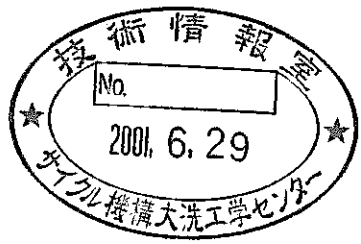
PROMILLE Database As a Part of JNC Reactor Physics Analytical System for BFS-2 Fast Critical Facility Experiments Analysis



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PROMILLE Database As a Part of JNC Reactor Physics Analytical System for BFS-2 Fast Critical Facility Experiments Analysis

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Abstract

The PROMILLE database for experimental data from the BFS-2 fast critical facility (Institute of Physics and Power Engineering (IPPE), Russia) has been developed and embedded into the JNC reactor physics analytical system to provide a strict documentation format, a common data source for different analytical tools and a unique export interface with different reactor codes. PROMILLE should be considered not only as a database but also as a bank of interfaces because of its dynamic role in the analytical process.

The database currently accepts data from the simulation materials (pellets, tubes and bars) as well as full cores descriptions. A core description involves all different unit cells forming loading elements, all types of the loading elements forming a layout and the layout itself. In fact it is a description of criticality experiments.

Export interfaces for the CITATION-FBR code and the SLAROM and CASUP codes have been developed.

The PROMILLE software was developed with MS Visual Basic 6.0 and the data is kept in the data tables generated with the MS Access database management system.

Data for eight BFS-2 assembly configurations have been incorporated. They include BFS-58-1i1 uranium-free plutonium assembly with inert material included in its fuel matrix and also seven BFS-62 modifications simulating different stages of investigation of MOX fuel based BN-600 core.

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サイクル機構炉物理コードシステムによる解析を目的とした BFS-2 高速臨界実験データベース PROMILLE の整備

（研究報告書）

セルゲイ　ベドニアコフ*

要旨

ロシア物理エネルギー研究所（IPPE）にある高速臨界実験装置 BFS-2 の実験データベース PROMILLE を開発し、サイクル機構の炉物理解析システムの一部として組み込んだ。PROMILLE の内部のデータは、厳密に書式化されており、様々な解析ツールへの共通データ源としての利用が可能である。更に、PROMILLE は様々な計算コードとの画期的なインターフェイスとしての機能を果たすよう工夫されている。従って、PROMILLE は単なるデータベースであるだけでなく、解析における動的役割からインターフェイスの宝庫とも考え得る。

データベースは、炉心全体の構造に加え、ペレット、チューブ、支持棒と言った詳細な構造まで取り扱い可能である。また、燃料要素を構成する全てのセル、炉心を構成する全ての燃料要素、そして、炉心構成自身を情報として含んでいる。それは、まさに臨界実験そのものである。

データ提供用インターフェイスとして、CITATION-FBR コード用、SLAROM コード用、CASUP コード用のものを用意した。

PROMILLE のソフトウェアは MS Visual Basic 6.0 を用いて開発されており、そのデータは MS Access データベース管理システムによって作成されている。

PROMILLE には、計 8 つの BFS-2 臨界実験体系に関する情報が保管されており、ウラン無しプルトニウム燃料で構成され、希釈材の含まれている BFS-58-1i1 体系、及び、MOX 炉心である BN-600 炉心の様々な段階の模擬炉心体系である 7 つ BFS-62 体系が含まれている。

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CHAPTER 1.

INTRODUCTION

1. Introduction

Experimental investigations on critical facilities require careful documentation for simple access and utilization. Experience shows that a lot of experimental data are lost very soon after the finishing of the experimental programs because of inadequate documentation. Often, different experimental data sources are used for the analysis and that introduces more uncertainties into analyses results. It is clear that special formats have to be developed for the experimental data conservation in order to avoid confusion when used by different analysts. Moreover, these are not dead formats just for the storing and demonstrating old data. Such a system of formats has to play a role of an active assistant in the analytical process, so it should provide enough options to access the data and use them in a variety of analytical procedures.

The problem occurs for different facilities and each solves it in their own way because of the large variety of geometries and experimental methods. However, there are common areas between these different facilities and this allows different sites to use the same general solution. One of the first such systems is the SNEDAX database developed in Germany for the SNEAK zero power fast critical facility in the late 1980s. Later it has become an asset of several European countries because it has been extended for MASURCA (France), ZEBRA (Great Britain) and RRR/SEG (Eastern Germany) zero power facilities [1].

In 1997, the earliest version of PROTVA database for BFS-1, BFS-2 and KOBR zero power fast critical facilities (Russia) was installed in France (CEA/Cadarache) as an independent section of SNEDAX [2]. Later the work has begun to establish PROTVA as an independent database on the basis of modern tools of development and database control system [3].

The experience of SNEDAX and PROTVA development has been widely used in creating of PROMILLE database for BFS-2 facility. It was developed for IBM PC compatibles running MS Windows-98. The development tools were MS Visual Basic 6.0 language and MS Access database management system for data archiving. Maximum efforts have been applied to make the format so that the information could be full, visual and easily retrieved for analysis.

The system currently incorporates the simulation materials data as well as full core descriptions. A core description involves all different unit cells forming loading elements, all types of the loading elements forming a layout and the layout itself. In other words, it is a description of a critical experiment. The graphical user interface presents an intuitive interface for editing and viewing a core configuration.

In order to make PROMILLE a dynamic part of JNC's reactor physics analytical system special export interfaces have been developed. Three important JNC reactor physics calculation codes have been chosen for interface development: the three-dimensional CITATION-FBR (It's omitted as CITATION for simplicity.) [4, 5] full core model, the one-dimensional SLAROM [6] and CASUP [7, 8] cell models sets are now available for export from the database for use in calculation analyses. In fact, PROMILLE should be considered not only as a database but also as a bank of interfaces because of its dynamic role in the analytical process. The bank of the existing interfaces can be extended according to requirements of analysis. Other export interfaces for some Russian reactor physics calculation codes as well as for some commonly used Monte-Carlo codes are very desirable.

Eight configurations of BFS-2 assemblies have been incorporated into PROMILLE by December 2000. They include the BFS-58-1i1 uranium-free plutonium assembly with an inert material included in its fuel cell and also seven BFS-62 modifications simulating different stages of investigation of MOX fuel based BN-600 core.

The release PROMILLE version is named by 6.1-JNC, where "6" is the code version, "1" is the data version and "- JNC" is added automatically by the code.

CHAPTER 2.

ALLOCATION OF PROMILLE ON A HARD DISK AND ITS EXECUTION

2. Allocation of PROMILLE on a hard disk and its execution

PROMILLE database consists of two parts: the **promille.mdb** data file and the **promille.exe** executable module. The data file involves a set of specially formatted tables and different kinds of data stored in the tables. In fact the executable module doesn't contain any data. Taking into account the structure of the above data tables it provides access to them in three different ways: incorporation interface, visual interface and export interface.

The release PROMILLE version has been numbered by 6 for **promille.exe** and by 1 for **promille.mdb**.

By default the database is located on D:\ hard disk. The name of the disk is indicated in a file dialog when the **promille.exe** starts executing. If necessary, the user can change the disk name immediately before the software accesses the data file. After entering a password the access to the data is permitted.

The following directories structure has been chosen for the disposition of software, data and other files that are generated or used by PROMILLE.

Table 2.1. Directories structure and files allocation in PROMILLE database.

Directory	File	Note
D: \ PROMILLE	**promille. exe**	Executable module
D: \ PROMILLE \ MDB	**promille. mdb**	ACCESS type data file
D: \ PROMILLE \ EXPORT \ OUTPUT	***. cit** ***. slm** ***. csp**	ASCII type files generated by the ***Export*** option as complete models for reactor calculations: ***.cit** – for CITATON, 3D; ***.slm** – for SLAROM, 1D; ***.csp** – for CASUP, 1D. A user gives files names.
D: \ PROMILLE \ REPORTS	***. rep**	ASCII type files generated by the ***Reports*** option: **bfs2summ. rep** - a brief summary of PROMILLE; **coremass. rep** - integral nuclides mass parameters for a whole core in different zones; ***.rep** – homogeneous concentration of nuclides in a cell. A user gives the file name.

All of the generated files (***.cit**, ***.slm**, ***.csp**, ***.rep**) are needn't for PROMILLE operation. They just present the information from the database in special formats. If necessary they can be removed from the disk by a simple deletion without any undesirable consequences. Only in one special case either ***.slm** or ***.csp** file indicated by a user are utilized by the ***Export*** PROMILLE option in order to generate a CITATION model into ***.cit** file for subsequent core physics calculation.

CHAPTER 3.

USER INTERFACE AND FUNCTIONS OF PROMILLE

3. User interface and functions of PROMILLE

Common review. All priorities in the development of PROMILLE database have been given to BFS-2 facility though the smaller BFS-1 and KOBR facilities can also be easily represented by it. All of them have been included into facilities list but only BFS-2 can be activated currently.

The connection scheme for the different sections of PROMILLE is shown in Fig. 3.1. The idea and real embodiment are emphasized in it by two different kinds of lines and backgrounds. The most visible lines and backgrounds indicate the completed options of PROMILLE in the context of the whole concept of PROMILLE. The completed work implements the first priority functions and it can be considered as a release software version of PROMILLE as of December, 31, 2000.

A cascading control button user interface allows users to make their choices by a series of mouse clicks: after pressing down on a button another set of buttons appears to make the choice in more detail. In fact, the scheme in Fig. 3.1 shows the buttons interconnection with the same commands on them. The whole code has been arranged in a such way that a user could avoid mistakes during operation with the database: special warning messages appear when important steps have to be made (deleting, editing etc.) as well as locking of some buttons, textboxes or list boxes depending on the task in order to avoid ambiguous situations. Sometimes the code can slightly correct the data incorporated by the user (mainly it concerns unit cells, loading elements and assemblies names) accepting them in a lower case of characters. In some textboxes during data incorporation both data reasonability and length are checked and corrected. So, if incorporated unit cells, loading elements and assemblies names are shorter then it is allowed they will be automatically prolonged by a "_" sign until their maximal possible length. Also it is impossible to incorporate too long character data.

The most important panels of PROMILLE are shown in Attachment 1 as screenshots and are supplied with explanatory remarks.

A start panel of PROMILLE is shown in Fig. A1.1.

A main menu contains six choices: ***Assembly***, ***Experiment***, ***Material***, ***Geometry***, ***Utility*** and ***Export*** (see Fig. A1.2). Every choice is described below.

Assembly* option.** This button is responsible for the viewing of all details of an assembly configuration including unit cells, loading elements, layout as well as experimental data obtained on it. After clicking the button the list of all assemblies included in PROMILLE with their brief description appears. After the double clicking on an assembly of interest all the posterior operations and data are available only for this assembly until the ***Main Menu button is pressed.

From the following ***Configuration*** and ***Experiment*** options the second one is not yet activated while the first makes available three choices: ***Cell***, ***Element*** and ***Layout***.

The ***Cell*** gives a list of all cell names in the assembly. Clicking on any cell name from this list draws a picture of the cell on the computer display (see Fig. A1.3).

The ***Element*** gives a list of all elements in the assembly. Clicking on an element name from this list draws a picture of the element on the computer display (see Fig. A1.4).

The ***Layout*** provides six different types of drawing for the assembly layout the choice of which can be initiated by a ***Graphics Menu*** button. These drawing types include (see Fig. A1.5): full facility layout (***Full layout***), its upper and lower left part (***Upper left quarter*** and ***Lower left quarter***), its upper and lower right part (***Upper right quarter*** and ***Lower right quarter***) as well as round central area (***Circle***) of the specified radius. By default 170 cm radius is usually used for convenience though a user can easily change it here. Scaling is provided by the code automatically. Upon choosing one of the possible layout drawing

types the layout picture appears on the computer display. The examples for the ***Circle, Full layout*** and ***Upper left quarter*** options are displayed in Fig. A1.6-A1.8.

Clicking on any of loading elements from the layout displays the element raster coordinate in the lower left corner of the panel.

***Experiment* option.** This button is not activated in the release PROMILLE version. A future PROMILLE version will involve all the experimental methods shown in Fig. 3.1. The experimental data for the indicated method (or nuclide) in this option are planned to be collected throughout all assemblies deposited in the database. The selection can be used in a further analysis.

Material* option.** It shows the parameters of all the original materials used for the cores simulation and experimental tools. The ***Simulation option can be activated in the release PROMILLE version to access real and virtual (if necessary) pellets, tubes and bars of BFS-1,-2 and KOBR facilities armory. The example of this panel is displayed in Fig. A1.9. Currently, the ***Tools*** option for experimental tools description like fission chambers, activation foils, small samples for reactivity perturbation, solid track detectors etc. is reserved for future development.

***Geometry* option.** This button shows the geometry conditions of the specified facility to allow the user to become more familiar with it. The view of this panel and some explanations of the accepted coordinate system are given in Fig. A1.10.

The list on the left contains coordinates of the center of every cell of the facility layout where a loading element can be installed. The explanation of the coordinates is given in the lower left corner of the panel in addition to auxiliary scheme in Fig. A1.10. It should be noted here is that rows numbering begins from the real facility left side as far as often in PROMILLE 22 rows from the left part (a part of so called metal column) of BFS-2 facility are cut out for convenience. In such cases the first row on the PROMILLE layout corresponds to a number 23 in the list of coordinates.

The list on the right indicates the positions of the facility's safety rods.

Utility* option.** Some useful utilities have been established in this section. They have been separated into two functionally different sub-sections: ***Reports and ***Editor***.

There are three working options (***Database Summary***, ***Configuration Mass*** and ***Cell Homogenization***) and one planned (***Experiments***) to establish in frames of the ***Reports*** sub-section.

Database Summary option provides a summary file with a brief list of all experimental data contained in PROMILLE. This file is named automatically by **bfs2summ.rep** and is placed in the default directory (see Table 2.1). A report about the PROMILLE content for 31/12/2000 is displayed in the Attachment 2.

Configuration Mass option is responsible for generation of a report about masses of all assembly materials. Double clicking on the assembly name in "Assembly" list, see Fig. A1.11, summarizes the different parameters in other lists of the panel. The report file named **coremass.rep** contains the same information that is collected in "Zone masses (from bottom to top), g" and "Total masses, kg" lists and is placed in the default directory (see Table 2.1) after the request for a report. Additionally, the information about types and amount of loading elements used and pellets is indicated on the panel.

Cell Homogenization option allows the homogeneous concentrations of materials composing every cell in each assembly to be obtained. The panel for this option is shown in

Fig. A1.12. After a double click on the assembly name in the "Assembly" list all the used unit cells for the chosen assembly are displayed in the "Cell" list. The cells are selected in the same way and results in the filling of the "Element" list by loading elements names where the clicked cell is loaded. It is necessary to specify the element and the next simple example demonstrates it. Some zones in the core can differ by the number of bars in the inter-tube gaps only whereas they have the same material configuration inside their tubes. So, the cells homogeneous concentrations will be different only because of the different inter-tube gaps status. Different kinds of tubes also can be used and cause differences in the concentrations. The result of the calculation is shown in the "Homogenization" list. It can be saved as a file with the name specified in the special text window.

Both ***Configuration Mass*** and ***Cell Homogenization*** functions take into account ^{241}Pu to ^{241}Am radioactive decay as well as height changing of some most important cells in the core because of the pressure from the materials placed above. The so-called "squeeze factor" is used in this case (see Fig. A1.3, A1.4).

Experiments option for reporting is not activated in the release PROMILLE version. A future PROMILLE version will involve all the experimental methods listed in Fig. 3.1. The experimental results for the specified method (or nuclide) in this option are planned to be reported and saved as a file throughout all assemblies deposited in the database.

The ***Editor*** sub-section *is the only place* in PROMILLE *where data can be incorporated, edited or deleted.* There are six working options (***General Service***, ***Material***, ***Cells***, ***Elements***, ***Layout***, and ***Kill Assembly***) and one planned option (***Experiment***) in its frames in future.

General Service button is responsible for incorporation of two kinds of passwords and the database version number based on the data contained in it, see Fig. A1.13.

Both passwords are interchangeable in the release PROMILLE version. In future the master password will provide a full access to the data as well as the slave password will provide visual and export interfaces only.

Material/Pellets buttons provide an interface for editing the cores simulation pellets. All necessary explanations are given in Fig. A1.14. It should be noted here that "Cover thickness" on the panel means a cover from one pellet side, i.e. full pellet thickness equals to the sum of "Core thickness" and double "Cover thickness" meanings.

Boron content can be incorporated in the database in two ways: either as natural B or as ^{10}B and ^{11}B isotopes separately. Such choice was established due to the fact that both natural and enriched boron carbide pellets are used at BFS facilities and it is convenient to choose one or another selection mode. There is no possibility to incorporate it in both options at the same time. The same conditions are fulfilled for ***Material/Tubes and Bars*** choice.

Material/Tubes and Bars buttons provide a very similar interface as the previous one, see Fig. A1.15. The textboxes under the "Cover" title are locked because there are no covered units in the BFS-2 facility at present.

Cells button with subsequent choosing of the assembly name in the assemblies list (see Fig. A1.16) opens access to the panel for cell structure incorporation and editing. A start panel for these procedures is shown and explained in Fig. A1.17. It is valid for the case where no pellets allocation changing in the cell is envisaged. Only the cell name and squeeze factor can be edited in this option and the pellet order, their colors and amount in the cell can't be changed.

"All pellets" list contains all the pellets included in the database. The same list is available also on the panel of the pellets viewing (see Fig. A1.9). A note about the chosen pellet is indicated on the top of the panel.

"All colors" list contains conventional names of colors used in PROMILLE for graphics purposes. It has no function on this panel.

"Arranged cells" list contains all cell names completely described in the database for the chosen assembly even if they are not included in any loading elements description. Choosing the cell name here results in its indication in the "Cell" textbox as well as appropriate squeeze factor in the "Squeeze" textbox. Both meanings can be incorporated there using arbitrary characters number and case for the cell name. The cell name can be automatically corrected as it was described above.

"Used cell names" list contains cells names that were used already for some loading elements description even if the cells structure has not been described in the database yet.

The same unit cell can be used in different assemblies. To avoid entering the data for every new configuration a special function for copying it from the current assembly to another one from the proposed list has been implemented. The only condition here is that the cell has to be described in the database at least once. After pressing the ***Add the cell to another assembly from the list*** button (see Fig. A1.17) a list of assemblies appears on the panel and the actions that are possible after this are either to select the assembly or to cancel the copy. This situation is shown in Fig. A1.18. In the case when there is already cell with the same name in the database for the assembly a special message will warn the user and the name of the cell has to be changed (edited) in a corresponding textbox to complete the operation.

To create a new cell description in the database the "Yes" option has to be chosen in the "Changing pellets allocation" option box, see Fig. A1.19. After pressing the ***OK*** button a draft scheme of the cell is drawn. It is separated into a number of equal zones corresponding to the amount of pellets in the cell in order to be filled with a special color for each zone. A double textbox for associating colors and pellets names also appears on the panel, see Fig. A1.20.

The order of operations should be the following: choose a pellet name ("Click 1"), choose a color for the pellet ("Click 2"), clicking onto each zone of the scheme where the pellet should be placed ("Click 3" and more) so that they are filled with this color. The same cycle has to be repeated for each pellet until the scheme is completed. The order of pellet and color choosing is not interchangeable. It is recommended to choose the existing items from menu to avoid hand made mistakes and only new meanings should be incorporated by hand.

The code gives a special message if any data are missed.

The ***Add***, ***Edit*** and ***Delete*** buttons provide a corresponding management of the incorporated cell data.

A viewer (see Fig. A1.3) shows the editing results taking into account the real pellets sizes.

Elements button with subsequent choosing of the assembly name in the assemblies list (see Fig. A1.16) opens access to the panel for loading element structure and editing. A start panel for these procedures is shown and explained in Fig. A1.21. It is valid for the case when no zones allocation changing in the element is envisaged. The element name, hatching (conventional color name) for a core layout, tube type, the number of inter-tube bars per element, bar type and support only can be edited in this option whereas zones order and amount, the number of cells in them and their colors can't be changed.

"All tubes/bars" list contains all types of tubes and bars included in the database. The same list is also available on the panel for viewing the tubes and bars (see Fig. A1.9). A note about the chosen tube or bar is indicated on the top of the panel.

The "All colors" list contains conventional names of colors used in PROMILLE for graphics purposes. Choosing them in the list displays the real color in a color box so that it could better help in color selection.

The "Elements" list contains all loading elements names for the assembly. It includes the names of both completely described elements and those that have been only put into correspondence with their colors during editing of the layout. Choosing the element name here results in indication in the "Element", "Hatching", "Tube type", "Bars/element", "Bar type" and "Support, mm" textboxes their appropriate meanings. All of them can be incorporated there or simply edited by hand but it is recommended to incorporate data into "Tube type" and "Bar type" textboxes by choosing them from the corresponding lists in order to avoid entry mistakes. Before making this choice, a click on the corresponding textbox in order to focus is necessary.

The element name can be automatically corrected as it was described above.

The "Used cell names" list contains all cell names that were used already for the loading elements description even if the cells structure has not been described yet in the database.

An element can be copied with all its structure from the current assembly to another one from the proposed list. The only condition here is also that the element has to be described in the database at least once. The ***Add the element to another assembly from the list*** button (see Fig. A1.21) shows a list of assemblies on the panel. The possible actions are either to select the assembly or to cancel the copying. This situation is shown in Fig. A1.22. In the case when there is a loading element with the same name in the database for the assembly, a special message will warn the user that the name of the element has to be changed (edited) in a corresponding textbox to complete the operation.

Independently of the "Yes" or "No" option chosen in the "Changing of zones allocation" option box (see Fig. A1.23) choosing of any item in the "All tubes/bars" menu results in the indication of both the type of selected tube (bar) on the top of the panel and its name in the corresponding textbox.

To create a new loading element description in the database, the "Yes" option has to be chosen. The number of zones has to be indicated in the corresponding textbox. The empty space between the top of tube and upper zone as well as a support which sometimes takes place under the lowest zone inside the tube in reality are not included in this scheme. They are treated automatically by the code. After pressing down of the ***OK*** button, a draft scheme of the element is drawn in order to be filled with a special color for each zone. A triple textbox for associating of every zone name, its color and cells amount in it also appears on the panel, see Fig. A1.24.

The order of the scheme filling operations should be: incorporation of the data on the zone in the triple textbox, clicking onto each place of the scheme where this zone should be placed so that they are filled with this color. The same procedure has to be repeated for all different zones until the scheme is completed. It is recommended to choose the existing items from the menu to avoid entry mistakes and only new meanings should be typed in.

The code gives a special message if any data are missed.

As in the case of the cell description after pressing down ***Add***, ***Edit*** or ***Delete*** buttons only the corresponding changing of the element data is completed.

A viewer (see Fig. A1.4) shows the editing results taking into account the real zones sizes.

The ***Layout*** button enables the graphical constructing of a core layout. The list of the assembly names for this option unlike on the Fig. A1.16 includes also "..." item which means a choice to begin constructing of completely new core layout. After selecting the appropriate item from the list a panel for editing of common information about the core appears, as shown in Fig. A1.25. The ***OK*** button completes incorporation of the textboxes content into the

database and displays a panel where the layout presentation type can be chosen, see Fig. A1.26. These types are the same as the layout viewing. The difference is that the editing isn't possible when a central circular part is extracted. Besides, the ***Cut layout*** function has been implemented here to eliminate the metal column of BFS-2 facility when it is desired. The idea is shown in Fig. A1.27. The BFS-2 facility is large and eliminating 22 rows of tubes from its left part makes a better layout presentation on the PC display.

The procedure for the core layout editing is shown in Fig. A1.28 based on the layout lower right quarter example. The scheme of this part of the layout appears on the main area of the panel as well as a color palette on its right side. The layout may already contain some results of previous editing whereas the new layout has all the channels shown in a white color.

The editing procedure should have the following order: first a color on the palette should be chosen with a mouse click, then all channels to be marked by the selected color should be clicked one by one. The mouse maintains the selected color until the next click on the palette.

When the color is chosen, a textbox for the corresponding element name appears on the upper right corner of the panel in order to associate the element and the color on the layout. Some additional information about the color and coordinate of the marked channel, as is shown in the Fig. A1.28, appears on the lower part of the panel.

The BFS-2 has many channels so it is tiresome for a user to click on every channel. To facilitate this procedure an option of filling of the layout by hexagons of channels of the chosen color has been implemented. A box named "Hexagon side" provides its initialization. A superposition principle is used when some hexagons cover each other: the last one fills the whole hexagon area whereas the previous ones loose their color on the place of the superposition.

By default the hexagon side is 1. To change it any item from the "Hexagon side" menu has to be selected.

The editing of the layout is fulfilled just after mouse click on it ("Click 2, ...", see Fig. A1.28) so that no special confirmation is necessary to complete it.

New BFS-2 configurations are very often based on some previous ones, so a layout copying function to another one with a new name has been implemented into PROMILLE. A user has to choose the assembly name from the panel described in Fig. A1.16 when he needs to copy and change it on the panel described in Fig. A1.25. It is recommended to edit the other textboxes at the same time on this panel.

There is no danger to replace by mistake any layout contained in the database by this function because the code does not allow it and a special warning appears in this case.

According to the early above remarks the assembly and element names can be corrected automatically after their incorporation (see Fig. A1.25 and A1.28).

The ***Kill Assembly*** button allows deleting of all the data in the database related to the assembly from the proposed list. After a double click on the chosen assembly (see Fig. A1.16) and just before the data elimination the delete is confirmed.

The ***Experiment*** button for editing different kinds of experimental data is not implemented in the current PROMILLE version. A future PROMILLE version will provide this interface for all the experimental methods listed in Fig. 3.1.

Export **option.** The informational content of PROMILLE and different types of its presentation can be output in several ways. One of the basic design ideas was to ensure its dynamic and easy utilization for different reactor physics analysis. To meet this goal, the database has to be interfaced with different reactor physics calculation codes used routinely for analysis. This approach has advantages including utilizing the common data source for

different codes, eliminating editing mistakes during preparation of calculation models and essential time saving. The PROMILLE interface is organized so that it generates necessary models and saves them to disk (export) as ready to calculate input files for a number of codes.

Three export interfaces has been established in the current version of PROMILLE. They include the SLAROM and CASUP one-dimensional cell models and the CITATION three-dimensional full core model. When the ***Export*** button in the main panel is selected, only these options are active amongst six options displayed there. The others (***ECCO***, ***MCNP4***, ***MVP***) have been reserved for future interface development.

The export to CITATION, 3D uses the preliminary generated SLAROM (or CASUP) export models explained below.

In all the export models the radioactive decay of ^{241}Pu into ^{241}Am are taken into account along with the height changes of the important core cells due to resulting material pressure.

***SLAROM* and *CASUP*.**

The interfaces for generating of SLAROM and CASUP export cell models have no essential difference. The only difference is the export file formats, so the interface of preparing of such file is shown on the basis of CASUP example only.

The panel for preparing the export is shown in Fig. A1.29. In this example, the assembly, unit cell and element containing the cell have been already chosen. The need to choose an element after the assembly and cell is explained by the fact that different kinds of elements can contain the same type of unit cell. For instance, elements can differ from each other by the number of bars installed in the nearby inter-tube gaps only. But according to the idea of an element description in PROMILLE the averaged content of two nearby inter-tube gaps is also assigned to the element.

Three kinds of cell models are possible to generate after this triple successive choice: homogeneous cell model, plate-stretch model with a single additional fictitious layer and plate-stretch model with an arbitrary amount of fictitious layers between pellets core materials.

To run each of these tasks special buttons have been arranged on the panel.

The status of the panel when homogeneous cell model has been generated is shown in Fig. A1.30. All types of cell models exports use a combination of ***Start Export***, ***Continue Export*** and ***OK*** buttons. Their export files are stored in a special directory according to Table 2.1 and no file name extension is required in the "File Name" textbox.

The idea and principles of the plate-stretch cell modeling for one or several fictitious layers is illustrated in Fig. 3.2. The pellet cores are transformed into layers of the corresponding materials filling all the space in the hexagon (see view of the cell from above) and conserving the material mass and density. This decreases the thickness of the layers clearing some flat space for wrapper materials (inter-tube gaps, gap between pellets and tube, pellets covers, tube and if any, bars in the inter-tube gaps) layers. The mass of the wrapper material in frames of the whole cell is conserved when transition to the cell model is made. It is distributed between all wrapper layers of the cell model equally so that they have the same content, mass, thickness and density. As far as the height of the model is the same as of the cell, the thickness of the wrapper layers is explicitly determined. Wrapper material layers are disposed at the place determined by a user and their amount also can be different depending on the task the user is pursuing.

The status of the panel when the plate-stretch cell model with one fictitious layer has been generated is shown in Fig. A1.31. The fictitious layer in this case is automatically arranged above or below the all layers modeling pellets core materials.

The panel status shown in Fig. A1.32 corresponds to the case when ***Some fictitious layers*** button has been pressed. In this case a draft scheme for the model is proposed to the user as a list of pellets names separated by wrapper layers ("Eliminate unwanted wrappers"). The pellets names in the scheme symbolize the layers of pellets' cores as well as wrappers

include all materials outside the pellets' cores in the cell according to Fig. 3.2. One can arrange the positions and number of wrapper layers in the model by a simple excluding them from the list. It is possible to double click on the wrappers to be removed whereas there is no risk to remove the pellets names even by mistake. Also there are no possibilities to remove the only wrapper layer remaining in the scheme because it is the only place to put the cell wrapper materials. Of course, when wrapper layers are removed, the thickness of the remaining ones increased to keep the cell height constant.

Fig. A1.33 presents the stage when, as an example, three wrapper layers have been configured and the ***Complete selection*** button has been pressed to complete the model generation. If necessary, the ***Some fictitious layers*** button can be pressed again on this step in order to re-arrange the model.

Choosing the assembly-cell-element combination for the export is flexible so that upon the selection of the assembly one can choose any cell-element combination. When an assembly-cell combination has been selected, any element for it can be chosen. In all these cases the panel is ready to begin the new task.

