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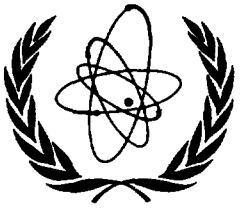
DATABASES ON SAFETY ISSUES FOR WWER AND RBMK REACTORS

USERS' MANUAL

A PUBLICATION OF THE EXTRABUDGETARY PROGRAMME ON THE SAFETY OF WWER AND RBMK NUCLEAR POWER PLANTS

April 1996



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FOREWORD

The IAEA initiated in 1990 a programme to assist the countries of eastern Europe and the former Soviet Union in evaluating the safety of their first generation WWER-440/230 nuclear power plants. The main objectives of the Programme were: to identify major design and operational safety issues; to establish international consensus on priorities for safety improvements; and to provide assistance in the review of the completeness and adequacy of safety improvement programmes.

The scope of the Programme was extended in 1992 to include RBMK, WWER-440/213 and WWER-1000 plants in operation and under construction. The Programme is complemented by national and regional technical co-operation projects.

The Programme is pursued by means of plant specific safety review missions to assess the adequacy of design and operational practices; Assessment of Safety Significant Events Team (ASSET) reviews of operational performance; reviews of plant design, including seismic safety studies; and topical meetings on generic safety issues. Other components are: follow-up safety missions to nuclear plants to check the status of implementation of IAEA recommendations; assessments of safety improvements implemented or proposed; peer reviews of safety studies; and training workshops. The IAEA is also maintaining a database on the technical safety issues identified for each plant and the status of implementation of safety improvements. An additional important element is the provision of assistance by the IAEA to strengthen regulatory authorities.

The Programme is extrabudgetary and depends on voluntary contributions from IAEA Member States. Steering Committees provide co-ordination and guidance to the IAEA on technical matters and serve as forums for exchange of information with the European Commission and with other national, international and financial organizations. The general scope and results of the Programme are reviewed at Advisory Group meetings.

The Programme, which takes into account the results of other relevant national, bilateral and multilateral activities, provides a forum to establish international consensus on the technical basis for upgrading the safety of WWER and RBMK nuclear power plants.

The IAEA further provides technical advice in the co-ordination structure established by the Group of 24 OECD countries through the European Commission to provide technical assistance on nuclear safety matters to the countries of eastern Europe and the former Soviet Union.

Results, recommendations and conclusions resulting from the IAEA Programme are intended only to assist national decision makers who have the sole responsibilities for the regulation and safe operation of their nuclear power plants. Moreover, they do not replace a comprehensive safety assessment which needs to be performed in the frame of the national licensing process.

EDITORIAL NOTE

In preparing this publication for press, staff of the IAEA have made up the pages from the original manuscript(s). The views expressed do not necessarily reflect those of the governments of the nominating Member States or of the nominating organizations.

Throughout the text names of Member States are retained as they were when the text was compiled.

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SUMMARY

At the beginning of the IAEA Extrabudgetary Programme on the safety of WWER reactors a great number of findings and recommendations (safety items) were collected as a result of design review and safety review missions of the WWER-440/230 type reactors. On the basis of these findings a technical database containing more than 1300 records was established to support the consolidation of the information obtained and to help in identification of safety issues. After the scope of the WWER extrabudgetary programme was extended similar data sets were prepared for the WWER-440/213, WWER-1000 and RBMK nuclear power plants.

This publication describes the structure of the databases on safety issues of WWER and RBMK NPPs, the information sources used in the databases and interrogation capabilities for users to obtain the necessary information.

The IAEA has also assisted the G-24 Nuclear Safety Assistance Co-ordination (NUSAC) Secretariat to establish a database on nuclear safety assistance to countries of eastern Europe and of the former Soviet Union. This database serves as a management tool for coordination of the assistance projects. An important result of this cooperation is the harmonization of the structure and the software of the G-24 Project Data Bank and the technical databases maintained at the IAEA. Such a link between different databases facilitates the analysis of gaps and overlaps in the assistance programmes.

1. GENERAL DESCRIPTION OF DATABASES

At the beginning of the IAEA Extrabudgetary Programme on the Safety of WWER Reactors a great number of findings and recommendations (safety items) were collected as a result of design review and safety review missions of the WWER-440/230 type reactors. On the basis of these findings a technical database containing more than 1300 records was established to support the consolidation of the obtained information and to help in the identification of safety issues. As a further step, the WWER-440/230 safety issues and their priorities have been published as an IAEA Technical Document [1].This publication has been a basic reference for the follow-up safety review missions and for the planning and implementation of the WWER-440/230 extrabudgetary programme activities.

When the scope of the programme was extended to include the WWER-440/213, WWER-1000 and RBMK NPPs a similar approach was used for these reactor types. Information on reviews of safety improvements, results of topical meetings, technical committee meetings, ASSET and OSART missions were consolidated in safety issues. In this work the results of other programmes (e.g. Consortium for RBMK reactors, Risk Audit studies) were also taken into account.

The safety issues for the WWER and RBMK NPPs are all included in the relevant IAEA databases. The databases also contain the safety items used for the consolidation of safety issues. An overview on the databases including their current size and the number of records in the primary tables is given in Table I.

All forms, queries and report formats which were used for the data input have been removed from the databases and only database objects necessary for the interrogation and output have been kept. This has reduced the size of the files.

The structure of the databases allows for the input of specific actions which are taken by individual plants in order to address safety issues. The status of implementation of safety modifications varies from

plant to plant. Therefore, periodic technical visits to the plants are conducted by the IAEA to update the inputs on the implementation of safety upgrading programmes. This information is then included in the database.

The IAEA has also assisted the G-24 Nuclear Safety Assistance Coordination (NUSAC) Secretariat to establish a database on nuclear

TABLE I. OVERVIEW OF THE DATABASES

Database	Size Mbyte	Number of records
WWER-440/230	2.26	1419
WWER-440/213	1.08	1244
WWER-1000	0.85	1037
RBMK	1.15	2413
Total:	5.34	5077

safety assistance to countries of eastern Europe and of the former Soviet Union. This database serves as a management tool for coordination of the assistance projects. An important result of this cooperation is the harmonization of the structure and the software of the G-24 Project Data Bank and the technical databases maintained at the IAEA. Such a link between different databases facilitates the analysis of gaps and overlaps in the assistance programmes and gives an opportunity to perform simultaneous analyses of these databases.

In order to ensure the high reliability of information in the databases all inputs have been reviewed by international experts. All information compiled is free for distribution to the IAEA Member States, since the databases contain only information from IAEA publications and other reports which were made available to the IAEA.

In the beginning, the databases were built up using dBase IV as the database management software. This solution had two major limitations. Firstly, the primary information source is mostly text oriented (findings and recommendations of reports and missions), and secondly, the analytical approach of analysis used at the IAEA required a wide range of combinations of different textual information. Therefore, it was decided to transfer all the data into Microsoft ACCESS running in the Windows environment.

The data are organized in series of so-called "primary tables". Each primary table contains either recommendations or plant status for safety issues identified for the four reactor types. The list of primary tables and their sizes are described in the following sections.

In order to facilitate data retrieval a dialog screen was developed which offers an easy way to display and print the necessary information. The layout and usage of a dialog screen for each reactor type are described below.

The databases are available in run-time format on four diskettes. They can be installed on an IBM compatible personal computer with a 386 processor or higher. To run the databases the computer should meet the following requirements: hard disk with 8 megabyte free space, Microsoft Mouse or compatible pointing device, VGA or compatible display, four megabyte of random access memory and Microsoft Windows© version 3.1 or later.

The databases can be obtained upon written request from the IAEA's Division of Nuclear Installation Safety. The IAEA staff members responsible for this work were Mr. Laszlo Czibolya and Ms. Marja Zrunek of the Safety Assessment Section of the Division of Nuclear Installation Safety.

To set up the databases insert disk 1 in drive A. In Windows Program Manager choose **Run** from the **File** menu. Windows displays the **Run** dialog box. Type "a:setup" in the **Command Line** box and choose **OK** button. Follow the setup instructions on the screen.

2. WWER-440/230 DATABASE

2.1. STRUCTURE AND FEATURES

In 1992 the IAEA issued a technical document [1] containing inter alia the results of the design concept review and the safety review missions to all WWER-440/230 plants.

The information included in [1] was taken as a basis to establish the database on findings and recommendations for the WWER-440/230 reactors.

The size of the database on findings and recommendations for WWER-440/V-230 reactors is 2 Mbytes. The primary tables with the number of records in each of them are listed in Table II. The database includes three more tables which are not listed because they are used exclusively as a part of the software to handle the main screen form of data display.

The structure of the database is shown on Fig. 1. The central table, named TECDOC-640, contains the following fields:

PRISSCD	Issue number as defined in [1].
ITITLE	Title of the issue.
ICAT	Category of the issue (I—IV).
RECOMMENDATION	Conceptual recommendation of the IAEA for the issue.
IAEALINKCODE	Issue code ensuring the link between the WWER-440/230 database and the G-24 Project Data Bank.

