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Summary Report of Consultants' Meeting

IAEA International Database on Irradiated Nuclear Graphite Properties

12th Meeting of the Technical Steering Committee

IAEA Headquarters, Vienna, Austria
12–13 November 2009

Prepared by

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February 2010

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February 2010

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**IAEA International Database on Irradiated Nuclear
Graphite Properties**

12th Meeting of the Technical Steering Committee

Prepared by

H.K. Chung and A.J. Wickham

Abstract

The 12th Meeting of the Technical Steering Committee for the International Database on Irradiated Nuclear Graphite Properties was held on 12–13 November 2009 at the IAEA Headquarters, Vienna, Austria. All discussions, recommendations and actions of this Consultants' Meeting are recorded in this report. The purposes of the meeting were to review the matters and actions identified in the previous meeting, undertake a review of the current status of the database, and make recommendations for action over the next year. This report contains the status of the identified actions as well as a summary of the recommendations on enhancements to the database.

February 2010

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12th Meeting of the Technical Steering Committee for the International Database¹ on Irradiated Nuclear Graphite Properties

12–13 November 2009, IAEA Headquarters, Vienna, Austria

Present

Mr A.J. Wickham, United Kingdom (*Chairman*)
Ms H.K. Chung, IAEA (*Scientific Secretary*)

Other Members:

Mr S. Yu (China, Peoples Republic of) (*Membership application in process*)
Mr G. Haag (Germany)
Mr M. Eto (Japan) (representing Mr T. Shibata, JAEA, and Tyo Tanso Co. Ltd)
Mr E.. Kim (Korea, Republic of)
Mr W. Windes (USA) (representing Mr T.D. Burchell, *part time*)
Mr B. Braams (IAEA, *part time*)

Observers:

Mr G. DeCombarieu, Le Carbone Lorraine (France)
Mr P. Homerin, Graftech International Inc (France)
Mr A. Potier, Le Carbone Lorraine (France)
Mr M. Meicl, SGL Carbon Ltd (Germany)
Mr S. Fazluddin, PBMR Co. (Pty) Ltd (South Africa)
Mr M. Odeychuk (Ukraine)
Mr P. Adler, KorteQ Ltd (United Kingdom, *part time*)
Mr L. Ralph, KorteQ Ltd (United Kingdom, *part time*)
Mr M. Srinivasan, NRC (USA)
Mr M. Gladyshev, (IAEA, *part-time*)

Apologies for Absence:

Mr T. Shibata, JAEA (Japan)
Mr A. Smaizys (Lithuania)
Mr J.A. Vreeling (The Netherlands)
Mr T.D. Burchell (USA)

Welcome and Opening Remarks

The meeting was welcomed to the IAEA by Mr. Braams on behalf of the Nuclear Data Section, and he introduced the new Scientific Secretary, Ms. Chung. Although both were new appointees, they had familiarized themselves with the work of the Technical Steering Committee and recognized the value of the project to the Agency, especially with the renewed commitment to a second phase of activity which had been reached in March 2009. Recognizing that the project would shortly move to the Division of Nuclear Energy, Mr. Braams felt certain that the project would be seen to be of great value in supporting activities internationally in the field of nuclear graphite, particularly with the expansion of the activity to include a new Knowledge Base.

¹ Henceforth to be known as the ‘IAEA International **Knowledge Base** on Irradiated Nuclear Graphite Properties’

The Chairman then welcomed delegates and observers, inviting the latter to take a full role in the meeting. In view of the forthcoming change of Division, he invited the meeting to recognize the singular contribution of Mr. Khalid Sheikh in supporting the meetings over the years: an opportunity was taken when Mr. Sheikh later visited the meeting to offer those thanks in person.

The Chairman also informed the meeting that Mr. Burchell had had to return to the USA in the early hours to address a family emergency. The meeting expressed their support for the family, and Mr. Windes agreed to represent the USA formally although he could not attend on the second day.

The Chairman commented that the purpose of holding a second meeting in the same year was to move forward the installation of Knowledge-Base software and to define the initial work programme. He explained that the United Kingdom had elected to fund the software installation using the services of KorteQ Ltd, and Mr. Ralph would provide an extensive presentation of the structure for comment.

The Chairman again stressed the need for the fullest commitment from all Members, stressing that, valued though voluntary contributions from sponsoring organizations are, the level of work planned by Members would require inputs of effort or funding from all. He then took the opportunity to thank the sponsors present who had renewed their commitments for Phase 2, and also welcomed Le Carbone Lorraine as a potential future sponsor if they felt that the work of the project was likely to be of value to the Company. He identified shortfalls in some promised contributions from a sponsor, and also intimated that there would be an ongoing annual financial commitment associated with the Knowledge Base which Mr. Ralph would later explain.

Next, he advised that the People's Republic of China had prepared all necessary procedures to join the project as a Full Member, but there had been a last-minute hitch arising from change of personnel in Beijing which meant that the final approved letter had not yet reached the Agency. The Chairman invited the meeting to regard Mr. Yu as representing a Full Member, and this was willingly agreed. The Chairman also noted that the Republic of South Africa had intended to seek full membership, and now that a clear separation between the project and the work of the Gen IV International Forum had been demonstrated, he was hopeful that this membership application would soon be forthcoming. The Chairman asked Mr. Fazluddin to follow up this proposed Membership application.

Action 1: Mr. Fazluddin to follow up the proposed Membership application from the South Africa.
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Ukraine was also considering membership, and Mr. Odeychuk was encouraged to follow this up with his government.

Minutes and Actions

The Chairman moved the adoption of the Agenda for the meeting and this was carried *nem con*.

The Minutes of the previous Technical Committee Meeting (March 2008, IAEA Vienna), published as INDC-(NDS)-0556, were accepted without amendment. All actions had been completed, except for Actions 3 and 4, and would be addressed at appropriate points in the meeting Agenda. Action 3, relating to the establishment of specific targets and timescales, had proven challenging for some Members and would be further addressed through this meeting. Some responses to Action 4, relating to the specific future contributions of Member States, were also outstanding. The Chairman expressed again the need for a full commitment on the part of participating Members.

Presentation on the Status of the Project

The Chairman made a short presentation on the status of the project, highlighting the issues facing the Committee as he now saw them. A clear separation of the activity from GIF activities had been demonstrated. This project essentially addressed existing information whereas GIF activities related to

data arising from new investigations, and there was no duplication. This explanation had satisfied those members who worked also within the GIF framework. Mr. Windes remarked that data arising through GIF projects could certainly be released to the project in the longer term, although it was a condition of GIF agreements that it should be made available first to GIF members only through a separate database established for the purpose at ORNL. All present appeared happy with this position.

The 'Phase 2 Mission Statement', appearing as an Annex to the previous Minutes, was reviewed and deemed acceptable to all. This now therefore becomes the formal 'Knowledge-Base Mission Statement' and is re-printed here as Appendix 1. It was agreed that the Project would henceforth be identified as the **IAEA International Knowledge Base on Irradiated Nuclear Graphite Properties**, within which the existing Database, constantly under review, would be a major feature.