The examples of export files for SLAROM and CASUP are given in Fig. A3.1-A3.4 (see Attachment 3). They cover both homogeneous models and cases with several plate-stretch layers. All data generated by PROMILLE are put in bold whereas the other ones always the same for different cases.

Some remarks are needed to explain the logic for taking of a number of solutions:

1. In the case of the cell export for CASUP, a buckling has to be included in the model. To accelerate the iteration process its meaning is roughly assessed by PROMILLE in the following way: 3.0000E-03 is accepted if ($^{235}U+^{239}Pu+^{241}Pu$)/ ($^{235}U+^{238}U+^{239}Pu+^{240}Pu+^{241}Pu$) nuclear ratio is not lower then 0.05 otherwise -3.0000E-03 is used.

2. If an empty cover without material inside is used in a cell, a trace (about 10^{-12} nuclei/cm^3) of Fe is added in its core to make proper the cell codes work.

3. Almost always the loading element tubes are filled up uncompletely. The user cannot describe the space between the tops of the upper pellet and the tube. In this case PROMILLE automatically generates an additional cell for the core. By default it calls the cell "unfilled" and gives it homogeneous status. This cell is not available for viewing but it is included in all PROMILLE exports. The materials content in the "unfilled" cell corresponds to the cell consisting of the empty tube, inter-tube gaps and bars (if any) and no pellets.

4. Sometimes a support under the pellets column inside loading elements is used in order to shift the core upper or lower. Often a detailed information about its geometry (excluding height) and content isn't well documented. In this case, PROMILLE automatically generates an additional cell for the core. By default it names the cell "__prop__" and gives it homogeneous status. This cell is not available for viewing but it is included in all PROMILLE exports. By default this cell includes the same materials like "unfilled" cell with its concentrations multiplied by a factor 3.

5. The names of PDS files that are associated with cell models are generated automatically by PROMILLE. They all have a "C**E**" mask. "C" is the indication of a cell, "E" is the indication of an element, "**" are their ordinal numbers in the list boxes on the panel for export generation. For instance, "core_dn_" cell and "zle_____" element have been chosen for "bfs_621" core in Fig. A1.33. The cell is the second (02nd) in the "Cell" list and the element is the first (01st) in the "Element" list, so that C02E01 PDS file name has been generated for the cell. A "bfs_621/zle_____/core_dn_/" fragment is also included in the comment of the cell model (see Fig. A3.2).

6. The export procedures for CITATION, 3D input models use the generated PDS file names so no changing of them is allowed.

CITATION, 3D.

The PROMILLE interface for CITATION 3D code has the same idea to implement several procedures step by step on its special panel in order to obtain a three-dimensional core model with required parameters.

Any core configuration independently of its form and size in the database is automatically enlarged and transformed in such a way that the full array of loading elements presents a rhombic area including in it the real configuration, see Fig 3.3. The area outside the real core layout and inside the rhombic border is filled with fictitious loading elements in the same hexagonal lattice as in the real core. By default the type of the fictitious elements is accepted according to the type of the first loading element in the lower right corner of the real layout. Besides, one additional row of these elements is constructed outside the rhombic border along every side.

Strictly speaking the "rhombic" area is just a special case while PROMILLE provides extraction of a "parallelogram" area. But since rhombic area is used for symmetrical calculations this term is also used in PROMILLE.

It is reasonable to limit the area of calculation by smaller dimensions in order to save time and memory for the calculation when the size of the assembly isn't very large. The scheme to eliminate the peripheral elements outside the chosen rhombic area is shown in Fig. 3.4. By default the chosen rhombic area is surrounded by one row of elements from each side but in this case the elements really take place in the assembly on their positions.

A panel for generating of CITATION, 3D export file is shown in Fig. A1.34. Two successive operations have been made already: selection of assembly ("Double click 1") and selection of the file containing SLAROM or CASUP models for all cells belonging to the assembly and generated previously by PROMILLE ("Double click 2"). After that main procedures are transferred to the frame of the panel named "Select and adjust the upper borders of axial zones". The goal of the operations in this frame is to idealize axial coordinates of the zone's borders and to simplify essentially the generated core model. The software detects when there are relatively small differences between axial coordinates of zones borders of different elements take place and smoothes them to a common level. The function simplifies the difficult task of a real configuration transformation into a model.

The procedure is illustrated in Fig. 3.5: the real zones for several elements are shown on the left side of the figure and they are shown transformed into adjusted zones on the right.

Thus, just upon transition of the procedures into the previously mentioned frame (see Fig. A1.34) the list "All borders" is filled with the z-coordinates (in mm) associated with upper axial borders of all zones including tube top (and the support top if any) and for all elements of the core. In example in Fig. 3.5 all these coordinates correspond to horizontal lines, both continuous and dotted, excluding the line at the bottom.

A mouse click on any of those z-coordinates results in the indication of its origin in the "Select reference fissile zone" list: the loading element name separated by a slash from the zone (the cell) name that lies just under this level. This operation doesn't influence the status of the calculation and has been established for convenience only to orient the user.

Double clicking on the same item ("Double click 3" in Fig. A1.34) results in the accumulating of the item meaning in the "Selected borders" list. This is a list of all z-coordinates selected from "All borders" list which will be used later as axial z-coordinates for zones in the CITATION, 3D calculation model. In the example shown in Fig. 3.5 these coordinates correspond to all horizontal continuous lines excluding the line at the bottom. The procedure has to be repeated as many times as required to determine axial borders for the model.

The status when all axial coordinates have been already chosen and placed in the "Selected borders" list box is shown in Fig. A1.35.

The next step is smoothening of the real axial borders to the model conditions. All axial borders from the "All borders" list which have not been placed in the "Selected borders" list must be smoothened or, in other words, adjusted to the borders from the "Selected

borders" list. In the example in Fig. 3.5, these coordinates correspond to all horizontal dotted lines. The beginning of this procedure is shown in Fig. A1.36. A mouse click on any of the items from the "Selected borders" list results in the indication in the "Borders adjacent to the selected one" list of all adjacent coordinates (lower and upper) between the selected one and lower and upper adjacent coordinates from the "Selected borders" list. For instance, according to Fig. A1.36 the "2469.737" coordinate is under "2747.39" and above "2235.61" so all real coordinates between "2235.61" and "2747.39" are included in the "Borders adjacent to the selected one" list (from "2246.39" to "2746.79" excluding "2235.61", "2469.737" and "2747.39"). The coordinates are put into the first column of the list. The second column here is a distance from them to the chosen coordinate from the "Selected borders" list whereas the third one (in parenthesis) is a distance from them to the closest coordinate of the "Selected borders" list but from the opposite side, see Fig. A1.37. Sign "-" here shows that adjusted coordinate is lower then coordinate from the "Selected borders" list. So, for the chosen coordinate in the "Borders adjacent to the selected one" list the following interrelations take place: "2460.642" – "2469.737" = "-9.1" and "2460.642" – "2235.61" = "225.03", where "2460.642" can be adjusted either to "2469.737" or to "2235.61" coordinates only. Obviously, it is more reasonable to adjust it to the first value but this is the user's choice. There is an illustration in the extracted circle in Fig. 3.5 that shows how the coordinates can be adjusted.

It is necessary to select all coordinates from this list that have to be adjusted to the coordinate chosen in the "Selected borders" list: after a double click on the adjusted coordinate from the "Borders adjacent to the selected one" list its value is placed into the "Adjusted" list. Thus, in Fig. A1.37 only the closest coordinates ("2474.15", "2470.02", "2465.391", "2464.61" and "2460.642") have been adjusted to the value "2469.737". When a set of coordinates to be adjusted has been created in the "Adjusted" list the ***Apply*** button has to be pressed in order to confirm the adjustment. The status when the ***Apply*** button has been pressed is shown in Fig. A1.38. After that the adjusted coordinates can't be adjusted again to another coordinate because they are not accessible in the list of coordinates which still can be adjusted.

Every time the ***Apply*** button is pressed a special check is done to prevent the adjustment to the same level of more then one z-coordinates for the same element.

The adjustment procedure has to be done for every z-coordinate from the "Selected borders" list. When it is complete, the user is notified with a message.

It is possible to construct a core model without z-coordinates adjustment. For this the ***Select All*** button should be pressed when the "All borders" list just has been formed and the "Selected borders" list is still empty.

Since the axial zone borders are changed in some loading elements in the above procedures their material concentrations in the model have to be corrected to preserve the total material masses in corresponding zones. The information on the materials concentrations is contained in the previously generated cell models for SLAROM or CASUP read by PROMILLE at the beginning of the export (see Fig. A1.34). after the coordinates adjustment all material concentrations in the corresponding plate-stretch models are corrected according to the zone height-changing factor. A new file with corrected cell models is created in the directory according to the Table 2.1 (see also Fig. A1.39) and has to be used for the generation of the necessary PDS-files to provide CITATION, 3D calculations. Its default name is **casup.csp** or **slarom.slm** depending on the current problem. The original file with the cell models isn't changed.

As mentioned above, it is possible to eliminate the extra area around the main core to simplify the CITATION, 3D calculations (see scheme in Fig. 3.4). The eliminated loading elements rows can be inserted in the "Cut rhomb around layout" frame (see Fig. A1.35) when the corresponding textboxes are enabled for editing and before pressing a ***Finish*** button.

Another necessary operation (see Fig. A1.38) is to provide the export model with the name of the PDS file associated with the cell responsible for the reference fission spectrum. It is enough to choose the appropriate "element/zone" combination in the "Select reference fissile zone" list for this because it is associated with a corresponding PDS file name generated by PROMILLE. This operation can be done any time and PROMILLE prompts the user if necessary.

The CITATION, 3D export file is generated when the ***Finish*** button is pressed. The result is shown in Fig. A1.39. The CITATION, 3D output can be viewed on the panel and saved to file in the default directory. An example of such export is shown in Fig. A3.5. All data generated by PROMILLE are shown in bold whereas the plain text is the same forever. The fission spectrum defining PDS file name is underlined and used twice - at the beginning and at the end of the model.

To run the problem for another assembly a double click on the assembly name from the "Select assembly" list should be done.

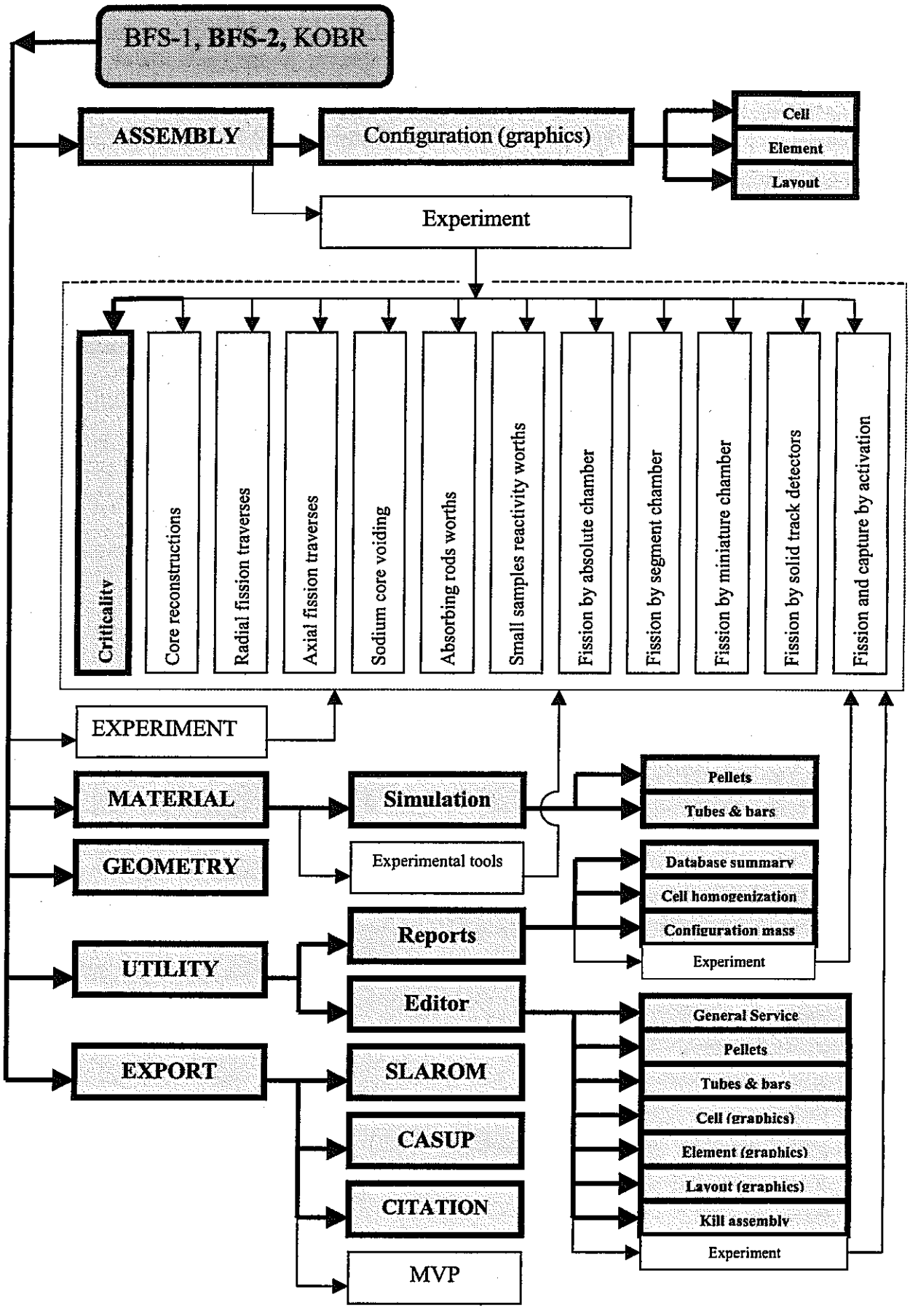

Fig. 3.1. A concept scheme and current PROMILLE database status.

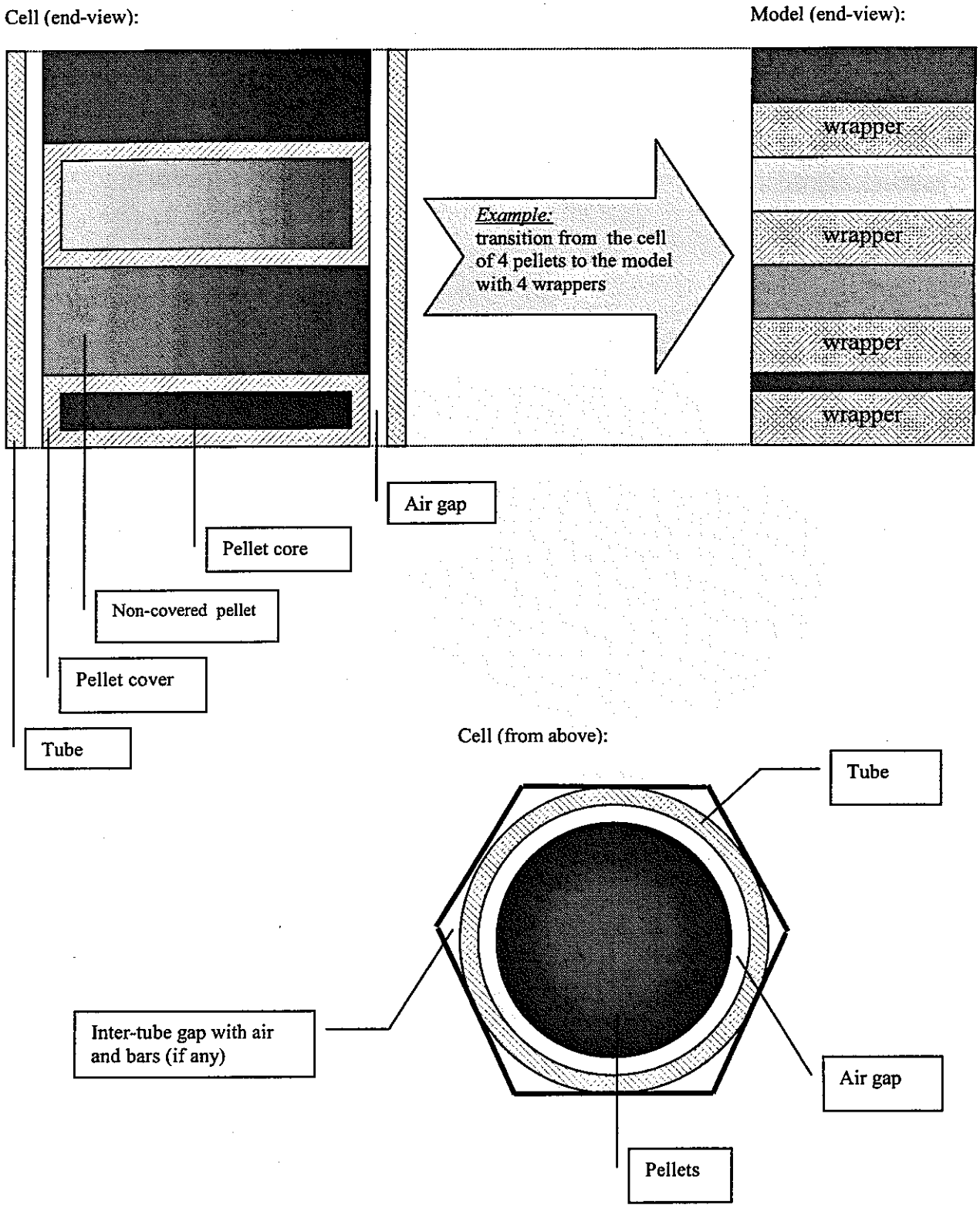

Fig. 3.2. Construction of plate-stretch cell model for SLAROM and CASUP 1D export.

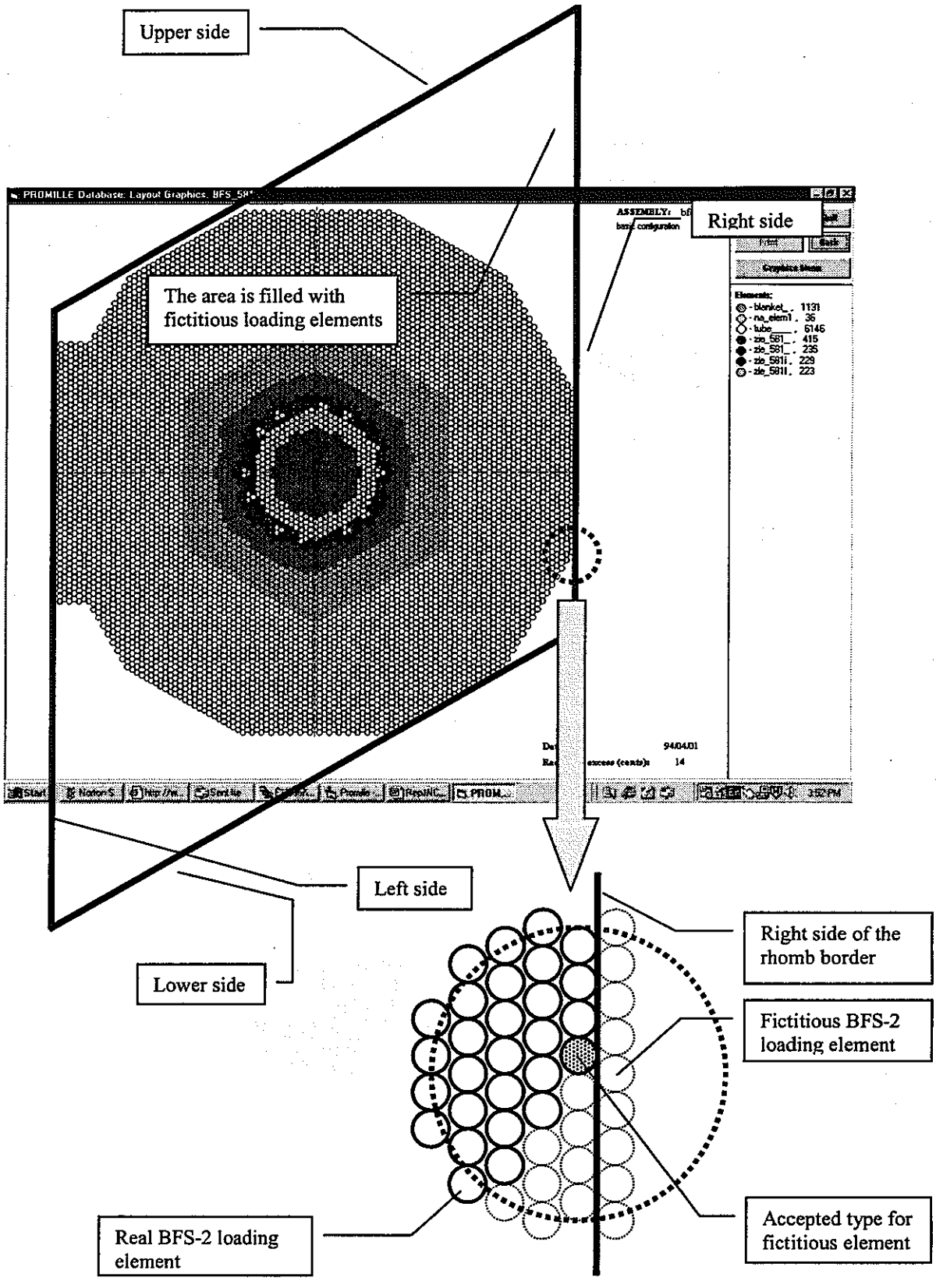

Fig. 3.3. Scheme of layout presentation in CITATION, 3D export model.

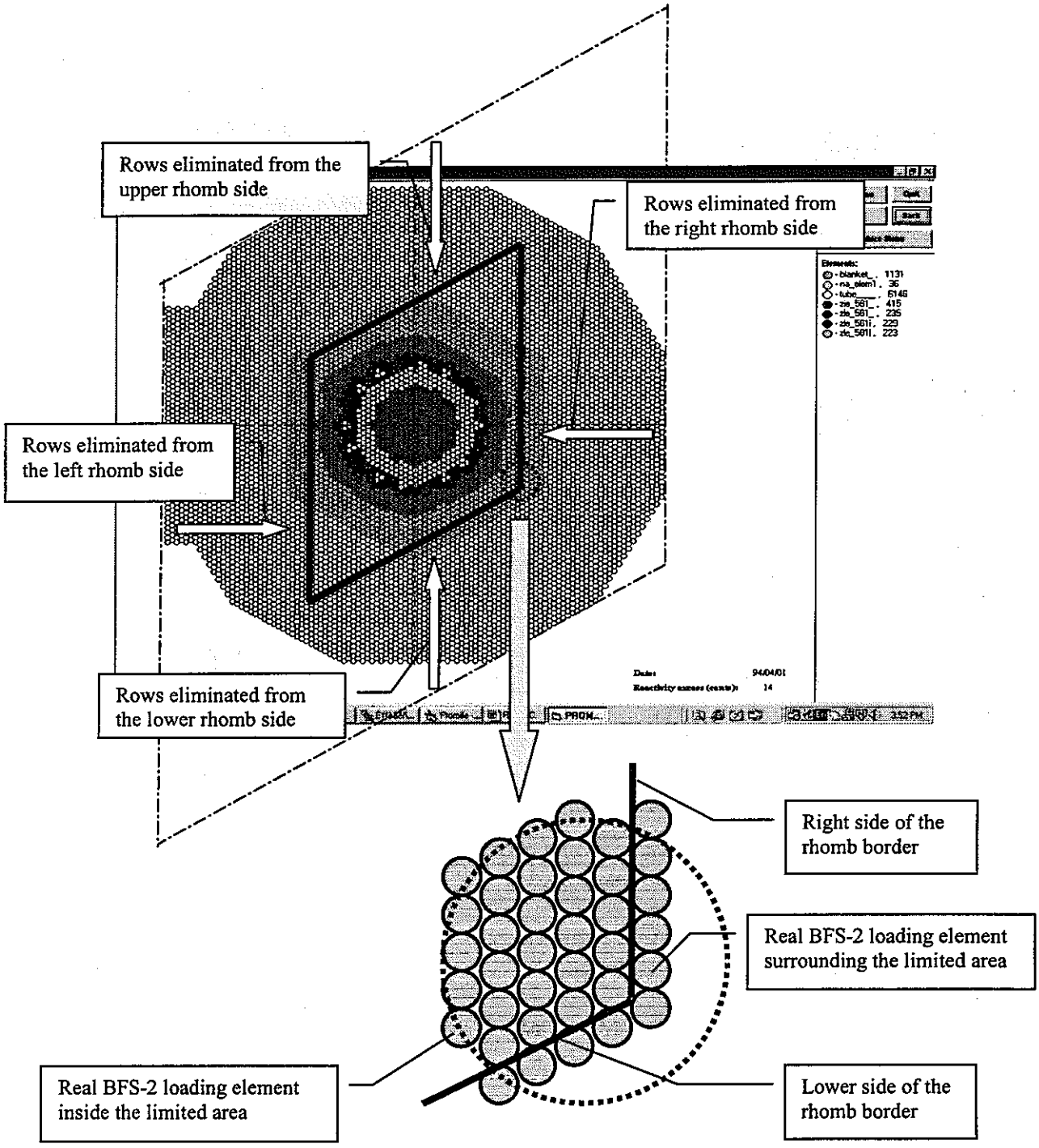

Fig. 3.4. Scheme for eliminating peripheral loading elements rows in CITATION, 3D export model.

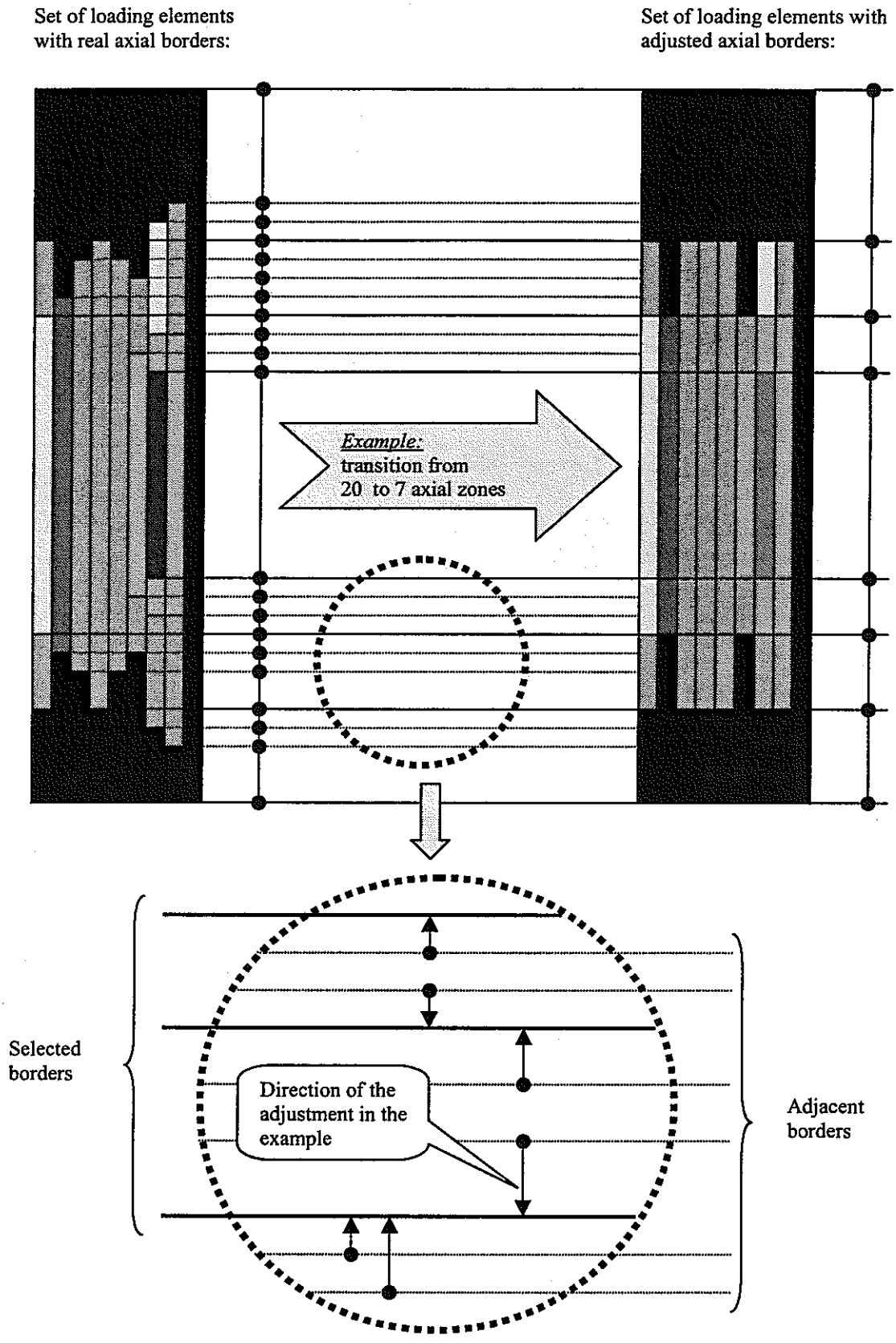

Fig. 3.5. Border adjustment between loading element axial zones to facilitate axial modeling in CITATION, 3D export.

CHAPTER 4.

PROMILLE DATA TABLES DESCRIPTION

4. PROMILLE data table descriptions

The MS Access database management system was used for the PROMILLE database to store experimental and other relevant data. The **promille.mdb** data file has been created and necessary data tables have been developed inside it.

The names and description of the tables are shown in Attachment 4. The first 11 tables are used in the release PROMILLE version and they contain information about BFS-2 simulation tools, coordinates system, some service data and critical configurations descriptions. The other tables are related to different types of experiments. Their preliminary structure is documented in this report as a first approximation since no experiments excepting critical ones can be incorporated currently. The previous experience with data formatting has been taken into account on the basis of both the earlier [2,3] works and communication with BFS experimental team.