All other tables are connected to the central table. The left side of Fig. 1 shows the tables with various sets of recommendations which have been elaborated in response to the international concerns to address the WWER-440/230 safety issues. Four sets of these recommendations

are included in the database. These are the regulatory requirements for the Bohunice NPP (so-called 81+14 measures), Consortium recommendations for the Kozloduy NPP, additional recommendations of the IAEA for Novovoronezh as a result of the safety review follow-up

TABLE II. PRIMARY TABLES IN THE WWER-440/230 DATABASE

Primary table name	**Number of records**
TECDOC-640	99
81+14 measures	92
81+14 measures - issue	96
Additional recommendations for Novovoronezh (1993, design)	34
Bohunice	97
Consortium	212
Consortium - issue	233
IAEA comments	53
KOLA	95
NOVOVORONEZH	97
KOZLODUY	99
Safety area types	94
Safety areas	118
Total:	1419

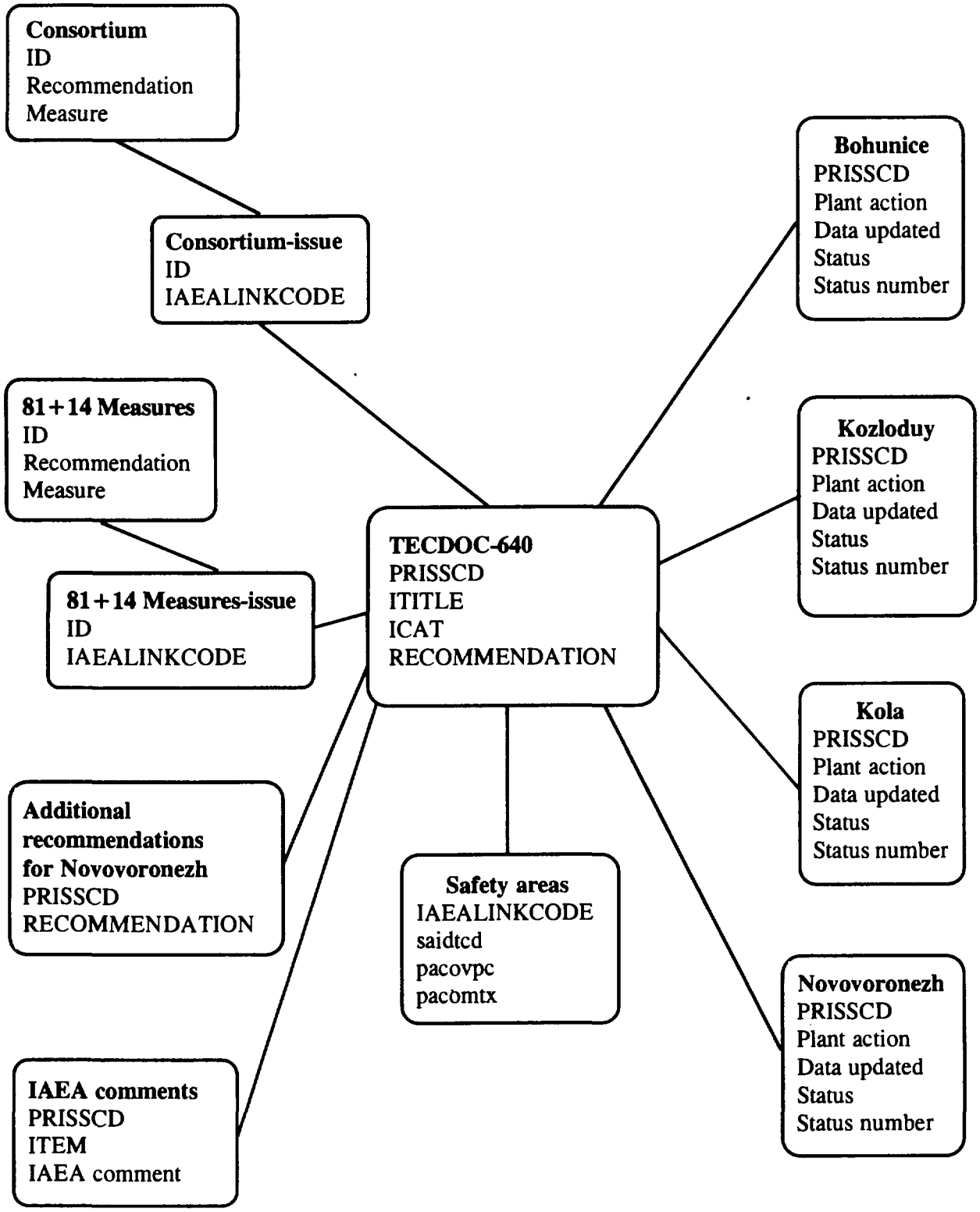

FIG. 1. Structure of the WWER-440/230 database.

mission in 1993, and IAEA comments describing the remaining safety concerns after the plant actions were reviewed in 1994 [2].

A "one-to-many" relationship is implemented between the tables of recommendations and the central table, because usually several recommendations address the same issue. This type of relationship can be built using the so-called "relation table".

A meeting of international consultants convened by the IAEA in September 1994 concluded that significant progress had been made in addressing the safety problems of the ten operating WWER-440/230 units, but that several major safety concerns still remain. Progress on the implementation of safety solutions varies from plant to plant and depends on national resources and international assistance. A report [2] on the plant specific status of safety improvements has been prepared and information on plant actions gained during the preparation of the report has been input into the database.

The right side of Fig. 1 shows the relevant tables containing the description of the plant action, the date when the information was obtained and the status of the issue at the plant. For the description of the status a simple scale was used with the following codes:

for the design issues:

1 - No action
2 - Action under way
3 - Partly resolved
4 - Fully resolved

for operational issues:

1 - No action
2 - Little progress
3 - Satisfactory progress
4 - Complete

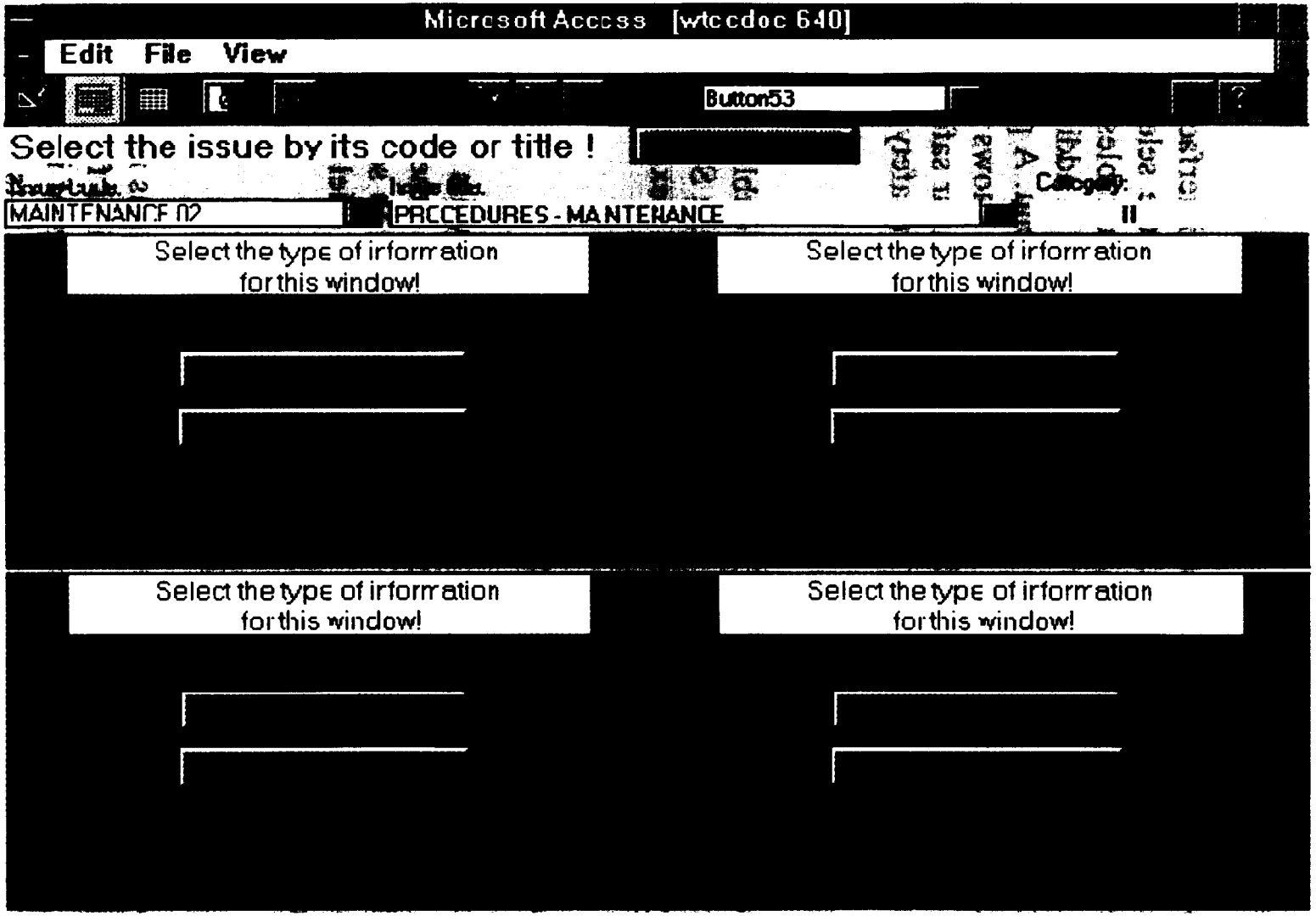

FIG. 2. Main dialog screen of the WWER-440/213 database

The report was complemented with a print-out from the database in a separate volume on plant actions for each issue.

2.2. USER INTERFACE

For convenient use of the database a specific user interface screen was developed. This screen offers several options for the selection of various sets of data for display. The contents of four tables can be displayed simultaneously from the eight primary tables. In addition, the related recommendations [1] can be selected from the menu. A powerful text search option has also been implemented. Figure 2 shows the user interface screen designed to display the status of a particular safety issue at chosen NPPs and/or recommendations concerning that safety issue.

Start

To open the IAEA WWER-440/230 database double-click the V-230 icon created by the setup programme. Click on the **Start** button to display the main dialog screen (Fig. 2) which offers a flexible way to select information from the database.

