MAC-4, the JCT benefitted from contributions both to the work on the Outline Design and on the Work Programme made by staff and input provided by the Home Teams at short notice. The Director expressed his appreciation for the co-operation of the Parties and the contributions of the Home Teams.

The Director presented the ITER Outline Design Report as well as the ITER Work Programme.

With an increasing number of JCT members arriving at the three Joint Work Sites, and with the progress towards an agreed Outline Design, the formal management approaches/tools which have been developed are being progressively implemented. The timely implementation of the ITER Process Management System (IPMS) remains a vital element of the ITER management plan. The IPMS is the principal tool for managing the evolution of the ITER design through a geographically distributed computing system via high-speed data communications networks connecting the three Joint Work Sites.

Progress has been made in moving towards more efficient procedures for managing Task Assignments. Following meetings with the Home Team Leaders, draft comprehensive Task Agreements for 1994 have been agreed upon. The Task Agreements initially cover 251 tasks with credit of over 46K IUA (ITER Units of Account) and 115 PMY (Professional Man Years) of Design Effort. [Note: 1 IUA = 1,000 US$ January 1989.]

The remainder of the ITER Director's report covered the developments of Task Assignments and the Joint Central Team in more detail.

Task Assignments

In addition to the comprehensive Task Agreements, work has continued in formulating Task Agreements following the standard procedures. As of the end of December 1993, the JCT had issued 82 Task Agreements. The total value of technology R&D credits granted, proposed or imminent now exceeds 300K IUA. Total values of the above are shown below:

Type	IUA	PMY
TA Work Completed	5,800	2.5
TAs Approved	60,734	23.0
Proposed for Approval	49,245	0.0
<300 IUA		15.9
Under 1993 Procedures	89,888	66.6
1994 Comprehensive Task Agreement	46,219	115.3
Not yet assigned to Party	52,200	0.0
Totals	**304,086**	**223.3**

The pattern of assignment to Parties is summarized as follows:

Party	IUA	PMY
EC	56,101	62.1
JA	62,582	41.9
RF	35,868	44.7
US	51,335	74.6
Joint EC/RF	23,600	
Joint JA/US	22,400	
Not yet assigned to Party	52,200	0.0
Totals	**304,086**	**223.3**

In most respects, the implementation of the Model Coil Development Programme is progressing very well, with a high level of collaboration being established between the Parties. An interesting new feature is the formulation of Tasks in this area, which will be undertaken jointly by combinations of the Parties.

Following the recommendations of MAC-3, Task Agreements are now being prepared on the basis of standard general terms and conditions which have been agreed upon with the Home Team Leaders.

The Joint Central Team

At its first meeting the IC agreed that the Parties should provide a total of 150 professionals to the JCT by the end of Protocol 1 (March 1994), with the build-up being done as quickly as possible. The first IC also approved the Director's proposed staff selection procedures.

For a number of reasons, the rate of build-up of the team has been slow. This has had an impact on the start-up of the technical work and the overall management and functioning of the JCT. During the first 17 months of the ITER EDA the total manpower effort expended in the JCT amounted to 48.4 Professional Man Years - 14.1 in Garching, 13.8 in Naka and 20.5 in San Diego.

As of the end of 1993, 122 staff had been selected; 83 had arrived at the three Joint Work Sites. The table below demonstrates the effort made to achieve a reasonable balance between Parties and Sites.

Arrangements for formally seconding Canadian JCT members under the forthcoming involvement of Canada in the EC contribution to the ITER EDA are ready to be implemented. Some new Team Members from the RF Party are now starting to arrive on site; more are expected shortly as soon as visa formalities have been completed.

JCT Status by Joint Work Site and by Party

	Total	Garching	Naka	San Diego	EC	JA	RF	US
On Site	83	26	26	31	23	25	6	29
Selected	122	38	39	45	30	31	24	37

Conclusion

The Director expressed his appreciation of the excellent work and the progress achieved during the first 18 months of the ITER EDA by the JCT and Site Support Staff, and by the Home Teams.