All data fields are listed along with their lengths and descriptions. The descriptions are useful for the user but there is no need to remember them in detail since all communication with the tables is done by the interface described in Chapter 3.

The number of the tables in **promille.mdb** can be changed. Every time when a new assembly layout is created a new data table with the same name is also created. Also, when the ***Kill Assembly*** procedure is selected, the table containing the corresponding layout data is removed from the database.

There are two types of plutonium pellets available at BFS facilities for core simulations. Both of them have a very close dates of isotopic composition study. For this reason these dates have not been incorporated into any table – the only date has been simply included in the executable module. It is enough for the release PROMILLE version but if any new plutonium will be involved into the experimental BFS programs some update of PROMILLE should be done. This update has to correct accounting of ^{241}Pu fraction decay from plutonium with different origin.

CHAPTER 5.

CONCLUSION

5. Conclusion

The PROMILLE database for the experiments at BFS-2 fast critical facility has been developed and embedded as a dynamic part of the JNC analytical system for fast reactor physics analysis.

Special formats for data storage have been developed for the current PROMILLE version.

Three interfaces have been implemented for PROMILLE: a data input interface, a visualization interface and an export interface for reactor physics codes.

Eight configurations of BFS-2 assemblies have been incorporated into PROMILLE by December 2000. They include the BFS-58-1i1 uranium-free plutonium assembly with an inert material in its fuel cell and seven BFS-62 modifications simulating different stages of investigation of MOX fuel based BN-600 core.

The cells, elements and layouts for all configurations can be displayed and visually edited. Three JNC reactor physics calculation codes have been chosen for connecting with PROMILLE by means of export interface: CITATION, 3D full core model, SLAROM and CASUP, 1D unit cell models.

The existing export interfaces can be extended according to analysis requirements. The interfaces for some Russian reactor physics calculation codes as well as for some commonly used Monte-Carlo codes are very desirable and could be implemented. Participation of foreign partners in the BFS analysis process could result in the extension of the interfaces set to allow the export of configurations into reactor physics calculation codes used in other countries.

Since PROMILLE is a common source of data for different codes it excludes the uncertainties caused by a different data sources for different calculations. The user interface and related functions make data entry more efficient and less error prone.

Besides, PROMILLE should be developed in other directions. They can include completing of its conceptual scheme (see Fig. 3.1) for different kinds of experiments, development of search system on the basis of some criteria (name of nuclide, type of experiment, method of investigation, date etc.), establishing a special section for some calculation results, description of experimental methods and so on.

REFERENCES

References

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ATTACHMENT 1

USER'S INTERFACE OF PROMILLE

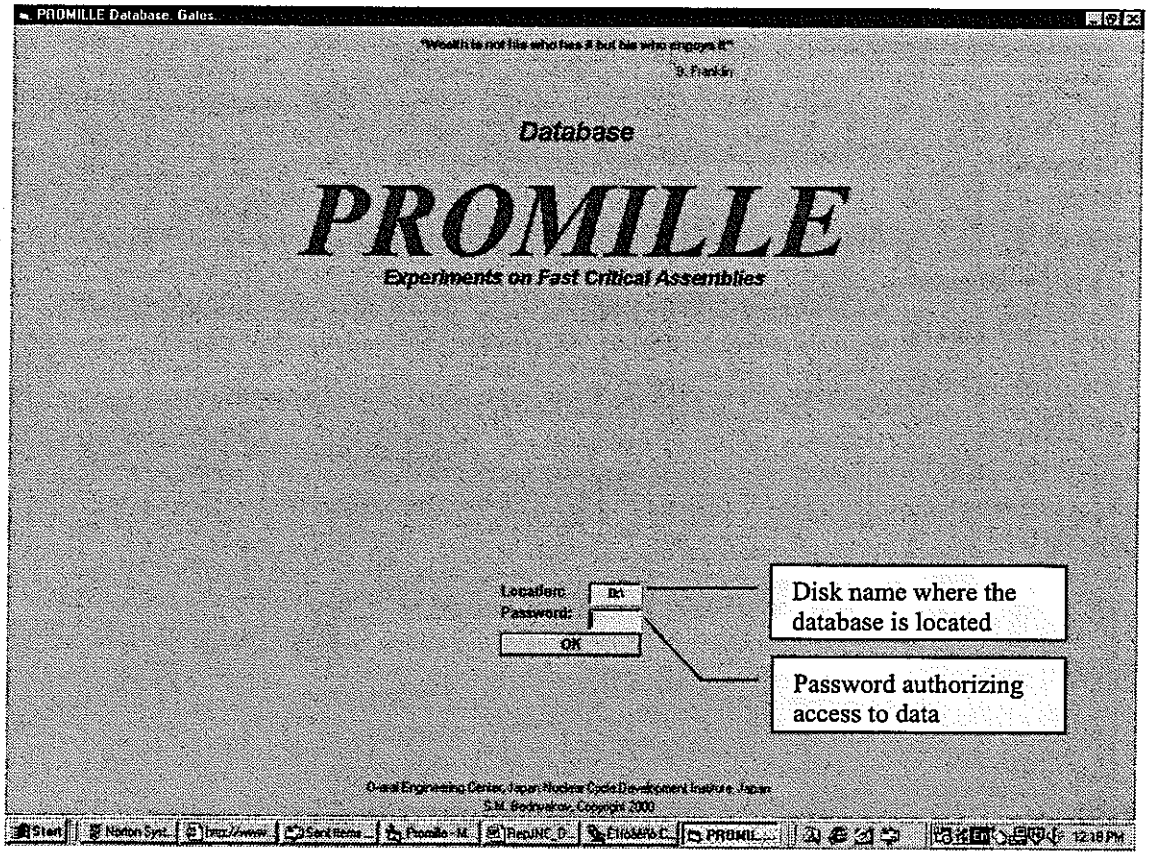
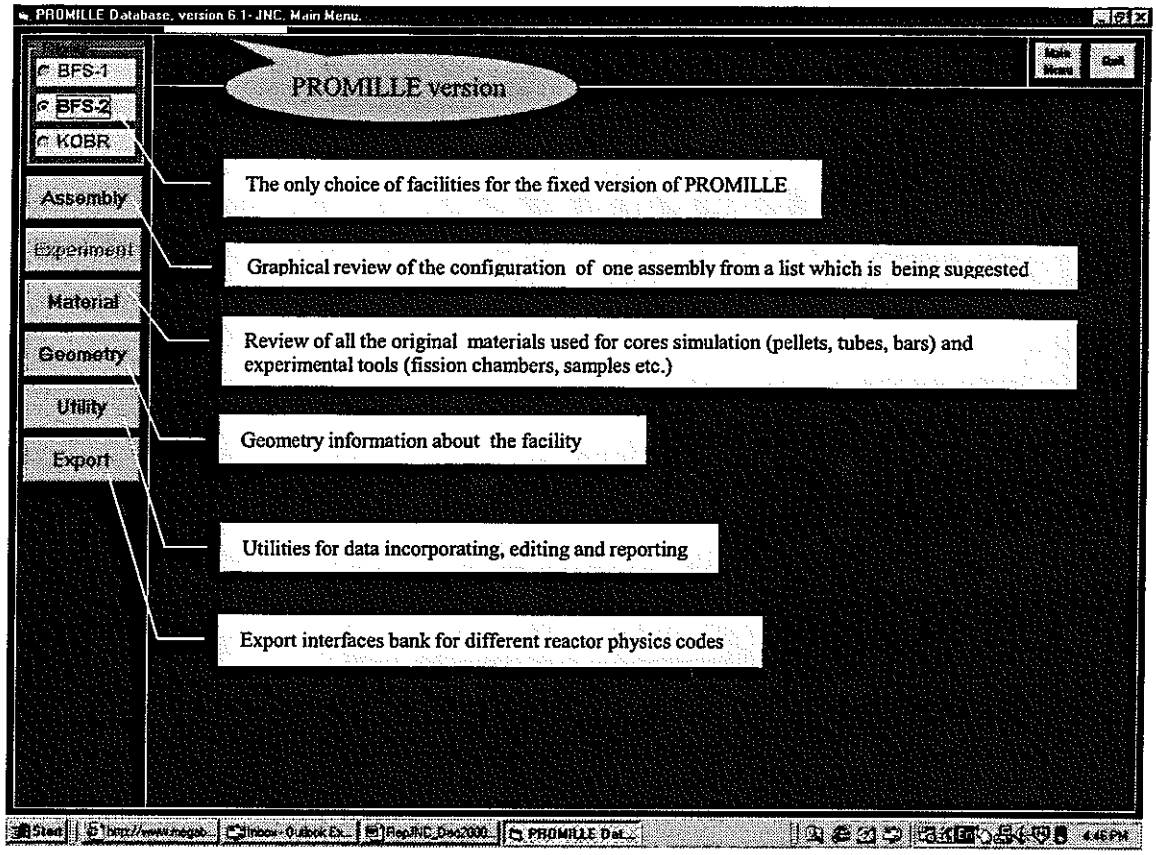


Fig. A1.1. Starting PROMILLE.



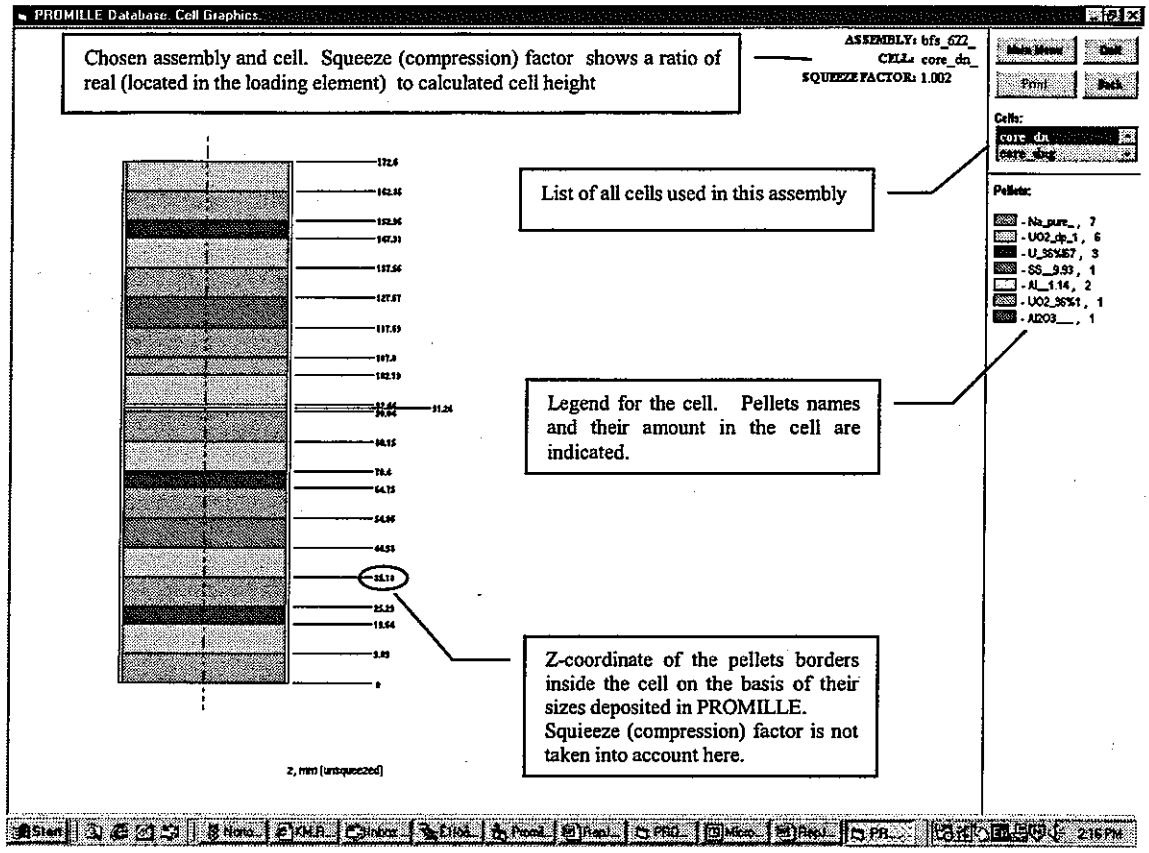
BFS-1, KOBR choices are not activated. An interface for these facilities is planned to be established.

Experiment button is not activated. An access to data for a chosen experiment investigation comprising all assemblies is planned to be established.

Main Menu button clears the main panel.

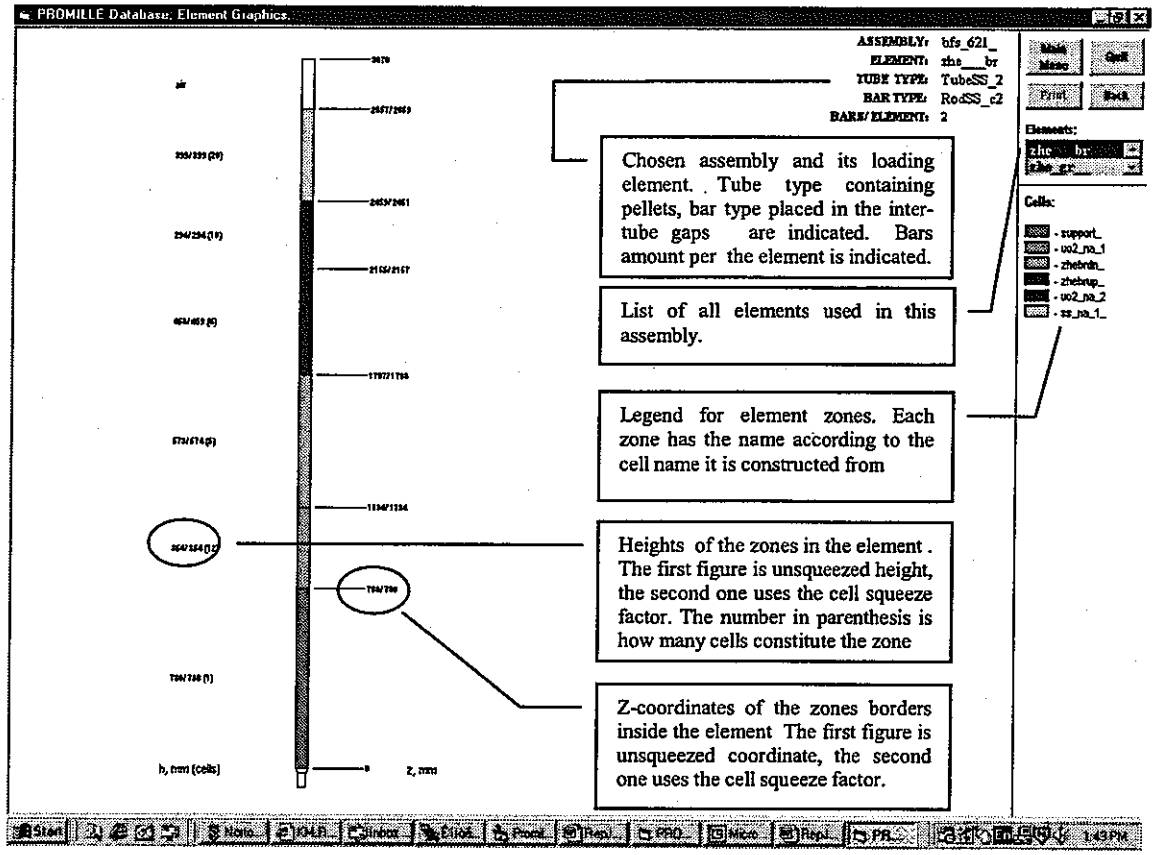
Quit button quits PROMILLE.

Fig. A1.2. PROMILLE main menu.



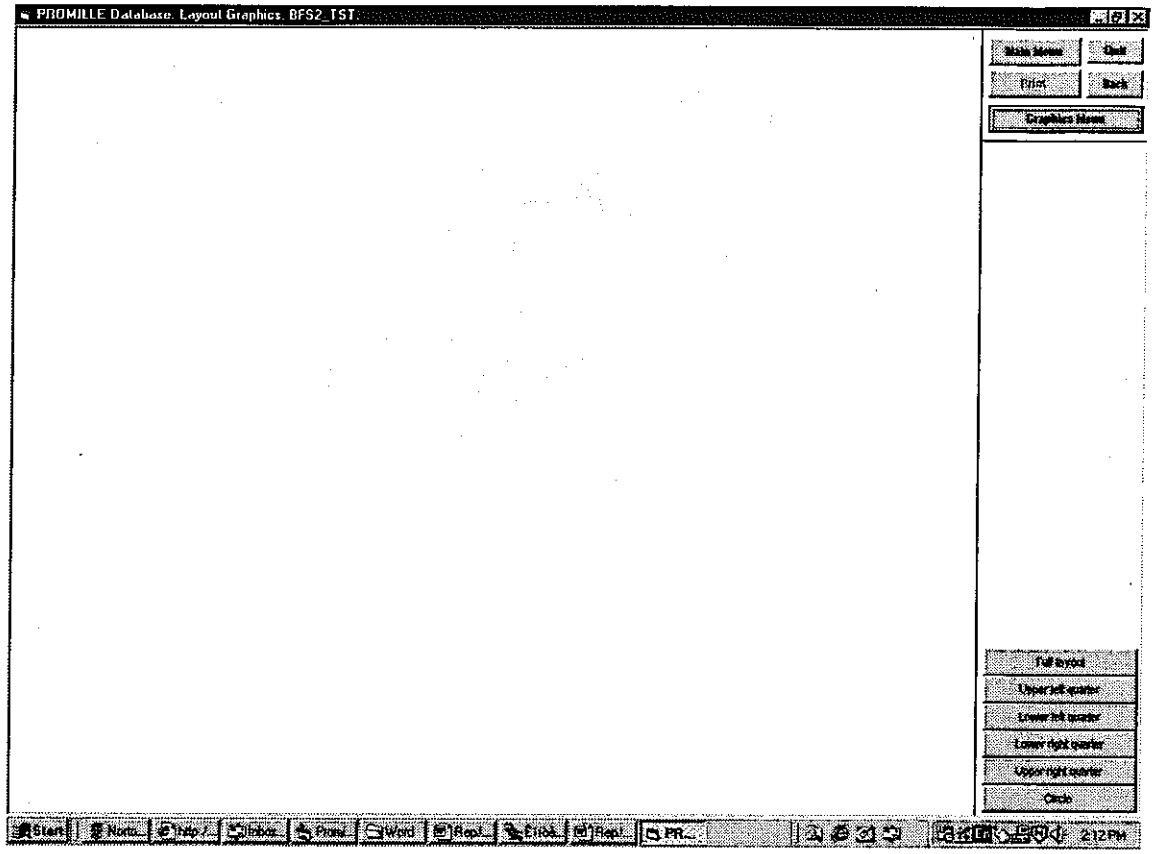
Main Menu button returns to the main panel.
Back button returns one step back for the assembly review.
Print button is not activated. Printing from the screen is planned to be established.
Quit button quits PROMILLE.

Fig. A1.3. Assembly cell viewer.



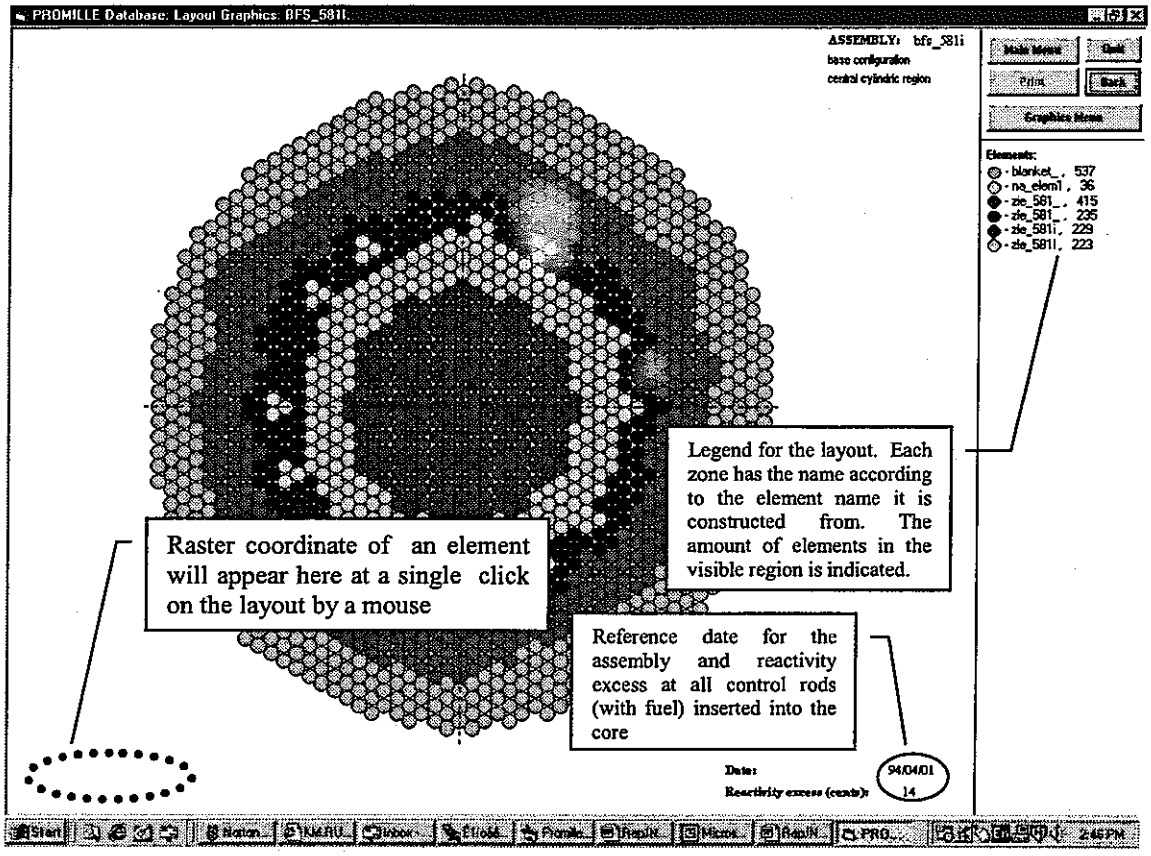
Main Menu button returns to the main panel.
Back button returns one step back for the assembly review.
Print button is not activated. Printing from the screen is planned to be established.
Quit button quits PROMILLE.

Fig. A1.4. Assembly loading element viewer.



Main Menu button returns to the main panel.
Back button returns one step back for the assembly review.
Print button is not activated. Printing from the screen is planned to be established.
Quit button quits PROMILLE.
Graphics Menu button causes the appearing of the hereinafter buttons.
Full layout button provides a full facility layout drawing.
Upper left quarter, Upper right quarter, Lower left quarter, Lower right quarter buttons provide corresponding mode of facility layout drawing.
Circle button provides drawing of central cylindrical region of an indicated radius (after pressing on this button the inquiry about region radius will follow) is drawn.

Fig. A1.5. Layout viewer: preliminary panel.



Main Menu button returns to the main panel.

Back button returns one step back for the assembly review.

Graphics Menu button allows to choose a mode of the layout drawing (full layout, upper left part, upper right part, lower left part, lower right part and central cylindrical region of an indicated radius).

Print button is not activated. Printing from the screen is planned to be established.

Quit button quits PROMILLE.

Fig. A1.6. Assembly layout viewer for the central cylindrical region.

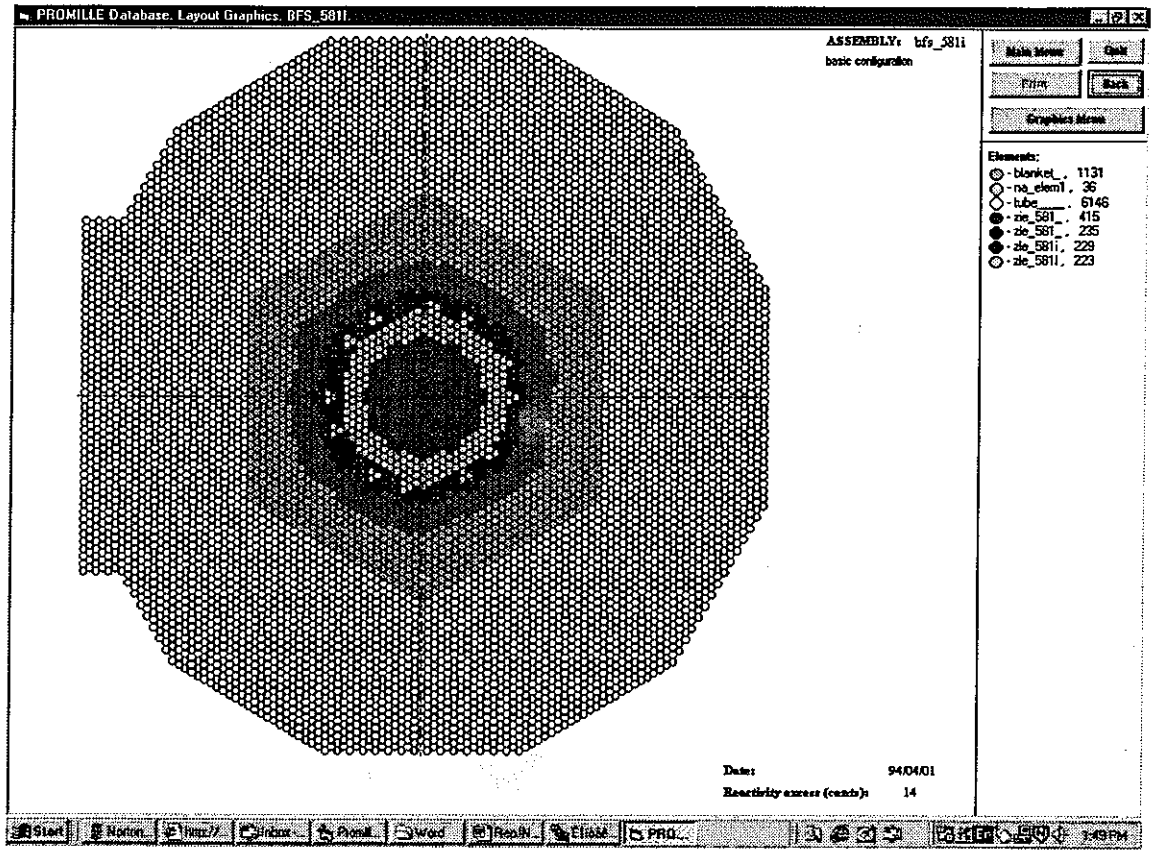


Fig. A1.7. Layout viewer of the entire chosen assembly (see also Fig. A1.6).

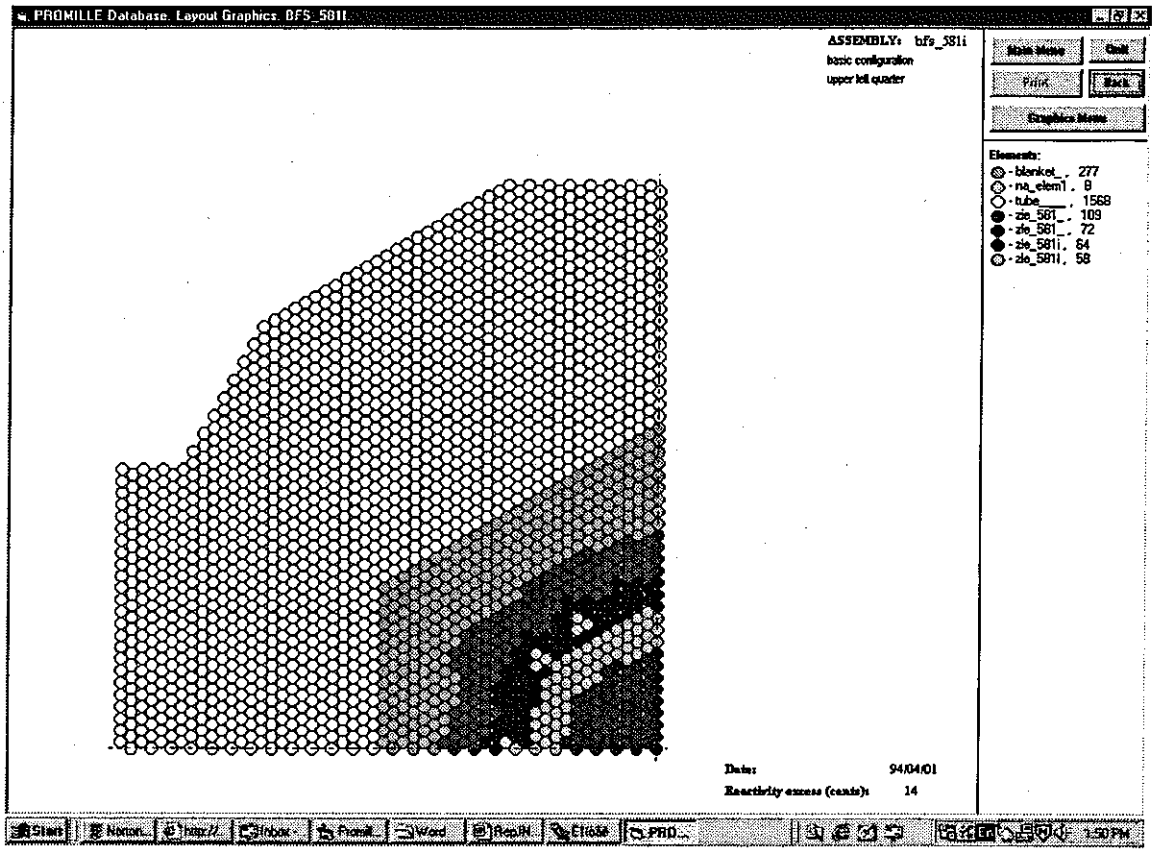
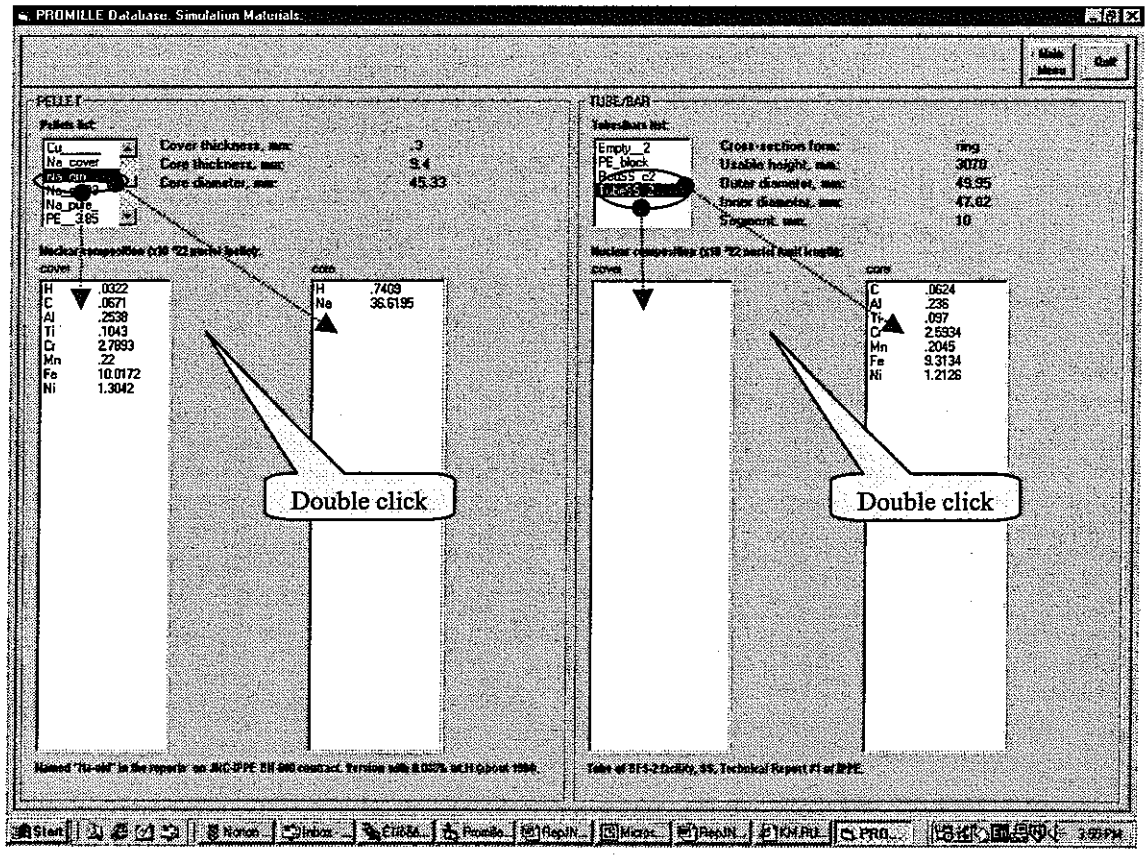


Fig. A1.8. Assembly layout viewer: upper left quarter (see also Fig. A1.6).



