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EIGHTH MEETING OF THE ITER DIAGNOSTIC EXPERT GROUP

by Dr. A. E Costley, ITER Joint Central Team, and
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The Eighth Meeting of the ITER Diagnostics Expert Group was held at the San Diego Joint Work Site, 11 - 13 February 1998. The meeting was combined, as usual, with a Technical Meeting.

This was the last meeting of the Expert Group in the present term of the EDA but it is expected that the Group will continue with approximately the same scope of work during the planned extension of the EDA. The meeting had two main technical goals: to discuss the status and plans for developing kinetic control, and to review the current status of the design of the magnetics system. In addition, developments in the topics normally dealt with by the Group were discussed and plans for future work were made. The principal conclusions of the meeting are as follows:

- The initial work on kinetic control is good but the modelling needs to be enhanced to include the full diagnostic set so that the impact of individual diagnostic failures and limitations can be better assessed. More work is required on the implementation of control in the next phase of ITER design.
- The design of the magnetic diagnostics is now in a relatively advanced state and offers good promise to meet the measurement requirements. However, there are some concerns remaining and these should be addressed.
- Since the last Expert Group meeting, substantial progress has been made with the integration of diagnostics in the tokamak: in-vessel and in radial and divertor ports and in the areas around the tokamak. However, the integration of diagnostics into the top ports is still outstanding and awaiting the completion of the design of the top ports.
- Substantial contributions to diagnostics were made in the FDR. As part of the costing exercise the Start-up set was revised and some additional diagnostic components are now deferred to the Upgrade set.
- The work of the Group undertaken in 1997 was presented to the ITER Physics Committee at its annual meeting in November, and the list of tasks to be done under the voluntary physics arrangements was updated.
- Many ITER relevant diagnostic activities are ongoing in the Parties and some of these overlap with specific requirements of ITER diagnostics. Progress has been made in some specific areas on the list of diagnostic topics to be addressed under the voluntary physics arrangements. However, some important specific ITER needs are not being addressed, and it is disappointing that we have not been able to initiate work on these tasks under these arrangements. The status of the voluntary physics R&D is summarized in the Table overleaf.
- Progress has been made with the credited design and R&D activities in most topic areas. The EU has had a particular problem launching the R&D activities on component development but it is hoped that this problem is solved now.
- A strategic plan for a programme of work on the first mirror issue has been developed. It is proposed that there should be action under credited R&D activity in addition to the voluntary physics activity.
- A very successful design progress meeting on Optical and Spectroscopic Diagnostic Systems was held at the San Diego JWS immediately before the Expert Group meeting. The current status of the design of all the optical and spectroscopic diagnostics was reviewed, and key areas where further work is required were identified. Some specific issues require attention from the Expert Group.

Status of Voluntary Physics R&D

Measurement Requirement	Status
URGENT	
8.3 Determination of life-time of plasma facing mirrors used in optical systems	Preferred mirror materials recommended: tags from JET examined: some activity in Ukraine. Rhodium mirror fabrication tests in progress at IPP
HIGH	
8.1 Development of alternative methods for measuring core n_D/n_T ratio	Fast-wave reflectometry test at DIII-D in progress. Promising recent results using NPA on JET for measuring n_D/n_T ratio in plasma edge
8.2 Development of methods for measuring tile erosion in real-time	Reflectometry, interferometry proposed; no action
8.4 Determination of life-time of optical elements in the divertor	Some theoretical/experimental modeling of effect of disruptions on optical elements in the divertor. No new activity
8.5 Development of methods of measuring the energy and density distributions of confined alpha-particles	Preliminary results on a plasma with a significant fast-ion population recently obtained on JET; CO_2 scattering for JT-60U: hardware started; "Knock-on tail" tested on TFTR-and JET; data now being analyzed.
8.6 Development of methods of measuring the number and energy of escaping alpha particles	Faraday cup test in progress on JET; IR imaging demonstrated on JT-60U.
8.7 Devise new concepts for measuring light in-core impurities (e.g. He-ash) that do not rely on the diagnostic neutral beam (DNB)	No concept yet.
8.8 Devise new concepts for measuring j(r) that can be applied to ITER with sufficient spatial resolution	MSE (uses "modulated" heating beam) well demonstrated; heavy-ion beam will operate on T-10; No other concepts proposed.
8.9 Determination of impurities in divertor using only visible and UV spectroscopy	No action on recommending lines and procedures that could be used on ITER. Some modeling has been started by the Spectroscopy Working Group.
8.12 Investigation of spectroscopic methods for measuring the spatial distributions of n_e and T_e in the divertor	(Proposal added on 3/10/97) No response yet.
8.13 Measurement of runaway electrons	(Proposal added November 1997) New proposal to use 'killer pellet' of Argon and observe K_a emission; technique using vertical ECE developed on PBX-M
8.14 Measurement of core density profiles and MHD activity	(Proposal added November 1997) No response yet
8.15 Measurement of density profile across divertor leg	(Proposal added November 1997) No response yet
LONG TERM	
8.10 Development of new methods to measure steady state magnetic fields accurately in a nuclear environment	TFTR test of Hall probes inconclusive; now in test on a Japanese gamma-source. New proposal to use ferromagnetic spheres
8.11 Demonstration of direct measurement of local electric field	Demonstration of E_r measurement on TFTR and DIII-D by MSE; poloidal rotation on TFTR; Test of heavy-ion beam proposed; No new independent technique.