In completion of Phase 1, the Chairman recorded that with the assistance of Mr. Haag, the 'final' DVD had been issued to Members and Sponsors. With much improved internet security, he invited Members to contemplate future access to the Database through the Knowledge-Base 'parent page', allowing the Database to be a constant 'live' and 'up-to-date' version. Mr. Ralph would amplify this point subsequently.

QA Grading of New Entries on 2009 DVD

The Chairman presented the proposed QA gradings to the meeting, drawing attention to the hyperlinking now introduced between Data Strings and the relevant explanation of them. As not everyone present had taken the opportunity to check these proposals, the Chairman reminded the meeting of the collective responsibility for their accuracy and proposed that they would be adopted *nem con* unless adverse comments were received within two months of the meeting.

<p>Action 2: All Members to review the proposed Data Strings on recent data on the 2009 DVD and to notify any disagreement to the Chairman by the end of January 2010.</p>

The Chairman also drew attention to an outstanding issue with the Japanese data which had now been re-inserted into the Database. Without a linked copy of the source report(s), it was impossible to apply any QA grading to these data. Mr. Wickham requested Mr. Eto to convey to JAEA the need both to provide a copy of the relevant report(s) and also to propose QA gradings for this information.

<p>Action 3: Mr. Eto to request the urgent cooperation of JAEA in providing both a copy of the so-called 'Final Report' from which a majority of Japanese data were taken, together with proposed QA data strings relevant to those data.</p>
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Irradiation-Creep Database to support the CRP

Mr. Haag provided a brief description of the specific Database that he was developing from the main Database in order to facilitate the work of the Collaborative Research Programme on Irradiation Creep in Nuclear Graphites recently established under the Division of Nuclear Energy.

Establishment of the Knowledge-Base Software

Mr. Wickham advised the meeting that the United Kingdom Health and Safety Executive (Nuclear Directorate) was generously sponsoring the installation of Knowledge-Base software in association with the IAEA webpage for the project: this page, becoming the 'parent page' for the Knowledge Base, would be held on a Nuclear Energy Division server after migration from the present site within Nuclear Data Section. He introduced Mr. Adler and Mr. Ralph from KorteQ Ltd, the company which had been commissioned by UK HSE to undertake this task. This company had been responsible for the installation within British Energy which had been shown to members at the previous meeting, and had been selected

by competitive tender. Mr. Ralph then gave a comprehensive presentation of the proposals, for discussion and approval by the committee.

Presented with a list option or a graphics option for displaying the Knowledge-Base top-level content, the meeting unanimously preferred the graphic option, modelled on the British Energy installation which they had previously seen. It was agreed that the Database (Excel spreadsheet) would in future be accessed through the same 'parent page', with appropriate security provision if it continued to include Restricted Data. The Chairman commented that, with the exception of small amounts of Japanese data, only UK Magnox-reactor data now remained restricted, and he was taking steps to encourage a de-restriction with the Company.

Mr. Gladyshev explained that he was responsible for IT within the new section into which the project would be moving, and he was rapidly facilitating the necessary changes in the webpage and working closely with Mr. Ralph. One problem which had been identified was that the preferred platform, Microsoft SharePoint, was not supported by the IAEA, whilst their chosen alternative, 'Open Text', did not offer the full functionality required. After some further discussion, it was agreed to pursue the option of third-party hosting (as used in the British Energy site), which was acceptable to the Agency and which would be accessed automatically (and 'invisibly') by users of the 'parent page'. The drawback of this decision is that it will incur an annual cost, although the sum involved is well covered by the existing offers of Sponsorship (voluntary contributions). Mr. Wickham explained that the UK was not willing to shoulder this on-going fee, and again stressed the need for all participating Member States to take an active role in either finding additional funding or conducting work within their own organisations, to keep the programme moving forward.

There was a lengthy discussion on the relative merits of the formal 'Reports' content and the 'Wiki' content, both of which would be moderated. The meeting generally favoured concentrating effort on the formal reports, but the dual facilities will be incorporated in the finished product.

Following a lengthy discussion, the meeting pronounced itself very satisfied with the KorteQ proposals, and looks forward to the installation being completed by 31st March 2010.

The meeting also developed a provisional top-level structure for the Knowledge Base (topic headings and sub-headings) in order to enable the installation to be completed. Mr. Ralph requested that three key users be nominated to prepare draft or 'dummy' material on a rapid timescale which could be placed within the Knowledge Base to test the system before it went fully 'live'. Mr. Wickham and Mr. Haag agreed to contribute on 'Radiation Induced Structural and Dimensional Changes' and 'Chemical Properties' respectively, and Mr. Wickham suggested that the absent Mr. Vreeling should be invited to contribute similarly on 'Test Reactor Experiments' (*a request to which he subsequently agreed*).

Action 4: Messrs. Haag, Vreeling and Wickham to prepare simple 'dummy' material for the draft Knowledge Base installation and to forward this to Mr. Ralph as quickly as possible.

A graphical representation of the draft two levels of the Knowledge Base and a suggested Index of Knowledge Topics are attached as Appendix 2. All Members are asked to review this and to offer any suggestions for additions or changes on an urgent basis.

Action 5: All Members to review the content of Appendix 2 on an urgent basis and to pass their comments and suggestions to the Chairman for forwarding to Mr. Ralph.

Members agreed in principal that provision of very specialised information (*e.g.* related to a specific reactor design or graphite type used only in one Member State) and that the relevant Member States would in due time provide such information, which they may prefer to do in the form of URL links to Knowledge Bases on their own servers. Provision for this would be included in the KorteQ 'package'.

Other Elements of Phase 2

The Chairman reminded the meeting that it had been agreed in the previous meeting that work should continue on three other topics:

1. Maintaining, developing and rationalising the existing numerical Database;
2. Adding data on Matrix Material to the existing Database; *and*
3. Acquiring data on Carbon Composites for a parallel Database.

On the last of these, there was a long discussion about the importance of the inclusion of SiC-containing composite materials as well as just carbon/carbon composites. Mr. Windes pointed out that including this information would be of considerable value for NGNP and the fusion programmes, and this was generally agreed. Mr. Eto commented that three companies were involved with JAEA upon production and irradiation of carbon-carbon composite materials, and that there was no obvious reason why this work could not be contributed.

Mr. Yu confirmed that China would offer graphite data. They were also making their own carbon wall material, and this kind of material should not be overlooked in the future. A large internal meeting was due to take place in China in mid-April 2010 which would determine the future shape of the graphite programme and related work.

Mr. Haag confirmed that data on matrix material was available from former KFA reports.

Mr. Odeychuk confirmed that, upon joining the project, his laboratory could contribute a quantity of irradiation data on their unique graphite material formed from natural gas, and also on carbon-carbon composites and SiC matrix material. He was concerned however that the accompanying reports would be in Russian, but indicated that there was a possibility to organise translations.

