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HTR-M Materials Database Guidelines

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1 Introduction

A major aim of the HTR-M project is to generate a set of databases for HTR materials. The databases will cover properties used in design, for candidate HTR materials, and will eventually provide a comprehensive collection of relevant data for use in the HTR design. This document describes how the databases are intended to operate, and provides guidelines to contributors for the addition of data.

2 Form of the database

The databases will address the following areas.

- Vessel materials
- Turbine materials
- Control rod materials
- Graphite

It is intended that each database will consist of a set of Microsoft Excel files, with one file for each different material. Within each file is a series of worksheets containing material details and property data.

The databases for each area will follow the same general format, though the data requirements for metallic materials are significantly different from those for graphite and C-C composites.

3 Management of the database

The master versions of the databases will be available on SINTER in read-only form. The master versions will be maintained by NNC (coordinator D Buckthorpe).

For each material a database template will be prepared and posted on SINTER. The template is essentially an empty file showing the format for the data, examples covering some of the vessel materials are already in place. To add data, contributors are requested to enter their data on copies of the relevant worksheets from the template, and post these on SINTER. The coordinator will then arrange for the data to be added to the master database, and for the master version on SINTER to be updated.

If a need for additional data templates is recognised, the format should be agreed with the coordinator.

4 Entering data into the database

Detailed instructions for entering data are given on the worksheet templates. Essentially, to record a series of test results on a particular material, the material is assigned a unique number and information on the test material is entered into the material detail sheets.

Results from tests on the material are then entered into associated worksheets. Each set of test data is accompanied by the material unique number, so that the essential link

between material information and test data is maintained. It is proposed that the numbers take the form XYZ/ABC.../Q/nnnn, where:

- XYZ identifies the source (eg NRG, NNC, CEA, FRF for Framatome France);
- ABC... denotes the name of the specific material;
- Q identifies the type of material (M for parent metal, C for weld consumable, W for weldment);
- nnnn is a sequential number allocated by the originator (suggested 4-digit sequential number);

example: NNC/CC800/M/0002.

Data from design codes or material standards are entered in the same way, except that the material specification details (eg composition range) are entered in the material detail sheets.

When inserting a reference a similar form of identification is used: XYZ/ABC..../nnnn to enable the data to be traced back to its original source.

5 Priorities for contributing data

It is intended that the databases should include design data (from codes and standards), data from the open literature and test data from individual laboratories. As a general rule, if code data are available for a particular material property, then additional data are not required. However an important function of the database is to record information regarding the effect of operational factors (eg welding, thermal ageing, irradiation) on standard properties.

Thus for example if code data were available for the tensile properties of a particular material, then further data on the as-received material tensile properties would not be required. However test data relating to the tensile properties after thermal ageing would be valuable.

In the databases for metallic materials, all data are entered numerically, as x-y pairs. If data are only available graphically or expressed as an equation, then a series of x-y pairs must be generated (by digitising a graph, or by calculation from an equation) for insertion into the database. For the graphite and C-C composite databases, data may be added in numerical or graphical form.

6 Type of data to be included

Partners who have relevant information on any candidate material are invited to contribute to the databases.

It is recognised, however, that for the vessel and turbines a large number of materials are being considered; additionally some partners have large amounts of data for certain materials. It is preferable that all materials are covered in some detail, and that contributors can concentrate on the most appropriate materials for them. Therefore it is proposed that the data contribution should be 'shared out' between the partners, so that each partner gives priority to a reduced number of the candidate materials.

Additionally, for the vessel materials, there is a significant amount of information in design codes and standards; it is proposed that one partner from each country should be responsible for entering data from national standards for each material.

Suggested responsibilities for the vessel materials database are shown in Table 1, and for the turbine materials in Table 2.