Main Menu button returns to the main panel.
Quit button quits PROMILLE.

Fig. A1.9. Original materials viewer.

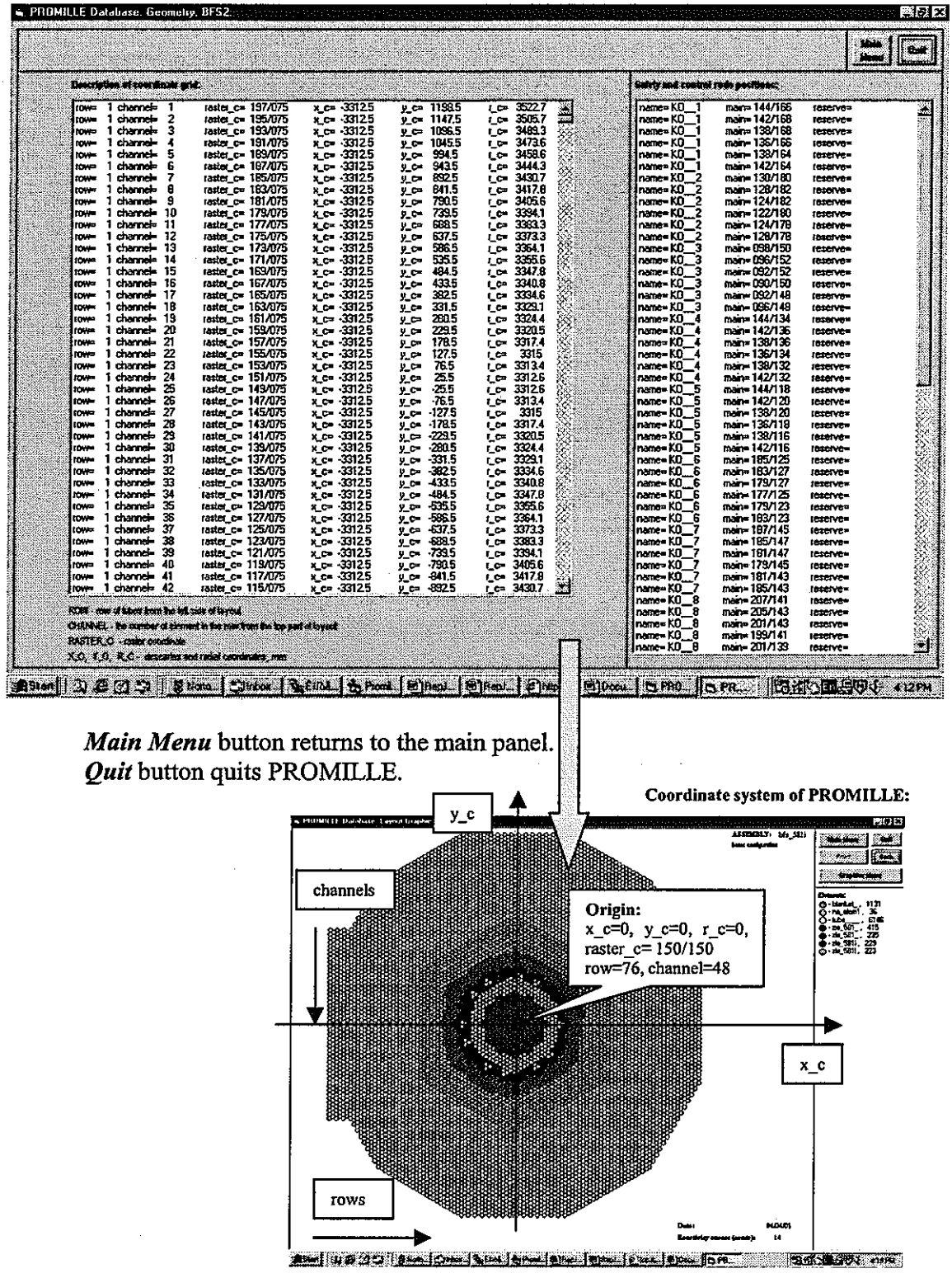
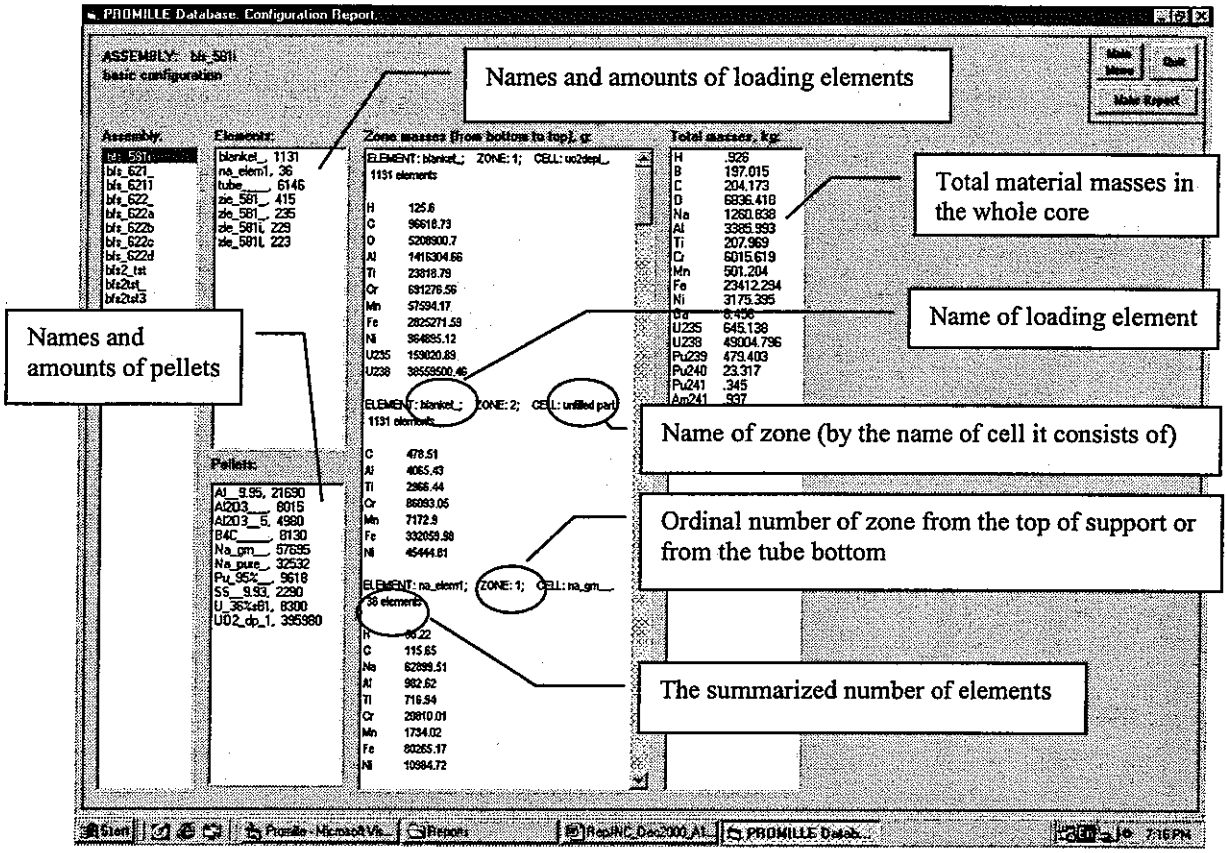
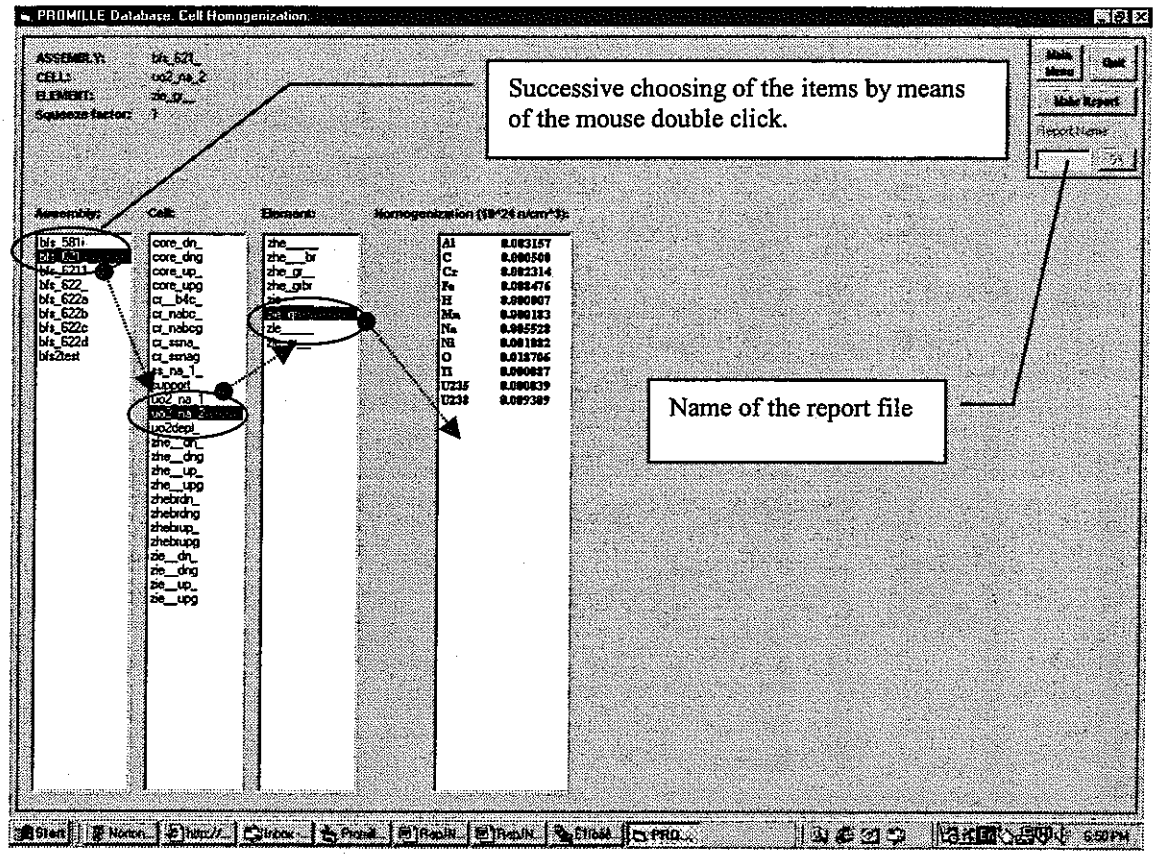


Fig. A1.10. Geometry parameters of the BFS-2 facility with graphical explanation of the coordinate system.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Make Report button make a report file about the materials loaded in the assembly.

Fig. A1.11. Example of a configuration mass report.



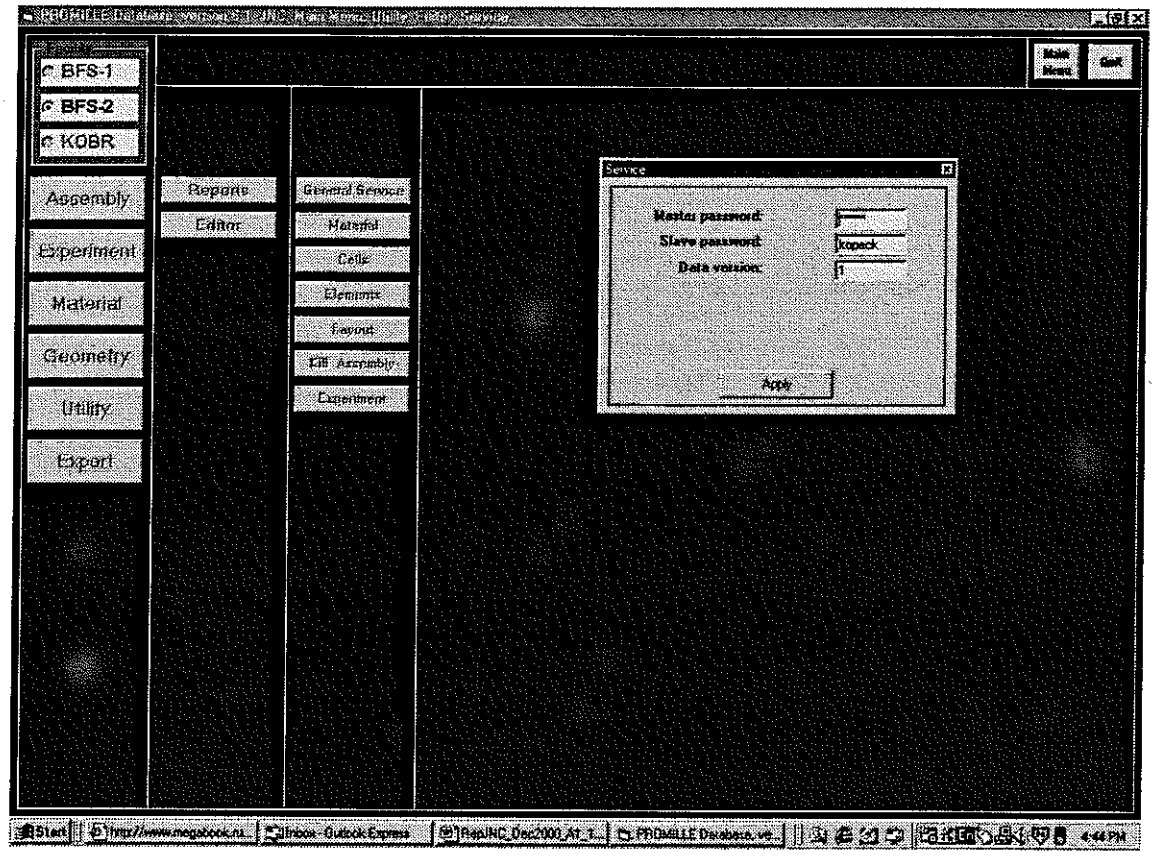
Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Make Report button activates the window to insert report file name and ***OK*** confirmation button.

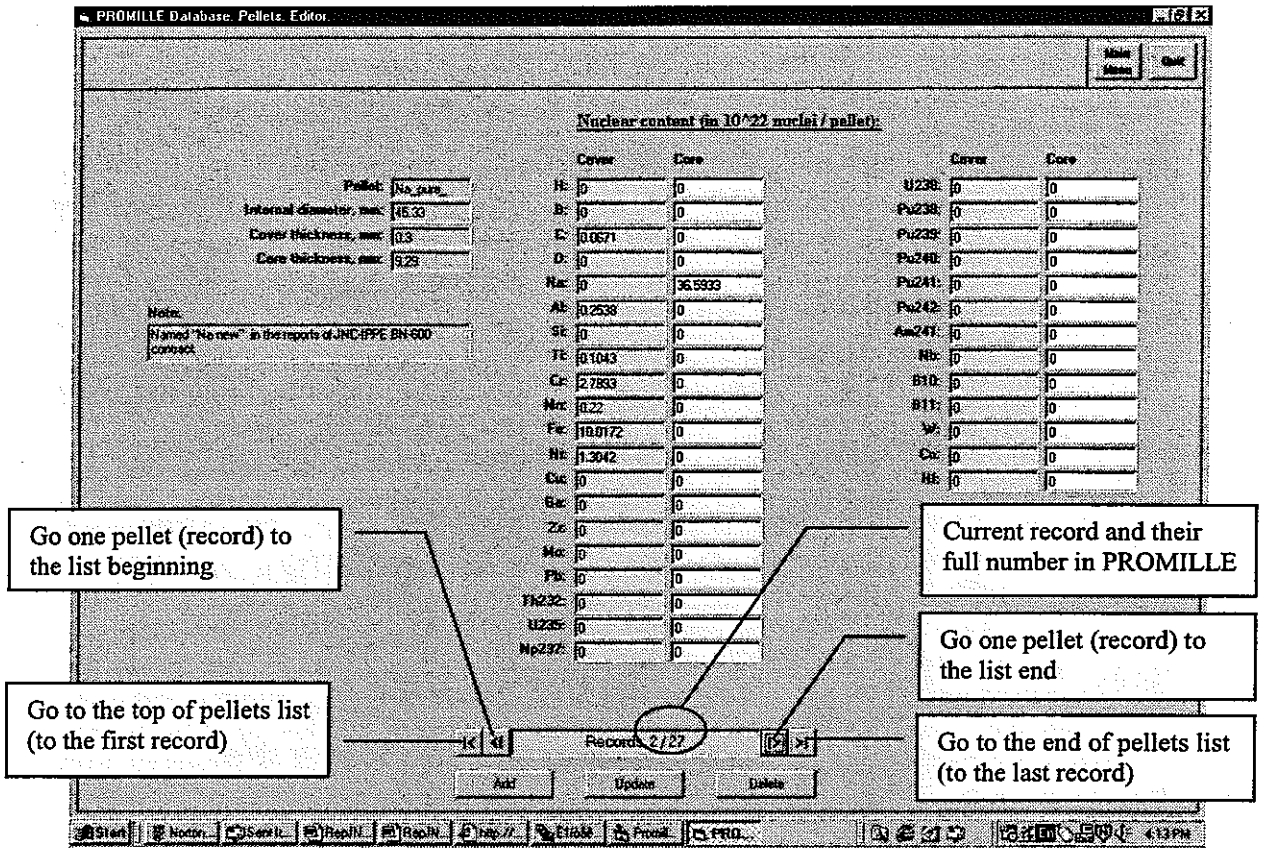
OK button creates a file of the specified name.

Fig. A1.12. Example of a cell homogenization report.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Apply button incorporates the content of the textboxes into PROMILLE.

Fig. A1.13. ***General Service*** panel.



Main Menu button returns to the main panel.

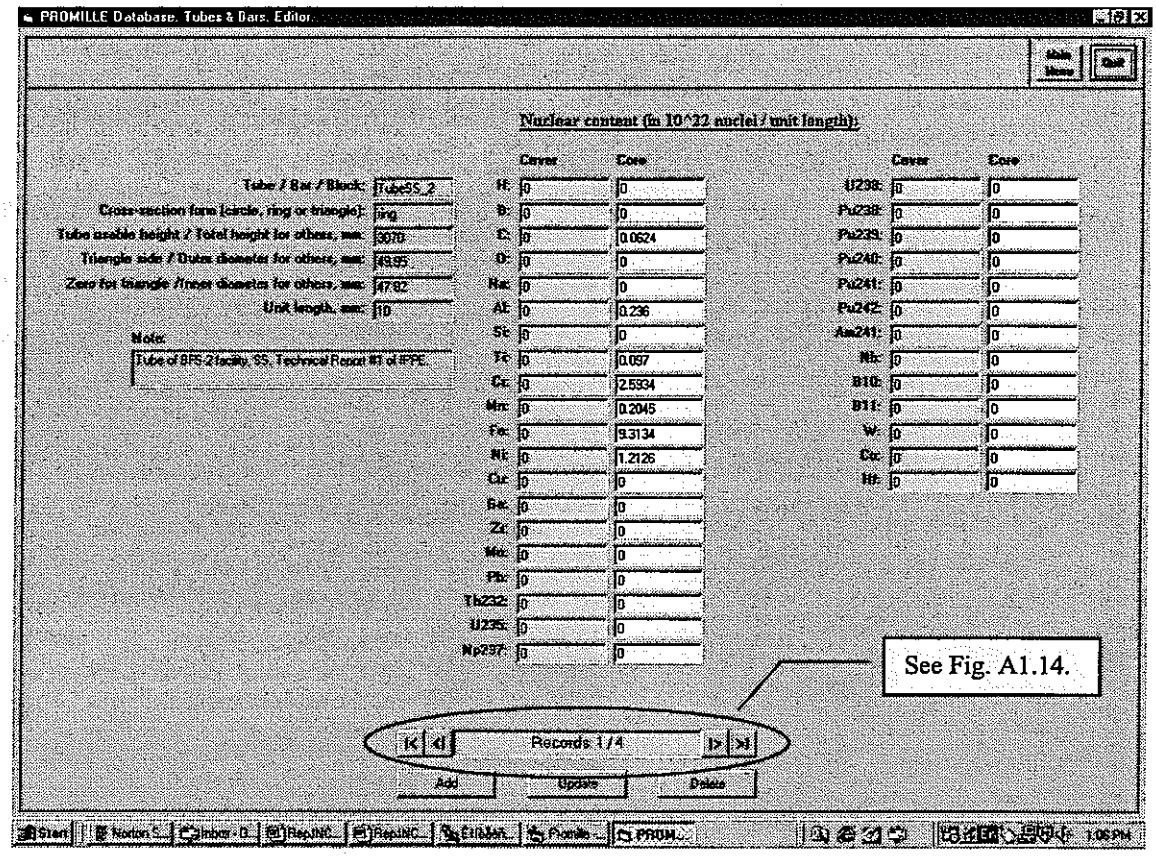
Quit button quits PROMILLE.

Add button adds empty record to the database.

Update button substitutes the originally indicated data in the textboxes for the result of their editing.

Delete button removes the textboxes information from PROMILLE.

Fig. A1.14. ***Pellets*** panel for pellets editing.



Main Menu button returns to the main panel.

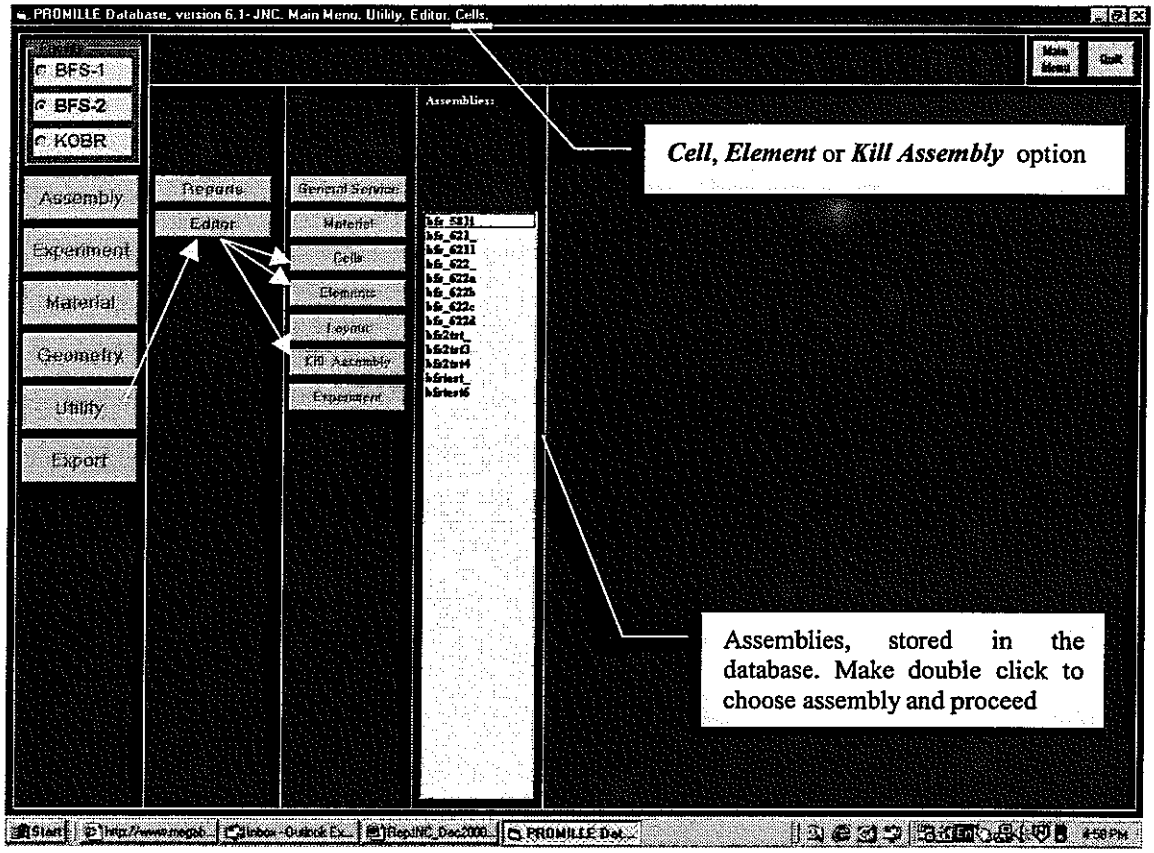
Quit button quits PROMILLE.

Add button adds empty record to the database.

Update button substitutes the originally indicated data in the textboxes for the result of their editing.

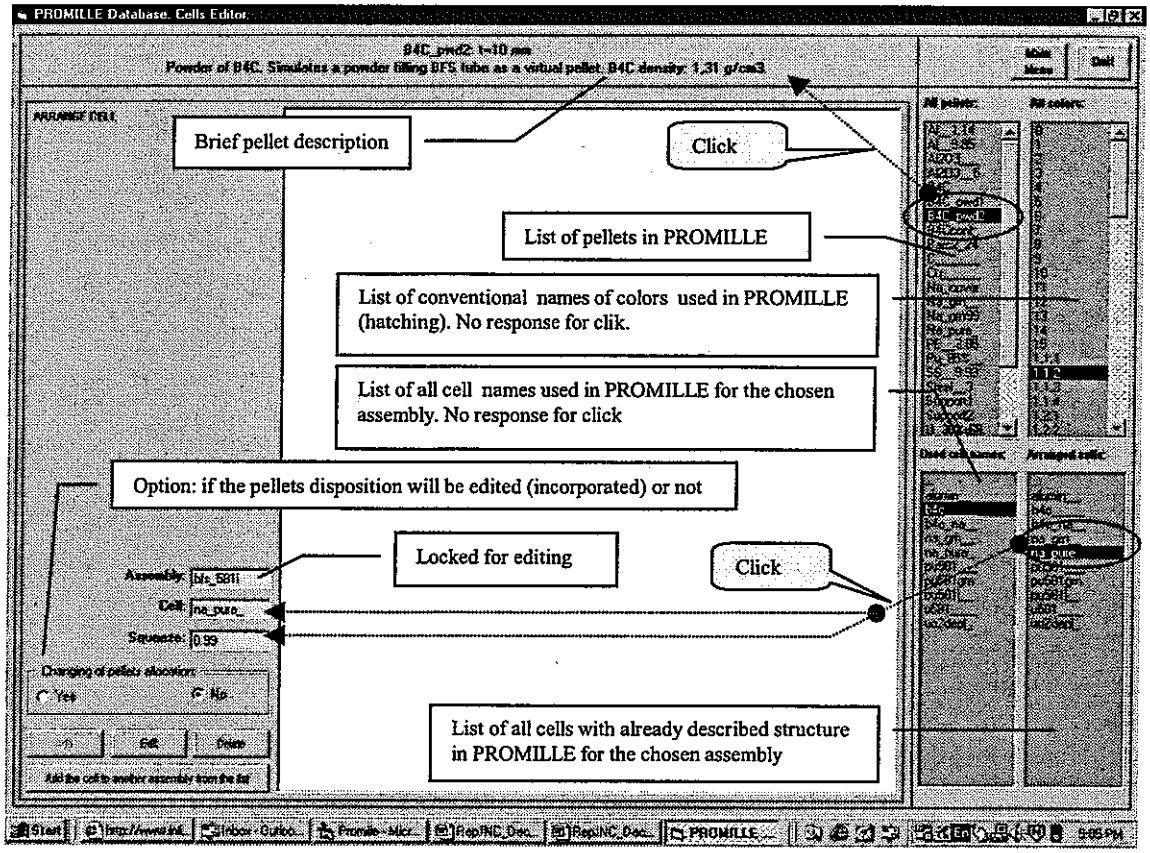
Delete button removes the textboxes information from PROMILLE.

