



# Computer system for International Reactor Pressure Vessel Materials Database support.

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## 1. Introduction

This report is presented description of computer tools for support International Reactor Pressure Vessel Materials Database, developed in IAEA. Work was focused on raw, qualified, processed materials data search, retrieval, analysis and presentation and export possibilities materials data.

Special software tools for querying and searching of any type of data in the database was developed. According IAEA demands, computer system is based on MS Access software. Controlled multi-user read-only access to all non-confidential data was realized in computer system, access to confidential data was realized only for authorized persons.

Developed software system has the following main functions:

- provide software tools for querying and searching of any type of data in the database;
- provide the capability to update existing information in the database;
- provide the capability to present and print selected data.
- provide the capability to export on yearly basis the run-time IRPVMDB with raw, qualified and processed materials data (without identifying info, diagrams and images) to Database Members;
- provide the capability to export any selected sets of raw, qualified, processed materials data (without identifying info)

All basic information is arranged in MS Access tables, include organization information, reactor information, reactor pressure vessel information, material properties, irradiation conditions, test conditions and results. File "MainBase" with a set of auxiliary files containing graphic images and other illustrative data referred to from the MainBase can be positioned on a server. In addition to the basic information tables, MainBase database involves some auxiliary tables filing permanent data such as code lists and units of measure.

## 2. Main Database definitions

All basic information is arranged in MS Access tables, building up VESSEL\_M.MDB database, here and after called "MainBase".

File "MainBase" with a set of auxiliary files containing graphic images and other illustrative data referred to from the MainBase is positioned on a server. In addition to the basic information tables,

MainBase database involves some auxiliary tables filing permanent data such as code lists and units of measure.

These are all the units comprising the database: it contains no other structures.

The MainBase database is designed for the following purposes:

- description of the structure of major data tables of IRPVMDB;
- description of relationships between tables and thus maintaining the data integrity by means of MS Access;
- providing the data security with respect to an unauthorized access and delimiting the access by means of MS Access.

Composition of the major data tables of the MainBase database almost completely coincides with that described in detail in "IRPVMDB Database Specification"[1].

The MainBase database comprises 19 major tables whose names are the names of corresponding DBF-files without the "DBF" extension.

The names of the fields and their specifications are left unchanged, with the exception of fields of 15-bite symbolic field IAEA\_CODE in the files of test results (RPV\_CV, RPV\_TEN, RPV\_SFR, RPV\_DFR, RPV\_HRD). Instead of the IAEA\_CODE field, each of these tables contains 12-symbol field (IAEA\_MCODE) and 3-symbol field (IAEA\_NUM), their catenation forming a complex IAEA\_CODE index.

The modification described above offers a possibility of using some built-in tools of MS-Access for maintaining the database integrity. Implying this purpose, this index is defined as "primary unique" in all the tables that have got the IAEA\_CODE complex index, while in the remaining tables the IAEA\_MCODE field is defined as "primary unique key".

Furthermore, all the tables are interconnected via the IAEA\_MCODE field. RPV\_AT table is the basic one. It is connected by "one-to-one" link to the tables that contain IAEA\_MCODE unique key and by "one-to-many" link with all the other ones. Main relationships of databases in developed software was shown on Fig.1.



### 3. Software organization

#### 3.1. Software installation.

For software installation user must create own directory with database VESSEL\_U.MDB. , run Microsoft Access and open this Database

After this procedure user must run Autoexec1 Macros and attach Main Database (VESSEL\_M.MDB) After some time must receive main picture of IRPVMDS

#### 3.2. Basic Window of the Supplement

Basic window of the Supplement serves for the program's general control. The window involves ( Fig.2):

- Menu of Selected Queries;
- Menu of Selected Results;
- Menu of units of measure;
- Mode menu;
- Functional keys.