In response to a comment from the Chairman about the extremely useful Graftech publication ('Graphite Handbook'), Mr. Homerin replied that his Company may be willing to offer contributions to the Knowledge Base utilising the content of this publication.

The Chairman reminded the meeting that he had been unable to complete an Action from the previous meeting requiring the preparation of a detailed Work Breakdown Structure covering these items, because the anticipated offers of assistance and contributions from Member States' representatives had not been forthcoming. He therefore intended to issue a formal message (by e-mail) requesting a clear statement from each participating Member State by the end of April 2010 on which areas of the work programme it would be willing to contribute, and in what manner (providing manpower or funding). This was agreed.

<p>Action 6: The Chairman to request information from each participating Member State on the areas of the Work Programme in which it will contribute (both Knowledge-Base 'population' and other Phase-2 proposals, with a clear statement to be provided to him by the end of April 2010.</p>

Revised 'Working Arrangement'

It had been necessary to review and expand the original 'Working Arrangement' in order to accommodate the additional kinds of activity now envisaged, along with the changed arrangements for accessing the original Database electronically *via* the Knowledge-Base 'parent page'. The document now defines the project as a 'Knowledge Base' which incorporates the original 'Database'. This draft document required the approval of the meeting (given, after a thorough review and discussion), the IAEA IT representatives (*agreed subsequently with only minor amendments*) and the Division of Nuclear Energy, into which the project would move on 1st January 2010.

The version agreed by the meeting (and subsequently by Nuclear Energy Division's IT representative, Mr. Gladyshev) is attached as Appendix 3. The Division of Nuclear Energy is now invited to review this document formally and to signify agreement or to identify any necessary changes.

Action 7: IAEA Division of Nuclear Energy, through the project Scientific Secretary Mr. Tyobeka, to review the proposed 'Working Arrangement' which will define the management of the Knowledge-Base project.

INGSM (International Nuclear Graphite Specialists Meetings)

These meetings were initiated by the Technical Steering Committee (TSC) but are not formal IAEA activities.

In the absence on the second day of the TSC of Mr. Windes (INGSM-10 organiser), the Chairman expressed thanks on behalf of the TSC for an excellent meeting hosted at West Yellowstone which had seen nearly 100 delegates present over 60 papers and posters. It was becoming clear that this meeting was gaining in popularity, and that more time was required at future meetings both for presentations and discussions. It was agreed that the experimental poster session could be a permanent feature of future meetings.

Mr. Wickham then reminded the meeting that it had already been agreed to host INGS-11 in the United Kingdom, at the South Coast town of Eastbourne which was easily accessible from London Gatwick airport and present little travel difficulty for those arriving elsewhere such as London Heathrow. This meeting would commence on Sunday September 12th 2010 and would finish late in the day on Wednesday 15th September, with delegates being encouraged to plan their return travel for the following day and not to cut short the meeting. A conference banquet would be held at Leeds castle in Kent. Sponsorship is already available from nine organisations to support the meeting. The managing organisation, as for the previous UK meeting held at Plas Tan-Y-Bwlch, will be The British Carbon Group. A website for this meeting will be available from early 2010 at www.britishcarbon.org/ingsm.

Mr. Kim then offered a proposal for INGS-12 in 2011, to be held from 5th – 7th September 2011 on Jeju Island, Republic of South Korea. Whilst this offer was enthusiastically accepted, concern was expressed that the reserved period was too short for a meeting which would probably see a large representation from Korea, Japan and China in addition to delegates from the west. Mr. Kim agreed to give this further consideration within KAERI, which would be the host.

Next Meeting

It was agreed that the next Technical Steering Committee meeting would take place at IAEA Vienna on 24th and 25th January 2011, in the same week as the next planned Research Coordination Meeting of the Irradiation-Creep CRP in which several representatives were also involved.

Closed Session (Administration)

The formal Membership convened a short session at the conclusion of the meeting to discuss the financial situation. A default of USD 10,000 in the expected income from 2007/2008 meant that completion of Phase 1 of the project had almost been compromised: Mr. Haag had however funded the work of his students on an interim basis but was now owed a larger sum than the funding currently available. Consequently he had not yet applied to the Agency for a contract to cover this work.

Separately, the TSC was embarking on an annual commitment to support the hosting of the SharePoint facility. It was agreed that the promised annual sponsorship income would easily cover this amount, and that this commitment would take precedence over other expenditure.

Under the terms of the (former) Working Arrangement, the tenure of the Chairman was due to come to an end in March 2010. Mr. Wickham suggested that the cycle should commence on 1st January 2010, coincident with the move to the Division of Nuclear Energy.

The Members present unanimously requested that Mr. Wickham continue as Chairman, subject to the approval of the Agency, and he accepted.

List of Actions

Action 1: Mr. Fazluddin to follow up the proposed Membership application from the Republic of South Africa.

Action 2: All Members to review the proposed Data Strings on recent data on the 2009 DVD and to notify any disagreement to the Chairman by the end of January 2010.

Action 3: Mr. Eto to request the urgent cooperation of JAEA in providing both a copy of the so-called 'Final Report' from which a majority of Japanese data were taken, together with proposed QA data strings relevant to those data.

Action 4: Messrs. Haag, Vreeling and Wickham to prepare simple 'dummy' material for the draft Knowledge Base installation and to forward this to Mr. Ralph as quickly as possible.

Action 5: All Members to review the content of Appendix 2 on an urgent basis and to pass their comments and suggestions to the Chairman for forwarding to Mr. Ralph.

Action 6: The Chairman to request information from each participating Member State on the areas of the Work Programme in which it will contribute (both Knowledge-Base 'population' and other Phase-2 proposals, with a clear statement to be provided to him by the end of April 2010.

Action 7: IAEA Division of Nuclear Energy, through the project Scientific Secretary Mr. Tyobeka, to review the proposed 'Working Arrangement' which will define the management of the Knowledge-Base project.

Knowledge-Base Mission Statement

OBJECTIVE

It is necessary to have a comprehensive knowledge of graphite behaviour in order to assess the integrity of components in graphite-moderated reactor design throughout the entire life cycle. The principal issue is the irradiation response of the material, and the existing IAEA TSC² has presently compiled an extensive collection of historical data in this respect. The TSC is an appropriate international forum to evaluate the body of accumulated knowledge for the collective benefit of current and future users.

The TSC now proposes to generate and to maintain a Nuclear-Graphite Knowledge Base, building upon the IAEA International Database on Irradiated Nuclear Graphite Properties. The value of the present comprehensive Database, which will be maintained and updated, will thereby be greatly enhanced.