Fig. A1.15. ***Tubes and Bars*** panel for tubes and bars editing.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.

Fig. A1.16. Choosing assembly for a cell and element editing or layout eliminating.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

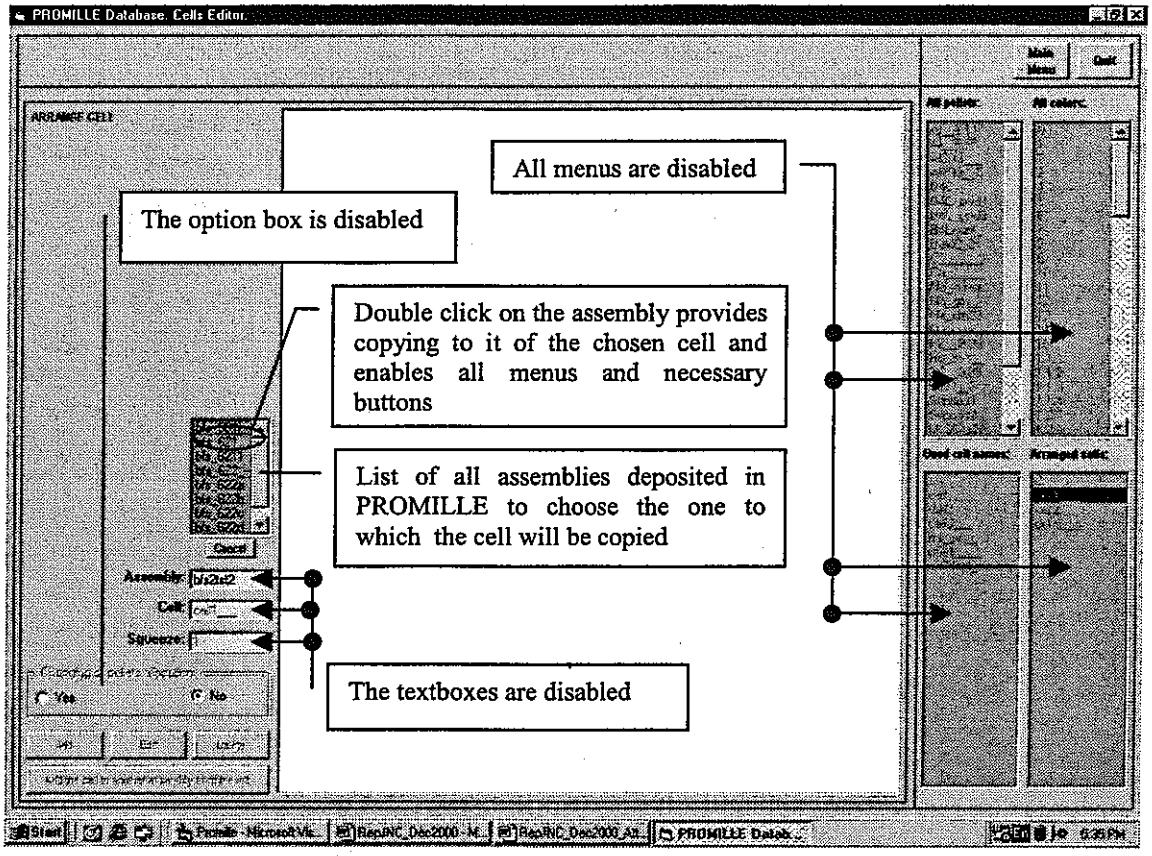
Add button doesn't active if "Changing of pellets allocaton" option is "No".

Edit button completes editing of the cell name and its squeeze factor only. Existing information about pellets allocation and their colors doesn't changed.

Delete button removes the chosen cell from the database.

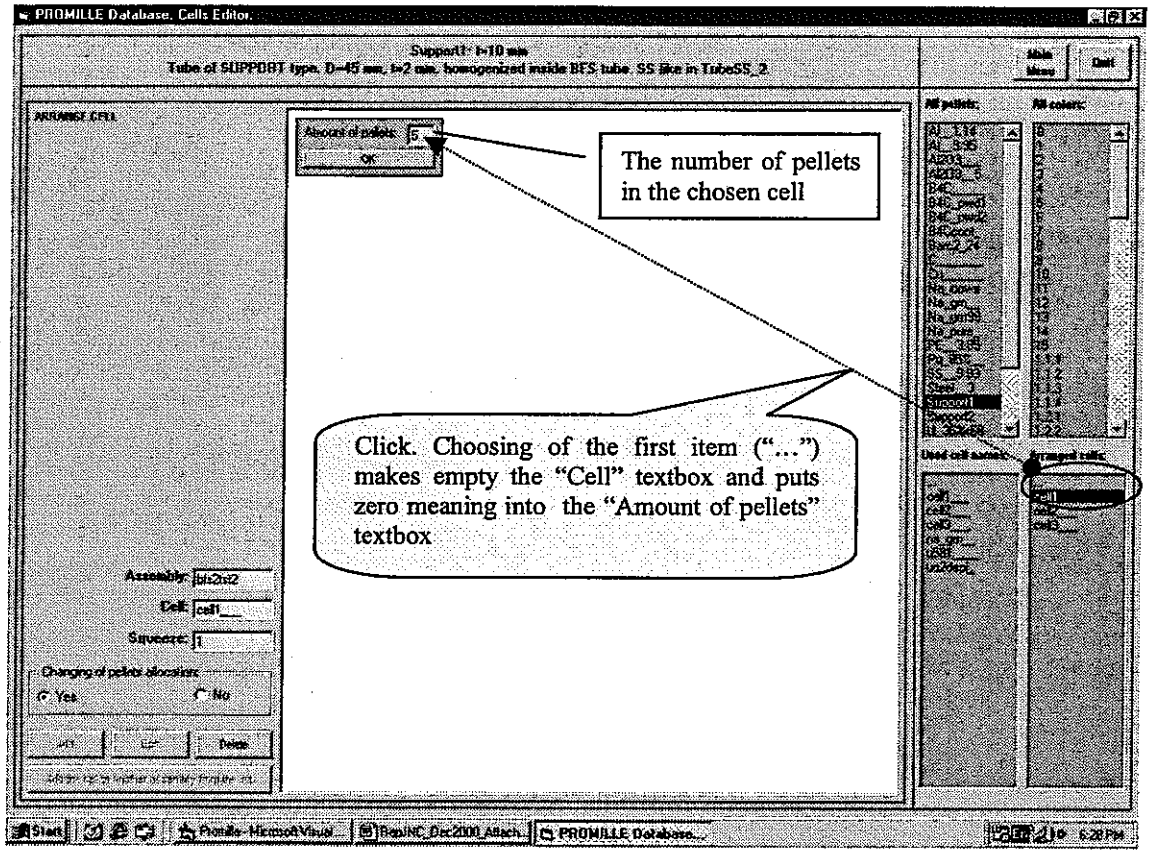
Add the cell to another assembly from the list button provides copying of the chosen cell to another assembly.

Fig. A1.17. Cell editor start panel when not "Changing of pellets allocation" option.



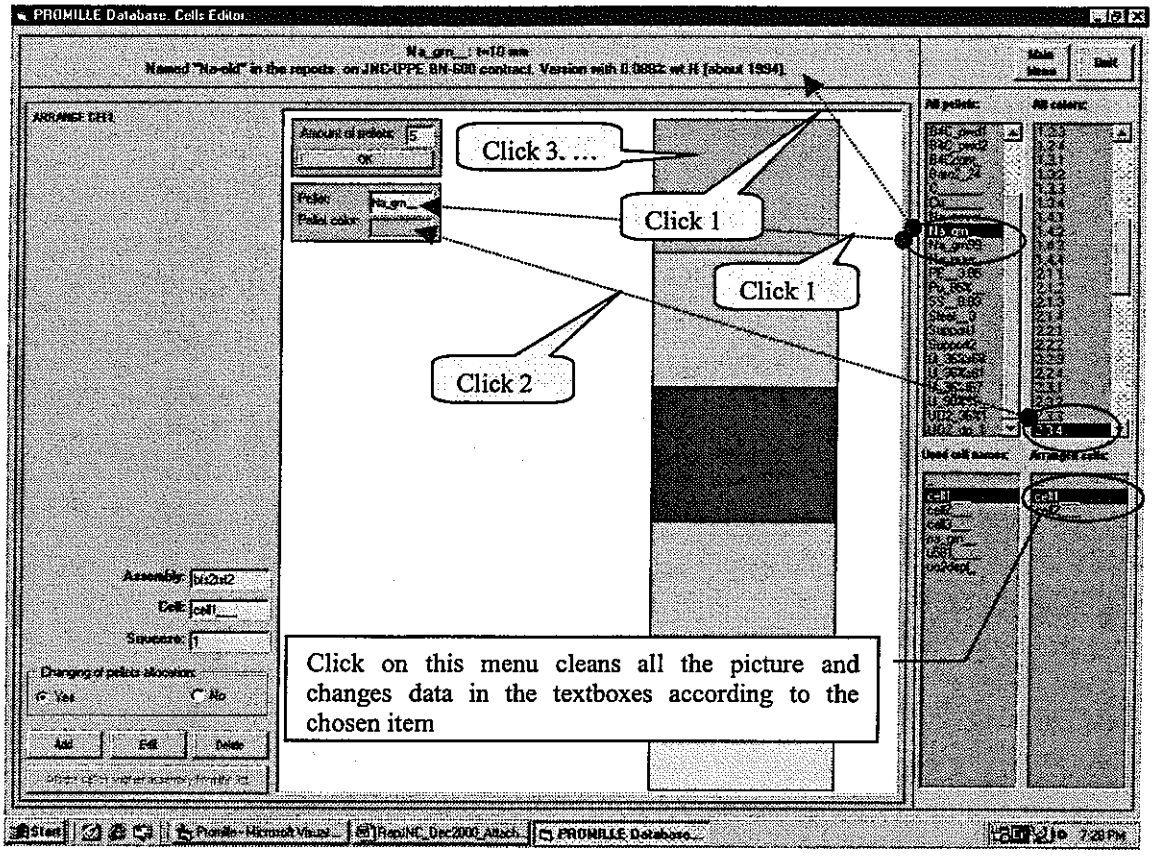
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button doesn't active.
Edit button doesn't active.
Delete button doesn't active.
Add the cell to another assembly from the list button doesn't active.
Cancel button discards copying of the cell to another assembly, enables all menus and necessary buttons.

Fig. A1.18. Cell editor panel: ***Add the cell to another assembly from the list.***



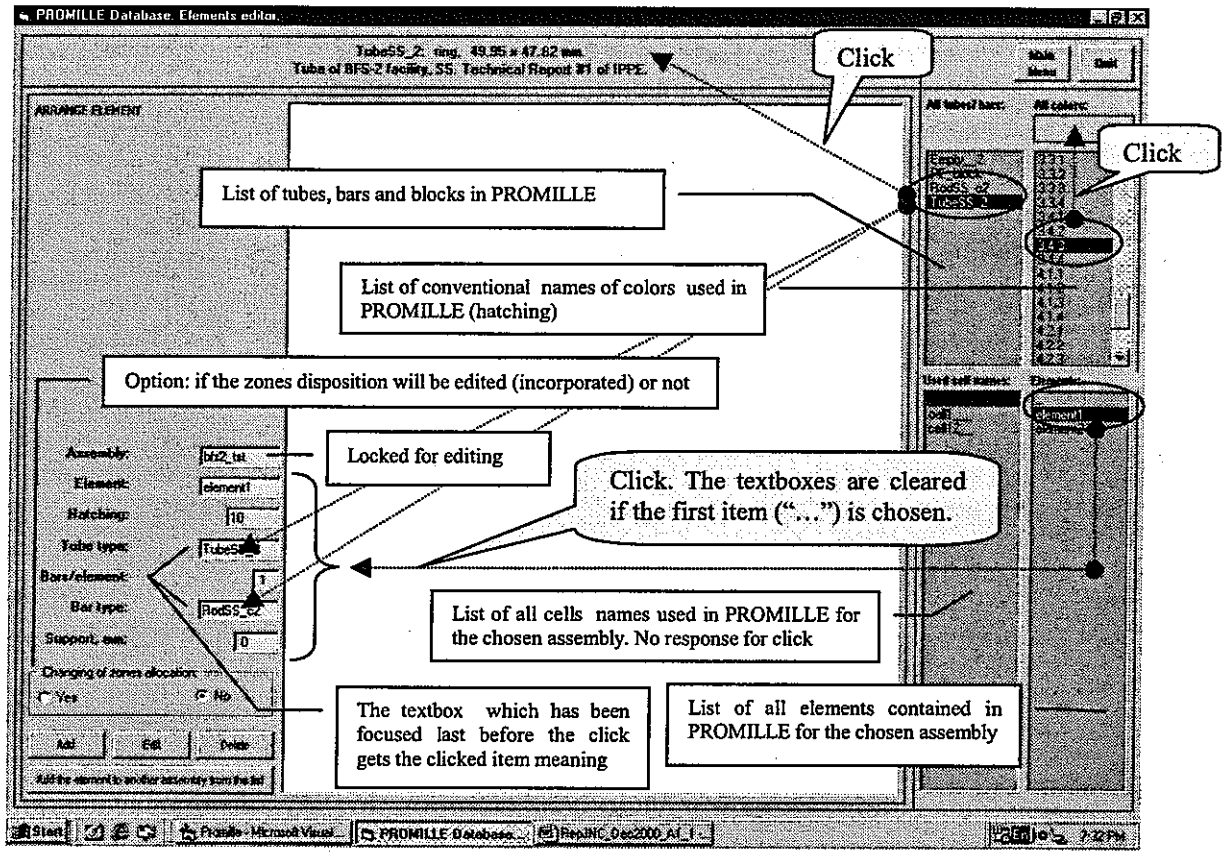
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button doesn't active.
Edit button doesn't active.
Delete button removes the chosen cell from the database.
Add the cell to another assembly from the list button doesn't active.
OK button activates a graphical editing of the cell.

Fig. A1.19. Cell editor panel when "Changing pellets allocation" selected.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button completes the incorporation of the new cell into the database.
Edit button completes changing in the existing cell.
Delete button removes the chosen cell from the database.
Add the cell to another assembly from the list button doesn't active.
OK button turns all the colors in the drawn cell to a white color.

Fig. A1.20. Cell editor panel : arranging a cell under "Changing pellets allocation".



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

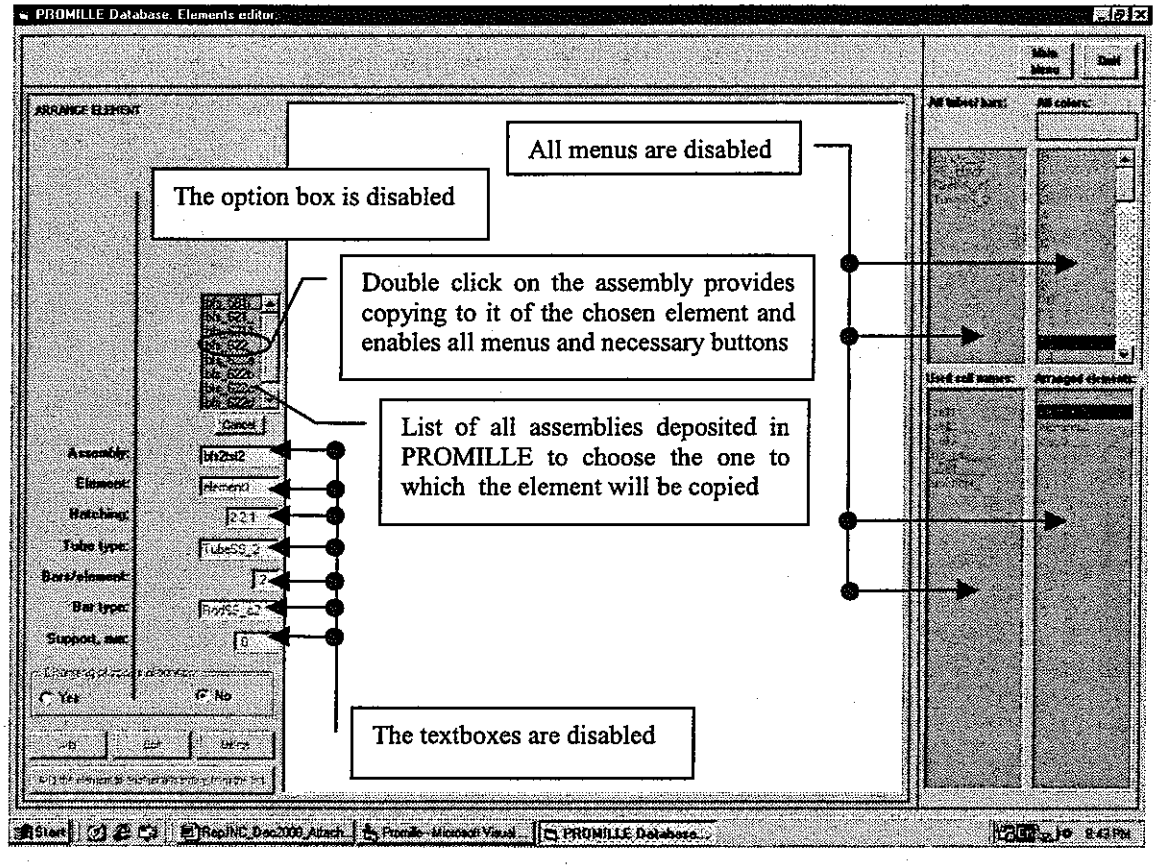
Add button completes incorporation of a new element into the database.

Edit button completes editing of the element parameters in the textboxes from the left side of the panel. Existing information on zones colors, names and heights doesn't changed.

Delete button removes the chosen element from the database.

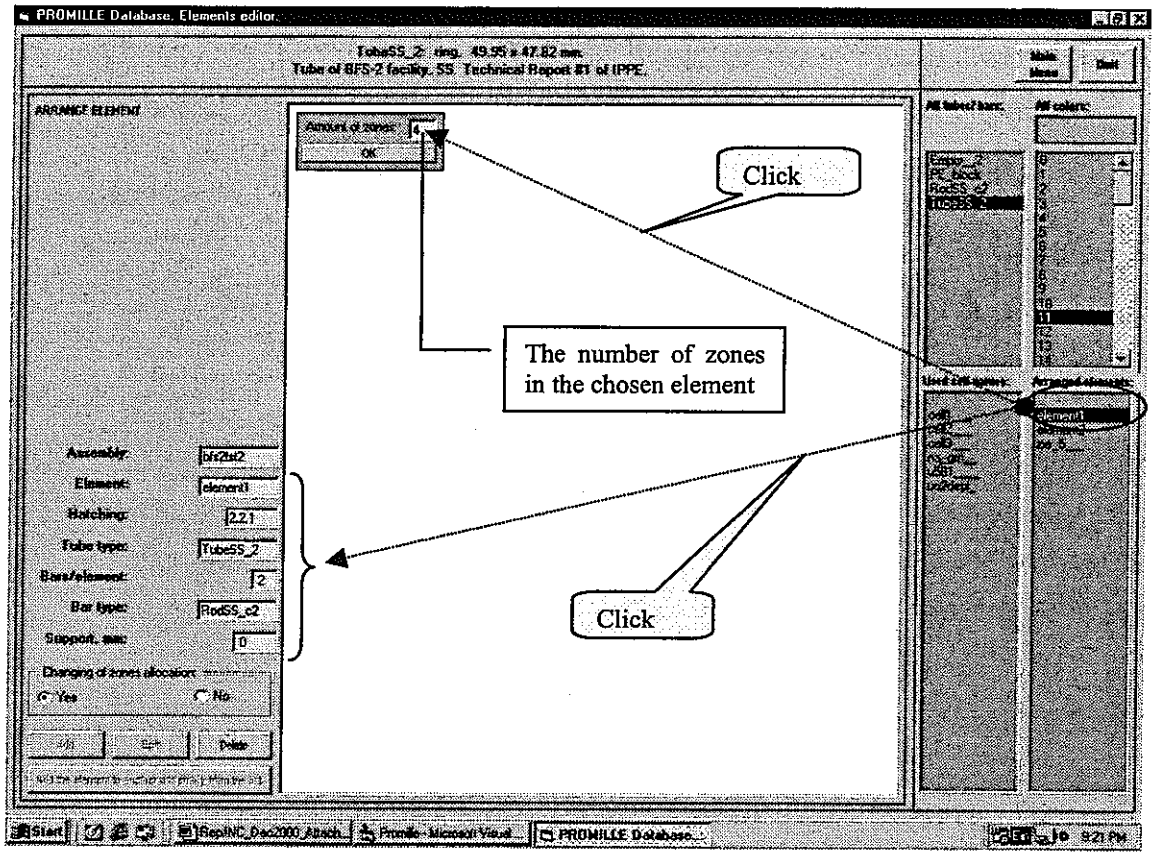
Add the element to another assembly from the list button provides copying of the chosen element to another assembly.

Fig. A1.21. Start panel of loading element editor with no "Changing of zones allocation".



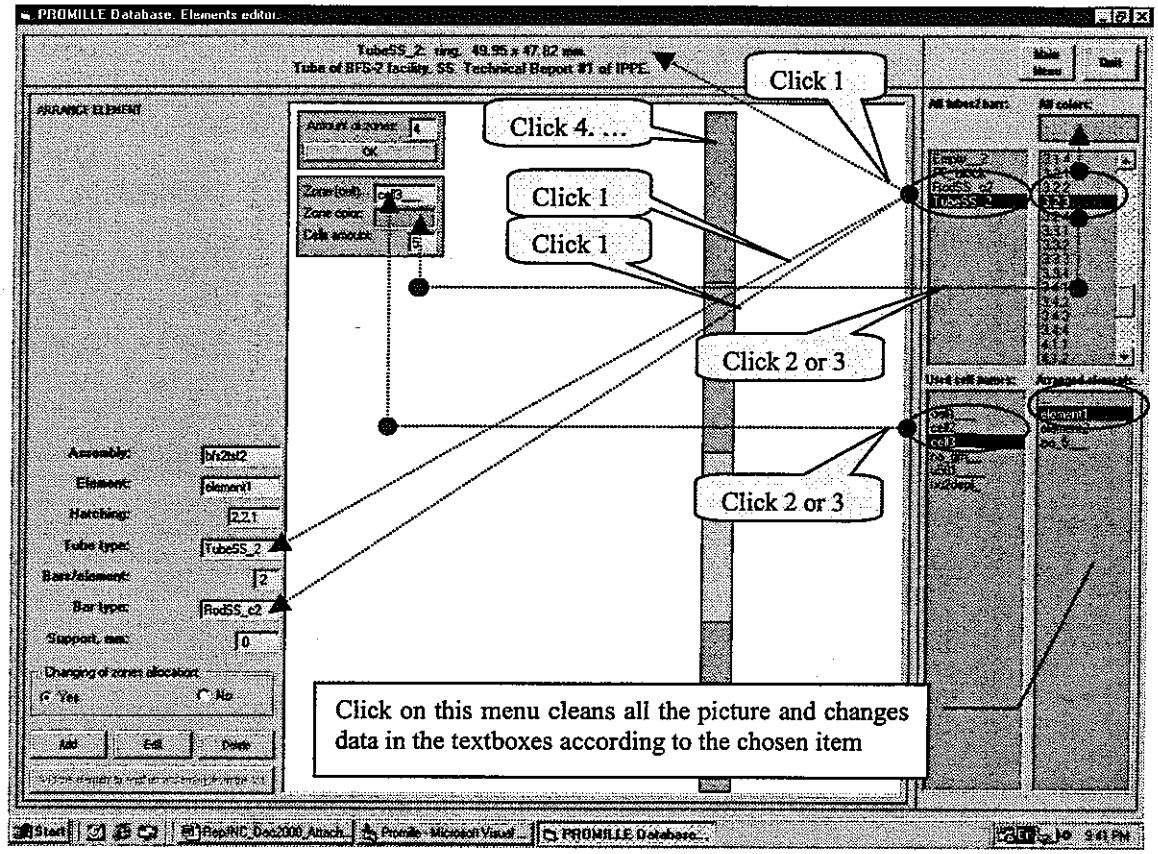
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button doesn't active.
Edit button doesn't active.
Delete button doesn't active.
Add the element to another assembly from the list button doesn't active.
Cancel button discards copying of the element to another assembly, enables all menus and necessary buttons.

Fig. A1.22. Element editor panel: ***Add the element to another assembly from the list.***



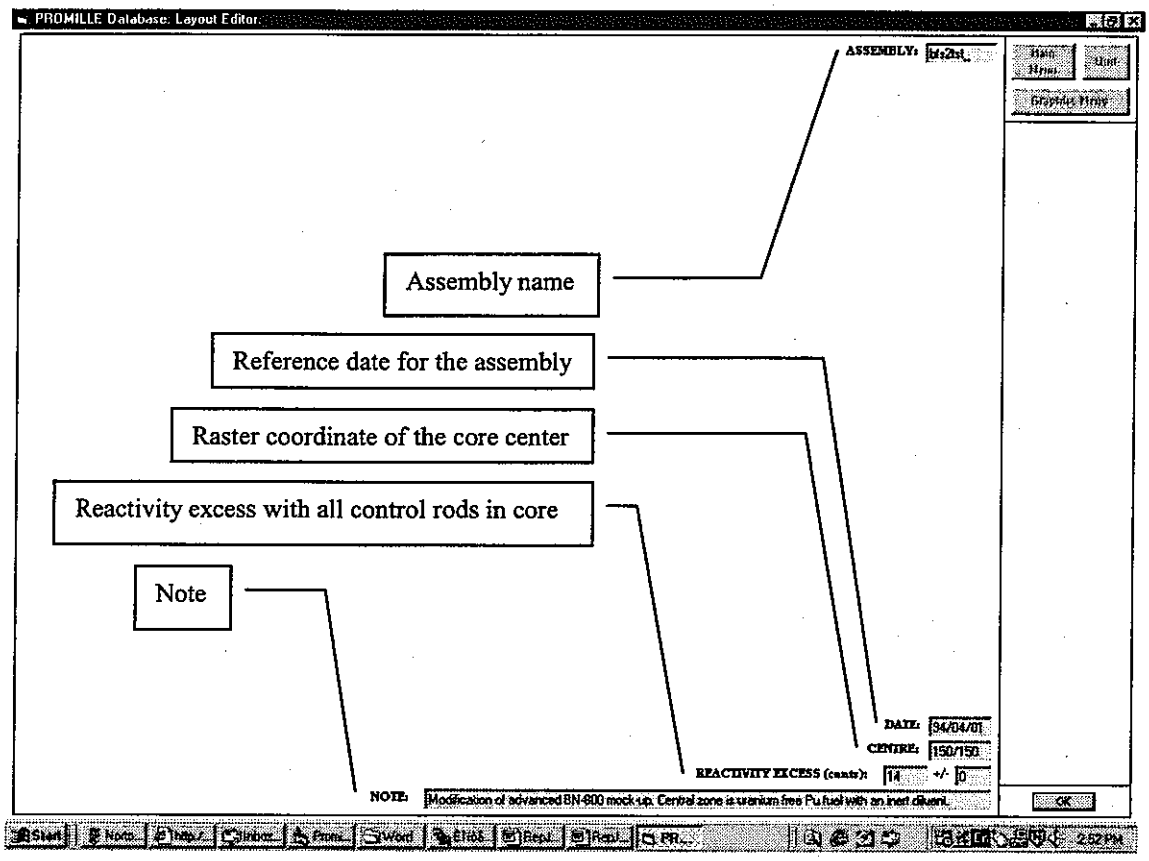
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button doesn't active.
Edit button doesn't active.
Delete button removes the chosen element from the database.
Add the element to another assembly from the list button doesn't active.
OK button activates a graphical editing of the element.

Fig. A1.23. Element editor panel: "Changing zones allocation"



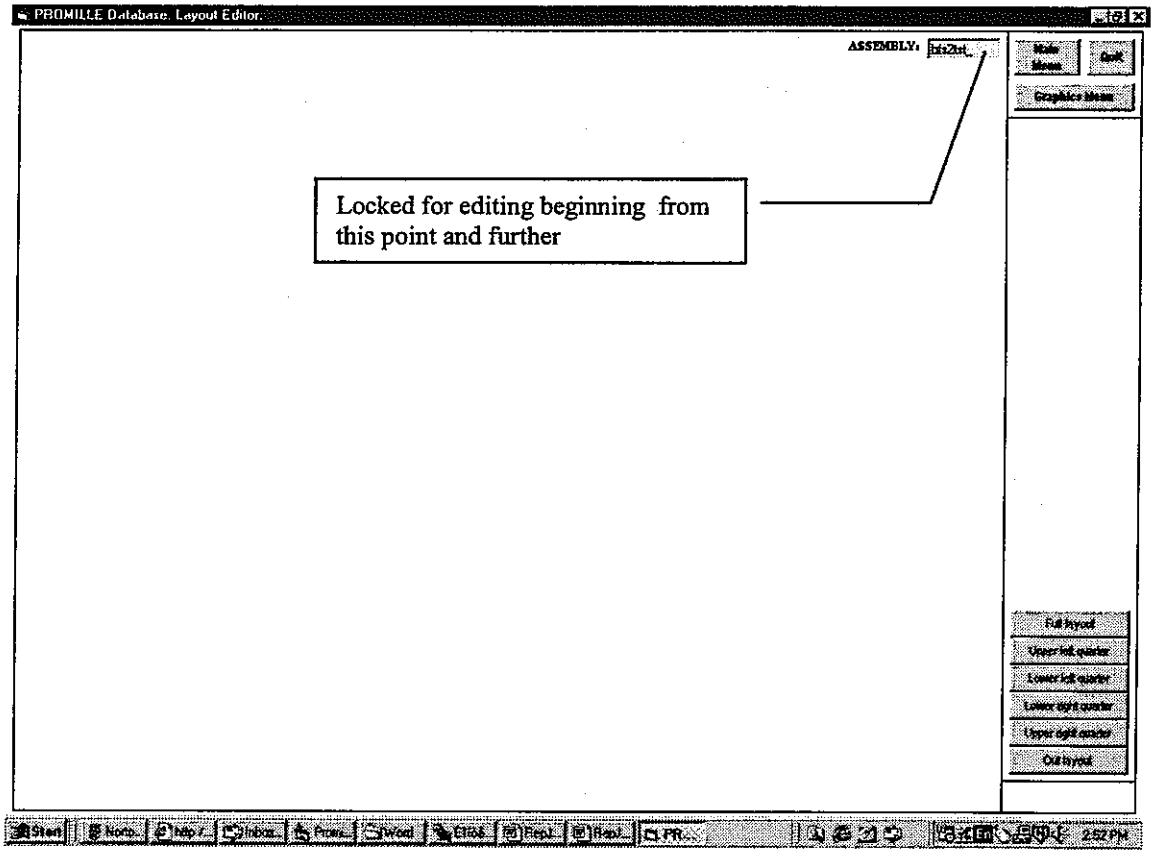
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Add button completes the incorporation of the new element into the database.
Edit button completes changing in the existing element.
Delete button removes the chosen element from the database.
Add the element to another assembly from the list button doesn't active.
OK button turns all the colors in the drawn element to a white color.