ITER TECHNICAL MEETING ON ASSEMBLY AND MAINTENANCE

by R. Haange and F. Puhn

A Technical Meeting on Assembly and Maintenance of the ITER machine was held in Garching, at the ITER Joint Work Site on January 19-26, 1994. Representatives of all four Parties and the three Joint Work Sites attended. The list of attendees at the meeting is shown below.

EC: D. Maisonnier, C. Vallone, K. Leinemann, C. Holloway, R. Thevenet, F. Amelotti, P. Bruzzone, T. Raimondi (p/t), Cantello (p/t), Chanussot (p/t)

JA: E. Tada, K. Obara, S. Kakudate, T. Honda

RF: A. Ivashkin, V. Muratov, N. Sidorkin

US: J. Doggett, J. Herndon, H. Pagliarulo, D. Loesser, A. Sturm, T. Burgess

JCT: M. Huguet, F. Puhn, R. Haange, R. Thome, C. Ahlfeld, F. Casci, K. Shibanuma, M. Kondoh, C. Bushnell, Z. Piec, J. O'Toole, A. Oikawa, E. Martin, S. Chicciho, G. Johnson, D. Lousteau, T. Izuka, K. Shimizu, K. Ioki, R. Parker (p/t), P.-H. Rebut (p/t).

The purpose of the meeting was to present the basic assembly and remote maintenance concepts and to review some of the general techniques that will be required and for which it is expected that development will be necessary. At the first two days of the meeting the JCT members from San Diego and Naka Joint Work Sites presented the present status of the procedures for initial machine assembly and remote maintenance. This was followed by four half-day sessions at which the Home Teams presented proposals on topics requested by the JCT including:

- handling experience with lifting very heavy equipment to close positioning tolerances;
- assessment of various combinations of cranes and temporary special heavy lifting gear;
- assessment of fabrication and assembly tolerances for ITER;
- alignment methods;
- assembly of large magnet systems;
- non-destructive testing (initial and for remote maintenance);
- optimization of cutting and welding applicable for thick sections;
- viewing systems and remote survey techniques.

The first meeting showed that the EDA outline design requires many assembly steps and maintenance scenarios different from approaches developed during the CDA.

The participation by representatives of major industries was very useful in showing that the techniques required for ITER assembly are either within the present capabilities or that modest extrapolations from the present state-of-the-art may be assumed. This is especially so for the very heavy lift requirements. Thick section welding and cutting will require further development with respect to minimization of thermal deflection and remotisation of equipment. The higher number of TF coils compared to CDA design make the port openings relatively smaller and hence require increased control during insertion and removal of in-vessel components.

Conclusions of the meeting have highlighted many areas that will require detailed study and development during the next years and will be addressed in an intensive collaboration between JCT and the Home Teams.

The technical meeting was followed by a half day session between JCT members and HT representatives to discuss and reach preliminary agreement on the allocation of R&D and Design Tasks for 1994. The meeting in which a lot of very detailed work was presented will be summarized in a short report.

The success of the meeting was to a considerable extent the merit of F. Casci, member of the ITER JWS Garching, who made the local arrangements.

RADIATION EFFECTS ON IN-VESSEL COMPONENTS TECHNICAL MEETING

by Dr. T. Nagashima, Head, In-Vessel Ancillaries Division, ITER Garching Joint Work Site

A Technical Meeting on "Radiation Effects on In-Vessel Components" was held at the Garching JWS on 15-19 November 1993. The Meeting was the first on this subject for the ITER EDA. However, it could also be considered as the second on this subject, as an ITER workshop on "Radiation Effects on Diagnostic Components" was already held from October 14 to 17, 1991, in St. Petersburg, Russia. The St. Petersburg workshop provided an excellent opportunity for radiation experts and diagnosticians to develop a common base for understanding radiation effects on diagnostic components. Thus, one of the objectives of the November meeting was updating the conclusions reached in the St. Petersburg workshop. Radiation effects on RF components and some discussion of magnetic diagnostic requirements were also included in this meeting.