Selecting the data to be displayed

An issue may be selected either by its code or by its title in the upper part of the screen. A new issue may be selected either from the issue code or the issue title pop-up lists. (It is sufficient to select either a new issue code or a new issue title The other fields change automatically after a selection is made.)

A group of issues may be selected in two ways:

(a) To obtain a subset of issues and recommendations related to a particular word in the database, type the word in the **Find** field (at the top right of the screen) and press enter. The pop-up lists of issue codes and issue titles will include the results of the search. The lists contain the issues with the word in *any* of the text fields.

For example, type ECCS, press enter and the system will display the selected issues and recommendations with the word ECCS in the text.

(b) To select and display the *full* set of issues and recommendations in the database type an asterisk, (*), in the **Find** field and press enter. Accident analysis 1 will be the first issue displayed.

Issue category

Once the issue code or issue title is selected, the system will display the category pertaining to the selected issue in the upper part of the screen.

Selecting recommendations and plant status

In the four "sub-windows" of the screen either recommendations or plant specific status can be displayed according the selection made by clicking on the "Recommendation" or "Plant status" button. Open a pop-up list and the particular set of recommendations or plant name will be selected. After selecting the plants/recommendations the issue can also be reselected.

To view the data, select the **Display** option from **View** menu bar at the top of the screen.

New selection

The top line of each of the four sub-windows indicates which data is being displayed (plant name or the name of the set of recommendations). The data changes automatically after a new safety issue is selected. However, in order to see data on other plants or other sets of recommendations press the "New selection" command button in the upper part of the screen.

IAEA recommendations for the issue (TECDOC-640)

To see the corresponding recommendation from [1], select "TECDOC 640" menu option from the **View** menu bar. Click on **OK** to close the window and continue.

*Link with the G-24 Project Data Bank**

Under the **Link** menu from the customized menu bar two menu items are available.

Show the link to G-24 Data Bank

Select this item to display the diagram showing the link between the G-24 Project Data Bank and the IAEA databases. Click on **OK** to close.

Export link table

If the G-24 Project Data Bank is installed on your computer you can create a table which provides a link between the IAEA technical databases and the G-24 Project Data Bank. Click on **Export link table** to display the **Generate table linking to G-24 Project Data Bank** dialogue box. The **Generate** button creates a link table for the selected issues or the currently displayed issue. After generation, the **Export** button is activated in bold face letters. Type in the correct path to the G-24 data bank on your PC, then click on **Export**. An error message will be displayed if the indicated path is incorrect. Click on **OK** and make the necessary change to the path, then click on **Export** again. The table will be exported to your G-24 data bank file which can then be used for further analysis.

Note, if the export operation is cancelled after generation of the table, generation must be made again before the export function can be performed.

* For the G-24 Project Data Bank contact the G-24 NUSAC Secretariat in Brussels.

3. RBMK DATABASE

3.1. STRUCTURE AND FEATURES

In the frame of the Extrabudgetary Programme on RBMK type reactors the IAEA has also prepared a list of design and operational safety issues for this reactor type [3]. During the preparation of this document the database on findings and recommendations for RBMK reactors was extensively used. From the working materials of previous meetings, the safety review mission reports to Smolensk and Ignalina, the ASSET reports and recommendations of the International Consortium sponsored by the European Commission, more than 1000 safety items were collected in the initial version of the database. The safety items were grouped by topical areas which gave a powerful tool

TABLE III. PRIMARY TABLES IN THE RBMK DATABASE

Primary table name	Number of records
RBMK Issues	58
IAEA recommendations	153
RBMK_IS2 (safety items)	1016
Plant status (RDIPE)	79
RDIPE date on plant actions (rel_tab)	85
Issue RDIPE relation table	81
Issue 95-measure relation table	772
Safety area types	94
Safety areas	75
Total:	2413

to consolidate the available information into 60 safety issues. In addition, recommendations of the topical reports on multiple tube rupture and on the shutdown system of RBMK reactors have been added into the database.

The primary tables and the number of records in each table are listed in Table III. Three tables are used only for displaying the data on the main screen and therefore they are not listed here.

The basic central table of the RBMK database is the table "RBMK issues" which contains the following fields:

ID	Identification number (index field).
Issue number	Code number of the issue with the reference to the topical area.
Issue title	Title of the issue.
Clarification	Description of the safety concern.
Category	Category identified on the basis of degradation of defence in depth (high, medium and low).
Justification	Justification of the category.
Applicability	Applicability of the issue to the various generations of the RBMK reactors.
Issue code	Code used internally in the software.

The IAEA recommendations for the issues are included in a separate table which is linked to the issues through the issue number.

The main design institute (RDIPE, Moscow) of the RBMK reactors made available to the IAEA data on the safety upgrading

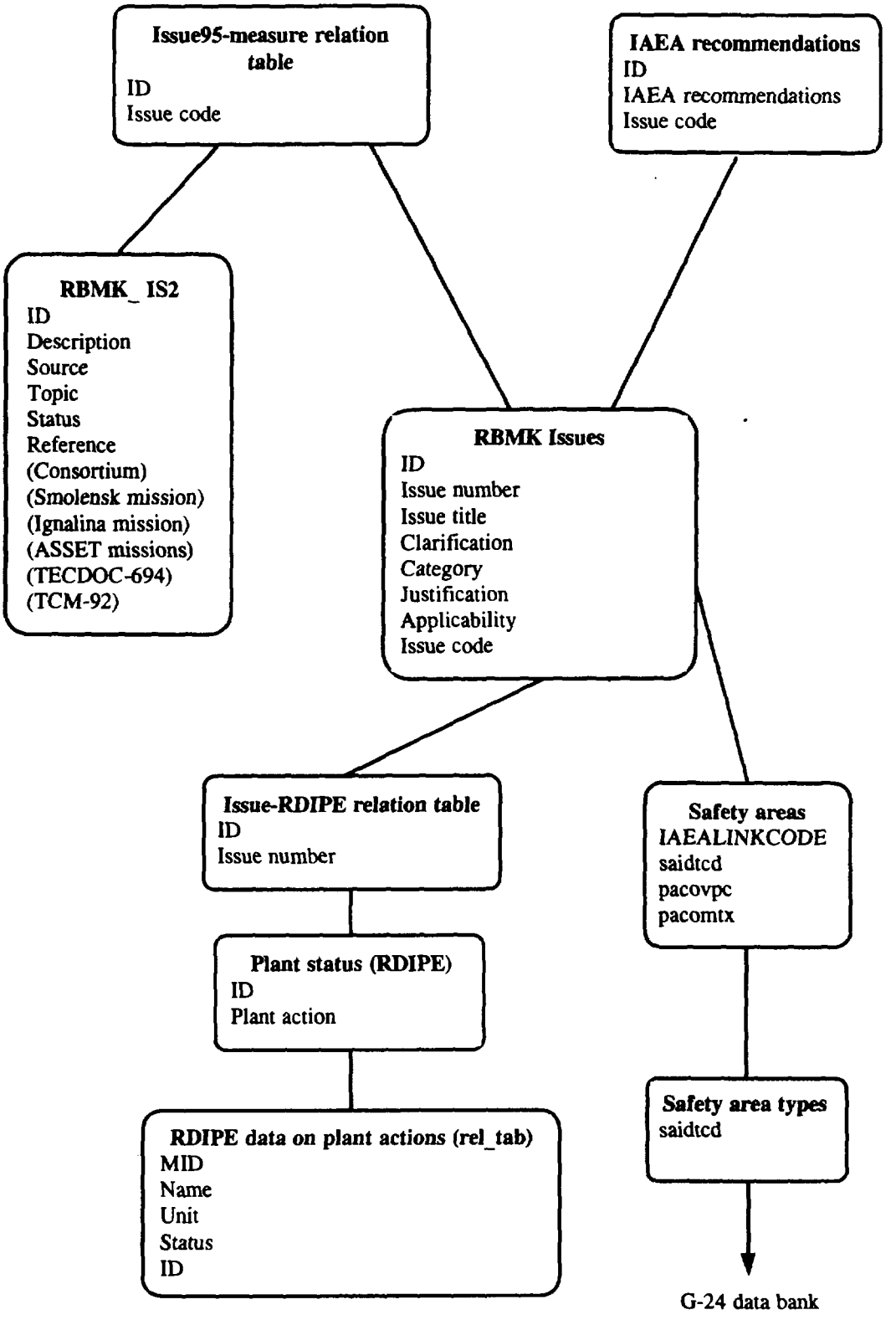

FIG. 3. Structure of the RBMK database.

programmes of individual plants addressing the safety issues. This plant specific information is also part of the database.

The database includes references to the original publications where the data were obtained. An interface table with the G-24 Project Data Bank can be prepared which makes the joint analysis of information from both databases easier.

The structure of the RBMK database is given in Fig. 3. This structure allows extension of the database with the plant specific data as the Extrabudgetary Programme of the IAEA progresses and the information becomes available. The attempt to include in the database the insights of the topical reports proved to be useful. The inclusion of the full text of reports is being considered as a possible future development.

3.2. USER INTERFACE

In order to facilitate the interrogation of the database a dialog screen format was developed (Fig. 4). On this screen the user can select a particular safety issue to display the information contained in the issue sheets of [3].

Start

To open the IAEA RBMK database double-click the RBMK icon created by the setup programme. Click on the **Start** button to display the main dialog screen (Fig. 4) which offers a flexible way to select information from the database.

Select the issue

An issue may be selected either by its code or by its title in the upper part of the screen. A new issue may be selected either from the new issue code or the issue title pop-up lists. (It is sufficient to select either a new issue code or a new issue title, the other fields change automatically after a selection is made.)