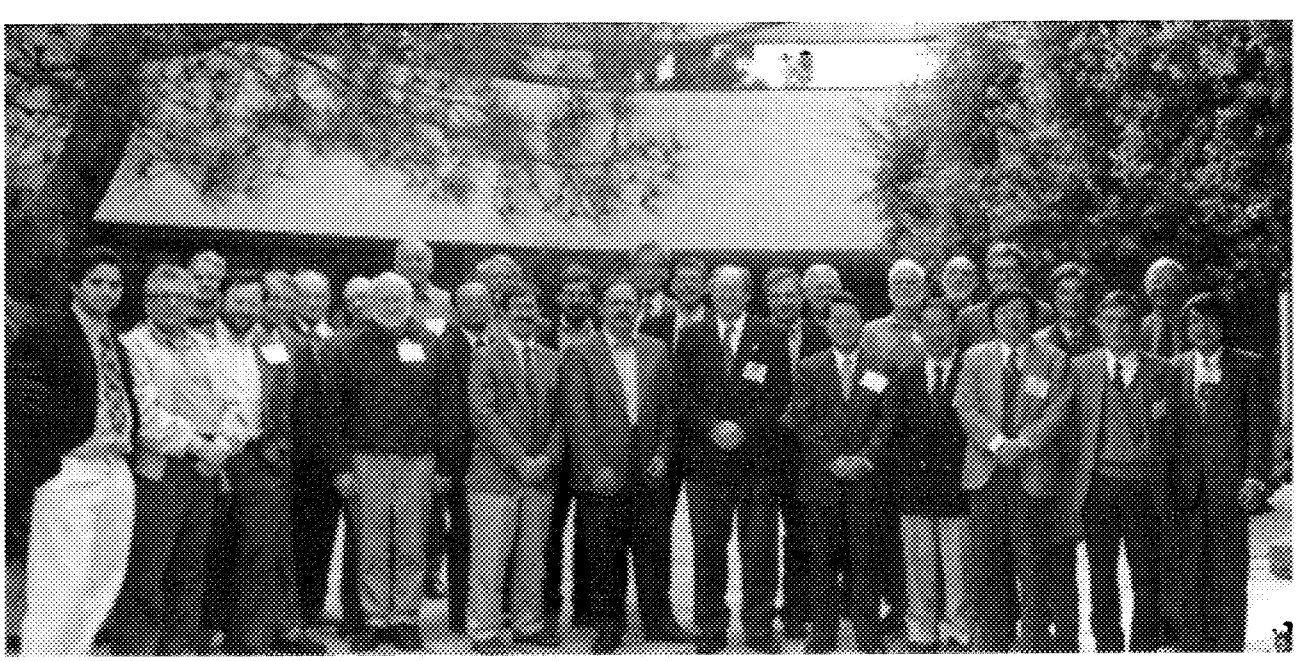
- The Reflectometry and Neutron Working Groups are working well and giving advice and help to system designers on specific topics. Two new groups have been established: one on Thomson Scattering and one on Spectroscopy.
- Plans for future design and credited R&D have been developed. For the design, a logical continuation of the present work is envisaged with the emphasis being placed on the engineering design and integration of the systems into the tokamak. Activity under four headings is proposed for the R&D:
  * development and testing of key diagnostic components;
  * residual work on irradiation effects including further measurements on candidate diagnostic materials and testing of prototypes of key diagnostic components;
  * continuation of the development of the New Concept diagnostic techniques; and
  * continuation of the development of the short-pulse, high power, Diagnostic Neutral Beam for active spectroscopy.

