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ROBERT AYMAR LEAVES ITER FOR CERN

by Acad. E. Velikhov, former Chair of ITER EDA Council

As of 1 September 2003, Dr. Robert Aymar, former ITER Director and subsequently Interim Project Leader, has relinquished his leadership of the ITER Project. I am convinced that everyone involved in the ITER activities will join me in expressing our sincere appreciation of Dr. Aymar's enormous contribution to the success of the ITER Project during the EDA and ITA phases.

Dr. Aymar was appointed Director of ITER by the ITER Council in July 1994, after having served for nearly two years as a member of the ITER Technical Advisory Committee.

Under his leadership, the results of 50 years of fusion research crystallized into the engineering project ready for practical implementation. The successful results of the ITER activities helped to attract the new ITER Participants who joined in 2003, and the countries participating in ITER now represent almost half of the world population.

After the many years of Dr. Aymar's involvement in ITER, one might ask what attributes of his character allowed him to demonstrate the practical success of ITER. Of course, the work he performed required a broad scientific background, great experience and dedication, a creative mind and engineering intuition. In addition, however, a really unique attitude of Dr. Aymar was his human approach to the people working on the project under his leadership. He never imposed his ideas on other people, even when there were no other scientific or technical solutions. With patience, he persuaded people to accept and to implement solutions as their own ideas. He was able to organize work with the Participants' Home Teams in a friendly and fruitful manner, thus rendering the ITER Project truly international.

Dr. Aymar is leaving the ITER Project as its Leader for a new post as the Director General of CERN. We all wish him every success in his new work and hope that in future we will be able to interact with him again in international projects.

ITER-RELATED ISSUES AT THE IAEA GENERAL CONFERENCE

Information from the Editor

The 47th General Conference of the IAEA was held at the Austria Center in Vienna from 15 to 19 September 2003. Academician E. Velikhov was one of the keynote speakers at a session on advances in the field of nuclear science and technology, which featured presentations on nuclear power, nuclear medicine, safety standards and safeguards technology. Please see below an extract from his presentation.

STATUS AND PROSPECTS OF NUCLEAR POWER

The advantages of nuclear power from fusion are inexhaustible fuel resources, ecological attractiveness, inherent safety, significantly lower level of radioactive wastes and the absence of the materials that could be used for weapons. Since the 1950s, intensive work has resulted in a unique scientific and technological database. In 1985 M. Gorbachev, F. Mitterand and R. Reagan suggested the creation of the first experimental fusion reactor on an international basis. In 1988 an international team comprising specialists from the USSR, the USA, the EC and Japan started activities on the design of a reactor, which was named ITER, under the auspices of and with active support from the IAEA. The engineering design of the 500 MW reactor was completed in 2001. Negotiations concerning ITER construction have been started. Canada, Japan, France and Spain have proposed construction sites. The USA, the People's Republic of China and the Republic of Korea have joined the countries that pioneered the project. ITER would have important socio-economical and political implications for the world community. The time to create such a reactor has come.

ACTIVITY DURING THE ITA ON MATERIALS FOR VESSEL AND IN-VESSEL COMPONENTS

by Dr. V. Barabash, ITER International Team, Garching JWS

With the approaching construction of ITER, the materials activity is entering a new stage. During previous ITER phases the main materials for various components were proposed and specific ITER requirements were identified. Materials for all ITER components were selected on the basis of their availability and well established manufacturing technologies, while taking into account their physical and mechanical properties, performance in the design and activated waste minimization. In some cases, improved materials were developed, in particular for in-vessel components.

The results of the ITER materials R&D programme have indicated the feasibility of the selected materials and joining technologies for providing the required operational lifetime and structural integrity. The list of selected materials and specific grades is shown in the table on page 3.

During the ITA, the materials activity is concentrated on the following main areas:

— preparing for the procurement of the materials for the vacuum vessel components;
— consolidation of the materials properties database and preparation of reliable recommendations;
— preparing for any licensing issues related to the use of vacuum vessel materials.

The following documents related to materials for the vacuum vessel and in-vessel components were prepared during the ITER EDA:

1. **ITER Materials Properties Handbook (MPH-IV[1]):**
   A collection of data on physical and mechanical properties of materials, including ITER reference grades (IG). This document gives the justification for the recommended properties used for the design analysis.

2. **ITER Materials Assessment Report (MAR):**
   A description of the rationales for the selection of the specific materials and grades for each ITER component and assessment of the critical issues related to materials performance during operation.

[1] IV means vessel and in-vessel components.