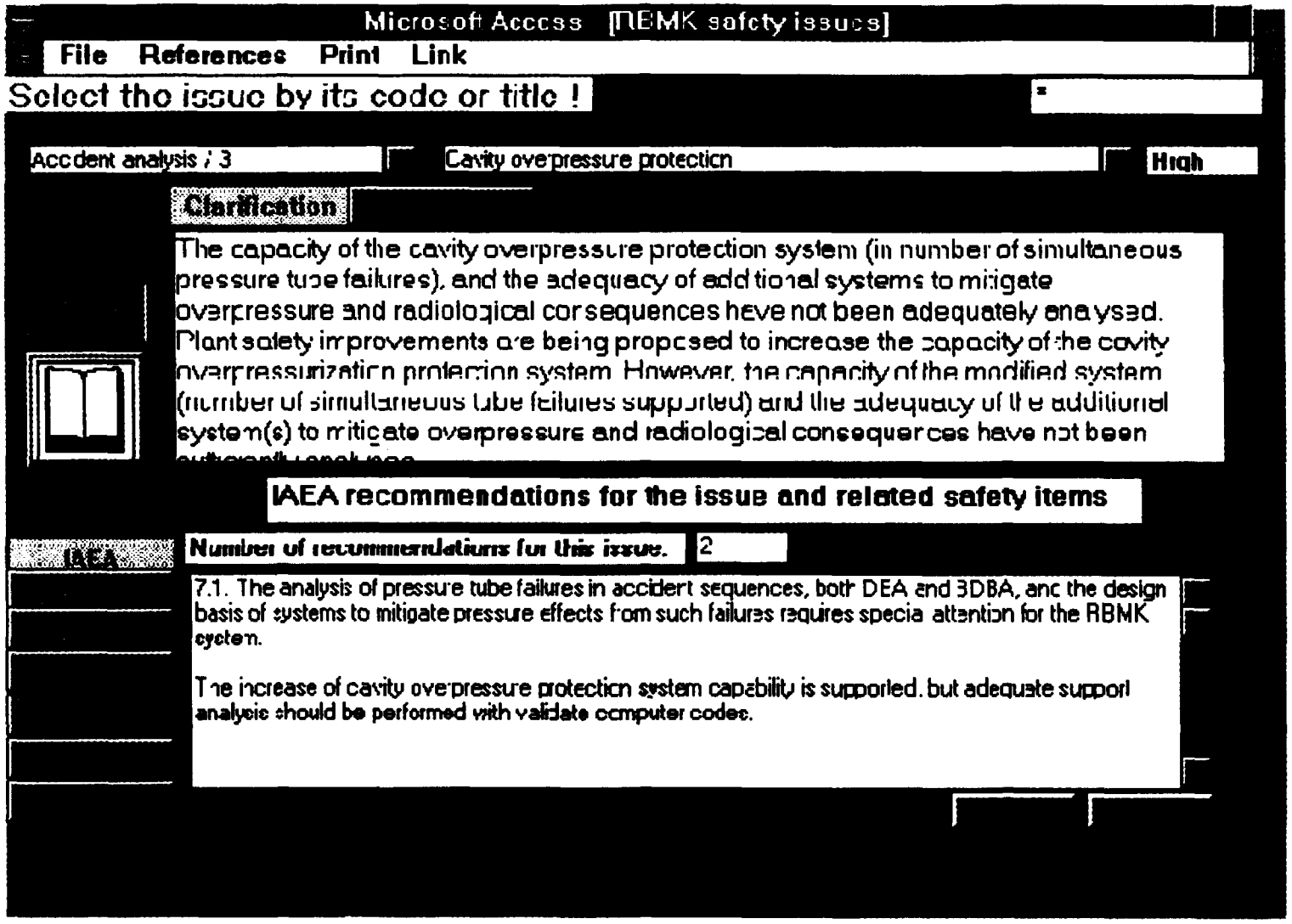

FIG. 4. Main dialog screen of the RBMK database

A group of issues may be selected in two ways:

(a) To obtain a subset of issues and recommendations related to a particular word in the database, type the word in the **Find** field (at the top right of the screen) and press enter. The pop-up lists of issue codes and issue titles will include the results of the search. The lists contain the issues with the word in *any* of the text fields.

For example, type ECCS, press enter and the system will display the selected issues and recommendations with the word ECCS in the text.

(b) To select and display the *full* set of issues and recommendations in the database type an asterisk, (*), in the **Find** field and press enter. Accident analysis 1 will be the first issue displayed.

Issue category, clarification, justification and recommendations

Once the issue code or issue title is selected, the system will display the category and issue clarification pertaining to the selected issue in the upper part of the screen.

Click on the **Justification** button to display the justification of the category.

Recommendations for the issue and related safety items were taken from various information sources and are identified on the left side of the bottom half of the screen. The recommendations listed under **IAEA** are from Ref. [3]. Those listed under **Consortium** are the recommendations of the International RBMK Safety Project sponsored by the European Commission. **Smolensk** and **Ignalina** recommendations are the results of IAEA safety review missions to those two plants [4], [5]. **RDIPE** items include data provided by the RDIPE to the IAEA on plant status. **ASSET** recommendations are those which were developed during Assessment of Safety Significant Events Teams (ASSET) missions [6]. **Other items** displays items which were derived from earlier IAEA documents [7], [8].

The references which contain information related to the displayed issue are enabled in boldface letters and may be selected. No information is available from those references which are shadowed in grey letters, are disabled and are unaccessable.

To display the recommendations contained in Ref. [3], click on the **IAEA** button which is located at the bottom left of the screen. The system will display the number of recommendations which the IAEA made for the selected issue and these can be read in turn when the **Next** button is used (at the bottom right of the screen). This button also scrolls forward through the entire list of selected issue recommendations. To scroll backwards click on the **Previous** button.

The **RDIPE** subset may also have plant information on actions relating to the selected issue. In this case, the **Plant actions** button (at the bottom left of the screen) is enabled in boldface letters. Click on this button to open the window with the different plant names at the bottom. Plant names are enabled in bold face letters when information is available on their actions relating to the selected issue. Select a plant name and the system will display the unit(s) for which such plant actions are applicable. Close the window to continue.

Topical reports

In the framework of the IAEA Extrabudgetary Programme on safety of RBMK NPPs topical meetings are organized to review some of the most important safety issues. Recommendations of two topical meetings [9], [10] are included in the database under **Topical reports**.

The topical reports icon, an open book, is displayed when recommendations from these reports relating to the selected issue are available. Click on the **Open book** button to display these recommendations. The number of recommendations is displayed as well as the reference identification number of the particular topical report. To scroll forward through the list of recommendations, click on the **Next** button, to scroll backwards, click on the **Previous** button. Click on **OK** to close the window and continue.

Menu bar

The database has a customized menu bar with file, references, print and link menu names. The commands under the menu names are executed in the following way.

File menu on the menu bar

Copy

To copy text from the clarification, justification, or recommendation areas, block, and select the text then click on **File** in the menu bar and select **Copy**, (for the **Topical reports** press **Ctrl+C** to copy). The selected text can be pasted into word processing, spread sheet or other applications.

Exit

To exit the database, click on **Exit** in the File menu. All the Microsoft ACCESS files will be closed and the system will exit the application.

References menu on the menu bar

Info sources

Select the **Info sources** menu item from the References menu to display a list of publications used as information sources in the database. Close the window to continue.

Topical reports

Topical reports menu item displays a list of IAEA topical reports quoted in the recommendations in the Topical reports area of the database. Close the window to continue.

About...

About... displays the names and addresses of the contact persons, relating to the IAEA Extrabudgetary Programme and the developer of the database. Click on **OK** to close the window.

Print menu on the menu bar

Print

To print a selected group of issues (for example, from the **Find** operation previously performed), or the issue currently displayed on the screen, click on the **Print** menu and choose **Print....** The **Report printing** window will be displayed. Choose **Selected items** or **Current issue**, then select specific related items from the references which are enabled on the particular issue(s) or **All items** (to print all items related to the issue(s) selected). Click on **Print** and the **Print dialogue box** will be displayed indicating the default printer name and the requested print range To display a preview, before printing, click on the **Print preview** button. Click on **OK** to start printing.

Print setup

The usual Windows **Print Setup dialogue box** will be displayed. Choose the printer, orientation, paper size, etc., which are appropriate for the available hardware. Click on **OK** to close.

*Link with the G-24 Project Data Bank**

Under the **Link** menu from the customized menu bar two menu items are available.

Show the link to G-24 Data Bank

Select this item to display the diagram showing the link between

* For the G-24 Project Data Bank contact the G-24 NUSAC Secretariat in Brussels.

the G-24 Project Data Bank and the IAEA databases. Click on **OK** to close.

Export link table

If the G-24 Project Data Bank is installed on your computer you can create a table which provides a link between the IAEA technical databases and the G-24 Project Data Bank. Click on **Export link table** to display the **Generate table linking to G-24 Project Data Bank** dialogue box. The **Generate** button creates a link table for the selected issues or the currently displayed issue. After generation, the **Export** button is activated in bold face letters. Type in the correct path to the G-24 data bank on your PC, then click on **Export**. An error message will be displayed if the indicated path is incorrect. Click on **OK** and make the necessary change to the path, then click on **Export** again. The table will be exported to your G-24 data bank file which can then be used for further analysis.

Note, if the export operation is cancelled after generation of the table, generation must be made again before the export function can be performed.

4. WWER-440/213 DATABASE

4.1. STRUCTURE AND FEATURES

In 1993 the IAEA Extrabudgetary Programme on the Safety of WWER Nuclear Power Plants initiated the systematic work on compiling and ranking of safety issues for WWER 440/213 reactors. A report listing safety issues identified by the WWER 440/213 owners was completed under an IAEA contract in the middle of 1993 and after a review by WANO was presented at a WANO conference in Moscow in March 1994.