It is proposed to hold the next meeting in September in Russia. Key topics will be a review of the Start-up Set, consideration of the Party's reviews of the FDR, review of the work on first mirrors and shutters, diagnostic reliability, and planning of work for the EDA extension phase.

LIST OF PARTICIPANTS

Members of Expert Group: A.E. Costley (JCT - San Diego)L. de Kock (JCT - Garching), E. Marmar (MIT - US), V. Mukhovatov (JCT-San Diego), K. Muraoka (Kyushu U. - JA), A. Nagashima (JAERI - JA), M. Petrov (Ioffe - RF), P.E. Stott (JET - EU), V. Strelkov (RRC - RF), S. Yamamoto (JCT - Garching), K.M. Young (PPPL - US)

Guests and Attendees at the Technical Meeting: D. Boucher (JCT - San Diego), G. Razdobarin (Ioffe - RF), T. Carlstrom (GA - US), H. Salzmann (IPP - EU), K. Ebisawa (JCT - San Diego), R. Snider (GA - US), P. Edmonds (JCT - Garching), T Strait (GA), R. Giannella (CEA - EU), T. Sugie (JAERI - JA), L.C. Johnson (JCT - San Diego), G. Vayakis (JCT - San Diego), S. Kasai (JAERI - JA), C. Walker (JCT - Garching), A Kellman (GA), J. Wesley (JCT - San Diego), J. Lister (CRPP - EU), I. Yonekawa (JCT - San Diego), O. Mitarai (Kyushu Tokai U. - JA), V. Zaveriaev (RRC - RF), T. Nishitani (JAERI - JA)



Participants in the Meeting

FUSION RESEARCH AND TECHNOLOGY RECORDS IN INIS DATABASE

by C.-D. Hillebrand, Division of Scientific and Technical Information, IAEA

This article is a summary of a survey study *) on Fusion R&T records stored in the International Nuclear Information System (INIS) bibliographic database. In that study, for the first time, all scientometric and bibliometric information contained in a bibliographic database, using INIS records, is analyzed and quantified, specific to a selected field of science and technology. A variety of new science and technology indicators which can be used for evaluating research and development activities is also presented in that study.

The decentralized multidisciplinary bibliographic database of the IAEA is part of INIS which was created in 1970 and is administered by the INIS Section of the IAEA with the purpose of collecting and disseminating information on the peaceful use of nuclear science and technology through its Member States.

INIS has 118 Members including 17 International Organizations which provide records on nuclear science and technology documents published in the Member States. Records of documents are provided to INIS in the English language, with the titles in the original. All countries participating in the ITER Engineering Design Activities (EDA) are INIS Members.

The main INIS fields of scope are:

- chemistry, materials and earth sciences;
- life and environmental sciences;
- isotopes, isotope and radiation applications;
- engineering and technology;
- other aspects of nuclear and non-nuclear energy;
- physics.

The largest subject category is physics with about one third of all records followed by engineering and technology with one fourth of all records. Chemistry, material and earth sciences as well as life and environmental sciences represent about one fifth each.