For the Knowledge Base:

- to capture, organise and structure key knowledge from the Graphite Database and graphite specialists
- to develop a single source of comprehensive information on the 'state-of-the-art' of nuclear graphite for the benefit of present and successor generations by adding readily accessible 'intelligence' and background information to the basic data provided in the Database

to evaluate the relevant body of knowledge to support technical programmes (*e.g.* graphite irradiation creep CRP) utilising the best-available data and methods

For the Database:

- to maintain and to improve the quality of the present input;
- to incorporate additional historical data as it becomes available

This programme will concentrate on data already available, complementing any associated international programmes (*e.g.* Generation IV International Forum, EU FP7 CARBOWASTE etc).

SPECIFIC OBJECTIVES

1. Develop a structure for the Knowledge Base by defining the logistics best suited to assisting the needs of present and future users.
2. Identify and prioritise technical areas for inclusion in the Knowledge Base.
3. Provide commentaries upon technical areas relevant to ongoing and developing programmes, including specialist evaluation of historical data against current user requirements. The initial technical area for development will be graphite irradiation creep.

² Technical Steering Committee of the IAEA International Knowledge Base on Irradiated Nuclear Graphite Properties

4. Clarify elements of terminology within the Database, and review specific issues relating to fluence units: add additional as available
5. Include information on HTR Fuel matrix material and upon carbon-based composites in the Database

Draft Knowledge-Base Structure

The material in this Appendix was kindly prepared by Mr. Ralph of KorteQ Ltd.

Level 1 Knowledge Topics



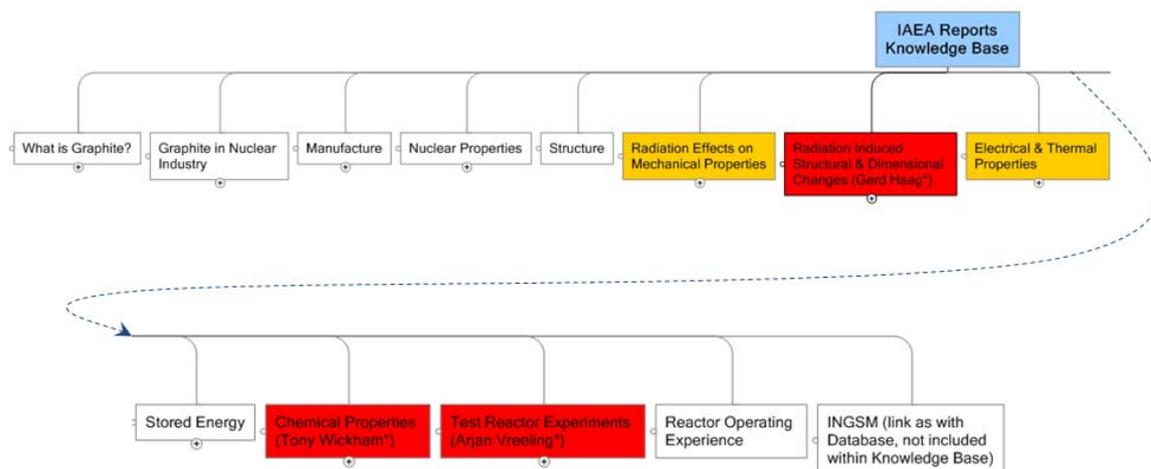
Key:

Red topic – selected for piloting in development phase

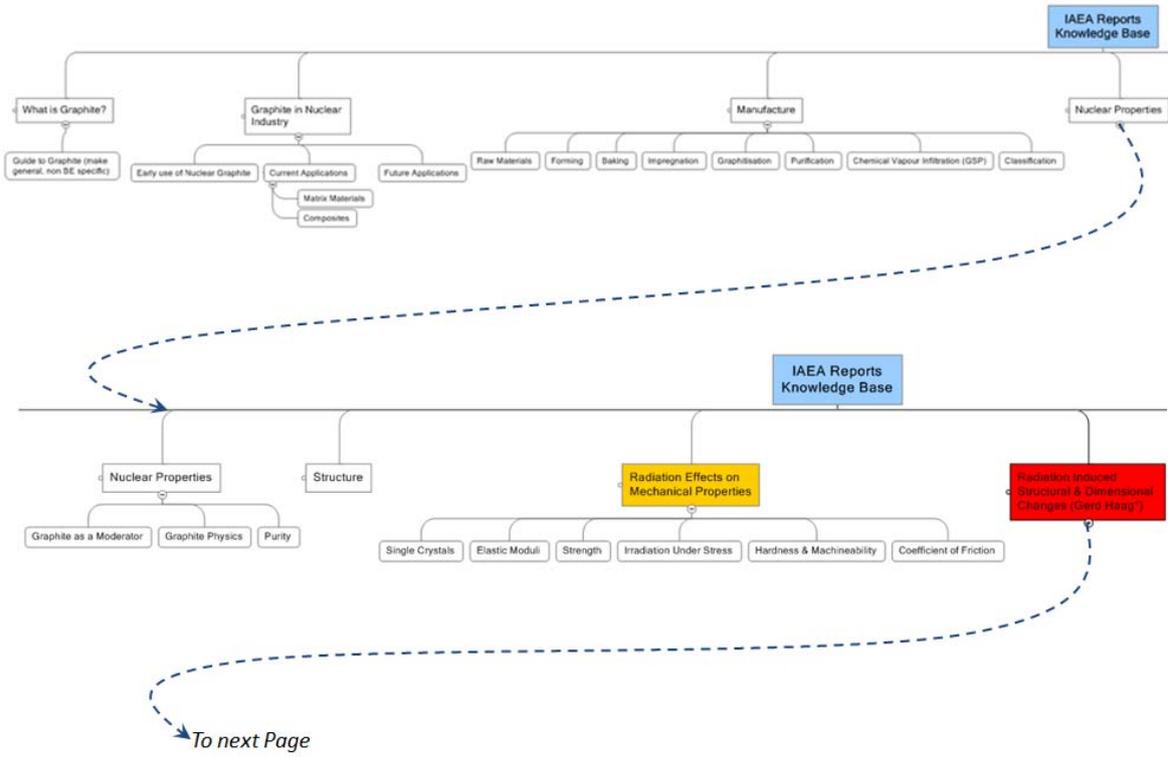
Amber topic – selected as second priority for development phase (if required)