The problems connected with bubbler condenser containment were studied under an IAEA/TC RER/9/004 project and discussed at an IAEA Consultants' Meeting organized within the framework of the

IAEA Extrabudgetary Programme in Vienna in November 1993. At the same time, the major findings of the RER/9/004 project concerning the design and design basis of WWER 440/213 reactors were summarized in Ref. [11] and served as an important input to further work on issue ranking.

In April 1994, an IAEA Consultants meeting on WWER 440/213 "Backfittings and Safety Issues" was organized within the framework of the IAEA Extrabudgetary Programme. It was further reviewed and completed by the IAEA Secretariat, taking into account the comments from the Steering Committee. The papers presented by all NPPs and several organizations concerned with WWER 440/213 safety studies helped to establish a draft list of safety issues and their ranking.

A final Consultants meeting was convened by the IAEA from 27 February to 3 March 1995 to harmonize the safety issues and ranking of both reactor types, WWER-440/213 and WWER-1000/320.

This finalized list of safety issues is included in a publication of the Extrabudgetary Programme [12].

The list of the safety issues was taken as a basis for creating a database on WWER-440/213 reactors. The basic primary table, named "WWER-213 Issues", contains the following fields:

ID	Identification number (index field).
Issue number	Code number of the issue with the reference to the topical area.
Issue title	Title of the issue.
Clarification	Description of the safety concern.
Ranking	Category identified on the basis of degradation of defence in depth (I—IV).
Justification	Justification of the category.

The primary tables and the number of records in each table are included in Table IV. Three tables are used only for displaying the data on the main screen and therefore they are not listed here.

TABLE IV. PRIMARY TABLES IN THE WWER-440/213

Primary table name	**Number of records**
WWER-440/213 Issues	87
IAEA recommendations	232
Measures proposed by Member States	186
Status	521
Safety area types	94
Safety areas relation table	124
Total:	1244

The database includes references to the original publications where the data were obtained. An interface table with the G-24 Project Data Bank can be prepared which makes a joint analysis of information from both databases easier.

To a large extent, the identified safety issues are being addressed by the Member States concerned within national safety improvement programmes for WWER 440/213 NPPs. The most relevant safety upgrading measures were compiled by the "Users Group for Soviet Designed Reactors - WWER 440/213" based mainly on the proposals made by user organizations. The structure of the database (Fig. 5) reflects both the proposals of national and international programmes, and plant specific status of issues.

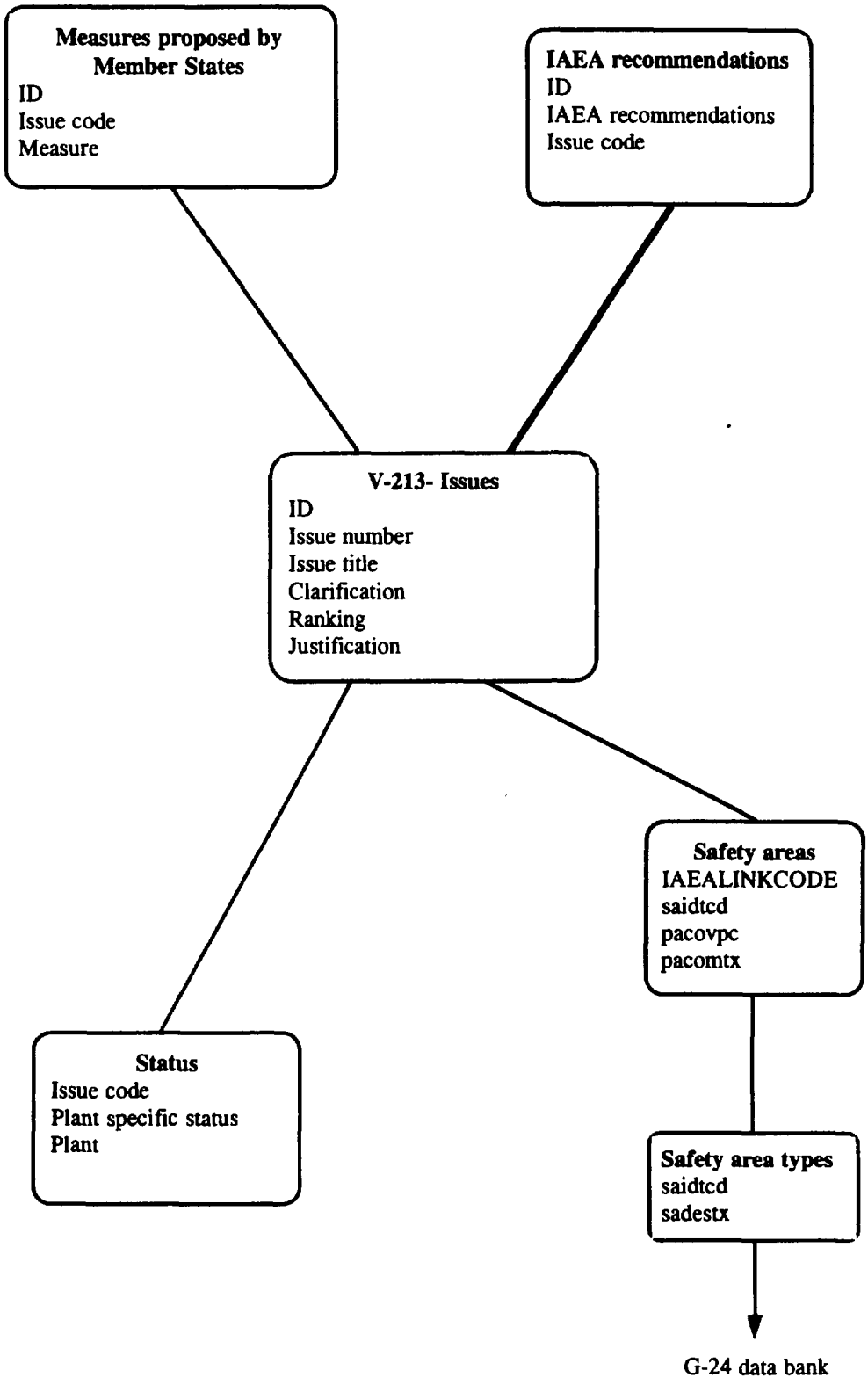

FIG. 5. Structure of the WWER-440/213 database.

These corrective measures for each issue have been reviewed and consolidated in the table "Measures proposed by Member States". The corrective measures are generic as the issues themselves, i.e. in general they are applicable to the units of the WWER 440/213.

The design weaknesses typical for the original WWER 440/213 plant described in safety issue clarification do not necessarily concern all presently operating or planned units with this type of reactor. In some reactors, e.g. in Loviisa NPP, far reaching changes were introduced already during plant construction and an intensive safety improvement programme has been implemented over several years. Other units realized some improvements in the early years of operation and have recently made major efforts for safety enhancement, or plan to introduce significant changes in the near future. Thus some safety concerns do not apply to several of the WWER 440/213 units.

The table "Status" includes the actual country/plant specific status determined partly by the IAEA staff upon the basis of available literature or the IAEA's own mission reports but mostly as the result of communications directly with the plants. In several cases, the plant status has been repeatedly verified and supplemented with actual data by the plant or by a joint action of specialists both from the plant and the regulatory authority. However, this is not the case for all plants, so that the level of detail in the plant status description varies in each case.

The data directly verified by the IAEA are only those taken from the IAEA mission reports. So far, the missions for the safety improvements review have been organized to three WWER 440/213 plants, namely Bohunice, Dukovany and Mochovce. The mission to Paks is planned for the autumn of 1996. Further missions to the remaining WWER 440/213 units are proposed. The results of these missions will be reflected in the plant specific status description supplementing and improving the data available at present. The information has also been introduced into the IAEA database and will be constantly updated as new sources of information become available.