Fusion R&T is within the INIS scope and represents about one fifteenth of the whole INIS database (more than 130.000 Fusion R&T relevant records in the period of 1970 to mid 1997). In this field, there is an input of 5500-7000 records every year. More than 86 % of the input comes from the ITER Parties (including Canada and Kazakhstan, participating in the ITER EDA through EU and RF, respectively, and Switzerland) and from the IAEA. It is to be noted that the number of publications per country rather reflects the concentration of scientific publishing houses in those countries than research activities. About 80 % of all documents related to fusion are published in English. This includes translated publications which are mainly published in the USA and, therefore, records thereof provided by the INIS Centre in the USA. As a result, almost one tenth of the input from the USA represents translated publications. Out of all authors listed in the Fusion R&T records roughly 66% are from non-English speaking countries.

The INIS records are categorized, according to INIS subject categories and scope descriptions arranged in conformity with the International Classification System for Physics developed by the International Council for Scientific and Technical Information, with the main Subject Categories Fields of Fusion Research and Fusion Technology and the subfields such as (shortened names) plasma (-confinement; -diagnostics; - transport and -impurities; -waves,-oscillations and -instabilities; -production,-heating; -reactions; -fluid and MHD-properties); elementary processes in plasma for Fusion Research and specific fusion devices; inertial confinement; magnetic confinement; plasma facing-components; magnet coils and fields; power-supplies; blankets and cooling-systems; heating and fuelling-systems; power conversion systems; component development and materials studies for Fusion Technology. Subject fields with a high number of records are

*) "Fusion Research and Technology in the INIS Bibliographic Database".
A survey on publications in Fusion Research and Technology. Science and Technology Indicators in Fusion R&T.
Claus-D. Hillebrand, IAEA, Division of Scientific and Technical Information, Vienna, 1998.

plasma waves, oscillations and instabilities; plasma (-production, -heating, -transport, -diagnostics) under Fusion Research; and components (-development, -materials, -study), inertial confinement and plasma-facing components under Fusion Technology.

The time development of records within the subfields in general shows a lower yearly fluctuation of records in Fusion Research than in Fusion Technology. The number of records within the inertial confinement fusion subfield is steadily increasing, and the number of records within the magnetic confinement fusion subfield is varying from year to year and correlating with the number of records in the subfield components development; materials study. This has probably to do with the number of biannual conferences on Fusion Research and Technology.

The multidisciplinarity of the INIS database allows the study of correlation with other scientific disciplines. For each record an assignment of a second and/or third subject category is foreseen, if its content covers more than one subject field. The number of records within the Fusion R&T fields and some other disciplines shows a strong overlap of subject fields with (in order of importance) materials science, other physics fields and instrument and reactor engineering and technology.

The record type (e.g. journal articles, reports, books, miscellaneous, patents) and literary type (e.g., short-communications, conferences, numerical data, progress reports) of each record entry is indicated in the database. This allows the publishing format to be characterized.

Journal articles represent about 50% of all records, 31% of them are reports, 13% books, 5% miscellaneous and 1% patents. The high number of book records originates from the publication format of some conference proceedings in which each contribution counts as a book record. But also under journal articles one can find a high number of conference contributions, numerical data and short communications. The "report" type is often used for progress reports, listing of numerical data and dissertations. The input of patents behaves somewhat erratically over the years covered by INIS database. This has to do with the change of copyright concerning patent records in some countries and the difficult conversion of records from patent to bibliographic databases.

The time development of publication types gives an indication of research activities. The number of journal articles varies about 10-15 % from year to year. The number of report records has decreased since 1989. The frequency of books is very irregular, the reason probably being the irregular choice of formats for the publishing of conference proceedings. The numerical data contained in the records increased tremendously between 1983 and 1992, but thereafter decreased steadily. No logical explanation thereof has yet been found. Dissertations have two prominent peaks in 1972 and 1986, both about 140 as compared with an average number of 80 records per year in the other years.

The publication type sorted by input country gives some additional information on the publishing activities in these countries and, with further analysis, also some indications on research activities. Eight countries (all participating in the ITER EDA), and the IAEA are the largest input centres with about 93% of all journal records. About 94% of the report records derive from 10 countries (again, all of them participants to the ITER EDA). About 98% of all books on fusion R&T are published in 9 countries, participants to the ITER EDA.