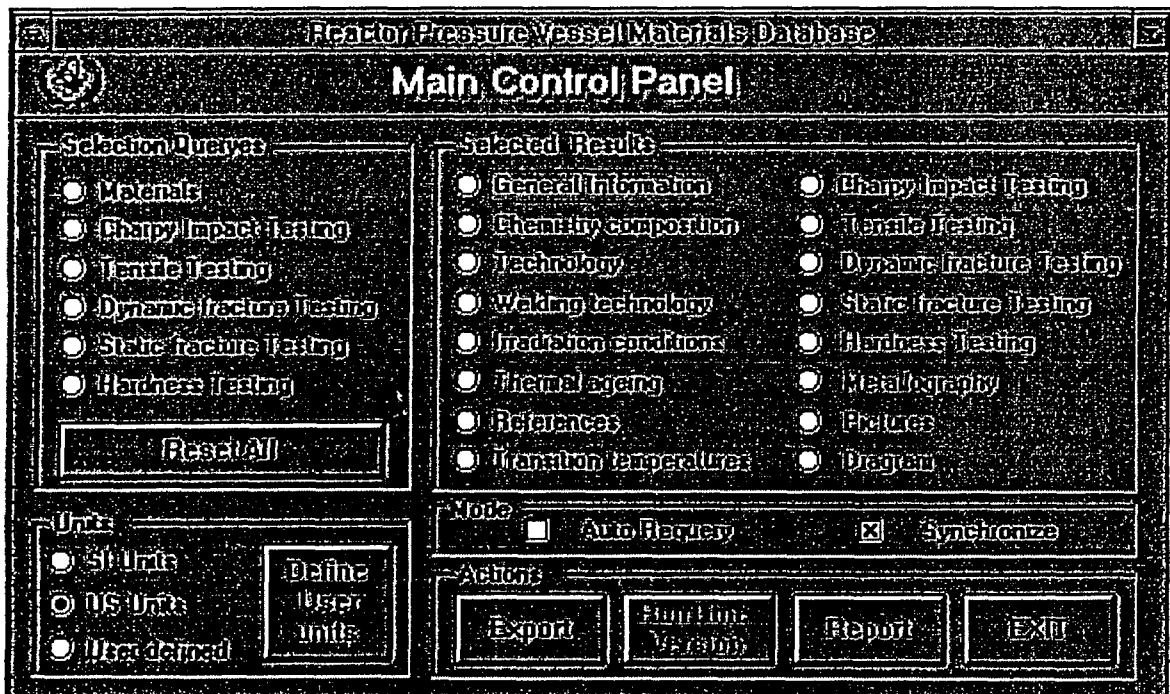


Fig.2 Main Control Panel of the developed system.

Selection Queries menu offers six forms for defining a choice criterion for materials and/or for test results.

Menu of Selected Results offers 16 forms to define the mode for the procedure of looking through the results of filtering. Menu of units enables

the user to specify the units in which he/she wants to have the data presented - SI-units, SU-units or his/her own set of units.

Functional keys are intended to call the forms for data export control and to look through and print reports. In this version Import option was realized as special subsystem, open direct from VESSEL\_M.MDB Database.

### 3.3. Data import subsystem

For starting Import subsystem user must open VESSEL\_M.MDB and run Autoexec1 Macros The data intended for the import should be previously arranged in standard DBF-files and the latter should be placed in a special directory.

Prior to accomplishing the import, the user should define a list of the files being imported. If the files have got standard names, it suffices to indicate the directory name. The user also needs to choose one of three import modes (Fig.3):

- "append mode" - for adding new records to the database. A key found in this mode is regarded as an error.
- "update mode" - the files being imported are implied to include only corrections for previously made records; in this mode, an error is an absence of a key to an imported record in a corresponding table.
- "update if exist mode" - the imported files may contain both new records and corrections for previously made ones. The action with the record from the imported file depends on whether or not its key have been found in the table.