Fig. A1.24. Element editor panel: "Changing zones allocation" arranging of an element



Main Menu button doesn't active.
Quit button doesn't active.
Graphics Menu button doesn't active.
OK button confirms changes in the textboxes.

Fig. A1.25. Layout editor: start panel.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

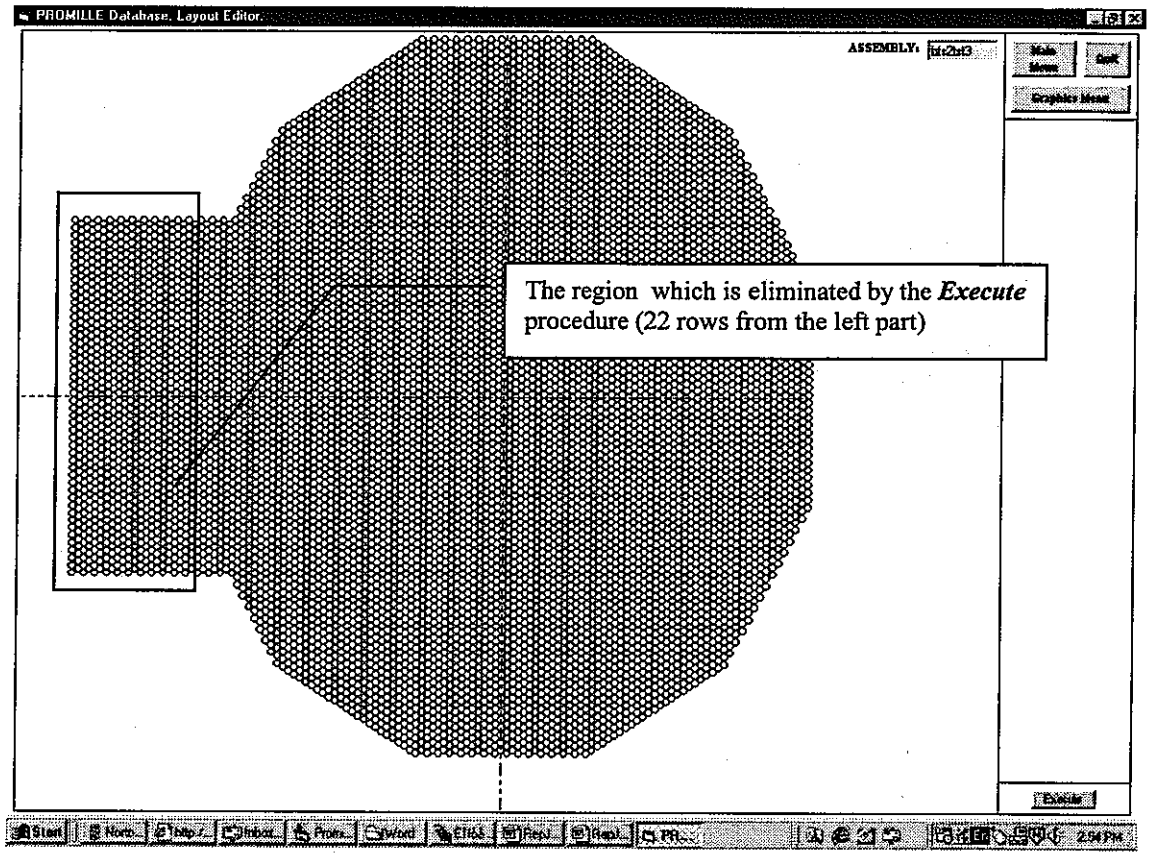
Graphics Menu button causes the appearing of the hereinafter buttons.

Full layout button provides a full facility layout drawing for editing.

Upper left quarter, ***Upper right quarter***, ***Lower left quarter***, ***Lower right quarter*** buttons provide corresponding mode of facility layout drawing for editing.

Cut layout button provides eliminating of the layout left part (so-called, metal column).

Fig. A1.26. Layout editor: choices for a layout presentation.



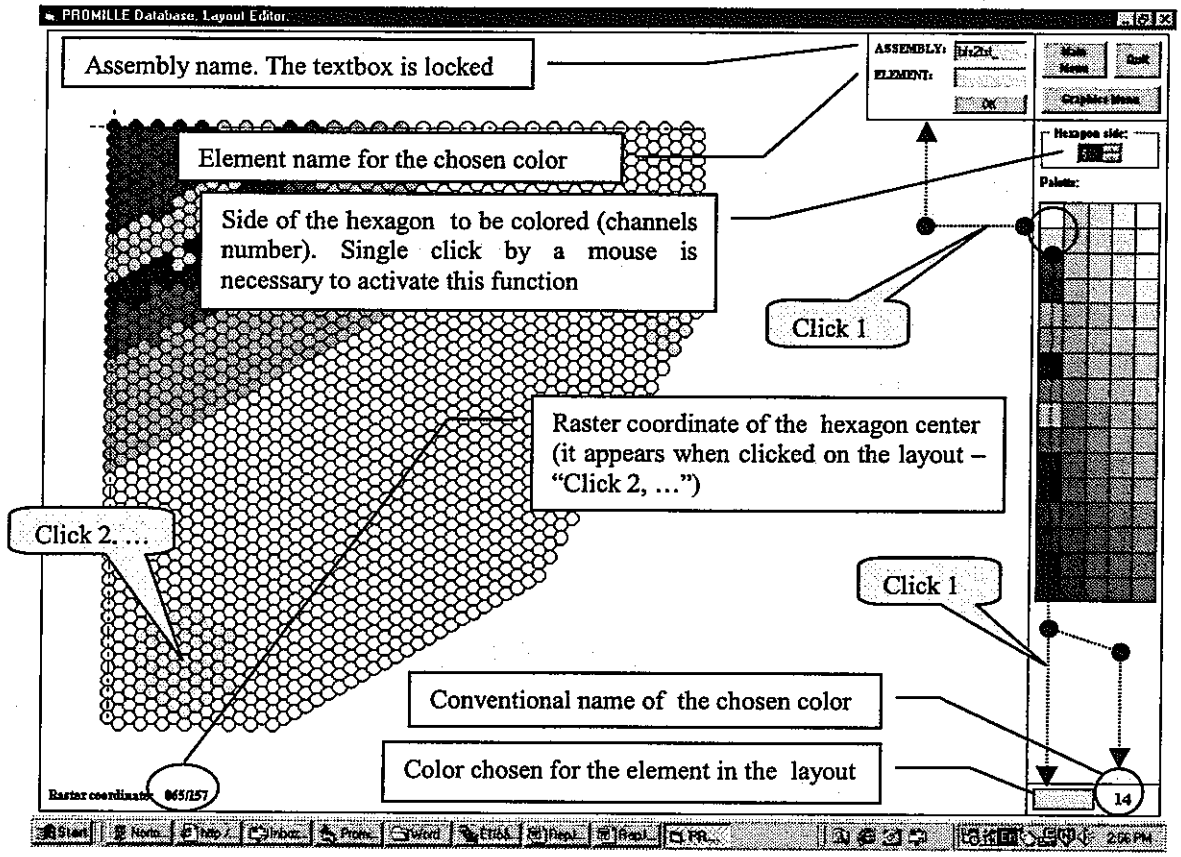
Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Graphics Menu button causes the appearing of the choice buttons for mode of layout drawing .

Execute button eliminates the left part of the layout if it has not been done before.

Fig. A1.27. Layout editor: ***Cut layout.***



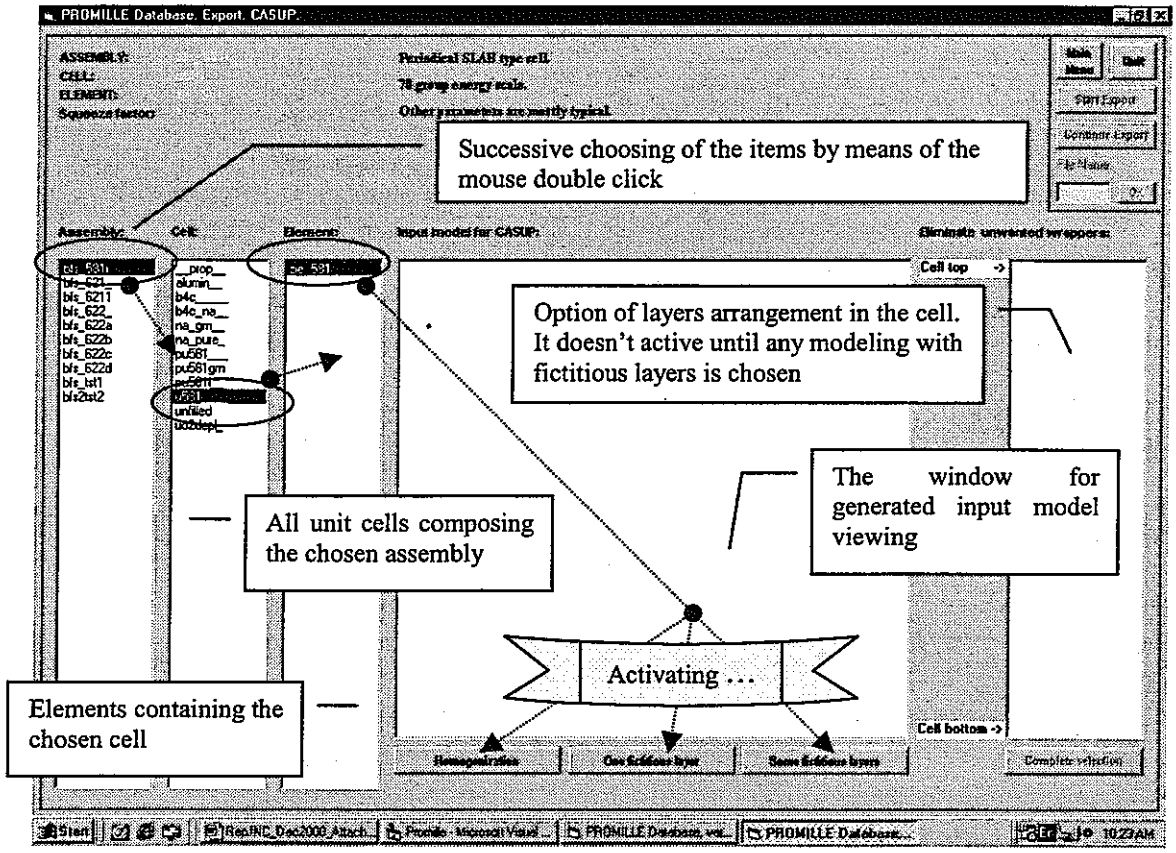
Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Graphics Menu button causes the appearing of the choice buttons for mode of layout drawing .

OK button adds the name of the loading element into the database.

Fig. A1.28. Layout editor : ***Lower right quarter*** selected.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Homogenization button provides generation of homogeneous cell model.

One fictitious layer button provides generation of a plate-stretch cell model with one fictitious layer.

Some fictitious layers button provides generation of a plate-stretch cell model with several fictitious layers.

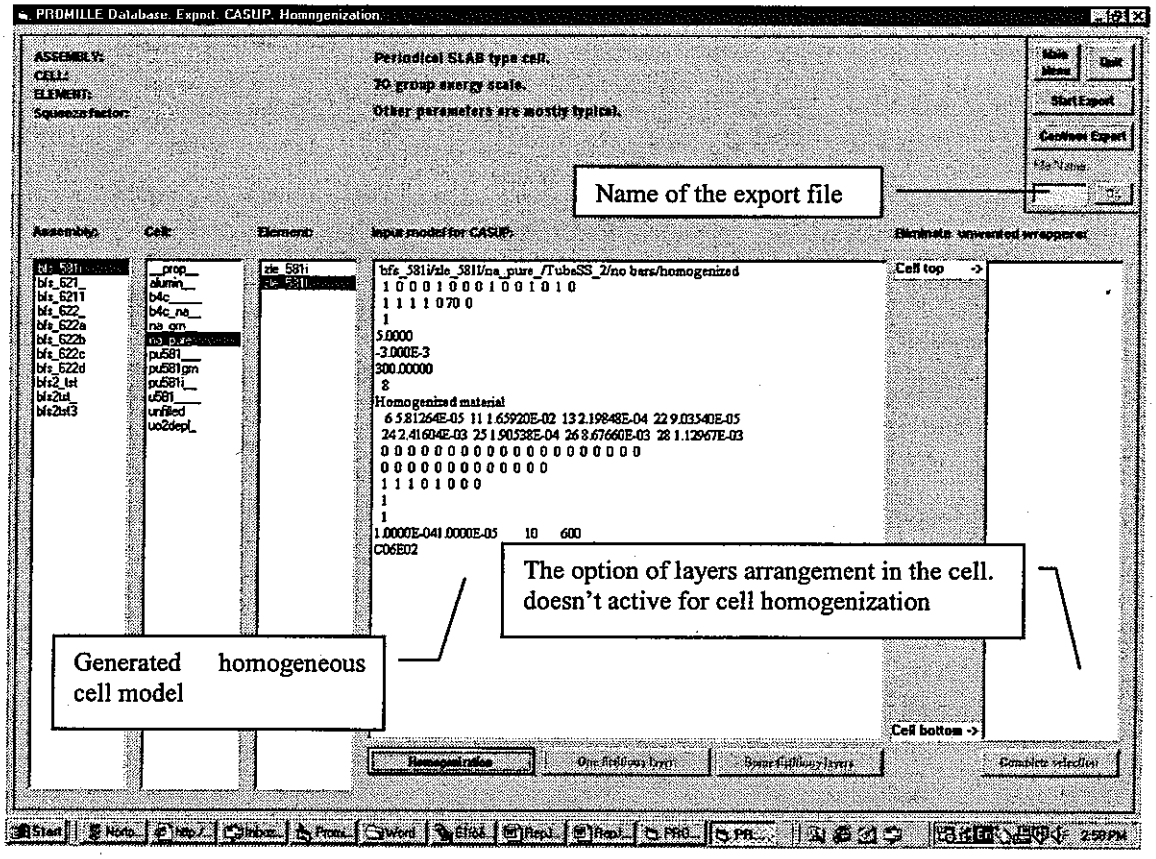
Complete selection button doesn't active.

Start Export button doesn't active.

Continue Export button doesn't active.

OK button doesn't active.

Fig. A1.29. CASUP export file panel: assembly, unit cell and loading element chosen.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Homogenization button provides generation of homogeneous cell model.

One fictitious layer button becomes disabled when ***Homogenization*** button is pressed.

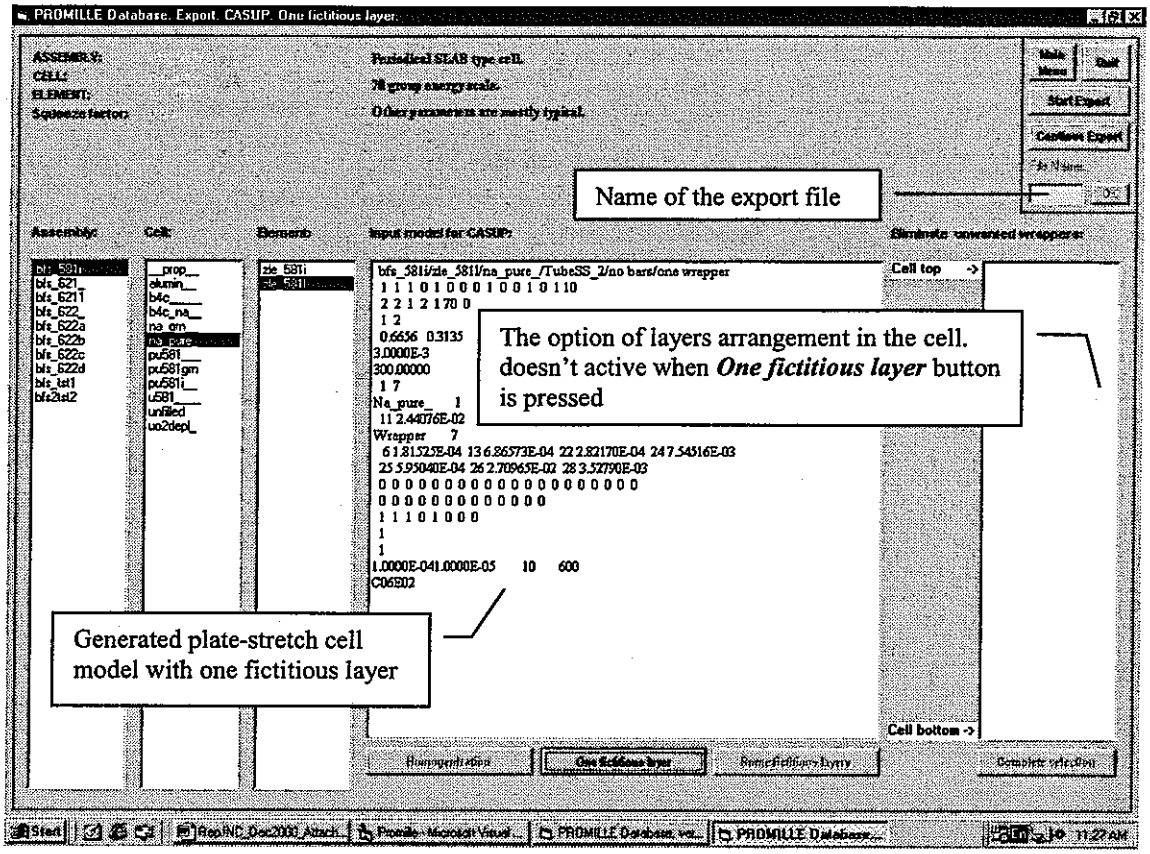
Some fictitious layers button becomes disabled when ***Homogenization*** button is pressed.

Complete selection button doesn't active.

Start Export button activates "File Name" textbox and ***OK*** button to begin export of the model. A new file of the specified name is created by pressing ***OK*** button.

Continue Export button commands to update the existing file of the specified name. ***OK*** button fulfills appending of the generated model to it.

Fig. A1.30. CASUP export file panel generating a homogeneous cell model.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Homogenization button becomes disabled when ***One fictitious layer*** button is pressed.

One fictitious layer button provides generation of plate-stretch cell model with one fictitious layer under the lowest pellet.

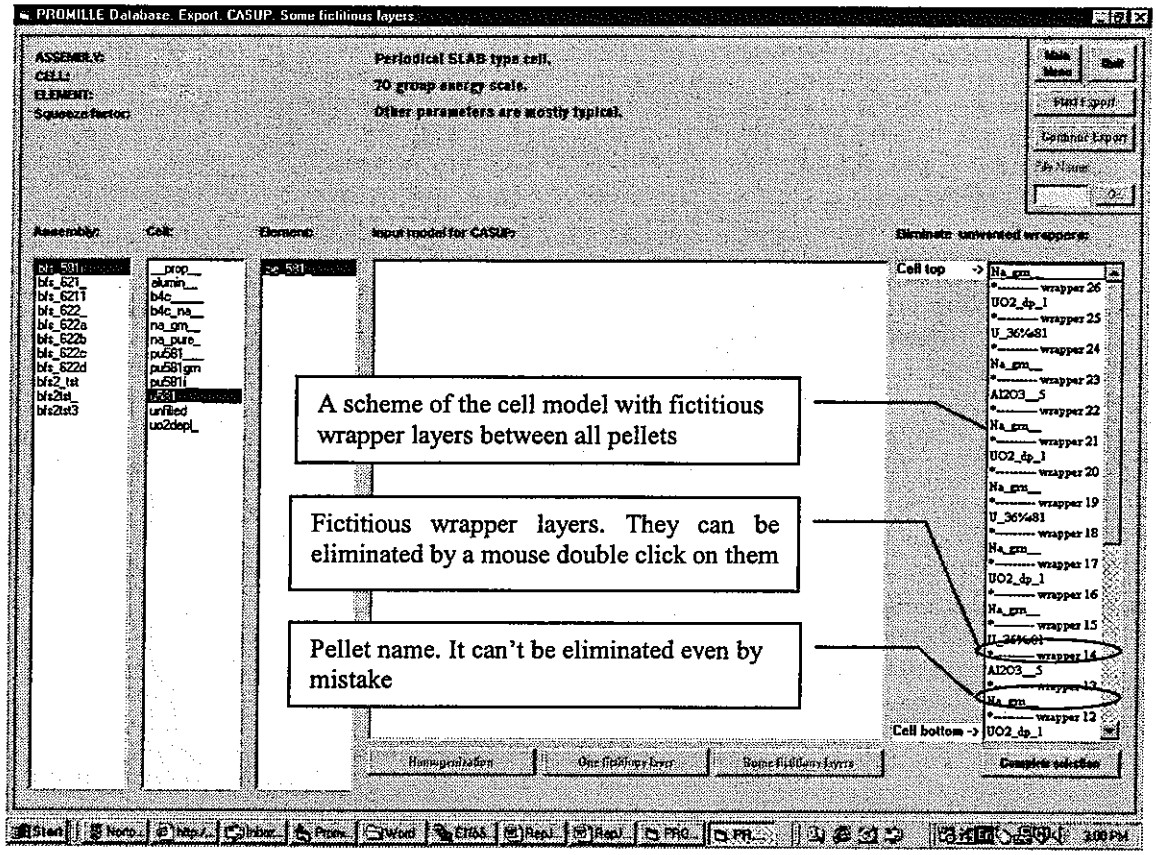
Some fictitious layers button becomes disabled when ***One fictitious layer*** button is pressed.

Complete selection button doesn't active.

Start Export button activates "File Name" textbox and ***OK*** button to begin export of the model. A new file of the specified name is created by pressing ***OK*** button.

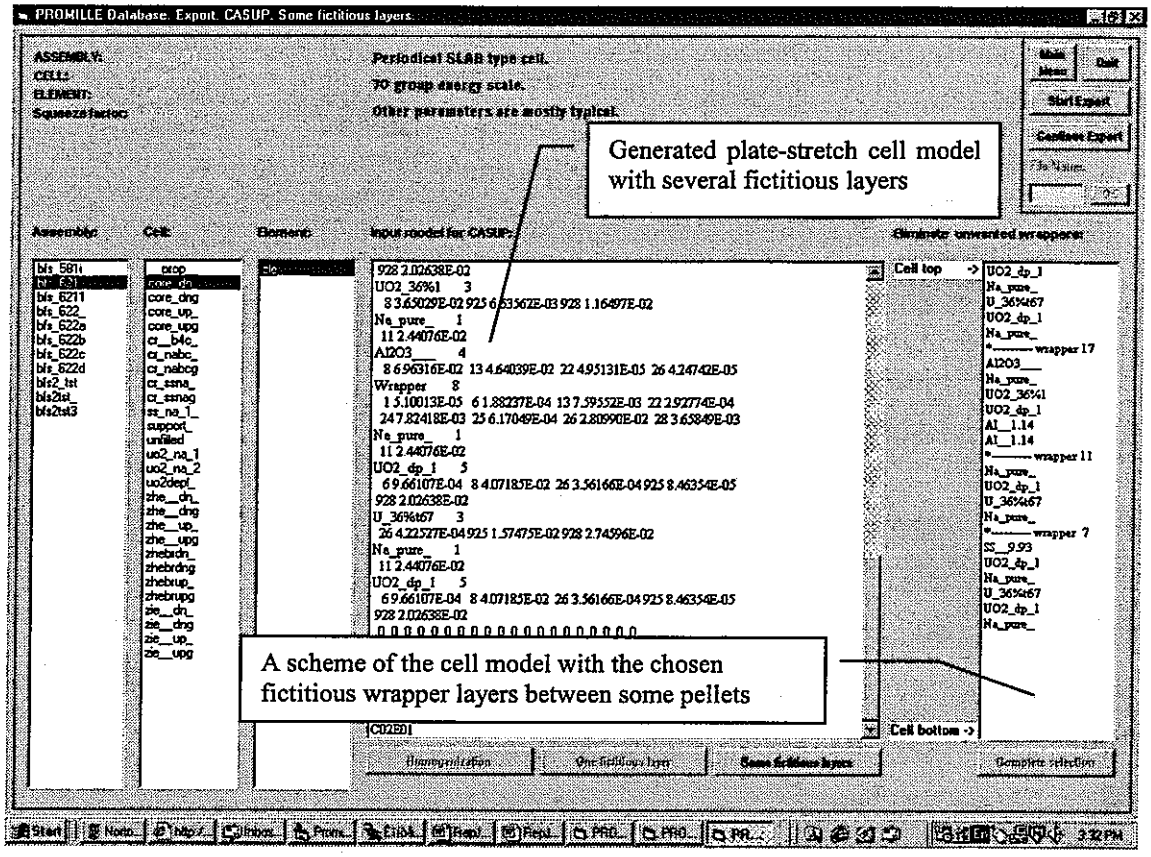
Continue Export button commands to update the existing file of the specified name. ***OK*** button fulfills appending of the generated model to it.

Fig. A1.31. CASUP export file panel for generating plate-stretch cell model with one fictitious layer.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Homogenization button doesn't active.
One fictitious layer button doesn't active.
Some fictitious layers button doesn't active.
Complete selection button completes arranging of the plate-stretch model.
Start Export button doesn't active.
Continue Export button doesn't active.
OK button doesn't active.

Fig. A1.32. CASUP export file panel for generating a plate-stretch cell model with several fictitious layers: cell modeling.



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Homogenization button doesn't active.

One fictitious layer button doesn't active.

Some fictitious layers button provides generation of another variant of the plate-stretch cell model with several fictitious layers, if necessary.

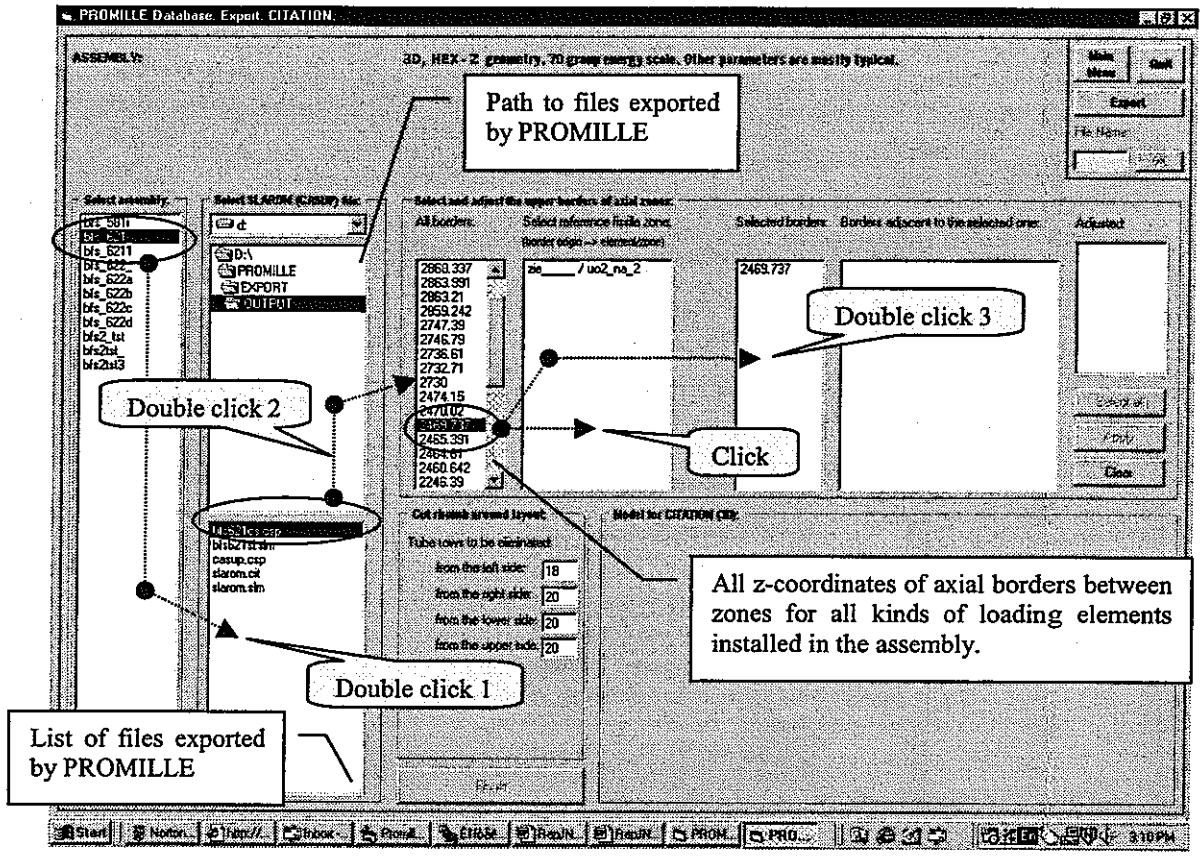
Complete selection button doesn't active.