Radiation effects on ceramics, windows, fibre optics, reflectors, mirrors and magnetic coils were discussed in order to evaluate and establish the ITER-relevant database. These components are the key elements of diagnostics systems and/or RF systems and require heavy irradiation tests. In the meeting, data with *in situ* measurements were emphasized. Diagnostic requirements and RF requirements were also presented. Twenty-nine specialists from Home Teams and JCT participated in the meeting (see List of Participants). The sessions for each component were plenary ones. Summary discussions for each component were in parallel, except for ceramics as this is a material used for many components and has a well developed methodology of testing, applicable to other materials.

The main discussions and conclusions are as follows:

- A considerable amount of data has been accumulated on radiation effects on the dimensional changes and mechanical and physical properties of ceramics. The phenomenon of radiation induced electrical degradation (RIED) has recently received particular attention. An IEA round robin experiment is currently in progress to verify that RIED is a bulk irradiation effect. Selected ITER-relevant irradiation experiments need to be performed on candidate ceramic insulators to address some outstanding issues regarding the suitability of particular ceramics for ITER, which should be followed by tests on a mock-up of diagnostic and RF components. These experiments will rely heavily on *in situ* (as opposed to conventional post-irradiation) measurements. The most promising ceramics are Al_2O_3 and BeO for both diagnostic and ICH applications. For ECH, the most promising ceramic for windows and supports is Al_2O_3 (used at cryogenic temperatures).
- Most windows would not survive in unprotected environments. This is particularly true for the UV and the visible light. Extensive data on the optical absorption properties are available in the open literature and provide the starting point for selection. The same quality and quantity of information is not available for radioluminescence and will, therefore, require further study, with particular attention to the temperature of irradiation. The ultimate engineering problem is that of joining the window to its metal structure. Validation of performance under irradiation is required.
- Mirrors reflectors will be set under the most severe environmental conditions in the ITER device. Irradiation tests have been performed on metal mirrors, layered synthetic microstructures (LSM/s) for UV reflectors, dielectric coatings on ceramics for high power laser beams, crystalline materials as are used in X-ray spectroscopy and graphite elements for submillimeter plasma diagnostics. Dielectric mirrors, especially of the multi-layer type, potentially have problems with temperature cycles, radiation and particle erosion deposition. Metal mirrors without coating look specially attractive for application near the first wall, in spite of their decreased performance compared to the multi-layer coating type mirror. Therefore, irradiation testing of metal mirrors under heavy irradiation conditions should be given high priority. The most important problem is the mutual influence of the neutron, gamma and neutral particle fluxes.
- After the St. Petersburg meeting, many intensive studies of radiation effects on fibre optics have been conducted by each Party and significant results for the ITER diagnostics were presented in the meeting. Three different kinds of radiation effects, i.e., fluorescence luminescence, transient opacity and permanent opacity, were obtained. In the case of SiO_2 fibres, a large absorption loss at wavelength < 700 nm and a loss peak at 600 nm, were observed. However, the SiO_2 fibres survived irradiation up to about 10^{20} n/cm^2. Operating the SiO_2 fibres at >350°C (or periodic heating) remedies the damage and appears a promising way of reducing the absorption substantially. Highly radiation resistant fibres would be useful if they could be developed to survive in the blanket region.
- A preliminary analysis of equilibrium reconstructions from magnetic measurements has been carried out in ITER-like geometry. The analysis shows that the sensor types and locations proposed by the ITER CDA and the JCT are basically adequate. Magnetic sensors for the equilibrium reconstruction and plasma control made by mineral insulated (MI) cable wound on metal supports are very simple and robust. Requirements of voltage stand-off, insulator conductivity and dimensional stability for magnetic sensors were given. Cooling of the sensors will be required and is a critical issue, especially for the high frequency (250 kHz) magnetic sensor set potentially for detecting alpha-driven toroidal Alfvén eigenmodes (TAE); it is mounted near the first wall. Recently, an integrator concept for much longer times than 10^3 sec has been demonstrated; therefore, ITER can operate with standard inductive sensors.
- Fission neutron irradiation sources are considered to be the best available irradiation facilities for testing ITER components. However, all irradiation facilities, i.e. fission reactors, 14 MeV neutron sources, charged particle accelerator facilities and X-ray and gamma ray sources should be utilized to provide timely and cost-effective data for ITER. Since *in situ* neutron irradiations may require a large amount of resources, such experiments should be carefully chosen and well co-ordinated between research organizations. A balance between low and high fluence experiments and between *in situ* and post-irradiation measurements must be found in order to make use of the resources in the most efficient way.