Materials for Vacuum Vessel (VV) and In-vessel Components

Material	Material Grade	Components
Beryllium	S-65C VHP (backup DShG-200)	Armour tiles for first wall and limiter
Tungsten	Pure sintered W	Armour tiles for divertor components
Carbon fibre composite (CFC)	SEP NB 31, NIC 01 (back-up CX 2002U, SEP NS31)	Armour tiles for divertor vertical target
Cu and Cu alloys	CuCrZr-IG	Substrate for plasma-facing components (PFCs) and for heating systems
	CuAl25-IG	Substrate for PFCs (first wall)
	Nickel-aluminium bronze	Nuts, bearings and other friction parts
	Glidcop Al60	Compression collar of the flexible support bolts
Austenitic and precipitation hardened steels	316L(N)-IG1 plates and forgings	Shield modules
	316L(N)-IG2 plates and forgings	Vacuum vessel, blanket cooling manifolds
	316L(N)-IG3 cast	Some vacuum vessel components and back-up material for divertor body
	316L(N)-IG4 tubes	Thin walled tubes for first wall
	316L(N)-IG5 tubes	In-vessel cooling pipes
	316L(N)-IG6 powder HIP	Back-up material for shield modules
	AISI 660 (A-286)	Fastening components for the port plugs (e.g. fixing wedges and bolts)
	Steel 30467	Borated steel for in-wall shielding structures (plates)
Ni alloys	Inconel 718	Bolts for the flexible supports and electrical straps, blanket cooling manifold support
Ti alloy	Ti-6Al-4V	Flexible cartridges for the module support
Ferritic steel	SS 430	Ferromagnetic insert
Ceramic	Al_2O_3 or $MgAl_2O_4$	Electrical insulators of module attachment and limiter plates

3. **Appendix A of the ITER Structural Design Criteria (SDC-IV):**
   A summary of properties and allowables for materials needed for structural analysis in accordance with ITER Structural Design Criteria for in-vessel components.

4. **Safety Analysis Data List (SADL) (in co-operation with the Safety Group):**
   A collection of safety-relevant properties.

During the CTA and the ITA so far, several new documents have been created that reflect the current needs:

5. **ITER Materials Properties Database (MPDB):**
   A collection of raw experimental data with detailed information for the ITER reference materials. The database maintains the data in an easily accessible form and is an important tool to maintain full traceability of the data, test details and data sources. This database is the main supporting document for further recommendations.

6. **Summary of Vacuum Vessel Materials Properties:**
   A document similar to App. A of SDC-IV, but including only vacuum vessel materials. This document is based on ASME code requirements for materials properties. The main thermo-mechanical properties and allowables (S_m, etc.) are included in this document.

7. **Specifications for the Supply of Materials for the Vacuum Vessel:**
   Prepared as a part of the Technical Specification Documents for the supply of the Vacuum Vessel, Ports and Blanket Manifolds.

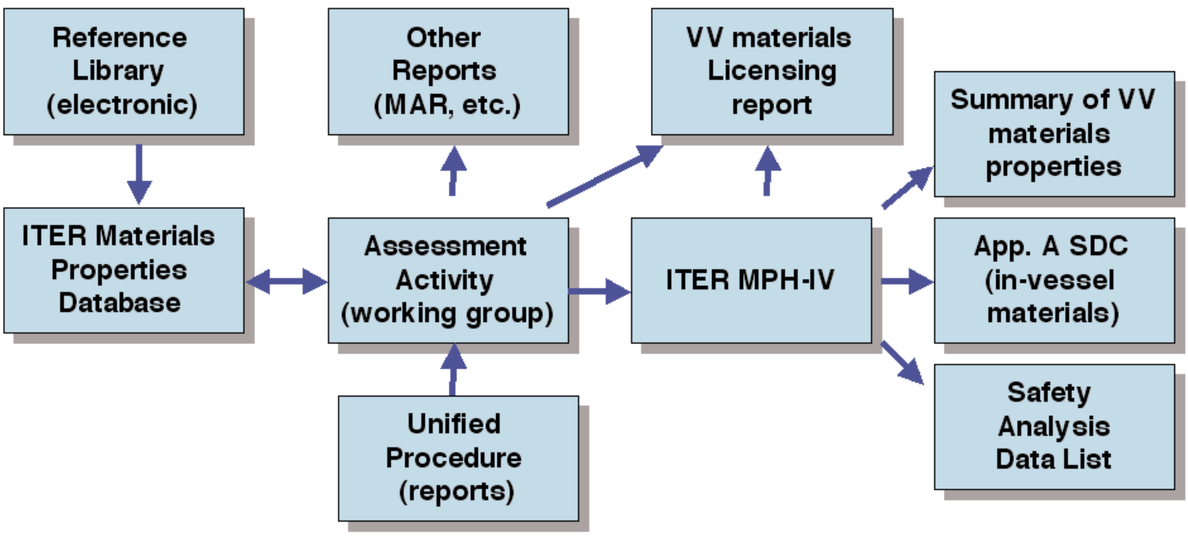
8. **Electronic Materials Library:**
   Collection of all references (R&D Task's reports, papers, etc.) made by the above documents.