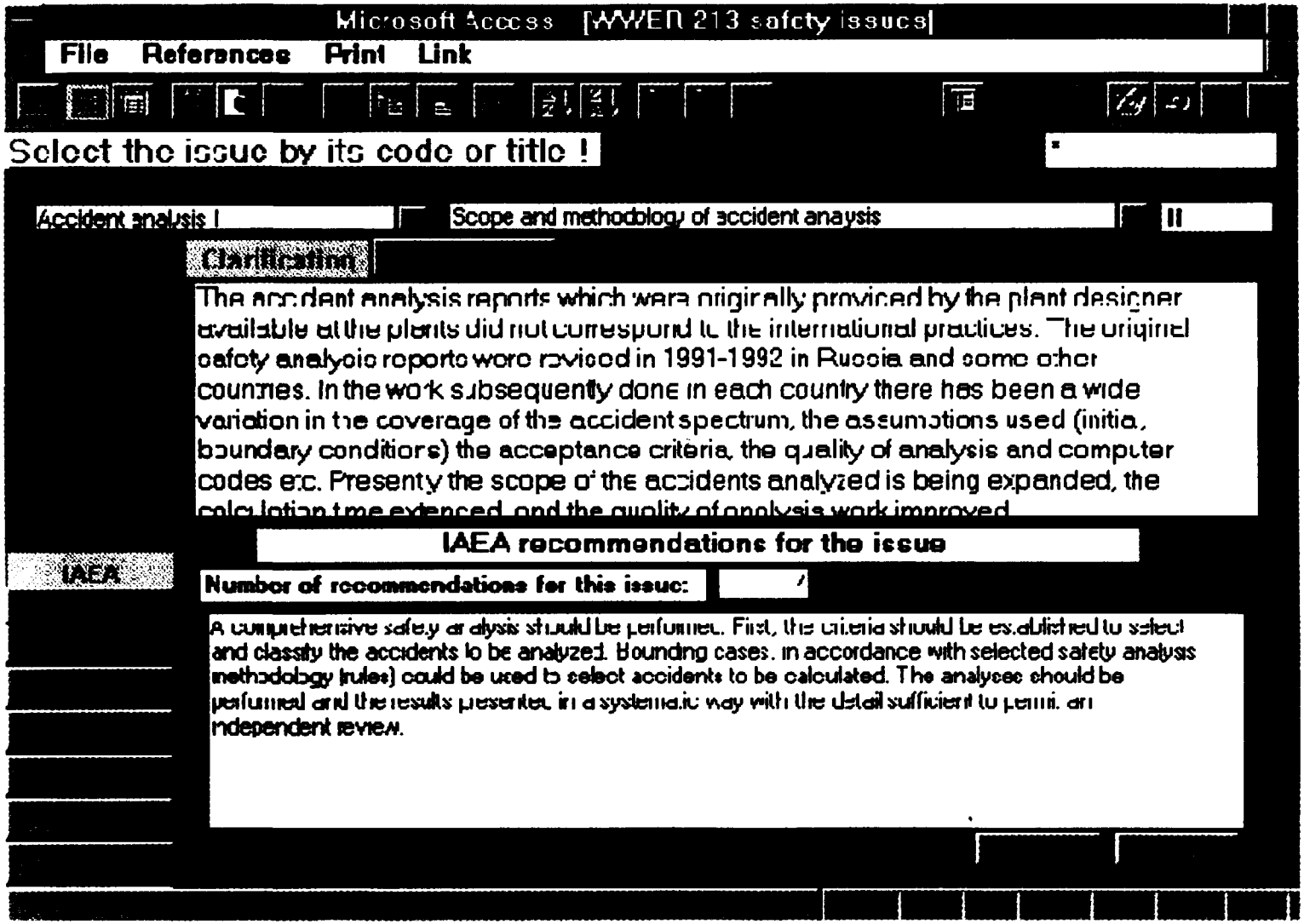

FIG. 6. Main dialog screen of the WWER-440/213 database

4.2. USER INTERFACE

A dialog screen for easy retrieval of information was developed for the WWER-440/213 database on which all information from the issue list can be displayed including the plant specific information (Fig. 6). On this screen the user can select a particular safety issue and display the information contained in [12].

Start

To open the IAEA WWER-440/213 database double-click the V-213 icon created by the setup programme. Click on the **Start** button to display the main dialog screen (Fig. 6) which offers a flexible way to select information from the database.

Select the issue

An issue may be selected either by its code or by its title in the upper part of the screen. A new issue may be selected either from the new issue code or the issue title pop-up lists. (It is sufficient to select either a new issue code or a new issue title, the other fields change automatically after a selection is made.)

A group of issues may be selected in two ways:

(a) To obtain a subset of issues and recommendations related to a particular word in the database, type the word in the **Find** field (at the top right of the screen) and press enter. The pop-up lists of issue codes and issue titles will include the results of the search. The lists contain the issues with the word in *any* of the text fields.

For example, type ECCS, press enter and the system will display the selected issues and recommendations with the word ECCS in the text.

(b) To select and display the *full* set of issues and

recommendations in the database type an asterisk, (*), in the **Find** field and press enter. Accident analysis 1 will be the first issue displayed.

Issue category, clarification, justification and recommendations

Once the issue code or issue title is selected, the system will display the category and issue clarification pertaining to the selected issue in the upper part of the screen.

Click on the **Justification** button to display the justification of the category.

Recommendations of the IAEA, measures proposed by the Member States for the issue, and status of the plants were taken from [12].

The IAEA recommendations from Ref. [12] are displayed when the **IAEA** button at the bottom left of the screen is selected. The system displays the number of recommendations which the IAEA made for the selected issue which can be read in turn when the **Next** button is selected (at the bottom right of the screen). This button also scrolls forward through the entire list of selected issue recommendations. To scroll backwards click on the **Previous** button.

Information on the number of measures proposed by Member States for the current issue are displayed when the **Measures** button is selected.

Plant names are enabled in boldface letters, bottom left of the screen, when information is available on the status of items relating to the displayed issue or recommendation. Click on a particular plant name button and the number of items for the issue are displayed which can be read in turn when the **Next** button is used (at the bottom right of the screen). This button also scrolls forward through the entire list of selected issue recommendations. To scroll backwards click on the **Previous** button.

Menu bar

The database has a customized menu bar with file, references, print and link menu names. The commands under the menu names are executed in the following way.

File menu on the menu bar

Copy

To copy text from the clarification, justification, or recommendation areas, block and select the text then click on **File** in the menu bar and select **Copy**. The selected text can be pasted into a word processing, spread sheet or other application.

Exit

To exit the database, click on **Exit** in the **File** menu. All the Microsoft ACCESS files will be closed and the system will exit the application.

References menu on the menu bar

Info sources

Click on **Info sources** from the References menu bar to display a list of publications used as information sources in the database. Close the window to exit.

About...

About... displays the names and addresses of the contact persons, relating to the IAEA Extrabudgetary Programme and the developer of the database. Click on **OK** to close the window.

Print menu on the menu bar

Print

To print a selected group of issues (for example, from the **Find** operation previously performed), or the issue currently displayed on the screen, click on the **Print** menu and choose **Print....** The **Report printing** dialogue box will be displayed. Choose **Selected items** or **Current issue**, then select specific related items from the references which are enabled on the particular issue(s), or **All items** (to print all items related to the issue(s) selected). Click on **Print** and the **Print** dialogue box will be displayed indicating the default printer name and the requested print range. To display a preview, before printing, click on the **Print preview** button. Click **OK** to start printing.

Print setup

The usual Windows **Print Setup** dialogue box will be displayed. Choose the printer, orientation, paper size, etc., which are appropriate for the available hardware. Click on **OK** to close.

*Link with the G-24 Project Data Bank**

Under the **Link** menu from the customized menu bar two menu items are available.

Show the link to G-24 Data Bank

Select this item to display the diagram showing the link between the G-24 Project Data Bank and the IAEA databases. Click on **OK** to close.

* For the G-24 Project Data Bank contact the G-24 NUSAC Secretariat in Brussels.

Export link table

If the G-24 Project Data Bank is installed on your computer you can create a table which provides a link between the IAEA technical databases and the G-24 Project Data Bank. Click on **Export link table** to display the **Generate table linking to G-24 Project Data Bank** dialogue box. The **Generate** button creates a link table for the selected issues or the currently displayed issue. After generation, the **Export** button is activated in bold face letters. Type in the correct path to the G-24 data bank on your PC, then click on **Export**. An error message will be displayed if the indicated path is incorrect. Click on **OK** and make the necessary change to the path, then click on **Export** again. The table will be exported to your G-24 data bank file which can then be used for further analysis.

Note, if the export operation is cancelled after generation of the table, generation must be made again before the export function can be performed.

5. WWER-1000 DATABASE

5.1. STRUCTURE AND FEATURES

The WWER-1000 nuclear power plants are more similar than other reactors of Soviet design to PWRs of western design when considering design philosophy, design features and construction. The design of the model 320 is, in general, consistent with standard international practice for safety systems and safety-related systems. The basic safety concept of defence-in-depth is realized by general design criteria including the use of redundancy, diversity, independence and fail-safe design.

However, operational experience has revealed some deficiencies regarding implementation of engineering design solutions, quality of manufacture and reliability of equipment used and the consequential need for safety improvements. Other shortcomings reflect deviations

from current safety standards which evolved over the last two decades since the design of WWER-1000 plants.

In February 1992, Bulgaria, the Czech Republic and the Ukraine separately requested that the IAEA initiate a comprehensive safety evaluation for WWER-1000 NPPs.

A consultants meeting was held by the IAEA in Vienna in June 1992 to compile information on safety aspects and studies carried out on the design differences between WWER-1000 plants and similar western plants as well as safety reviews already performed for this reactor type. At this meeting, the Member States operating and constructing WWER-1000 NPPs requested that a compilation be made of all safety concerns of WWER-1000 NPPs as a reference for plant specific safety improvements. Therefore, the activities of the IAEA Extrabudgetary Programme on the Safety of WWER-1000 NPPs were directed at identifying main safety issues and priority actions, by considering the major reconstruction programmes for WWER-1000 developed in Russia, the Ukraine, Bulgaria and Czech Republic, by considering the results of topical meetings on main generic issues and by considering safety studies for specific plants such as Stendal and Rovno. These activities have been complemented by the results of plant specific reviews carried out within the IAEA Programme. The Safety Review Mission to Zaporozhe (Ukraine) in 1994 and various ASSET, OSART and Seismic Safety Missions in all Member States concerned were major activities in this respect.

This issue list for the WWER-1000/V-320 type of nuclear power plants was initially drafted by the participants of the consultants meeting from 3-7 October 1994. It was further reviewed and completed by the IAEA Secretariat, taking into account the comments from the Steering Committee, new information made available to the IAEA from the Rovno Report [13], comments received to date from meeting participants and harmonization with the issues identified and ranked for the WWER-440/213 NPPs. A final consultants meeting was convened by the IAEA from 27 February to 3 March 1995 to harmonize the safety issues and ranking of both reactor types, WWER-440/213 and WWER-1000/320.

This finalized list of safety issues is included in a publication of the Extrabudgetary Programme [14].

The list of the safety issues was taken as a basis for creating a database on WWER-1000 reactors. The basic primary table, named as "WWER-1000 Issues" contains the following fields:

ID	Identification number (index field).
Issue number	Code number of the issue with the reference to the topical area.
Issue title	Title of the issue.
Clarification	Description of the safety concern.
Ranking	Category identified on the basis of degradation of defence-in-depth (I—IV).
Justification	Justification of the category.