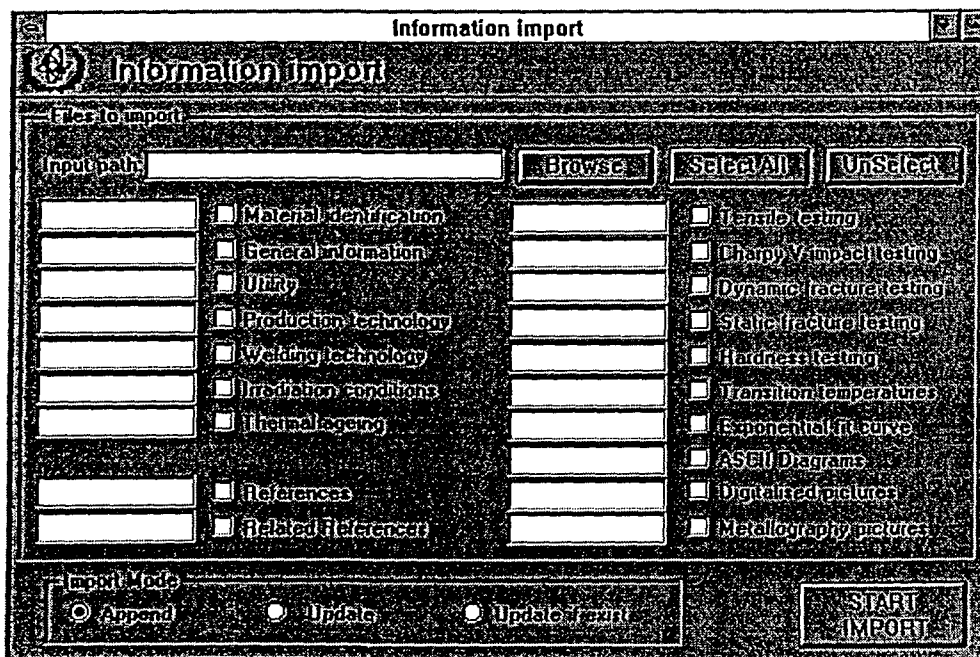


Fig.3. Menu of Choosing Import Files and Directories.

The import as it is accomplished file-by-file, following the sequence in the file list, each file undergoing some preliminary minor check of its structure. In the course of the file import the following errors can be fixed:

- wrong structure (absence of a field or presence of an extra-field in the file);
- nonlegitimate value of a field;
- inconsistency between a record and the chosen mode (see above);
- failure of adding a new record, when, if added, it will upset the database integrity.

After an error have been found and corresponding message appeared on the screen, the user is allowed to

- ignore the error by skipping the error-containing record;
- skip the import of the error-containing file (the import of already processed records can be abandoned as well),
- stop the import procedure and abandon the results of its portion that have been performed to the moment of the error finding.

## 4 Description of main system functions.

### 4.1 Data selection

The Selection Queries filter formation is organized as definition of choice criteria in one of the corresponding forms.

Each form involves a built-in table with a list of chosen records and a set of fields that determine the choice criterion. The latter is formed as a list of conditions specified in the form, linked to each other by "and" connective.

Since execution of the choice request may occur time-consuming, two modes of the procedure are offered - manual and automatic. Switching the modes is carried out by clicking on the "AutoRequery" flag in the basic window of the Supplement. In the "AutoRequery" mode, every change in any field of the choice form is accompanied by executing the request, that results in the changes in the state of all the tables on the screen. In the manual mode, the choice request is not executed and the data on the screen remain unchanged till the user clicks on the "Requery" button in the choice form.

The criterion for the material selection is to be defined using the "material choice" form, based on the values of the fields in RPV\_MAT and RPV\_IRR tables, i.e. on the major characteristics, chemical composition, and irradiation conditions. For the fields, containing numerical values, range limits (or one of them) for these values are defined. (see Fig.4,5)