The comparison of publication types per subfields shows that in Fusion Research the number of journal article records is higher than in Fusion Technology, whereas the number of reports is higher in the Fusion Technology field.

The country tag in the author field gives a better representation of the actual national research activities than the country in which the document has been published. More than 86% of the authors come from the "ITER countries". The country distribution of authors somewhat resembles the distribution of the world Gross Net Product (GNP) and is different from the distribution of input countries because in some countries there is a high concentration of science publishing houses.

Journal articles are published in more than 1500 different journals and represent about 50% of all Fusion R&T records in INIS. Whereas the 15 journals (1%) with the highest number of fusion relevant journal article records (more than 1000 records per journal) represent 57% of all journal records, the further 63 journals (4.2 %) with more than 100 and less than 1000 records per journal represent about 29% of all journal records and journals with more than 10 but less than 100 records represent about 10% of all journal records. Journal articles with 4 pages are the most frequent ones, and the average page number is 7.3 pages.

The survey study "Fusion Research and Technology in the INIS bibliographic database" contains a list of journal profiles in which for larger journals the number of records are plotted against the Fusion R&T subfields. The profiles allow to compare the scope of each journal. The list of fusion journals in the survey contains a ranking of journals by the number of records (which is a function of publication years, input years, articles published per year and scope) and is compared with the list of the Science Citation Index (SCI) of the Institute of Scientific Information (Philadelphia, USA). The comparison shows that, for instance, the scope of the SCI list in Fluids and Plasmas (not controlled fusion itself) is broad but does not cover certain fields such as material studies, etc. Furthermore, the Fusion Technology journals are not distinguished from Fusion Research journals in the SCI list.

A feature of a bibliographic database is the subject indexing of records by assigning keywords. As the subject index is used in books, each database record is complemented by a list of 'controlled terms' (keywords, in INIS terminology - descriptors) which are chosen to better describe the content, concepts, methods and models. These controlled terms are scientific and technical words listed in the INIS Thesaurus which defines relationships (e.g. hierarchical, affinitive, etc.) to other controlled terms. These terms are used for the retrieval of documents. Descriptors are assigned to each input record by indexers working in each INIS centre. About 8000 different descriptors are relevant to Fusion R&T and on average 9-10 descriptors per record are used. The most frequently used descriptors are plasma, tokamak devices, magnetic fields, plasma diagnostics, thermonuclear reactors. These descriptors indicate that the main emphasis in Fusion R&T of the INIS database is on Fusion Reactors and on Controlled Fusion Experiments.

An alternative retrieval tool is the search by "free text" (that is, natural language-words and phrases occurring in all textual fields, including titles, abstracts). The free text can be a scientific term which appears in the title or abstract and is not necessarily a descriptor, but, nevertheless, can be used for retrieval. In addition to the use of descriptors, "free text terms" are permitted to be input in another indexing field and allow flexibility of indexing and search. Newly proposed descriptors are usually accepted with a delay of several months. The free text "ITER" has been in use since March 1987, when it was agreed by the four ITER Parties, in the light of the international nature of the proposed design activity, to use the name ITER for international thermonuclear experimental reactor, instead of ETR, which was in use until then. The usage of this term increased steadily, year by year, since that time, with the exception of 1993. This has probably to do with the termination of the ITER Conceptional Design Activities in December 1990, and the ITER Engineering Design Activities actually starting in late 1992.

The survey study "Fusion Research and Technology in the INIS bibliographic database" contains many tables and graphs which are the basis for the content of this summary and provides more detailed information. A basic analysis was performed aiming at different interest groups such as the scientific and technology community, science publishers and editors, librarians and decision makers. Further, more advanced and focused analyses and evaluation of the data for some of these interest groups are also possible. The survey opens the possibility of further studies, e.g. the co-operation between different institutions and countries, etc. Additional information on science and technology indicators and trends is also shown in that study, as well as information on Fusion R&T related publications and their formats. The study will be published by the IAEA in the near future.

Items to be considered for inclusion in the ITER Newsletter should be submitted to B. Kuvshinnikov, ITER Office, IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: +43 1 237762, or e-mail: c.basaldella@iaea.org (phone +43 1 206026392).

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