The participants and members of the JCT staff agreed that this meeting was very useful and informative. A draft summary report was prepared at the meeting and already sent to the Home Teams. It is being revised by the Home Team and JCT, and a final summary report will be issued shortly. The specifications for diagnostics are in a very preliminary stage, while those of RF and magnetic components are better defined as just before the radiation meeting, two meetings on "RF Heating and Current Drive" and on "Plasma Equilibrium" were held at Garching and Naka Joint Work Sites, respectively.

The Home Teams expressed strong interest in joining the design activities for diagnostic systems. For the In-Vessel Diagnostics Groups of the In-Vessel Ancillaries Division, the study of generic access routes for diagnostic systems was considered to be an urgent task. This task should be started in collaboration with the Home Teams. It will be necessary to iterate the parameter specifications, access design, diagnostic selection and design, and materials development and selection before an optimized diagnostics system is reached.

The meeting secretary and her team were well organized in supporting this meeting. The meeting ran smoothly although a complete power cut happened for about two hours on Tuesday morning. A traditional German meal was organized for lunch in the basement of the ITER building on Wednesday, 17 November 1993, which was a German National Holiday.

Participants during the Meeting

LIST OF PARTICIPANTS

EC:
R. Heidinger
E. Hodgson
A. Kaye
G.P. Pells
P. Stott
J.-G. Wegrowe

JA:
T. Iide
T. Kakuta
T. Matoba
T. Shikama

RF:
S.E. Bender
G.M. Kalinin
A.V. Krasilnikov
D.V. Orlinski
Y.L. Tarabrin

US:
E. Farnum
R. Goulding
A. Ramsey
R. Snider
K. Young
S. Zinkle

JCT: G. Bosia, W. Gauster, L. de Kock, S. Mori, S. Nagashima, R. Parker, F. Puhn, S. Yamamoto

NEWS IN BRIEF

Atomic Energy Society of Japan bestows Distinguished Contribution Award upon ITER Engineer

Dr. Hiroshi Yoshida, Leader of the Tritium Plant Group at the ITER JWS Naka, will be the recipient, together with two JAERI colleagues, of an important prize in recognition of his work that led to the design of the Japanese Fuel Clean-Up System (FCU) developed during the period 1980-1992.

The design is based on palladium alloy membrane permeation of DT gas and conversion by oxidation of tritiated impurities in tritiated water followed by high temperature electrolysis. A prototype FCU system (≈1/3 - ITER scale) was designed in collaboration with DOE in the Tritium Systems Test Assembly at LANL, Los Alamos, USA. The latter tests included a successful uninterrupted operation lasting 25 days in tritium which showed that the plant performance was well within specification.

Dr. Yoshida, who joined ITER JCT in April 1993, will be given the award in a ceremony to be held at Tsukuba University on March 29, 1994.

FORTHCOMING EVENTS *)

- Technical Meeting on Tritium Plant, Naka, Japan, 14-18 March
- Technical Meeting on Neutronics Experiments for ITER Design, Garching, Germany, 21-25 March
- TAC-5, Garching, Germany, 11-13 April
- MAC-5, Naka, Japan, 21-22 April
- Technical Meeting on Test Program and Test Module Integration; Electromagnetic Analysis for In-Vessel Components, Garching, Germany, 25-29 April
- IC-6, Moscow, Russia, 15-16 June

*) Attendance at all ITER Meetings by invitation only.

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 (phone 23606392).

Printed by the IAEA in Austria
March 1994

94-00969