* - super-users selected to work with KorteQ in development phase

Level 1 Knowledge Topics – split into 2 halves to increase visibility

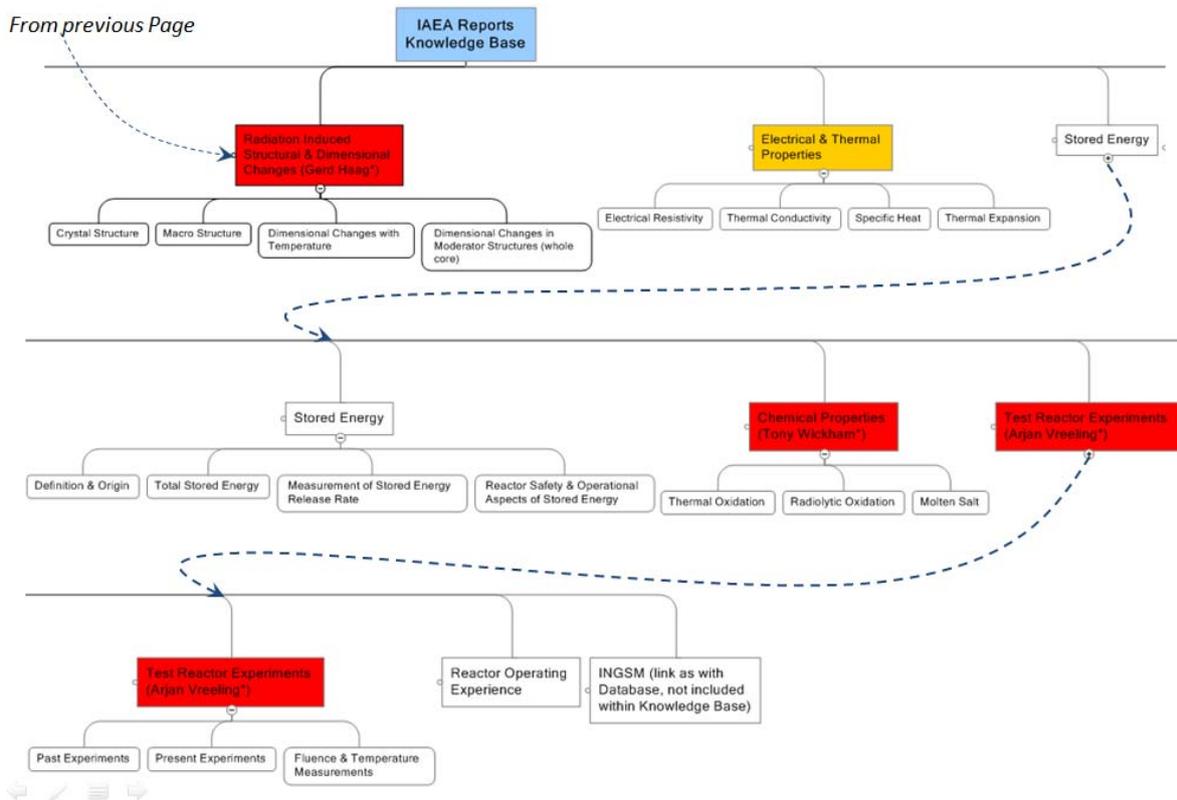


Level 2 Knowledge Topics – split into 5 sections to convey legible detail, page 1/2



Level 2 Knowledge Topics – split into 5 sections to convey legible detail, page 2/2

From previous Page



Index of Knowledge Topics

- **What is Graphite?**
 - Guide to Graphite (make general, non BE specific)
- **Graphite in Nuclear Industry**
 - Early use of Nuclear Graphite
 - Current Applications
 - Matrix Materials
 - Composites
 - Future Applications
- **Manufacture**
 - Raw Materials
 - Forming
 - Baking
 - Impregnation
 - Graphitisation
 - Purification
 - Chemical Vapour Infiltration (GSP)
 - Classification
- **Nuclear Properties**
 - Graphite as a Moderator
 - Graphite Physics
 - Purity
- **Structure**
- **Radiation Effects on Mechanical Properties**
 - Single Crystals
 - Elastic Moduli
 - Strength
 - Irradiation Under Stress
 - Hardness & Machineability
 - Coefficient of Friction
- **Radiation Induced Structural & Dimensional Changes (Gerd Haag*)**
 - Crystal Structure
 - Macro Structure
 - Dimensional Changes with Temperature
 - Dimensional Changes in Moderator Structures (whole core)
- **Electrical & Thermal Properties**
 - Electrical Resistivity
 - Thermal Conductivity
 - Specific Heat
 - Thermal Expansion
- **Stored Energy**
 - Definition & Origin
 - Total Stored Energy
 - Measurement of Stored Energy Release Rate
 - Reactor Safety & Operational Aspects of Stored Energy
- **Chemical Properties (Tony Wickham*)**
 - Thermal Oxidation
 - Radiolytic Oxidation
 - Molten Salt
- **Test Reactor Experiments (Arjan Vreeling*)**
 - Past Experiments
 - Present Experiments
 - Fluence & Temperature Measurements
- **Reactor Operating Experience**
- **INGSM (link as with Database, not included within Knowledge Base)**

Revised Working Arrangement (as at November 2009: subject to further review)

INTERNATIONAL GRAPHITE KNOWLEDGE BASE ON IRRADIATED NUCLEAR GRAPHITE PROPERTIES - WORKING ARRANGEMENT

1. Establishment of International Graphite Knowledge Base and Database

1.1 Pursuant to Article III, paragraph A.3 of its Statute, the International Atomic Energy Agency (hereinafter referred to as the "Agency") shall establish the International Knowledge Base (hereinafter known as the "Graphite Knowledge Base") on Nuclear Graphite, incorporating the International Database on Irradiated Nuclear Graphite Properties (hereinafter referred to as "Graphite Database") in collaboration with interested Agency Member States and organizations in Member States recognized by those States. This project shall be established within the Division of Nuclear Energy with effect from 1st January 2010, upon transfer from the Division of Nuclear Applications.

1.2 The Graphite Knowledge Base shall consist of documentary information on the behaviour of nuclear graphite, including irradiation behaviour, and the incorporated Graphite Database shall consist of data on the physical, chemical, mechanical and other relevant properties of irradiated nuclear graphites contributed by Member States and organizations in Member States recognized by those States.

1.3 The operation of the Graphite Knowledge Base and Graphite Database shall be financed by the participating Member States along with voluntary contributions from interested parties ("Sponsors").

2. Purpose and Objectives of Graphite Knowledge Base

2.1 The purpose of the Graphite Knowledge Base is to preserve and further expand the existing scientific information on the manufacturing and utilisation of nuclear-grade graphite, including the origins of source materials, upon its irradiation behaviour, and all relevant information associated with its employment in peaceful atomic energy applications, in order to assist all aspects of the graphite 'lifecycle' including reactor design, operation (including safety issues), dismantling and disposal.

2.2 The Graphite Knowledge Base shall (a) facilitate the development of national and international programmes on graphite moderated reactors and fusion technologies, (b) assist the safety authorities in the assessment of safety aspects of graphite moderated reactors, including the safety aspects of reactor decommissioning, and (c) serve as a comprehensive source of scientific information for a broad range of material science applications, including the non-nuclear technology areas.

3. Purpose and Objectives of Graphite Database

3.1 The purpose of the Graphite Database is to preserve and further expand the existing scientific information on the physical, chemical, mechanical and other properties of irradiated graphites (including zero dose) relevant for nuclear power, nuclear safety and other nuclear science and technology applications, and to create a comprehensive international source for such information including reference data.