Reactor Pressure Vessel Materials Database

### Material Selection

Material Code & Type: **IPR**

Ageing Type: **HFA** high cycle fatigue

SI Name: **IAP** irradiation and ageing in power reactor

Standard: **IAR** irradiation and ageing in research reactor

Thickness: **IPA** irradiation in power reactor and annealing

**IPR** irradiation in power reactor (surveillance)

**IRA** irradiation in research reactor and annealing

**IRR** irradiation in research reactor

**LFA** low cycle fatigue

**NUL** zero level testing

**THA** thermal aged in laboratory

**TMP** template cut from power reactor wall

Composition: **Clear** min max

Irradiation: **Clear** Min Max

HAETM CODE	STANDARD	THICKNESS	STANDARD	DEPTH	MIN
IPR00002WEL	Steel 393333	0.002755906	TU-14.1.2502-78	0.002755906	1
IPR00003FOR	Steel 396721	0.005905512	TU-108-765-78	0.005905512	0.43
IPR00004WEL	Steel 432279	0.002362205	TU-14.1.2502-78	0.002362205	0.67
IPR00005FOR	Steel 434561	0.006102362	TU-108-765-78	0.006102362	0.42
IPR00006WEL	Steel 434562	0.002559055	TU-14.1.2502-78	0.002559055	1.1
IPR00007FOR	Steel 478623	0.006299213	TU-108-765-78	0.006299213	0.48
IPR00008WEL	Steel 479501	0.001574803	TU-14.1.2502-78	0.001574803	0.98
IPR00009FOR	Steel 479602	0.005905512	TU-108-765-78	0.005905512	0.38
IPR00010WEL	Steel 485201	0.002362205	TU-14.1.2502-78	0.002362205	0.75

Record: 1 of 14

Fig.4. Example of Material Selection by Ageing.

Reactor Pressure Vessel Materials Database

### Material Selection

Material Code & Type: **IPR**

Ageing Type: **WEL01A**

SI Name: **all** unbound

Standard: **CAS** Casting

Thickness: **CLA** Cladding

**FOR** Forging

**HAZ** Heat affected zone

**LAB** Laboratory forging

**LBW** Laboratory welding

**OTH** Other

**PLA** Plate

Composition: **Clear** min max

Irradiation: **Clear** Min Max

HAETM CODE	STANDARD	THICKNESS	STANDARD	DEPTH	MIN
IPR00002WEL	Steel 393333	0.002755906	TU-14.1.2502-78	0.002755906	1
IPR00004WEL	Steel 432279	0.002362205	TU-14.1.2502-78	0.002362205	0.67
IPR00006WEL	Steel 434562	0.002559055	TU-14.1.2502-78	0.002559055	1.1
IPR00008WEL	Steel 479501	0.001574803	TU-14.1.2502-78	0.001574803	0.98
IPR00010WEL	Steel 485201	0.002362205	TU-14.1.2502-78	0.002362205	0.75
IPR00012WEL	Steel 295742	0.002362205	TU-14-130-78-73	0.002362205	0.53
IPR00014WEL	Steel 364379	0.002362205	TU-14.1.2502-78	0.002362205	0.94
IPR00015WEL	Steel 367202	0.001968504	TU-14.1.2502-78	0.001968504	0.78

Record: 1 of 8

Fig.5. Example of Material Selection by Type.

Provision is made for special tools for the choice according to the values in the OTHERn and PERCENTn fields.

To perform the material choice according to its code, the user defines the type of ageing code and/or material type set.

The choice according to the value in a symbolic field can be performed by indicating a particular value - symbol string, or a list of permitted values, or a mask, or a list of permitted masks.

In the "material choice" form, the choice conditions are arranged in a number of sections - "codes", "chemical composition", "irradiation conditions".

All other choice forms are intended for filtering the data in the tables of test results and their structure is basically the same.

Each form contains a table of the results chosen, a section of the choice conditions according to the fields of corresponding table, and the menu "Materials". This menu offers the modes of interaction between the choice criteria for the test results and for the materials.

The mode "all materials" ignores the material choice criterion, and the selection is performed on all the materials tested according only to the criterion for the test results. In the mode "n Select", the selection is made only among the materials meeting the material choice criterion. And eventually the "IAEA\_MCODE" mode enables the selection of the test results for one particular material.

Note that in all the choice forms the numerical data are presented in the units of measure, chosen by the user from the corresponding menu in the Supplement basic window.

#### 4.2. Selected Results forms

The list of the chosen records and the values of the major fields are composed as an immediate result of the choice request fulfilment and can be seen in the corresponding choice forms. The data in more detail can be found in "look-through" forms. The content of these forms also modifies answering the redefined choice requests for the materials and test results.