For the Carbon – Carbon Composite and Carbon-fibre materials which are likely to be considered for the control rod some experimental work has been completed on oxidation and the derivation of physical properties. However the main input of information at present is likely to come from published documents. As with graphite (see below) irradiation has a significant effect on properties and therefore a similar series of spreadsheets to those of graphite are used. The suggested responsibilities for the carbon-carbon composites database are shown in Table 3.

High temperature irradiation data for a variety of graphites have been obtained in the past. Large amounts of data are contained in the IAEA database, but most of these are restricted. There is a possibility that some existing data will be included in the SINTER database e.g. for the Japanese IG-110 graphite used for HTTR, which is included in the planned irradiation experiment as a reference material. This will be the responsibility of NNC and FZJ. There are no plans to include existing data for any other graphite at the present time. Entering the raw experimental data for the planned irradiation experiment, including pre-characterisation data and post-irradiation data will be the responsibility of NRG. The assessment of the raw data and the production of design data will be carried out by NNC and FZJ. Entry of all data (other than the raw experimental data) will be the responsibility of NNC. For graphite oxidation, entering all published, experimental and design data will be the responsibility of FZJ. The suggested responsibilities for the graphite database are shown in Table 4.

7 Quality assurance and security aspects

The quality assurance of the data and its transfer to the master database are as follows.

Each organisation is responsible for the content, accuracy and input of its own data. The input of the data will be in accordance with its own QA procedures.

Each organisation will establish its data according to the agreed format (via master excel spread sheets).

To ensure security of transfer between partners and between countries the Sinter website will be used for storing and transferring the data. E-mail exchange is considered less secure and will therefore not be used.

Each “Document “ can be updated to issue 01, 02, etc. throughout the project until complete. When a datasheet has been completed it can be graded as FINAL by the issuing organisation for the purposes of loading on to the master database held at NNC. This status should be confirmed to NNC (Mr. D. Buckthorpe) when achieved and that the file is available for transfer.

The master database containing the assembled information will be updated by NNC. The transfer of information by NNC from the individual partner generated files will be

achieved by simply copying data from each completed (FINAL) file onto a master file. This master file will be updated periodically at the beginning of every month for the remainder of the project and placed on Sinter (as a read only file) for all partners to comment on and view the progress of information assembly.

The information provided by the partners will be on the understanding that it is being made available to the other partners within the HTR-M / M1 Project but will not be divulged to a third party (outside the HTR-M / M1 Projects) without the prior agreement of the other partners.

8 Organisation of the Database on SINTER

In order to allow unique identification on Sinter of the individual work books for the different materials being entered into the database (identified in tables 1 to 4) a block of "Report Numbers" have been pre-authorised for each company for their own use.

The allocated "Report Numbers" are as follows.

Partner	**Associated Number**
NNC	1000
NRG	2000
CEA	3000
Framatome France	4000
Framatome Germany	5000
EA	6000
FZJ	7000
JRC	8000

The numbering system for the material groups.

Component/ Area	**Associated Number**
Vessel	001 – 100
Control Rod	101 – 200
Turbine Miscellaneous	201 – 300
Turbine Discs	301 – 400
Turbine Blades	401 – 500
Graphite	501 – 600
C Based Composites	601 – 700

The initiating organisation will be recognisable from the first digit, and the component/ area from the second, the final two numbers will be unique to the particular material.

Examples.

A document labelled as HTR-M-03/08-D-0-0-1402 is an NNC initiated excel file relating to turbine blades, for a material identified with the number '02' - the title of the document should identify the material.

A document labelled HTR-M1-03/09-D-0-0-6107 is an excel file initiated by EA relating to vessel materials and for a material identified with the number '07' – again the title of the document should specify the material.

Each partner company should start with a blank datasheet, enter its data and then load the information onto Sinter using the allocated sequence of Report Numbers identified for their organisation.

The blank datasheets have been established on Sinter under the following Report Numbers.