The primary tables and the number of records in each table are included in Table V. Three tables are used only for displaying the data on the main screen and therefore they are not listed here.

The database includes references to the original publications where the data were obtained. An interface table with the G-24 Project Data Bank can be prepared which makes a joint analysis of information from both databases easier.

To a large extent, the identified safety issues are being addressed by the relevant Member States within national safety improvement programmes for WWER-1000 NPPs. Most relevant safety upgrading measures have been compiled by the "Users Group for Soviet Designed Reactors - WWER-1000", and are based mainly on the proposals made by Russian design organizations. The structure of the database (Fig. 7) allows to reflect both the proposals of national and international programmes and plant specific status of issues.

TABLE V. PRIMARY TABLES IN THE WWER-1000 DATABASE

Primary table name	Number of records
WWER-1000 issues	82
IAEA recommendations	202
Measures proposed by Member States	103
Status	201
Status plant relation table	234
Plants	12
Safety area types	94
Safety areas relation table	109
Total:	1037

These corrective measures proposed by the Member States for each issue have been reviewed and consolidated in the table "Measures proposed in Member States". These corrective measures are generic as are the issues themselves, i.e. in general they are applicable to the units of the WWER-1000 model 320 NPPs.

The country/plant specific status so far made available to the IAEA has been included into the database. However, this information is incomplete, sometimes very general and lacking technical details. It should be further completed and updated.

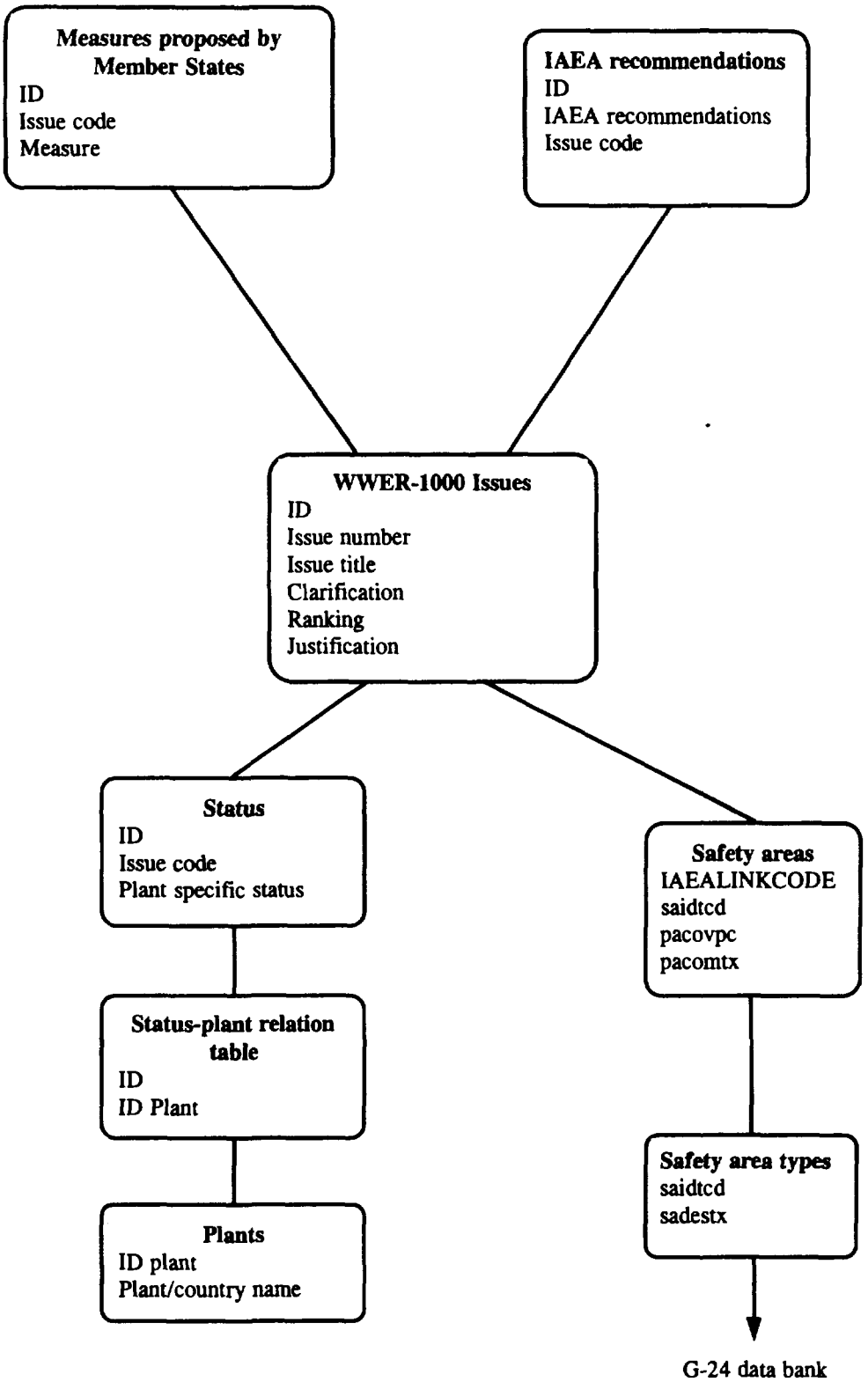

FIG. 7. Structure of the WWER-1000 database.

5.2. USER INTERFACE

A dialog screen for easy retrieval of information was developed for the WWER-1000 database on which all information from the issue list can be displayed including the plant specific information (Fig. 8). On this screen the user can select a particular safety issue and display the information contained in [14].

Start

To open the IAEA WWER-1000 database double-click the WWER-1000 icon created by the setup programme. Click on the **Start** button to display the main dialog screen (Fig. 8) which offers a flexible way to select information from the database.

Select the issue

An issue may be selected either by its code or by its title in the upper part of the screen. A new issue may be selected either from the new issue code or the issue title pop-up lists. (It is sufficient to select either a new issue code or a new issue title, the other fields change automatically after a selection is made).

A group of issues may be selected in two ways:

(a) To obtain a subset of issues and recommendations related to a particular word in the database, type the word in the **Find** field (at the top right of the screen) and press enter. The pop-up lists of issue codes and issue titles will include the results of the search. The lists contain the issues with the word in *any* of the text fields.

For example, type ECCS, press enter and the system will display the selected issues and recommendations with the word ECCS in the text.

(b) To select and display the *full* set of issues and recommendations in the database type an asterisk, (*), in the **Find** field and press enter. Accident analysis 1 will be the first issue displayed.

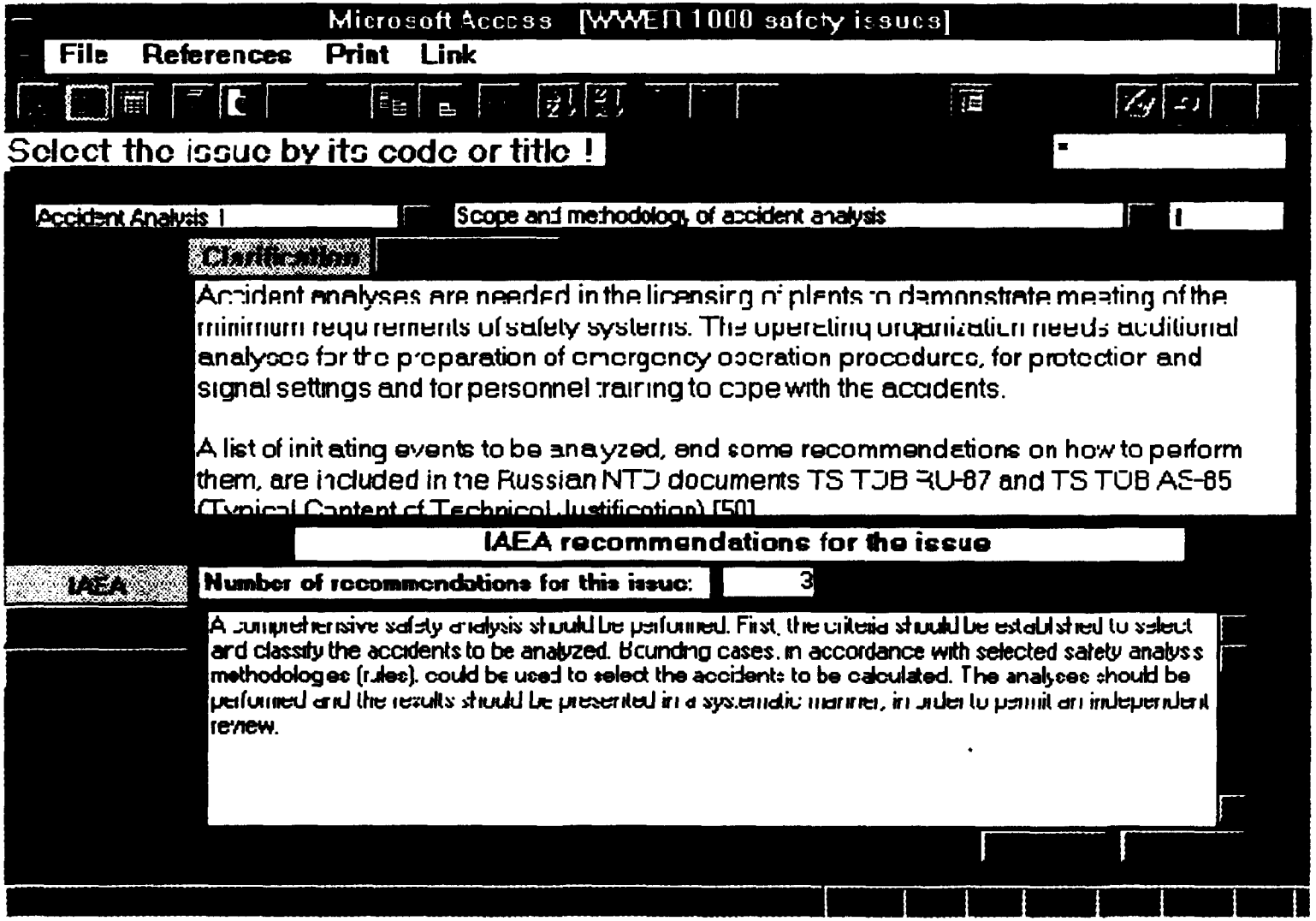

FIG. 8. Main dialog screen of the WWER-1000 database

Issue category, clarification, justification and recommendations

Once the issue code or issue title is selected, the system will display the category and issue clarification pertaining to the selected issue in the upper part of the screen.