In future, a special report on materials may be needed for licensing aspects of the vacuum vessel. This report will be prepared in close co-operation with licensing authorities and will be based on the specific host requirements of ITER licensing. This report will be based on the fully reliable, traceable data consolidated in the ITER database and other supporting documents.

To discuss the ITER materials activity, the ITER Meeting “Evaluation of the data for vessel and in-vessel materials for ITER” was organized at the ITER Garching Joint Work Site on 10–11 April 2003. During the meeting all aspects of the materials activity were discussed:

a) General organization of the data flow and materials activity. A simplified scheme showing the organization of the data evaluation is shown in the figure below. The following procedure, which maintains the complete traceability of the data and recommendations, was adopted for new ITER documents:

— All data must be supported by references, available in the ITER Materials Library.
— Data used for recommendations have to be included in the ITER MPDB with an assessment of quality and reliability.
— Recommendations have to be properly documented via ITER MPH files or separate reports/memos - in the latter case, ITER MPH files have to be subsequently modified.
— Recommendations have to be prepared in accordance with unified procedures (for vacuum vessel materials in accordance with the ASME code).
— An Expert Working Group has to be established to prepare recommendations.



Organization of the materials data flow and materials activity

b) Database activity. The key part of the activity during the CTA and ITA phases is the organization of the ITER Materials Properties Database (MPDB) for collection of the raw data from ITER R&D and other sources. The database includes detailed information about materials, chemical composition, sample geometry, test conditions, etc. The format is simple and flexible and can be modified for specific needs. The raw data from the database can be presented on request to licensing authorities. The requirements for the quality of the data were discussed. It was noted that the MPDB might include all relevant data, but for design purposes only qualified data should be used. It was agreed that the reports of new R&D must include the data in the MPDB format. Data in the MPDB have been collected by the IT with the help of the ITER Parties and they are traceable and readily accessible for further analysis. Priority has been given to vacuum vessel materials, but the collection of the raw data for the in-vessel materials should be continued. For the consolidation of new data being generated by the Parties, in particular for the Cu alloys, attention should be given to their heat treatment during the component fabrication process.

c) Modification and improvement of the ITER documents. Reflecting the current project needs, giving priority to vacuum vessel materials, the first step is modification of the ITER Materials Properties Handbook files related to 316L(N)-IG austenitic steel, 304 austenitic steel, 660 precipitated hardened steel, 430 ferritic steel, 304B7 borated steel and Inconel 718 superalloy. A good deal of the raw data have already been introduced in the MPDB. The recommended properties have to be fully traceable and prepared in accordance with internationally accepted procedures. The next step is the preparation of a separate document (Summary of vacuum vessel materials properties), that summarizes all recommendations needed for the design of the vacuum vessel components. This activity is planned to be completed in 2003. The EU and RF Parties will support this activity through ITA Tasks on database consolidation.

d) R&D activity. In the RF and EU Parties this activity is included in the ITA Tasks. Currently, the main activities in the EU Party are focused on investigation of the effect of the manufacturing cycle on CuCrZr and CuCrZr/SS joints, CuCrZr creep-fatigue and in-pile tests, low dose irradiation of Ti alloys and CFC qualification at high temperature. The RF Party is studying CuCrZr irradiation creep, the effect of the manufacturing cycle on CuCrZr, DS Cu, and their joints, low dose irradiation of “functional” materials (bolts, pins in NiAl bronze, etc.) and in-pile bake-out of CuCrZr.

It was concluded that the meeting was very useful for clarifying the current materials issues. The meeting participants expressed their satisfaction with the progress achieved during the CTA. The need for an Expert Working Group for revision, modification and preparation of the ITER documents was underlined. It was agreed to have the next meeting of the Working Group in October – early November 2003 to revise and modify the documents related to vacuum vessel materials.

Participants in the Meeting:

EU: W. Daenner, A. Peacock, P. Karditsas, J. Rensman, F. Gillemot, F. Tavassoli
JA: T. Kuroda
RF: S. Fabritsiev, G. Kalinin, A. Gervash, A. Kalashnikov
IT: V. Barabash

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