It should be noted here, that in every form and table demonstrated during the Supplement operation all the numerical data is presented in the units specified by the user in the basic window.

#### 4.3. Data export

The form for data export control is called up by clicking on "Export" functional key.

The export is accomplished by creating a set of files in a directory specified by a user. The files get standard names and a format chosen by the user from the following list: dBASE III, dBASE IV, FoxPro, Paradox, Lotus, Microsoft Excel, Microsoft Word, Text.

The default mode implies the export of all the 19 basic tables, but the user can limit the procedure to any subset of these files.

In the default mode, the values of all hidden private fields will be presented by empty rows in the export files. To export these values, one should define "Private fields export" mode for the procedure.

The user can export either the whole set of the records, or only those relevant to the selected materials, i.e. those ones that meet the criteria defined in the form for the material choice.

The user can choose the units of measure for the exported dimensional values (SI-units, US-units or user-defined set of units).



#### 4.4 Reports, pictures and illustrations

One can present the results of the Supplement work as one or several reports coming in sections, each of which can be rejected at printout. The subset of data included in the report is defined similarly to the data set selection at the export procedure. Also is possible to see information in diagram forms or arbitrary images (type metallography or illustrative pictures).(see Fig. 6).

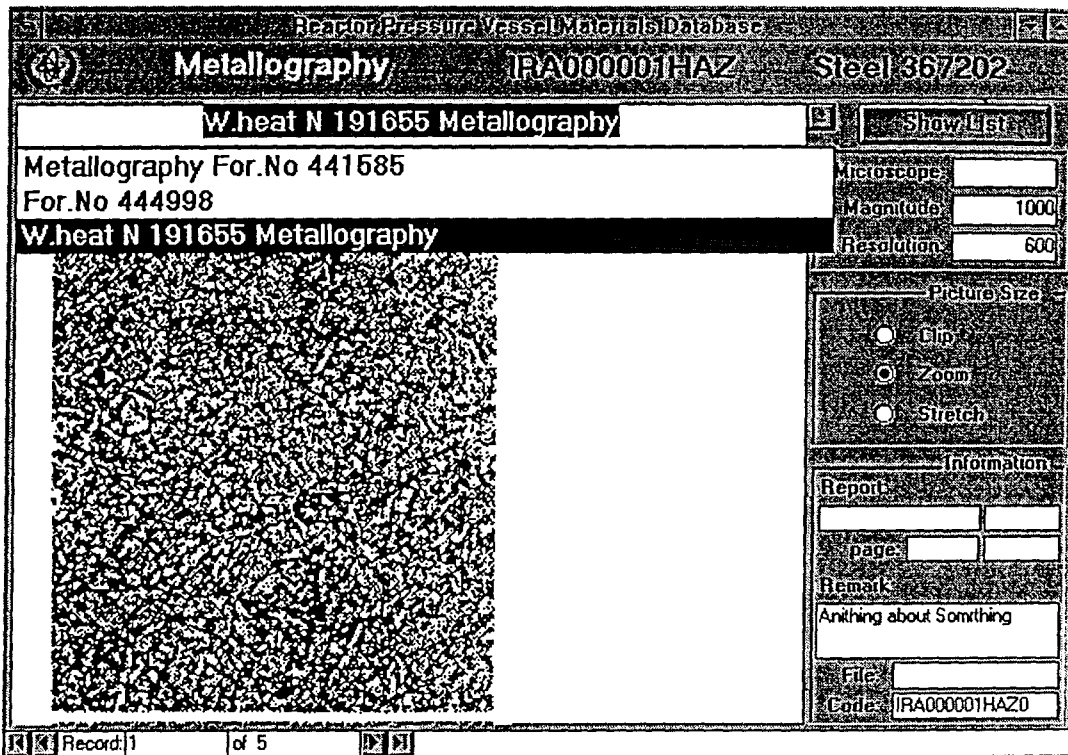


Fig.6. Example Metallography Pictures Presentation.

#### 5. References.

1. Working Material. International Database on Nuclear Power Plant Life Management. Database Specification, IWG-LMNPP-95/4, IAEA, Vienna, 1995.