Click on the **Justification** button to display the justification of the category.

Recommendations of the IAEA, measures proposed by the Member States for the issue and status of the plants were taken from Ref. [14].

The IAEA recommendations from Ref. [14] are displayed when the **IAEA** button at the bottom left of the screen is selected. The system displays the number of recommendations which the IAEA made for the selected issue and these can be read in turn when the **Next** button is selected (at the bottom right of the screen). This button also scrolls forward through the entire list of selected issue recommendations. To scroll backwards click on the **Previous** button.

Information on the number of measures proposed by Member States for the current issue are displayed when the **Measures** button, bottom left of the screen, is selected.

The **Plant status** button, bottom left of the screen, is enabled in boldface letters when plant specific information is available on actions relating to the selected issue. Click on this button to open the **Plant specific information and national programmes** window with different plant and country names at the bottom. The plant or country names are enabled in boldface letters when information is available on plant actions relating to the selected issue. Select a plant or country name and the system will display the number of items/actions relating to the current issue. Close the window to continue.

Menu bar

The database has a customized menu bar with file, references, print and link menu names. The commands under the menu names are executed in the following way.

File menu on the menu bar

Copy

To copy text from the clarification, justification, or recommendation areas, block and select the text then click on **File** in the menu bar and select **Copy**. (To copy text from the **Plant specific information and national programmes** window, block the text and press **Ctrl+C** then close the window.) The selected text can be pasted into a word processing, spread sheet or other application.

Exit

To exit the database, click on **Exit** in the **File** menu. All the Microsoft ACCESS files will be closed and the system will exit the application.

References menu on the menu bar

Info sources

Click on **Info sources** from the References menu bar to display a list of publications used as information sources in the database. Close the window to exit.

About...

About... displays the names and addresses of the contact persons, relating to the IAEA Extrabudgetary Programme and the developer of the database. Click **OK** to close the window.

Print menu on the menu bar

Print

To print a selected group of issues (for example, from the **Find** operation previously performed), or the issue currently displayed on the screen, click on **Print** in the Menu bar and choose **Print....** The **Report printing** dialogue box will be displayed. Choose **Selected items** or **Current issue**, then select specific related items from the references which are enabled on the particular issue(s) or **All items** (to print all items related to the issue(s) selected). Click on **Print** and the **Print** dialogue box will be displayed indicating the default printer name and the requested print range. To display a preview, before printing, click on the **Print preview** button. Click on **OK** to start printing.

Print setup

The usual Windows **Print Setup** dialogue box will be displayed. Choose the printer, orientation, paper size, etc., which are appropriate for the available hardware. Click on **OK** to close.

*Link with the G-24 Project Data Bank**

Under the **Link** menu from the customized menu bar two menu items are available.

Show the link to G-24 Data Bank

Select this item to display the diagram showing the link between the G-24 Project Data Bank and the IAEA databases. Click on **OK** to close.

Export link table

If the G-24 Project Data Bank is installed on your computer you can create a table which provides a link between the IAEA technical

* For the G-24 Project Data Bank contact the G-24 NUSAC Secretariat in Brussels.

databases and the G-24 Project Data Bank. Click on **Export link table** to display the **Generate table linking to G-24 Project Data Bank** dialogue box. The **Generate** button creates a link table for the selected issues or the currently displayed issue. After generation, the **Export** button is activated in bold face letters. Type in the correct path to the G-24 data bank on your PC, then click on **Export**. An error message will be displayed if the indicated path is incorrect. Click on **OK** and make the necessary change to the path, then click on **Export** again. The table will be exported to your G-24 data bank file which can then be used for further analysis.

Note, if the export operation is cancelled after generation of the table, generation must be made again before the export function can be performed.

6. LINK TO THE G-24 PROJECT DATA BANK

In 1992 the G-24 NUSAC was requested to develop a data bank containing assistance projects in the field of nuclear safety of Eastern and Central European nuclear power plants.The objective of the database was to support the G-24 co-ordination mechanism.

From the very beginning, the IAEA was asked to assist in the elaboration of the structure, provision of data on the IAEA's activities and suggestions for the further improvement of the data bank.

The IAEA entries in the G-24 Project Data Bank are updated three times a year in order to maintain up-to-date information on IAEA activities.

As a result of the early involvement of the IAEA in the development of the G-24 Project Data Bank, it was possible to develop both the IAEA technical databases and the G-24 Project Data Bank in such a way that they can be linked and jointly analysed. This link is implemented through the common tables in all databases containing the safety areas which are addressed by the issues or projects. The structure

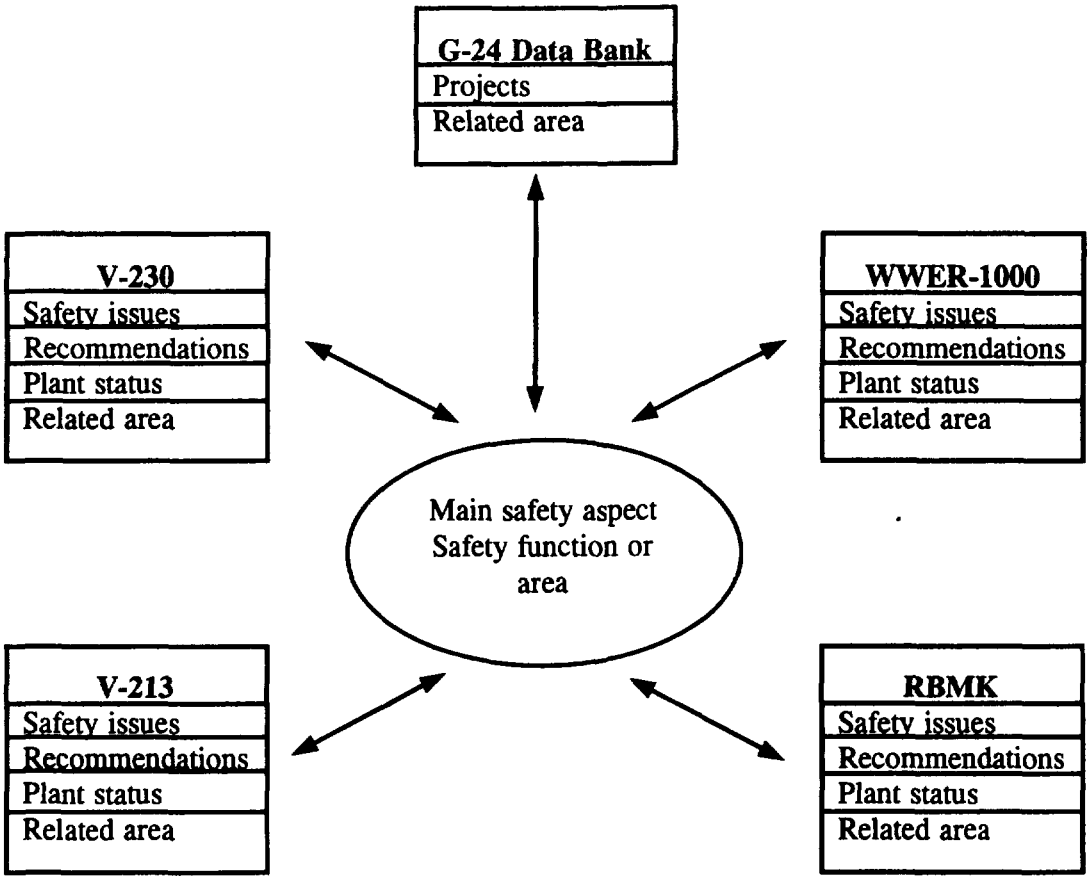

FIG. 9. Link between the G-24 Project Data Bank and the IAEA databases.

of this link is shown in Fig. 9. In the IAEA databases the user can create a table which links the selected issue or the group of issues to the G-24 Project Data Bank by selecting this action from the menu.

A joint analysis can be run to produce some indicators of the assistance activity, for example, the number of projects addressing a particular safety issue or group of issues. In preparing these types of queries several attributes of the projects (donor and/or recipient countries, status, aid-type, final product etc.) and issues (category, status of implementation etc.) can be specified. This type of analysis can support overall or topical reviews but should not be used an absolute measure of the assistance efficiency.

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ABBREVIATIONS

ASSET	Assessment of Safety Significant Events Team (IAEA)
ECCS	emergency core cooling system
G-24	Group of 24 OECD countries
NPP	nuclear power plant
NUSAC	Nuclear Safety Assistance Co-ordination
OECD	Organisation for Economic Co-operation and Development
OSART	Operational Safety Review Teams (IAEA)
PC	personal computer
RBMK	light boiling water cooled graphite moderated pressure tube type reactor (Soviet design)
RDIPE	Research and Development Institute of Power Engineering (Moscow, Russia)
VGA	PC graphic adapter and display standard
WANO	World Association of Nuclear Operators
WWER	water cooled water moderated energy reactor (Soviet design)