Start Export button activates "File Name" textbox and ***OK*** button to begin export of the model. A new file of the specified name is created by pressing ***OK*** button.

Continue Export button commands to update the existing file of the specified name. ***OK*** button fulfills appending of the generated model to it.

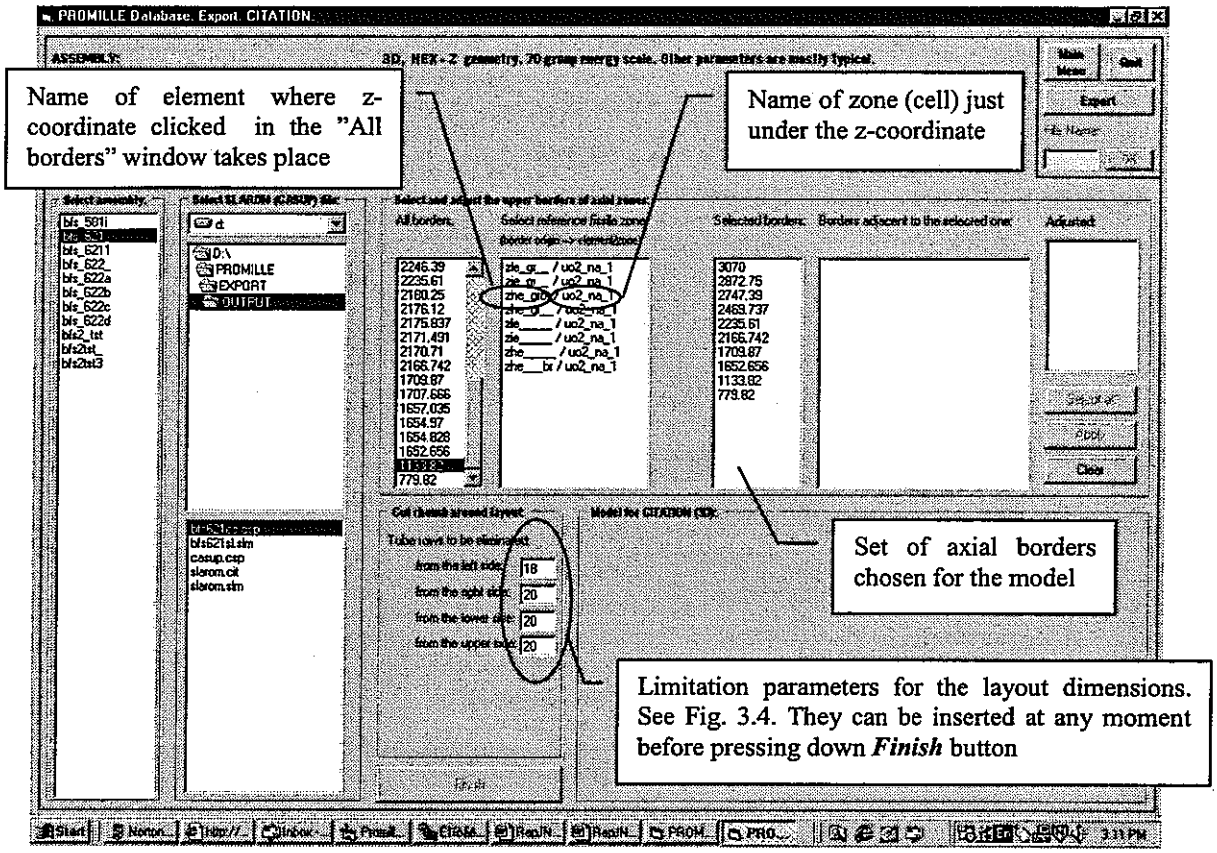
OK button doesn't active.

Fig. A1.33. CASUP export file panel for generating a plate-stretch cell model with several fictitious layers: result of cell modeling.



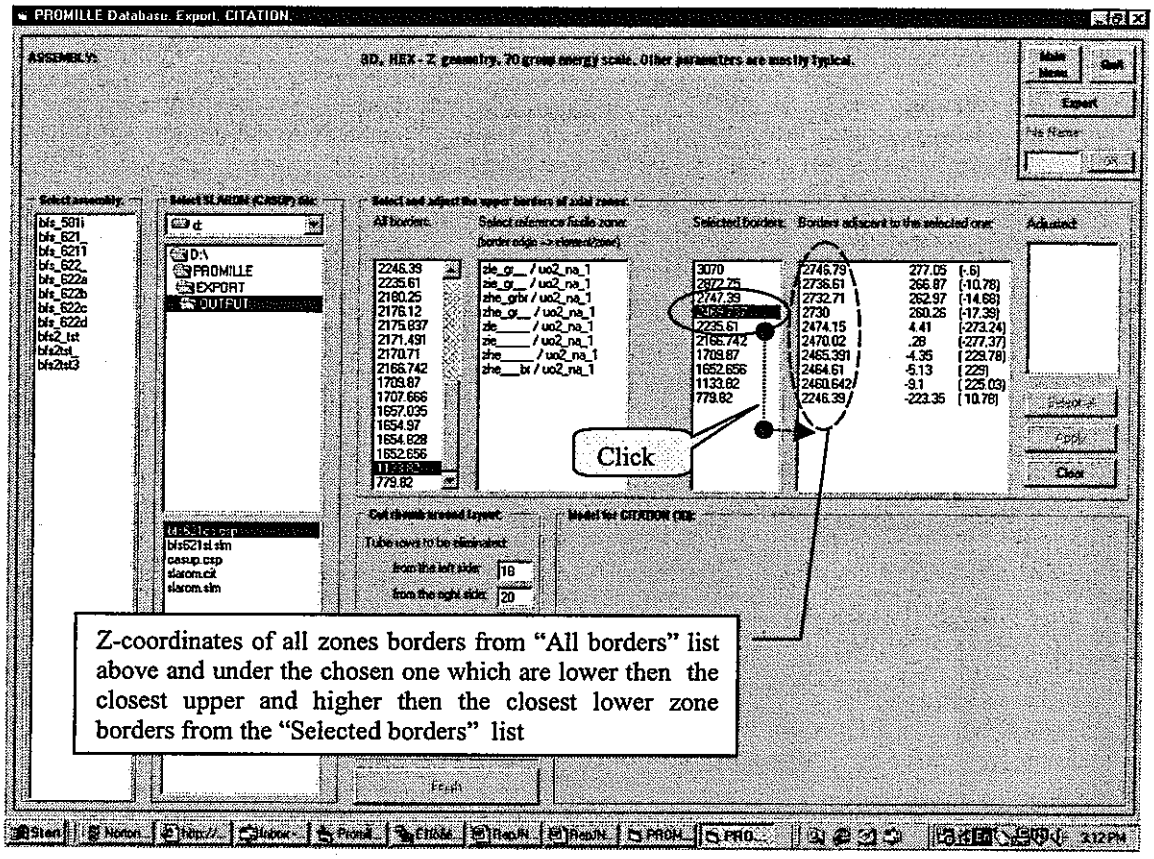
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Export button doesn't active.
Select all button doesn't active.
Apply button doesn't active.
Clear button clears all the windows from the right side of "All borders" window.
Finish button doesn't active.
OK button doesn't active.

Fig. A1.34. CITATION export file panel : "All borders" selection started.



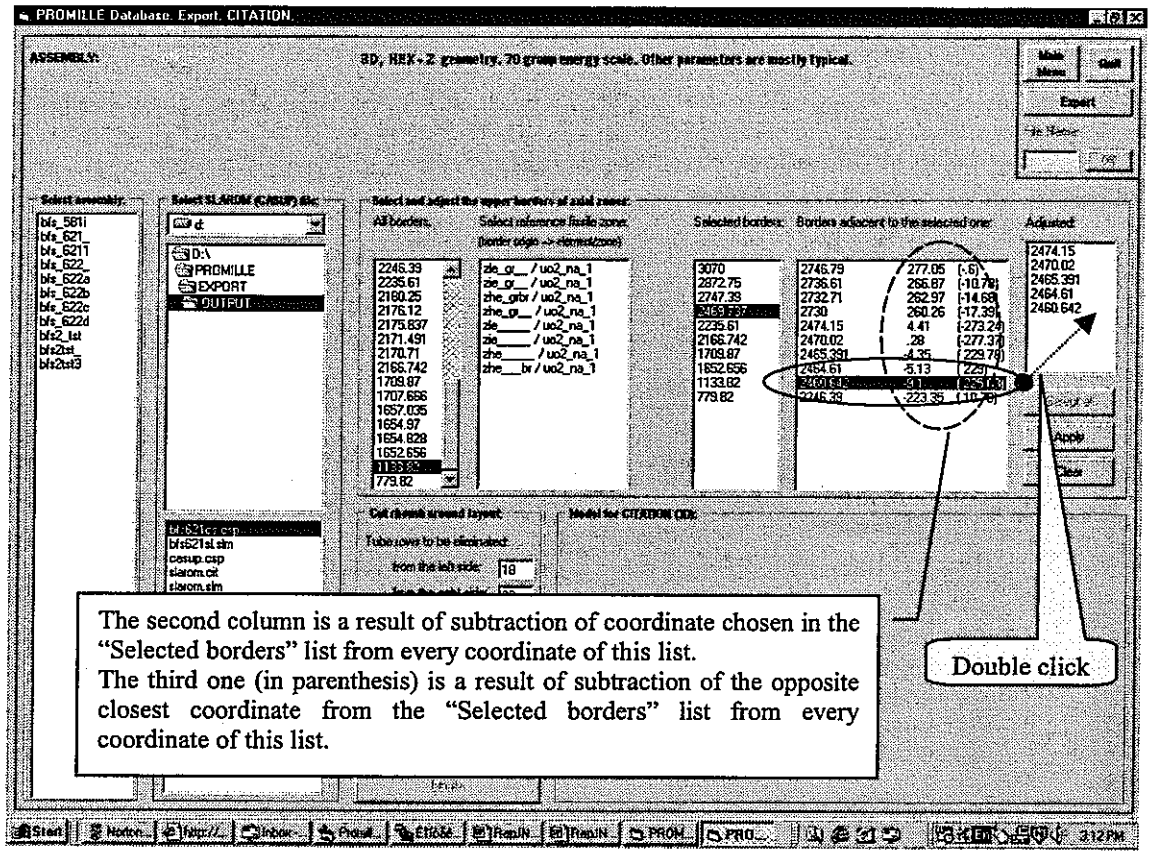
Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Export button doesn't active.
Select all button doesn't active.
Apply button doesn't active.
Clear button clears all the windows from the right side of "All borders" window.
Finish button doesn't active.
OK button doesn't active.

Fig. A1.35. CITATION export file panel: "All borders" selection finished.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Export button doesn't active.
Select all button doesn't active.
Apply button doesn't active.
Clear button clears all the windows from the right side of "All borders" window.
Finish button doesn't active.
OK button doesn't active.

Fig. A1.36. CITATION export file panel: "Selected borders".



Main Menu button returns to the main panel.

Quit button quits PROMILLE.

Export button doesn't active.

Select all button doesn't active.

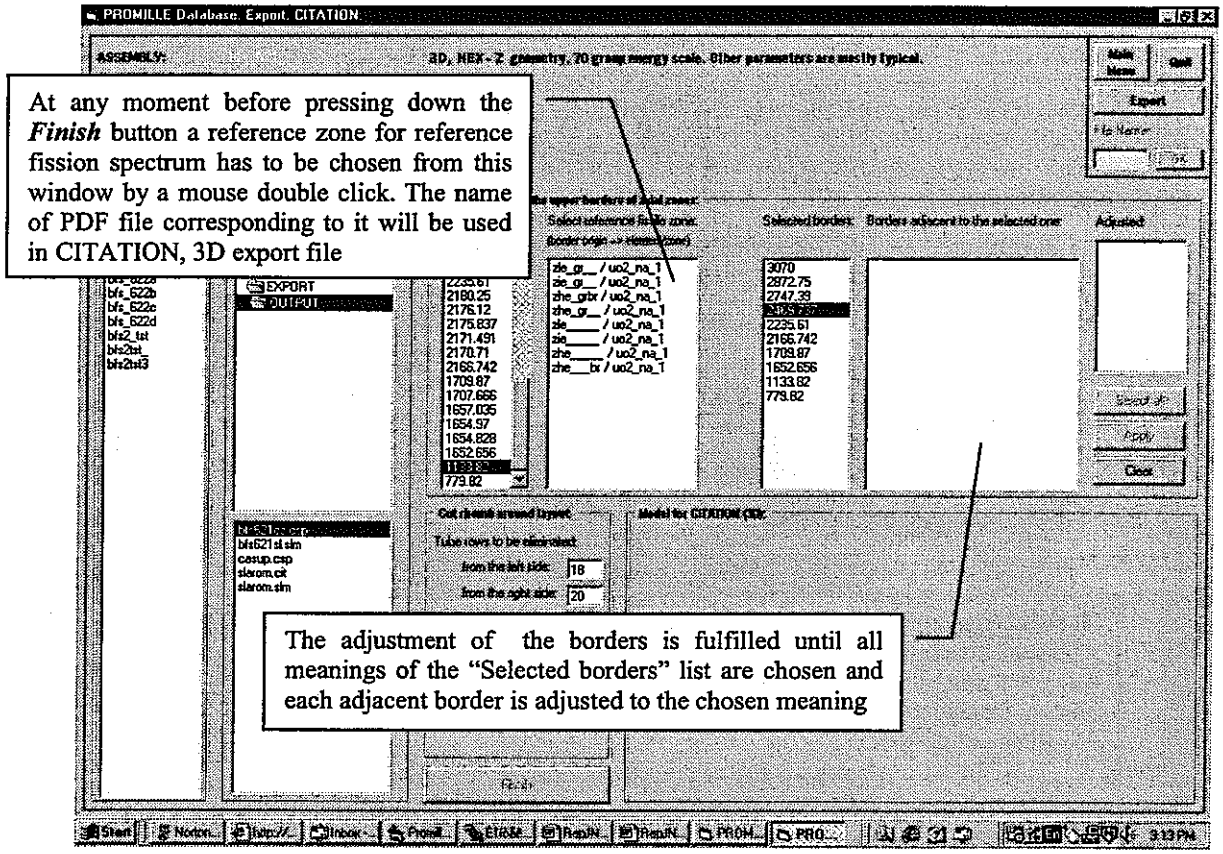
Apply button completes the adjustment of the z-coordinates from the "Adjusted" window to the one from the "Selected borders" window.

Clear button clears all the windows from the right side of "All borders" window.

Finish button doesn't active.

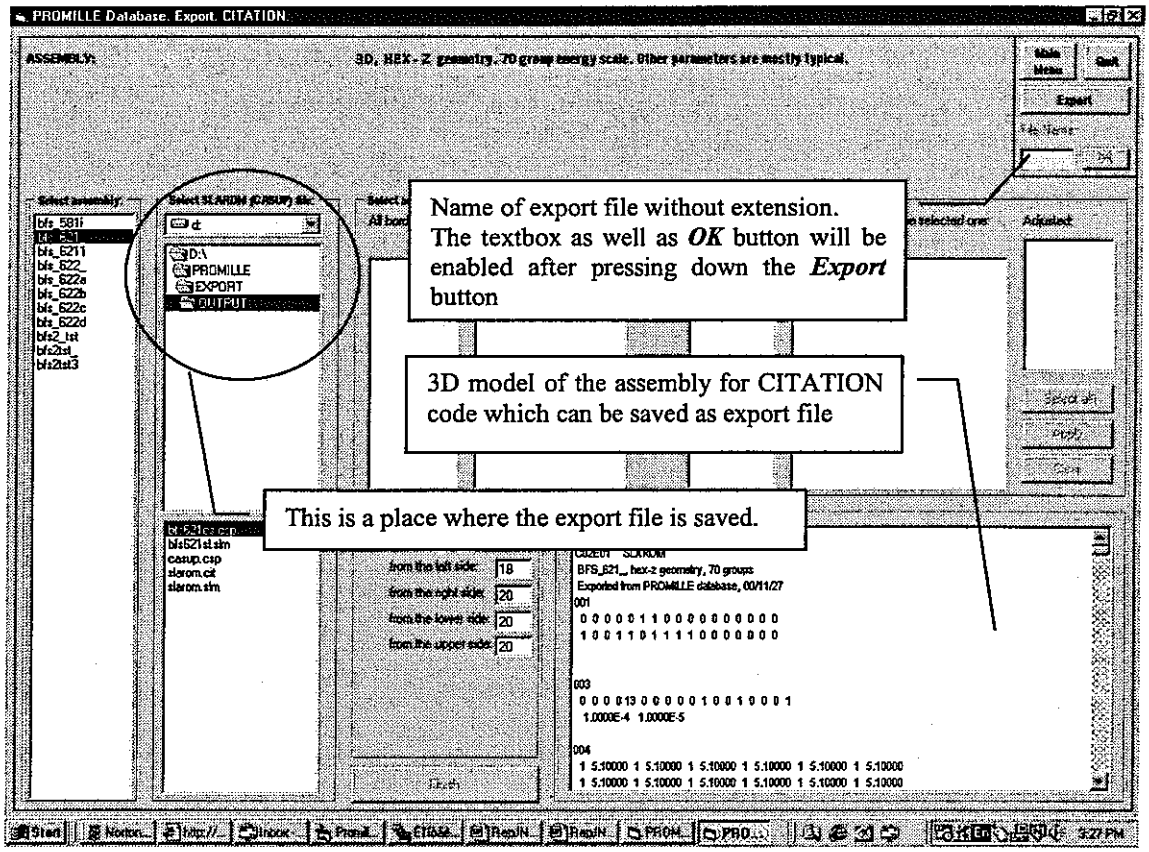
OK button doesn't active.

Fig. A1.37. CITATION export file panel: "Borders adjacent to the selected one".



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Export button doesn't active.
Select all button doesn't active.
Apply button doesn't active.
Clear button clears all the windows from the right side of "All borders" window.
Finish button doesn't active. It will be enabled just after completing of axial borders adjustment.
OK button doesn't active.

Fig. A1.38. CITATION export file panel: ***Apply***.



Main Menu button returns to the main panel.
Quit button quits PROMILLE.
Export button enables the "File Name" textbox and ***OK*** button.
Select all button doesn't active.
Apply button doesn't active.
Clear button doesn't active.
Finish button doesn't active.
OK button doesn't active. After enabling it completes the export to CITATION.

Fig. A1.39. CITATION export file panel: ***Finish.***

ATTACHMENT 2

THE DATABASE CONTENT (AT 31/12/2000)

BFS2

1. bfs_581i. Modification of advanced BN-800 mock-up. Central zone is uranium free Pu fuel with an inert diluent.
94/04/01

1.1. Reactivity worths measurements:

Al2O3____1	(150/150, h = 0 cm)	Al_____1	(150/150, h = 0 cm)
Am241diox1	(150/150, h = 0 cm)	Am241diox2	(150/150, h = 0 cm)
B10_____1	(150/150, h = 0 cm)	B10_____2	(150/150, h = 0 cm)
B10_____3	(150/150, h = 0 cm)	Graphite_1	(150/150, h = 0 cm)
Li6_____1	(150/150, h = 0 cm)	Li6_____2	(150/150, h = 0 cm)
Li6_____3	(150/150, h = 0 cm)	Na_____1	(150/150, h = 0 cm)
Np237diox1	(150/150, h = 0 cm)	Np237diox2	(150/150, h = 0 cm)
Np237diox3	(150/150, h = 0 cm)	PE_____1	(150/150, h = 0 cm)
PE_____2	(150/150, h = 0 cm)	PE_____3	(150/150, h = 0 cm)
Pu0diox__1	(150/150, h = 0 cm)	Pu0diox__2	(150/150, h = 0 cm)
Pu0diox__3	(150/150, h = 0 cm)	Pu1diox__1	(150/150, h = 0 cm)
Pu1diox__2	(150/150, h = 0 cm)	Pu9met___1	(150/150, h = 0 cm)
Pu9met___2	(150/150, h = 0 cm)	Pu9met___3	(150/150, h = 0 cm)
PuO2PWR1_1	(150/150, h = 0 cm)	PuO2PWR1_2	(150/150, h = 0 cm)
PuO2PWR1_3	(150/150, h = 0 cm)	PuO2PWR2_1	(150/150, h = 0 cm)
PuO2PWR2_2	(150/150, h = 0 cm)	PuO2PWR2_3	(150/150, h = 0 cm)
U5met____1	(150/150, h = 0 cm)	U8met____1	(150/150, h = 0 cm)

2. bfs_621_. BN-600. UO2 fuel. UO2 reflector. Safety rods and reactivity compensators are off core (variant 1).
99/04/13

3. bfs_6211. BN-600. UO2 fuel. UO2 reflector. Safety rods and reactivity compensators are off core (variant 2).
99/04/13

4. bfs_622_. BN-600. UO2 fuel. UO2+SS+B4C reflector. Safety rods and reactivity compensators are off core.
99/07/09

5. bfs_622a. BN-600. UO2 fuel. UO2+ 2 rows of SS reflector. Safety rods and reactivity compensators are off core.
99/07/01

6. bfs_622b. BN-600. UO2 fuel. UO2+ 4 rows of SS reflector. Safety rods and reactivity compensators are off core.
99/07/01

7. bfs_622c. BN-600. UO2 fuel. UO2+ 6 rows of SS reflector. Safety rods and reactivity compensators are off core.
99/07/01

8. bfs_622d. BN-600. UO2 fuel. UO2+ 8 rows of SS reflector. Safety rods and reactivity compensators are off core.
99/07/01

ATTACHMENT 3

EXPORT MODELS

```
PREP
 bfs_621_/zie_____/zie__dn_/TubeSS_2/RodSS_c2/2 bars/one wrapper
 12  1 -1  2  0  0  3 -23  0  0  0  0 70
 293.0  1.25  0.0
    7   5   1   5   1   3   5   1   5   1   5   8
 0.7557 0.6751 0.6656 0.6751 0.6656 0.3726 0.6751 0.6656 0.6751 0.6656
 0.6751 3.2541
   6 3.895831E-04  13 1.474036E-03  22 6.058745E-04  24 1.619795E-02
  25 1.277541E-03  26 5.817077E-02  28 7.573843E-03 /
   6 9.661067E-04   8 4.071853E-02  26 3.561659E-04 925 8.463544E-05
 928 2.026378E-02 /
  11 2.440759E-02 /
   6 9.661067E-04   8 4.071853E-02  26 3.561659E-04 925 8.463544E-05
 928 2.026378E-02 /
  11 2.440759E-02 /
  26 4.008293E-04 925 4.043621E-02 928 4.765150E-03 /
   6 9.661067E-04   8 4.071853E-02  26 3.561659E-04 925 8.463544E-05
 928 2.026378E-02 /
  11 2.440759E-02 /
   6 9.661067E-04   8 4.071853E-02  26 3.561659E-04 925 8.463544E-05
 928 2.026378E-02 /
  11 2.440759E-02 /
   6 9.661067E-04   8 4.071853E-02  26 3.561659E-04 925 8.463544E-05
 928 2.026378E-02 /
   1 1.616658E-05   6 1.900030E-04  13 7.367532E-03  22 2.967228E-04
  24 7.851702E-03  25 6.290237E-04  26 2.814603E-02  28 3.678207E-03 /

PATH
 Comment: ...
 70 12  2  1  0  0  0
  2 12 12  1 12  0  0  0  4  0  1  1  0  0  180  0
  1  2  3  4  5  6  7  8  9  10  11  12
 0.0  0.7557 1.4308 2.0964 2.7715 3.4371 3.8097 4.4848 5.1504
     5.8255 6.4911 7.1662 10.4203
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0                          .
C25E01
```

Fig. A3.1. Plate-stretch cell model for SLAROM.

```
PREP
 bfs_621_/zle_____/core_dn_/TubeSS_2/RodSS_c2/2 bars/homogenized
 1  1 -1  1  0  0  3 -23  0  0  0  0 70
 293.0  0.0  0.0
 12
 1.0
   1 1.595627E-05   6 3.021840E-04   8 1.328772E-02  11 6.575369E-03
  13 5.022147E-03  22 1.201856E-04  24 3.155699E-03  25 2.488765E-04
  26 1.144698E-02  28 1.475562E-03 925 1.188283E-03 928 6.785085E-03
C02E01
```

Fig. A3.2. Homogeneous cell model for SLAROM.

```
bfs_621_/zhe___br/zhebrdn_/TubeSS_2/RodSS_c2/2 bars/one wrapper
  1  1  1  0  1  0  0  0  1  0  0  1  0  1 10
 14 14  1 14  1 70  0
  1  2  3  4  5  6  7  8  9 10 11 12 13 14
  0.6751   0.6656   0.3758   0.6751   0.6656   0.3697   0.6751   0.6656
  0.3726   0.6751   0.7557   0.6656   0.6751   3.5653
3.0000E-3
300.00000
  5  1  3  5  1  4  5  1  3  5  7  1  5  8
UO2_dp_1        5
   6 9.66107E-04   8 4.07185E-02  26 3.56166E-04 925 8.46354E-05
 928 2.02638E-02
Na_pure_        1
  11 2.44076E-02
U_36%s81        3
  26 1.01078E-03 925 1.62789E-02 928 2.84377E-02
UO2_dp_1        5
   6 9.66107E-04   8 4.07185E-02  26 3.56166E-04 925 8.46354E-05
 928 2.02638E-02
Na_pure_        1
  11 2.44076E-02
Al2O3__5        4
   8 6.96410E-02  13 4.64102E-02  22 4.94742E-05  26 4.25094E-05
UO2_dp_1        5
   6 9.66107E-04   8 4.07185E-02  26 3.56166E-04 925 8.46354E-05
 928 2.02638E-02
Na_pure_        1
  11 2.44076E-02
U_90%SS_        3
  26 4.00829E-04 925 4.04362E-02 928 4.76515E-03
UO2_dp_1        5
   6 9.66107E-04   8 4.07185E-02  26 3.56166E-04 925 8.46354E-05
 928 2.02638E-02
SS__9.93        7
   6 3.89583E-04  13 1.47404E-03  22 6.05875E-04  24 1.61980E-02
  25 1.27754E-03  26 5.81708E-02  28 7.57384E-03
Na_pure_        1
  11 2.44076E-02
UO2_dp_1        5
   6 9.66107E-04   8 4.07185E-02  26 3.56166E-04 925 8.46354E-05
 928 2.02638E-02
Wrapper         8
   1 3.46535E-05   6 1.86918E-04  13 7.82877E-03  22 2.91823E-04
  24 7.72746E-03  25 6.18369E-04  26 2.77044E-02  28 3.61952E-03
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0
  1  1  1  0  1  0  0  0
  1
  1
1.0000E-041.0000E-05        10        600
C21E01
```

Fig. A3.3. Plate-stretch cell model for CASUP.

```
bfs_581i/z1e_581_/b4c_na__/TubeSS_2/no bars/homogenized
  1  0  0  0  1  0  0  0  1  0  0  1  0  1  0
  1  1  1  1  0 70  0
  1
5.0000
-3.000E-3
300.00000
 11
Homogenized material
   1 1.14252E-04   6 1.00151E-02  11 5.41180E-03  13 1.42279E-04
  22 5.84766E-05  24 1.56354E-03  25 1.23299E-04  26 5.61502E-03
  28 7.31068E-04 105 7.94161E-03 115 3.19660E-02
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0
  1  1  1  0  1  0  0  0
  1
  1
1.0000E-041.0000E-05        10       600
C04E01
```

Fig. A3.4. Homogeneous cell model for CASUP.

```
CITATION
C02E01     SLAROM
 BFS_621_, hex-z geometry, 70 groups
 Exported from PROMILLE database, 00/11/27
001
  0  0  0  0  0  1  1  0  0  0  0  0  0  0  0  0  0
  1  0  0  1  1  0  1  1  1  1  0  0  0  0  0  0  0


003
  0  0  0  0 13  0  0  0  0  0  1  0  0  1  0  0  0  1
   1.0000E-4   1.0000E-5

004
  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000
  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000
  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000
  1  5.10000  1  5.10000  1  5.10000

...

  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000
  1  5.10000  1  5.10000  1  5.10000  1  5.10000  1  5.10000
  4  19.7250  3  12.5360  6  27.7653  5  22.3347  2   6.6140 10  47.0380
  2   5.2835 11  52.3215  8  35.4000 16  77.9820
005
  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1

...

  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  1
008
-70 70  0 75  1  3  3  2
1
C13E06     SLAROM
2
C12E01     SLAROM

...

74
C13E05     SLAROM
75
C16E01     SLAROM

C02E01     SLAROM
023
  0  0  0  7
040
  0  0  0  0  0  0  0  2
999
```

Fig. A3.5. Three-dimensional core model for CITATION.