3.2 The Graphite Database shall: (a) facilitate the development of national and international programmes on graphite moderated reactors and fusion technologies, (b) assist the safety authorities in the assessment of safety aspects of graphite moderated reactors, including the safety aspects of reactor

decommissioning, and (c) serve as a comprehensive source of scientific information for a broad range of material science applications, including the non-nuclear technology areas.

4. Definition of 'Phase 2' of the Project

4.1 The compilation of the Graphite Database was considered essentially complete with the issue of a DVD record in July 2009, although the Database Members consider that further refinement and expansion will continue. However, future projects utilising the Database will be undertaken commencing in January 2010, alongside the creation of the Graphite Knowledge Base into which all other parts of the project will be incorporated. These combined activities shall for convenience be known as 'Phase 2'. Activities prior to this date shall for convenience be known as 'Phase 1'.

4.2 The combined Graphite Database and Graphite Knowledge Base shall for convenience be known as the Graphite Knowledge Base with effect from 1st January 2010.

5. Membership of the Graphite Knowledge Base

5.1 Membership in the Programme shall be restricted to Member States of the Agency which are willing and able to make relevant contributions to the project which are owned by them or non-governmental organizations within their territories.

5.2 To participate, an official request to this effect (Application for Membership) is to be made by the Member State to the Director General of the Agency. Such request shall include the information proscribed in Section 5.3 below and a commitment to fulfil the obligations laid down in Section 6.1 below. Member States participating in Phase 1 at the transfer date (1st January 2010) shall be deemed to be Members of Phase 2 without further requirements. Those States which are accepted are hereinafter referred to as 'Graphite Knowledge Base' Members.

5.3 A prospective member of the Graphite Knowledge Base shall provide to the Agency, together with the application for membership, the following information:

- (a) extent of relevant data or information offered for immediate inclusion in the Graphite Knowledge Base, or the planned contribution to an included project utilising the Knowledge Base information; (including any access restriction);
- (b) indications of the future contributions to the Graphite Knowledge Base;
- (c) statement of acceptance of the obligations stipulated in Section 6.

5.4 Every Member State which is a member of the Graphite Knowledge Base shall appoint a Liaison Officer to act as a co-ordinator and focal point for the Agency. A Deputy Liaison Officer may also be appointed.

5.5 Each Graphite Knowledge Base Member fulfilling its responsibilities as laid down in Section 6.1 below shall have the same rights and privileges with respect to the Graphite Knowledge Base.

5.6 Member States which are not in possession of information of data relevant to the Graphite Knowledge Base, but have a strong interest in the use of such data and in the development of the Graphite Knowledge Base, may be accepted as Associate Members of the Graphite Knowledge Base.

5.7 A prospective Associate Member State of the Graphite Knowledge Base shall make an official request (Application for Associate Graphite Database Membership) to the Director General of the Agency. Such request shall include the following information:

- (a) description of the current and future information needs of the Member State which motivate the application for Associate Graphite Knowledge Base Membership;

- (b) description of the expected contribution to the Graphite Knowledge Base development and maintenance, outwith the provision of existing information and data;
- (c) statement of acceptance of the obligations stipulated in Section 6.

5.8 A Member State which has been accepted as an Associate Graphite Knowledge Base Member shall appoint a Liaison Officer to act as a Co-ordinator and focal point. A Deputy Liaison Officer may also be appointed.

5.9 Each Associate Graphite Knowledge Base Member fulfilling the responsibilities of Section 6.2 below shall have equal rights and privileges with respect to the Knowledge Base.

5.10 The principal responsibilities of the Liaison Officer shall be to co-ordinate the input to the Knowledge Base from the corresponding Knowledge Base Member State, to ensure that it satisfies the accepted standards and format, and to regulate access to the Knowledge Base by appropriate organisations and individuals with that Member State.

6. Responsibilities of Graphite Knowledge Base Members

6.1 A Member of the Graphite Knowledge Base shall be responsible *at its own expense* for:

6.1.1 the collection, validation, categorization, specification and appropriate formatting of nuclear graphite information and property data relevant to the Graphite Knowledge Base;

6.1.2 providing periodically to the Agency, in accordance with the wishes of the Technical Steering Committee (Section 9), properly validated, categorized, documented and formatted information and data owned either by the Member State or non-governmental organization within its territory for inclusion in the Graphite Knowledge Base;

6.1.3 providing advice and recommendations to the Agency on matters relating to the maintenance, improvement and development of the Graphite Knowledge Base;

6.1.4 providing information services to and monitoring contact with, to the extent practicable, users of the Graphite Knowledge Base within its territory and representing users' views at Technical Steering Committee meetings;

6.1.5 obtaining clearance from appropriate Graphite Knowledge Base Members before providing information derived from the Graphite Knowledge Base to non-members of the Knowledge Base.

6.2 Each Knowledge Base Member shall identify any information amongst that provided as input into the Graphite Knowledge Base which shall be treated as 'restricted'. If no explicit indication in that respect is made, the Agency shall treat all such data as 'restricted', until clarification has been obtained. Knowledge Base Members should however seek to avoid the need for such restriction whenever possible.

6.3 An Associate Member of the Graphite Knowledge Base shall be responsible *at its own expense* for:

6.3.1 providing information at the meetings of the Technical Steering Committee regarding its needs for irradiated nuclear graphite data;

6.3.2 providing information on the Graphite Knowledge Base and its use to the users within its territory;

6.3.3 providing advice and recommendations to the Graphite Knowledge Base Members on matters relating to the use of the Graphite Knowledge Base within its territory.

7. Management of Graphite Knowledge Base

7.1 The Agency shall provide secretariat functions for the Graphite Knowledge Base.

7.2 The principal functions of the Agency Secretariat, subject to availability of funds, are:

7.2.1 the management of the Graphite Knowledge Base, to ensure that its rules and procedures are correctly implemented, and to ensure the efficient operation and continued improvement of the Graphite Knowledge Base. The Secretariat shall take into account the interests of all Graphite Knowledge Base members, including those with associate status, in managing the operation of the Graphite Knowledge Base;

7.2.2 arranging meetings of the Technical Steering Committee of the Graphite Knowledge Base and, if necessary, other meetings related to the Graphite Knowledge Base;

7.2.3 preparation and custody of registers of Graphite Knowledge Base Members, Associate Graphite Knowledge Base Members and Graphite Database sponsors;

7.2.4 administration of any granted internal Agency funding and the extra-budgetary contributions from Graphite Knowledge Base Members Associate Members, and other financial Sponsors in accordance with the Agency Financial Regulations and Rules;

7.3 The Agency shall provide a landing page and access to the IT platform for the Graphite Knowledge Base in association with the Knowledge-Base web page.

7.4 The principal functions of the Agency IT Services, subject to availability of funds, are:

7.4.1 provision for an interface between the IAEA webpage ('parent page') dedicated to the Graphite Knowledge Base and the Graphite Knowledge Base operational software (Microsoft SharePoint) and the Knowledge Base content;

7.4.2 training, upon request, of Member's personnel in the preparation and processing of data and document input and retrieval procedures the data input and with data retrieval procedures. Training material will be provided to the Agency to enable training delivery;

7.4.3 security advice for the Graphite Knowledge Base in accordance with Section 11 of this Working Arrangement.