Vessel & Turbine steels	HTR-M 03/08 D 0 0 75
C-C Composites	HTR-M 03/08 D 0 0 76
Graphite	HTR-M 03/08 D 0 0 77

9 Timescales

The Final database report for the HTR-M project is planned for completion by November 2004, and for HTR-M1 (Graphite plus Turbine medium term creep data) by May 2005.

Partners are requested to begin supplying data for this database as soon as practical in order to gather a substantial dataset within the remaining time available.

The master database containing the assembled information will be updated by NNC at the beginning of every month for the remainder of the project and will be available (as a read only file) for all partners to comment on and view the progress of information assembly.

10 Conclusions

This document is issued as a guide to prioritising the input of data for the developing HTR-M database. Specific materials and data types have been allocated to different partners within the project. These are the suggested priorities. Where other partners have data available on a particular material its supply is to be indicated and confirmed by e-mail before proceeding.

Table 1 Suggested priorities for vessel materials database contributions

	NNC	CEA	FR F	FR G	EA	NRG	JRC	FZJ
Carbon steel	S, D	S, D			S, D	S, D		S, D
MnMoNi steel		D	S, D	S, D	S, D		S, D	
2¼Cr Mo steel	S, D				S, D	D	S, D	S, D
Modified 9Cr steel	S, D	S, D	D, E	S, D		E	D, E	
12CrMoVNb steel			S, D	S, D		S, D		D

Table 2 Suggested priorities for turbine materials database contributions

	NNC	CEA	FR F	FR G	EA	NRG	JRC	FZJ
Udimet 720		P.E		P			P.E	
IN 718	P				P			P
IN 706			P			P		P
IN 100	P		P		P			
IN MA6000			P	P		P		
DS IN 792		P.E			P		P.E	
DS CM 247 LC		P.E					P.E	P
L-TZM		P		P			P	
IN 713	P		P					P
IN 738	P	P			P			
M 21				P		P	P	
SC 16				P	P	P		
MAR M 004			P		P		P	
Nimonic 80A	P					P		P
Hastelloy X [1]	P.D		P.D	P.D				
IN 617		P				P		P.E.D

Key

S – Data from National Standards
P – Published data (Pre 5th Framework)
E – Experimental data (5th Framework and beyond)
D – Data (not in National Standards)
Note [1]: Hastelloy X includes Hastelloy X, Hastelloy XR & Hastelloy XR-II

Table 3 Suggested priorities for carbon/carbon composites database contributions

	NNC	CEA	FR F	FR G	EA	NRG	JRC	FZJ
190G	P						P	
222	P							
223	P							
2D-C/C	P							
AC 250	P							
A05		P					P	P.E2
C/C-A	P							
C/C-B	P							
CC 2001 G								P
CX 270								
CX-2002U						P	P	
DMS 678	P	P						P
FMI 4D								
MCI							P	
MFC-1	P							
PCC-1S	P							
RFC	P							
UFC	P							
SiC		P				P		P.E2
N31 / S31								P.E2
INOXA14								P.E2
NOVOLTEX								P.E2

(Note: Manufacturers / suppliers for these C/C Composites are given in reports: HTR-M 02/06 D 2 1 36; HTR-M 02/12 3 3 55; HTR-M 02/12 3 3 56)

Table 4 Suggested priorities for graphite materials database contributions

	NNC	CEA	FR F	FR G	EA	NRG	JRC	FZJ
PCIB	P, D					E1		P, E2, D
PCEA	P, D					E1		P, E2, D
PPEA	P, D					E1		P, E2, D
NBG-10	P, D					E1		P, E2, D
NBG-20	P, D					E1		P, E2, D
NBG-25	P, D					E1		P, E2, D
IG-110	P, D					E1		P, E2, D
IG-430	P, D					E1		P, E2,D

S – Data from National Standards
P – Published data (Pre 5th Framework)
E1 – Experimental irradiation data (5th Framework and beyond)
E2 – Experimental oxidation data (5th Framework and beyond)
D – Data (not in National Standards)