ATTACHMENT 4

STRUCTURE OF DATA TABLES

1. **Table SERVICE:** *general service information.*

masterpas, 6 - master password
slavepas, 6 - slave password
dataversion, 6 - version of the database (**promille.mdb**)

2. **Table GENERAL:** *general information about assemblies.*

fac, 4 - facility name
core, 8 - name of assembly (core)
centre, 7 - raster coordinate of central channel
critstate, 8 - excess of reactivity at all control rods (with fuel) in core, cents
absuncer, 8 - absolute uncertainty of "critstate" value
date, 8 - reference date of the core
note, 100 - note

3. **Table PELLETS:** *description of BFS-2 pellets.*

pellet, 8 - name of pellet
int_diam, 8 - pellet core diameter, mm
cv_thick, 8 - pellet cover thickness, mm
cr_thick, 8 - pellet core thickness, mm
cv_____h, 8 - amount of H nuclei per cover (x10^{22} nuclei)
cr_____h, 8 - amount of H nuclei per core (x10^{22} nuclei)
cv_____b, 8 - amount of B nuclei per cover (x10^{22} nuclei)
cr_____b, 8 - amount of B nuclei per core (x10^{22} nuclei)
cv_____c, 8 - amount of C nuclei per cover (x10^{22} nuclei)
cr_____c, 8 - amount of C nuclei per core (x10^{22} nuclei)
cv_____o, 8 - amount of O nuclei per cover (x10^{22} nuclei)
cr_____o, 8 - amount of O nuclei per core (x10^{22} nuclei)
cv____na, 8 - amount of Na nuclei per cover (x10^{22} nuclei)
cr____na, 8 - amount of Na nuclei per core (x10^{22} nuclei)
cv____al, 8 - amount of Al nuclei per cover (x10^{22} nuclei)
cr____al, 8 - amount of Al nuclei per core (x10^{22} nuclei)
cv____si, 8 - amount of Si nuclei per cover (x10^{22} nuclei)
cr____si, 8 - amount of Si nuclei per core (x10^{22} nuclei)
cv____ti, 8 - amount of Ti nuclei per cover (x10^{22} nuclei)
cr____ti, 8 - amount of Ti nuclei per core (x10^{22} nuclei)
cv____cr, 8 - amount of Cr nuclei per cover (x10^{22} nuclei)
cr____cr, 8 - amount of Cr nuclei per core (x10^{22} nuclei)
cv____mn, 8 - amount of Mn nuclei per cover (x10^{22} nuclei)
cr____mn, 8 - amount of Mn nuclei per core (x10^{22} nuclei)
cv____fe, 8 - amount of Fe nuclei per cover (x10^{22} nuclei)
cr____fe, 8 - amount of Fe nuclei per core (x10^{22} nuclei)
cv____ni, 8 - amount of Ni nuclei per cover (x10^{22} nuclei)
cr____ni, 8 - amount of Ni nuclei per core (x10^{22} nuclei)
cv____cu, 8 - amount of Cu nuclei per cover (x10^{22} nuclei)
cr____cu, 8 - amount of Cu nuclei per core (x10^{22} nuclei)
cv____ga, 8 - amount of Ga nuclei per cover (x10^{22} nuclei)
cr____ga, 8 - amount of Ga nuclei per core (x10^{22} nuclei)
cv____zr, 8 - amount of Zr nuclei per cover (x10^{22} nuclei)
cr____zr, 8 - amount of Zr nuclei per core (x10^{22} nuclei)
cv____mo, 8 - amount of Mo nuclei per cover (x10^{22} nuclei)
cr____mo, 8 - amount of Mo nuclei per core (x10^{22} nuclei)

cv____pb, 8 - amount of Pb nuclei per cover (x10^{22} nuclei)
cr____pb, 8 - amount of Pb nuclei per core (x10^{22} nuclei)
cv_th232, 8 - amount of ^{232}Th nuclei per cover (x10^{22} nuclei)
cr_th232, 8 - amount of ^{232}Th nuclei per core (x10^{22} nuclei)
cv__u235, 8 - amount of ^{235}U nuclei per cover (x10^{22} nuclei)
cr__u235, 8 - amount of ^{235}U nuclei per core (x10^{22} nuclei)
cv_np237, 8 - amount of ^{237}Np nuclei per cover (x10^{22} nuclei)
cr_np237, 8 - amount of ^{237}Np nuclei per core (x10^{22} nuclei)
cv__u238, 8 - amount of ^{238}U nuclei per cover (x10^{22} nuclei)
cr__u238, 8 - amount of ^{238}U nuclei per core (x10^{22} nuclei)
cv_pu238, 8 - amount of ^{238}Pu nuclei per cover (x10^{22} nuclei)
cr_pu238, 8 - amount of ^{238}Pu nuclei per core (x10^{22} nuclei)
cv_pu239, 8 - amount of ^{239}Pu nuclei per cover (x10^{22} nuclei)
cr_pu239, 8 - amount of ^{239}Pu nuclei per core (x10^{22} nuclei)
cv_pu240, 8 - amount of ^{240}Pu nuclei per cover (x10^{22} nuclei)
cr_pu240, 8 - amount of ^{240}Pu nuclei per core (x10^{22} nuclei)
cv_pu241, 8 - amount of ^{241}Pu nuclei per cover (x10^{22} nuclei)
cr_pu241, 8 - amount of ^{241}Pu nuclei per core (x10^{22} nuclei)
cv_pu242, 8 - amount of ^{242}Pu nuclei per cover (x10^{22} nuclei)
cr_pu242, 8 - amount of ^{242}Pu nuclei per core (x10^{22} nuclei)
cv_am241, 8 - amount of ^{241}Am nuclei per cover (x10^{22} nuclei)
cr_am241, 8 - amount of ^{241}Am nuclei per core (x10^{22} nuclei)
cv____nb, 8 - amount of Nb nuclei per cover (x10^{22} nuclei)
cr____nb, 8 - amount of Nb nuclei per core (x10^{22} nuclei)
cv___b10, 8 - amount of ^{10}B nuclei per cover (x10^{22} nuclei)
cr___b10, 8 - amount of ^{10}B nuclei per core (x10^{22} nuclei)
cv___b11, 8 - amount of ^{11}B nuclei per cover (x10^{22} nuclei)
cr___b11, 8 - amount of ^{11}B nuclei per core (x10^{22} nuclei)
cv_____w, 8 - amount of W nuclei per cover (x10^{22} nuclei)
cr_____w, 8 - amount of W nuclei per core (x10^{22} nuclei)
cv____co, 8 - amount of Co nuclei per cover (x10^{22} nuclei)
cr____co, 8 - amount of Co nuclei per core (x10^{22} nuclei)
cv____hf, 8 - amount of Hf nuclei per cover (x10^{22} nuclei)
cr____hf, 8 - amount of Hf nuclei per core (x10^{22} nuclei)
note, 100 - note

4. Table TUBARS: *description of BFS-2 tubes and bars.*

tube_bar, 8 - name of tube (bar)
section_, 8 - form of cross-section
length__, 8 - height of empty (usable) space inside tube from the bottom to the top, mm
or
- total height of bar, mm
size___1, 8 - side length for bar with triangle cross-section form, mm
or
- diameter of bar with circle cross-section form, mm
or
- outer diameter of tube, mm
size___2, 8 - inner diameter of tube (bar with ring cross-section form), mm
or
- 0 for bar with triangle or circle cross-section form

segment_, 8 - part length used for concentrations description, mm

cv_____h, 8 - 0
cr_____h, 8 - amount of H nuclei per segment (x10^{22} nuclei)
cv_____b, 8 - 0
cr_____b, 8 - amount of B nuclei per segment (x10^{22} nuclei)
cv_____c, 8 - 0
cr_____c, 8 - amount of C nuclei per segment (x10^{22} nuclei)
cv_____o, 8 - 0
cr_____o, 8 - amount of O nuclei per segment (x10^{22} nuclei)
cv____na, 8 - 0
cr____na, 8 - amount of Na nuclei per segment (x10^{22} nuclei)
cv____al, 8 - 0
cr____al, 8 - amount of Al nuclei per segment (x10^{22} nuclei)
cv____si, 8 - 0
cr____si, 8 - amount of Si nuclei per segment (x10^{22} nuclei)
cv____ti, 8 - 0
cr____ti, 8 - amount of Ti nuclei per segment (x10^{22} nuclei)
cv____cr, 8 - 0
cr____cr, 8 - amount of Cr nuclei per segment (x10^{22} nuclei)
cv____mn, 8 - 0
cr____mn, 8 - amount of Mn nuclei per segment (x10^{22} nuclei)
cv____fe, 8 - 0
cr____fe, 8 - amount of Fe nuclei per segment (x10^{22} nuclei)
cv____ni, 8 - 0
cr____ni, 8 - amount of Ni nuclei per segment (x10^{22} nuclei)
cv____cu, 8 - 0
cr____cu, 8 - amount of Cu nuclei per segment (x10^{22} nuclei)
cv____ga, 8 - 0
cr____ga, 8 - amount of Ga nuclei per segment (x10^{22} nuclei)
cv____zr, 8 - 0
cr____zr, 8 - amount of Zr nuclei per segment (x10^{22} nuclei)
cv____mo, 8 - 0
cr____mo, 8 - amount of Mo nuclei per segment (x10^{22} nuclei)
cv____pb, 8 - 0
cr____pb, 8 - amount of Pb nuclei per segment (x10^{22} nuclei)
cv_th232, 8 - 0
cr_th232, 8 - amount of ^{232}Th nuclei per segment (x10^{22} nuclei)
cv__u235, 8 - 0
cr__u235, 8 - amount of ^{235}U nuclei per segment (x10^{22} nuclei)
cv_np237, 8 - 0
cr_np237, 8 - amount of ^{237}Np nuclei per segment (x10^{22} nuclei)
cv__u238, 8 - 0
cr__u238, 8 - amount of ^{238}U nuclei per segment (x10^{22} nuclei)
cv_pu238, 8 - 0
cr_pu238, 8 - amount of ^{238}Pu nuclei per segment (x10^{22} nuclei)
cv_pu239, 8 - 0
cr_pu239, 8 - amount of ^{239}Pu nuclei per segment (x10^{22} nuclei)
cv_pu240, 8 - 0
cr_pu240, 8 - amount of ^{240}Pu nuclei per segment (x10^{22} nuclei)
cv_pu241, 8 - 0
cr_pu241, 8 - amount of ^{241}Pu nuclei per segment (x10^{22} nuclei)
cv_pu242, 8 - 0
cr_pu242, 8 - amount of ^{242}Pu nuclei per segment (x10^{22} nuclei)
cv_am241, 8 - 0
cr_am241, 8 - amount of ^{241}Am nuclei per segment (x10^{22} nuclei)
cv____nb, 8 - 0
cr____nb, 8 - amount of Nb nuclei per segment (x10^{22} nuclei)
cv___b10, 8 - 0

cr___b10, 8 - amount of ^{10}B nuclei per segment (x10^{22} nuclei)
cv___b11, 8 - 0
cr___b11, 8 - amount of ^{11}B nuclei per segment (x10^{22} nuclei)
cv_____w, 8 - 0
cr_____w, 8 - amount of W nuclei per segment (x10^{22} nuclei)
cv____co, 8 - 0
cr____co, 8 - amount of Co nuclei per segment (x10^{22} nuclei)
cv____hf, 8 - 0
cr____hf, 8 - amount of Hf nuclei per segment (x10^{22} nuclei)
note, 100 - note

5. Table ISOTOPES: *information about elements enumerated in PELLETS and TUBARS tables as fields including their specification in reactor codes*

isotope, 5 - element (isotope) from the list of materials in PELLETS and TUBARS tables
amass, 8 - atomic mass of the element (isotope)
halflife, 8 - half-life period for radioactive nuclides, years
or
- 0 for stable materials
n_frac, 8 - the number of isotope fractions in the element (not more then 6)
frac_1, 8 - fraction of the 1st isotope in the element
frac_2, 8 - fraction of the 2nd isotope in the element
frac_3, 8 - fraction of the 3rd isotope in the element
frac_4, 8 - fraction of the 4th isotope in the element
frac_5, 8 - fraction of the 5th isotope in the element
frac_6, 8 - fraction of the 6th isotope in the element
abbr_1, 9 - designation of the 1st nuclide in MCNP4 code
abbr_2, 9 - designation of the 2nd nuclide in MCNP4 code
abbr_3, 9 - designation of the 3rd nuclide in MCNP4 code
abbr_4, 9 - designation of the 4th nuclide in MCNP4 code
abbr_5, 9 - designation of the 5th nuclide in MCNP4 code
abbr_6, 9 - designation of the 6th nuclide in MCNP4 code
slarom, 2 - designation of the material in SLAROM & CASUP codes

6. Table CONTRODS: *description of positions of staff BFS-2 control rods.*

facility, 4 - name of facility
controlrod, 5 - name of control rod
mainpos, 7 - raster coordinate of main control rod
reserpos, 7 - raster coordinate of reserve control rod

7. Table BFS2: *layout of channels of BFS-2 where loading elements can be installed.*

tube_1, 7 - raster coordinates of channels in the 1st row (see table COORD2) in the direction indicated on Fig. A1.10.
…
tube96, 7 - raster coordinates of channels in the 96th row (see table COORD2) in the direction indicated on Fig. A1.10.

8. Tables named by assemblies names: *layouts of BFS-2 assemblies.*

tube_1, 7 - symbolic meanings responsible for the color of every channel in the 1st row of the layout

…

tube96, 7 - symbolic meanings responsible for the color of every channel in the 96th row of the layout

9. Table COORD2: *description of different types of coordinates of all BFS-2 channels where loading elements can be installed.*

For better understanding see Fig. A1.10.
The table has two indexes on fields "row" and "x_c".

row, 8 - ordinal number of rows of channels for loading elements (tubes)from the left side of facility layout
channel, 8 - ordinal number of channel for loading element (tube) from the beginning of every row
raster_c, 7 - raster coordinates of channels
x_c, 8 - Descartes x-coordinates of channels centers, mm
y_c, 8 - Descartes y-coordinates of channels centers, mm
r_c, 8 - radius-vector length between Descartes coordinates origin and channels centers, mm

10. Table LOADING2: *description of all loading elements used either in a stuff assembly or in any experiments.*

core, 8 - name of assembly (core)
element, 8 - name of loading element
hatching, 7 - symbolic meaning responsible for the color of the element on core layout
tubetype, 8 - type of tube used in loading element (contained as "tube_bar" in the table TUBARS)
rods_num, 8 - the number of bars per the loading element
rodstype, 8 - type of bar located in the inter-tube gaps near the loading element(contained as "tube_bar" in the table TUBARS)
support, 8 - height of support disposed under the pellets, mm
cell_1, 8 - cell name forming 1st zone from the top of support
n_1, 8 - the number of cells of "cell_1" type in the 1st zone
h_1, 5 - symbolic meaning responsible for the zone color on the element graphical presentation

…

cell15, 8 - cell name forming 15th zone from the top of support
n15, 8 - the number of cells of "cell15" type in the 15th zone
h15, 5 - symbolic meaning responsible for the zone color on the element graphical presentation

11. Table CELL2: *description of all unit cells used either in stuff assembly or in any experiments.*

core, 8 - name of assembly (core)
cell, 8 - name of cell
squeeze, 8 - squeeze factor (ratio of measured height of cell located in a loading element to the calculated one)
pellet_1, 8 - 1st pellet name from the cell bottom

(contained as "pellet" in the table PELLETS)
h_1, 5 - symbolic meaning responsible for the 1st pellet color on the cell graphical presentation
...
pellet30, 8 - 30th pellet name from the cell bottom (contained as "pellet" in the table PELLETS)
h30, 5 - symbolic meaning responsible for the 30th pellet color on the cell graphical presentation

12-14. Tables AFCHAMB, MINCHAM, SEGCHAM: *description of absolute (AFCHAMB), miniature (MINCHAM) and segment (SEGCHAM) fission chambers.*

chamber, 8 - name of fission chamber
wall_mat, 8 - major structural chamber material
wallthic, 8 - chamber wall thickness, mm
base_mat, 8 - basement material for fissile deposit
basethic, 8 - deposit basement thickness, mm
depo_gap, 8 - gap between fissile deposit and chamber wall, mm
depodisp, 8 - spread of fissile deposit along assembly z-axis, mm
depo_mas, 8 - mass of fissile deposit, mcg
inv__mat, 6 - investigated nuclide
isotope1, 10 - 1st isotope in the fissile deposit
share1, 8 - fraction of the 1st isotope in the fissile deposit
isotope2, 10 - 2nd isotope in the fissile deposit
share2, 8 - fraction of the 2nd isotope in the fissile deposit
isotope3, 10 - 3rd isotope in the fissile deposit
share3, 8 - fraction of the 3rd isotope in the fissile deposit
isotope4, 10 - 4th isotope in the fissile deposit
share4, 8 - fraction of the 4th isotope in the fissile deposit
isotope5, 10 - 5th isotope in the fissile deposit
share5, 8 - fraction of the 5th isotope in the fissile deposit
isotope6, 10 - 6th isotope in the fissile deposit
share6, 8 - fraction of the 6th isotope in the fissile deposit
date, 8 - date on the isotopic analysis of deposit material

15. Table FOILS: *description of foils (samples) for irradiation experiments.*

foil, 8 - name of foil or irradiation sample
section, 10 - cross-section form of the foil (sample)
size___1, 8 - diameter of circle cross-section, mm
or
- side of rectangular cross-section form, mm
size___2, 8 - 0 for circle cross-section form
or
- another side of rectangular cross-section form, mm
thickness, 8 - foil (sample) thickness, mcm
note, 56 - note

16. Table RWSAMPLE: *description of small samples used for periodical reactivity perturbation.*

sample, 10 - name of sample
section, 10 - sample cross-section form
side___1, 8 - larger side of rectangular form cross-section, mm
or
- outer diameter of ring form cross-section, mm

side___2, 8 - smaller side of rectangular form cross-section, mm
or
- wall thickness of ring form cross-section (half of diameter for a circle form cross-section), mm
length, 8 - length of sample core, mm
quantity, 8 - the number of the same size samples used in a set for oscillations
coretmas, 8 - total mass of cores in the set, g
can_tmas, 8 - total mass of covers in the set, g
core_mat, 10 - core material (common name)
can__mat, 10 - cover material
inv__mat, 10 - investigated material (one of the materials from the sample core)
isotope1, 10 - 1st isotope in the sample core
share1, 8 - fraction of the 1st isotope in the sample core
isotope2, 10 - 2nd isotope in the sample core
share2, 8 - fraction of the 2nd isotope in the sample core
isotope3, 10 - 3rd isotope in the sample core
share3, 8 - fraction of the 3rd isotope in the sample core
isotope4, 10 - 4th isotope in the sample core
share4, 8 - fraction of the 4th isotope in the sample core
isotope5, 10 - 5th isotope in the sample core
share5, 8 - fraction of the 5th isotope in the sample core
isotope6, 10 - 6th isotope in the sample core
share6, 8 - fraction of the 6th isotope in the sample core
date, 8 - date on the isotopic analysis of sample material
note, 50 - note

17. Table TRACK: *description of solid track detectors.*

target, 8 - name of set of identical targets
base_mat, 8 - material of target basement
basethic, 8 - thickness of target basement, mm
depmas_l, 8 - main nuclide smallest mass from a set of identical targets, mcg
depmas_u, 8 - main nuclide largest mass from a set of identical targets, mcg
inv__mat, 6 - investigated nuclide
isotope1, 10 - 1st isotope in the target material
share1, 8 - fraction of the 1st isotope in the target material
isotope2, 10 - 2nd isotope in the target material
share2, 8 - fraction of the 2nd isotope in the target material
isotope3, 10 - 3rd isotope in the target material
share3, 8 - fraction of the 3rd isotope in the target material
isotope4, 10 - 4th isotope in the target material
share4, 8 - fraction of the 4th isotope in the target material
isotope5, 10 - 5th isotope in the target material
share5, 8 - fraction of the 5th isotope in the target material
isotope6, 10 - 6th isotope in the target material
share6, 8 - fraction of the 6th isotope in the target material
date, 8 - date on the isotopic analysis of target material

18. Table ABSEXP2: *description of fission cross-sections measurements by absolute fission chambers.*

core, 8 - name of assembly (core)
tube_n, 7 - raster coordinate of the measurement place

height_z, 8 - z-coordinate of the measurement place (z=0 in a physical core center, z-axis is directed to the top), mm
chamber, 8 - name of absolute chamber (contained as "chamber" in the AFCHAMB table)
efficien, 8 - efficiency of fission chamber
normisot, 5 - normalizing nuclide
fi_fn, 8 - integral fission cross-section ratio of investigated nuclide to the one of normalizer
dfi_fn, 8 - absolute uncertainty of "fi_fn" value
date, 8 - date of measurement
note, 60 - note

19. Table ROD_SUB2: *description of measurements on substitution of a set of stuff core loading elements for a set of twin elements of studied configuration.*

core, 8 - name of assembly (core)
experimt, 4 - abbreviation for designating of experiment type
cluster, 8 - the number of elements subjected to substitution as a cluster
r_element, 8 - name of reference (substituted) element (contained as "element" in the table LOADING2)
t_zone_n, 2 - ordinal number of the test zone from the top of support
support, 8 - height of support disposed under the pellets, mm (contained as "support" in the table LOADING2)
cell_1, 8 - cell name forming 1st zone from the top of support
n_1, 4 - the number of cells of "cell_1" type in the 1st zone
h_1, 5 - symbolic meaning responsible for the zone color on the element graphical presentation
…
cell15, 8 - cell name forming 15th zone from the top of support
n15, 4 - the number of cells of "cell15" type in the 15th zone
h15, 5 - symbolic meaning responsible for the zone color on the element graphical presentation
tube_1, 7 - raster coordinate of the 1st substituted element
…
tube18, 7 - raster coordinate of the 18th substituted element
worth, 8 - reactivity worth from the substitution of reference elements cluster with the cluster of investigated structure, cents
absuncer, 8 - absolute uncertainty of the "worth" value, cents

20. Table FIAXI2: *description of measurements of axial fission rates traverses carried out by miniature fission chambers.*

core, 8 - name of assembly (core)
tube_n1, 7 - raster coordinate of the 1st of 3 elements near inter-tube gap where the measurement took place
tube_n2, 7 - raster coordinate of the 2nd of 3 elements near inter-tube gap where the measurement took place
tube_n3, 7 - raster coordinate of the 3rd of 3 elements near inter-tube gap where the measurement took place
chamber, 8 - name of miniature fission chamber (contained as "chamber" in the MINCHAM table)

hz__1, 8 - height of the 1st (most lower) point of measurement in the gap over the mid-plane of the assembly, mm
fr__1, 8 - fission rate in the 1st point normalized to the mid-plane
…
hz100, 8 - height of the 100th (most upper) point of measurement in the gap over the mid-plane of the assembly, mm
fr100, 8 - fission rate in the 100th point normalized to the mid-plane
note, 50 - note

21. Table FIRAD2: *description of measurements of radial fission rates traverses carried out by miniature fission chambers.*

core, 8 - name of assembly (core)
tube_n1, 7 - raster coordinate of the 1st of two core elements used to indicate radial direction of measurement
tube_n2, 7 - raster coordinate of the 2nd of two core elements used to indicate radial direction of measurement
height_z, 8 - height of the measurement point in the gap over the mid-plane of the assembly, mm
chamber, 8 - name of miniature fission chamber (contained as "chamber" in the MINCHAM table)
r___1, 8 - distance of the 1st point of measurement (the 1st side point of the measurements traverse) to the core center, mm
fr__1, 8 - fission rate in the 1st point normalized to the core center (zero radius)
…
r_100, 8 - distance of the 100th point of measurement (the last side point of the measurements traverse) to the core center, mm
fr100, 8 - fission rate in the 100th point normalized to the core center (zero radius)
note, 50 - note

22. Table IRREXP2: *description of experiments on foil (samples) irradiation.*

core, 8 - name of assembly (core)
tube_n, 7 - raster coordinate of element where the irradiation has been carried out
element, 8 - name of element near, inside or in the place of which (if it was withdrawn) the irradiation has been carried out
zone_num, 8 - 0 if "p_t"=1 or 3
or
- ordinal number of zone in the element where the irradiation has been carried out from support top if "p_t"=2
cell_num, 8 - 0 if "p_t"=1 or 3
or
- ordinal number of cell in the "zone_num" zone where the irradiation has been carried out from the zone bottom if "p_t"=2
height_z, 8 - height of measurement place over the core mid-plane along z-axis if "p_t"=1 or 3, mm

or
- 0 if "p_t"=2

p_t, 8 - method of irradiation (1- in the inter-tube gap, 2- inside cell, 3- in the cavity of withdrawn loading element)

l01, 8 - 0 if "p_t"=1 or 3
or
- ordinal pellet number directly under the 1st irradiated foil (sample) counting from the cell bottom if "p_t"=2

u01, 8 - 0 if "p_t"=1 or 3
or
- ordinal pellet number directly above the 1st irradiated foil (sample) counting from the cell bottom if "p_t"=2

r01, 8 - 0 if "p_t"=1 or 3
or
- capture rate ratio of investigated nuclide from the 1st foil (sample) counting from the cell bottom to "nreact" reaction type of "normisot" nuclide if "p_t"=2

...

l10, 8 - 0 if "p_t"=1 or 3
or
- ordinal pellet number directly under the 10th irradiated foil (sample) counting from the cell bottom if "p_t"=2

u10, 8 - 0 if "p_t"=1 or 3
or
- ordinal pellet number directly above the 10th irradiated foil (sample) counting from the cell bottom if "p_t"=2

r10, 8 - 0 if "p_t"=1 or 3
or
- capture rate ratio of investigated nuclide from the 10th foil (sample) counting from the cell bottom to "nreact" reaction type of "normisot" nuclide if "p_t"=2

inv__mat, 6 - investigated material

normisot, 5 - normalizing material

nreact, 1 - reaction type (c- capture, f- fission) of "normisot" material used for normalization

ratio, 8 - ratio of capture rate of "inv_mat" nuclide to "nreact" reaction type rate of "normisot" nuclide (if "p_t"=2 the meaning is spatially cell averaged)

d_ratio, 8 - absolute uncertainty of "ratio" value

date, 8 - date of measurement

23. Table MINEXP2: *description of fission cross-sections measurements by miniature fission chambers.*

core, 8 - name of assembly (core)

tube_n1, 7 - raster coordinate of the 1st of 3 elements near inter-tube gap where the measurement took place

tube_n2, 7 - raster coordinate of the 2nd of 3 elements near inter-tube gap where the measurement took place

tube_n3, 7 - raster coordinate of the 3rd of 3 elements near

inter-tube gap where the measurement took place
height_z, 8 - z-coordinate of the measurement place (z=0 in a physical core center, z-axis is directed to the top), mm
chamber, 8 - name of miniature fission chamber (contained as "chamber" in the MINCHAM table)
inv__mat, 6 - investigated material
normisot, 5 - normalizing material
fi_fn, 8 - integral fission cross-section ratio of investigated nuclide to the one of normalizer
dfi_fn, 8 - absolute uncertainty of "fi_fn" value
date, 8 - date of measurement

24. Table RECONS2: *description of experiments on core reconstructions.*

core, 8 - name of assembly (core)
experimt, 4 - abbreviation for designating of experiment type (the same like in ROD_SUB2 table)
worth, 8 - worth of the entire substitution, cents
absuncer, 8 - absolute uncertainty of "worth" value, cents
change__1, 7 - raster coordinate of the 1st substituted loading element
newelm__1, 8 - name of the 1st substituting loading element (contained as "element" in LOADING2 table)
...
change100, 7 - raster coordinate of the 100th substituted loading element
newelm100, 8 - name of the 100th substituting loading element (contained as "element" in LOADING2 table)
note, 80 - note

25. Table RWEXP2: *description of experiments on reactivity worth measurements of small samples by their periodical oscillation.*

core, 8 - name of assembly (core)
tube_n, 7 - raster coordinate of loading element the measurement has been carried out about
height_z, 8 - z-coordinate of the measurement place (z=0 in a physical core center, z-axis is directed to the top), mm
sample, 10 - sample name (contained as "sample" in RWSAMPLE table)
worth, 8 - reactivity perturbation initiated by the sample core, mcents
absuncer, 8 - absolute uncertainty of "worth" value, mcents
normisot, 5 - normalizing material
ri_rn, 8 - ratio of mole reactivity worth of the investigated material of real sample size to mole reactivity worth of infinitely thin sample of normalizer
dri_rn, 8 - absolute uncertainty of "ri_rn" value
ext_meas, 8 - "ri_rn" meaning extrapolated to infinitely thin sample condition of investigated material sample
ext_uncr, 8 - absolute uncertainty of "ext_meas" value
date, 8 - date of measurement

26. Table SEGEXP2: *description of fission cross-sections measurements by segment fission chambers.*

core,	8	- name of assembly (core)
tube_n,	7	- raster coordinate of the channel where the measurement has been carried out
height_z,	8	- z-coordinate of the measurement place (z=0 in a physical core center, z-axis is directed to the top), mm
chamber,	8	- name of segment fission chamber (contained as "chamber" in the SEGCHAM table)
inv__mat,	6	- investigated material
normisot,	5	- normalizing material
fi_fn,	8	- integral fission cross-section ratio of investigated nuclide to the one of normalizer
dfi_fn,	8	- absolute uncertainty of "fi_fn" value
date,	8	- date of measurement

27. Table STDEXP2: *description of fission cross-sections measurements by solid track detectors.*

core,	8	- name of assembly (core)
tube_n,	7	- raster coordinate of the channel where the measurement has been carried out
height_z,	8	- z-coordinate of the measurement place (z=0 in a physical core center, z-axis is directed to the top), mm
target,	8	- name of target
inv__mat,	6	- investigated material
normisot,	5	- normalizing material
fi_fn,	8	- integral fission cross-section ratio of investigated nuclide to the one of normalizer
dfi_fn,	8	- absolute uncertainty of "fi_fn" value
date,	8	- date of measurement

28. Table SVAXI2: *description of measurements of sodium voiding along the height of loading element.*

core,	8	- name of assembly (core)
tube_n,	7	- raster coordinate of the channel where the measurement has been carried out
element,	8	- name of the element where the measurement has been carried out (contained as "element" in the table LOADING2)
worth,	8	- reactivity worth induced by the element re-composing, cents
absuncer,	8	- absolute uncertainty of "worth" value
cell_1,	8	- cell name forming 1st zone from the top of support
n_1,	8	- the number of cells of "cell_1" type in the 1st zone
…		
cell15,	8	- cell name forming 15th zone from the top of support
n15,	8	- the number of cells of "cell15" type in the 15th zone
note,	40	- note

29. Table K_INF2: *measurement results of K_{inf} value.*

```
core,          8 - name of assembly (core)
k_infinitive,  8 - measured k-infinitive value
absuncer,      8 - absolute uncertainty of "k_infinitive" value
```