7.5 All activities conducted in relation to the Graphite Knowledge Base shall be conducted in accordance with appropriate processes of Quality Assurance which shall be approved by the Technical Steering Committee and by the Agency. A current published Agency report documenting these procedures shall be available to participants and to any interested parties. For any new research activity (Section 13) additional QA documentation may be required.

8. Access to the Graphite Knowledge Base

8.1 Members and Associate Members of the Graphite Knowledge Base who have fulfilled all requirements specified in Section 6 shall have full access to all information in the Knowledge Base.

8.2 Non-members of the Graphite Knowledge Base may access all unrestricted information in the Graphite Knowledge Base.

8.3 Access to restricted information by non-members shall be through the Agency, and will require the express approval of the Member who supplied the information. Any request by a non-member made to the Agency for the release of restricted information from the Graphite Knowledge Base shall contain

detailed specification of the requested information and a description of the purpose and planned use of the information. The approval of the data supplier and all records of the request shall be entered and kept in a registry by Agency for the life of the Graphite Knowledge Base.

8.4 Any request for access to the Graphite Knowledge Base by a non-member shall be at its own expense.

8.5 Any final product or publication of any user resulting from the use of, or containing information obtained from, Graphite Knowledge Base shall refer to and acknowledge the Graphite Knowledge Base and the information supplier (*i.e.* original data source). Acceptance of such obligation by the potential user shall be a condition for release of the information.

8.6 The Agency shall have the same rights of access to the Graphite Knowledge Base as a Member. The Agency may use restricted data in the Graphite Knowledge Base for analyses, evaluations or for preparing guidelines and recommendations for developing countries, but without releasing the information itself.

8.7 If a Member of the Graphite Knowledge Base elects to withdraw from membership, information provided by that Member will remain in the Graphite Knowledge Base. Restricted information provided by a former Member may be released only with the approval of that Party.

9. Technical Steering Committee

9.1 There shall be a Technical Steering Committee of the Graphite Database made up of: (a) one representative from each Member State of the Graphite Knowledge Base appointed by the appropriate national authority, and (b) one representative each of Associate Member. The Working Group on Gas Cooled Reactors (TWGGCR) shall be invited as observer. A representative of the Agency shall attend meetings of the Steering Committee as an observer.

9.2 Members of the Technical Steering Committee shall elect from among themselves a Chairman who shall then hold the office for three years. This appointment shall be approved by the Director General of the Agency. The triennial cycle shall commence with the establishment of Phase 2 of the project in January 2010.

9.3 The Technical Steering Committee shall meet at intervals approximately once a year. The agenda for each meeting will be prepared by the Agency Secretariat in consultation with the Chairman of the Committee, and issued to the Committee Members at least one month before the meeting.

9.4 The programme of the Technical Steering Committee meetings will include:

- (a) all technical matters relating to Graphite Knowledge Base content operation, including Quality Assurance of the content;
- (b) evaluation of the Graphite Knowledge Base status and operations, and the progress made in its development;
- (c) management of the technical programmes for all supporting analytical and review activities;
- (d) consideration of any required annual progress report prepared by the Agency, in cooperation with the Liaison Officers of Graphite Knowledge Base Members;
- (e) preparation of a periodic report to the TWGGCR;
- (f) evaluation of the procedures regulating the operation of the Graphite Knowledge Base, including data and information security;
- (g) consideration of financial aspects of the Graphite Knowledge Base and recommending relevant measures and actions;
- (h) discussion of proposals from the Members and Associate Members relating to the operation and development of the Graphite Database;

- (i) advice to the Agency on any requests received for Membership, Associated Membership and information release.

9.5 Urgent decisions or recommendations of the Steering Committee which may be required by the Agency in the process of management and operation of the Graphite Knowledge Base shall be taken or formulated by the Chairman of the Technical Steering Committee after obtaining consent from all available members of the Steering Committee, by electronic communication if necessary.

9.6 The Chairman of the Technical Steering Committee may invite one representative of each of the *current* Graphite Knowledge Base Sponsors to attend the Technical Steering Committee meetings as observers for obtaining information or advice on specific items of the agenda or following a specific request for attendance from the Sponsors. The invitation will be extended through the Agency.

9.7 Participation in meetings of the Technical Steering Committee shall be at the expense of the respective Member, Associate Member or Sponsor.

10. Knowledge Base Sponsors

10.1 Non-governmental organizations which have made voluntary contributions to the operation and maintenance of the Graphite Knowledge Base are identified as Knowledge Base Sponsors.

10.2 An appropriate acknowledgment shall be given to a Knowledge Base Sponsor (and former Database Sponsors) in all general documents related to the Knowledge Base (*e.g.* webpage, CD/DVD Database issues, etc), with indication of the period of its sponsorship.

10.3 A *current* Knowledge Base Sponsor may access restricted information on the same basis as a Member, subject to the full provisions of this Working Arrangement.

10.4 In addition to the provisions of Section 9.6, a *current* Knowledge Base Sponsor shall be informed about the Agenda of each forthcoming Steering Committee Meeting and may request to be invited to attend the meeting.

10.5 A *current* Knowledge Base Sponsor may upon their request, be invited to any other technical meeting that may be organized by the Agency in relation with the Graphite Knowledge Base.

11. Security Matters

11.1 Responsibility for the security of the Graphite Knowledge Base shall rest with the Agency. There shall be no release of restricted data other than by the means described below.

11.2 Unrestricted information may be made available by the Internet via the Knowledge Base 'parent page'.

11.3 Restricted information will be held in the Graphite Knowledge Base by the Agency on a secure system which forbids external Internet access without appropriate security protocols (usernames/passwords). Transmission of these restricted data by any user to any authorized third party shall be entirely in the form of a password-protected CD-ROM or DVD with appropriate precautions to secure the material in transit.

11.4 Security for transmission of restricted data to the Agency for future inclusion in the Graphite Knowledge Base shall be the responsibility of the Member supplying the data.

11.5 The structure and operating system are specified in the Annexe.

12. Change of Status

If the Technical Steering Committee decides that a Knowledge Base Member or Associate Member is not adequately fulfilling its responsibilities laid out in Section 6 above, discussions will be initiated and a concerted effort made to bring the that Member or Associate Member into compliance. A Knowledge Base Member or Associated Member that has not fulfilled its responsibilities as laid down in Section 6 above for two consecutive years, shall forfeit the right to access the Graphite Knowledge Base stipulated in Section 8 above, except in cases where the Technical Steering Committee, is satisfied that the failure is due to conditions beyond the control of the Knowledge Base Member or Associate Member.

13. Research Project Management

13.1 The Technical Steering Committee may from time to time initiate specific research activities utilizing the Graphite Knowledge Base, or respond to external requests for such investigations. Subject to the approval of the Agency, such activities may be undertaken by the entire Technical Steering Committee or by a sub-committee which may include Technical Steering Committee members and members of appropriate organizations within the participating Member States.

13.2 In addition, where it is agreed to be appropriate, additional participants from Member States that are not present Members of the Graphite Knowledge Base may be included. In this case, these participants will be fully bound by the conditions of this Working Arrangement and must first provide such an undertaking in writing to the Agency before being granted access to the 'restricted' areas of the Graphite Knowledge Base. Such access will cease at the conclusion of the research activity.

13.3 At the commencement of any new activity, the participants shall review the need for compliance with Quality Assurance procedures and shall also review the need for any project-specific quality documentation.

13.4 All written and electronic reports and documents including working material arising from such research activities will be the property of the Agency and will remain subject to the requirements of this Working Arrangement indefinitely. Such materials may be further distributed beyond the Members of the Graphite Knowledge Base only according to current Agency protocols.

Definitions

"Member State" means a member state of the Agency

"Unrestricted Data" are data published in open literature and those data offered by Knowledge Base Members on behalf of data supplier for free dissemination. All other data are to be regarded as "Restricted Data".

"Data Supplier" or "Information Supplier" is the originating organization for data within the Member State.

Appendix 4

IAEA Consultants' Meeting: 12th Meeting of the Technical Steering Committee for the International Database on Irradiated Nuclear Graphite Properties

12–13 November 2009, building–A, floor–05 and room–31 (A05–31), IAEA Headquarters, Vienna, Austria

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Appendix 5

IAEA Consultants' Meeting: 12th Meeting of the Technical Steering Committee for the International Database³ on Irradiated Nuclear Graphite Properties

12–13 November 2009, building–A, floor–05 and room–31 (A05–31), IAEA Headquarters, Vienna, Austria

AGENDA

Thursday November 12th 2009

- 09h00 Welcome (*IAEA, Chairman*)
- Welcome to Sponsors' Representatives and Guests
- Adoption of the Agenda
- Apologies for Absence
- Minutes of the Previous Meeting (*March 2009*): INDC(NDS)-0556
- Matters Arising (*which are not covered elsewhere in the Agenda*)
- Applications by Additional Member States / Sponsors to join the Project
- 09h30 Review of the Status of the Project (*Chairman*): *A summary of the activities since March 2009, especially relating to the establishment of Phase 2 activities and the impending transfer of the project to the Department of Nuclear Energy:*
- *Separation from GIF Activities*
 - *Review of 'Phase 2 Mission Statement'*
(INDC(NDS)-0556 Appendix Ai)
- 09h45 'Final' Phase 1 DVD (*now issued*): Verification of Provisional QA Gradings and outstanding issues (Chairman, Mr. Haag). **Action2** of the previous minutes applies (*All*)
- 10h30 *Coffee Break*
- 11h00 Presentation and Discussion on Knowledge-Management Software and its Integration with the former 'Database' Webpage (Mr. Ralph, KorteQ Ltd, Mr. Gladyshev, IAEA)
- [This work is being funded by the United Kingdom Health and Safety Executive, Nuclear Directorate with implementation required by 31st March 2010. It was agreed at the previous TSC Meeting that the Knowledge Base will be the framework for the entire 'Phase 2' project]*
- KorteQ proposals based upon existing British Energy Graphite Knowledge Base and Wiki model, adapted for IAEA
 - Migration/adaptation of existing Nuclear Data Section website to Nuclear Energy: integration of Knowledge Base 'Parent Page'

³ Henceforth to be known as the 'IAEA International **Knowledge Base** on Irradiated Nuclear Graphite Properties'

- External Links to Specialist Parts of the Knowledge Base to be constructed by individual Member States and separately hosted: debate structure
- Review of Data Security (*standing item*): Proposal to create direct access to the Database via the Knowledge-Base parent page with password-protected access to participating Member States' representatives for more sensitive areas: separation of restricted and unrestricted data to allow some open access

breaking at approximately...

12h30 *Lunch (Cafeteria)*

13h30 Knowledge-Base Discussions continue (all)

- *Conclude discussion on the above items (as necessary)*
- Role of Participating Member States (*to include individual requirements and expectations, manpower, and funding*)
 - 'Population' of Knowledge Base Parent-Page
 - External sites relating to specific issues/plant designs/graphite types/applications
- Create Project Plan beyond March 2010 for these aspects of Phase 2 (Milestones, Deliverables)

15h00 *Coffee Break*

15h30 Irradiation-Creep Database (in support of CRP) (Mr. Haag)

16h00 Moving Forward with Other Identified Phase 2 Projects (*discussion will continue on second day*)

In order to fulfil the expectations for the other items in our provision 'wish list' we now need to identify the contributions to be made by Member States (along with interested Sponsors), and their timescales

- Matrix Material Data (*to existing Database*)
- Carbon Composites Data (*to separate Database*)
- Extension of Existing Database and 'Clarification of Terminology' (*'cleaning up' the existing entries for searchability etc.*)
- Commercial Sponsors' Expectations and Interests
- Inclusion of these items in the Project Plan (Milestones, Deliverables)

17h00 *End of First Day*

19h30 *Social Event: to be decided*

Friday November 13th 2009

- 09h00 Moving Forward (continuation of discussion from previous afternoon)
- 10h30 *Coffee Break*
- 11h00 Revision of Working Arrangement (*Draft revision already circulated by e-mail*)
- This potentially allows for:
- New definitions within the project
 - Widening and changing Membership (*suggestions for widening Membership invited*)
 - Integration with IAEA IT platform (*comments raised at paras 7.3 and 7.4 of the Draft Revision should be resolved earlier in the meeting*)
 - Access rights to the Knowledge Base and Security Issues
 - Research Project Management (*inclusive of specific sponsorships*)
 - Change of Division within the IAEA from 2010 and consequences for Management of the Project
- 12h30 *Lunch (Cafeteria)*
- 13h30 ASTM Graphite Standards and GIF Graphite Committee: Progress and their Implications for the IAEA Graphite Database Project – update (*Mr. Burchell*)
- 13h45 INGSM Meetings
- Report on INGS-10 (West Yellowstone, USA)
 - Format and length of future INGS meetings
 - Update on INGS-11 (Eastbourne, UK)
 - Proposal for INSGM-12
- 14h15 Finalise Project Plan and Meeting Resolutions and Actions
- 15h00 Selection of Chairman of the TSM for three-year period 2010-2012 inclusive
- 15h15 *Any Other Business (prior notification to the Chairman would be appreciated)*
- Dates for Next Committee Meeting*
- 15h30 ***Sponsors and Observers take their leave***
- (Closed Session): Discussion of Sponsorship and Financial Arrangements
- 16h00 (*Close of Meeting*)

STRUCTURE OF THE GRAPHITE KNOWLEDGE BASE

TO BE ADDED LATER AFTER ESTABLISHMENT OF THE KNOWLEDGE BASE

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