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International Agreement Report

A Tool for Drawing With Excel

Prepared by

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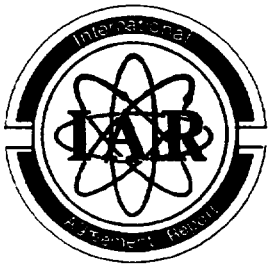
NUREG/IA–0191



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ABSTRACT

Worldwide the research is conducted how to reduce the user effects on safety analysis in the nuclear engineering field. It was shown that user effects could be reduced with automatic display of the result. Therefore a program was developed for automatic creation of figures with Microsoft Excel 97 with capability to present single curve or multiple curves. Primarily the program was developed for the RELAP5 users. However, due to flexibility it can be used for graphic presentation of severe accident or user developed codes when the output is in columns and ASCII format. The testing of the tool showed that figure can be quickly and easily created. The tool conforms also to quality assurance requirements, because all input data used are archived. Additionally a figure list is created including titles, boundaries, ranges of cells for plotting etc. A huge number of quickly generated figures enable detail analysis of certain phenomena, thereby improving the quality of the analysis.

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1. Introduction

Post processing of the calculated data is very important when performing thermal-hydraulic safety analyses. It is known that user effects can be reduced with automatic display of the results therefore research is conducted also in this direction. An example of such tool is Nuclear Plant Analyzer (NPA) [1]. It was developed for the RELAP5/MOD3 code and higher versions while it is not applicable to RELAP5/MOD2. Generally graphical presentation of the results is time consuming.

Therefore in 1997 the macro was developed to create figures for Excel 95 and then converted to Excel 97. It was developed primarily for printing. The macro printed on A4 sheet, landscape oriented, 9 charts with maximum 5 curves each and closed the workbook. The advantage of such tool was that many results could be presented graphically with the possibility of comparison. The disadvantage of the macro was (because there was no need) that linking with other documents was not possible. The reason was because only one sheet with nine plots could be saved. Another disadvantage was archiving of the workbooks because of the size and automatic renaming of worksheets and workbooks names. Also the figures could not be edited.

In order to present the calculated results graphically in standard format, with clear and nice outlook, reducing the possibility of user errors, as well as time and effort needed for plotting as much as possible (depending on the processor speed only), the new macro was developed. It is intended for creating plots from any safety analysis for the reports, journal paper, published papers, diplomas, thesis etc. whenever the data were properly formatted. With the macro commands stored in the workbook for drawing with Excel the user can define the style of the chart (font size and type, grids, line thickness, chart size, colors etc.). The macro is intended for creating large number of similar plots (more than 5), while for generating smaller number of plots it may be faster to use Excel commands.

2. Capabilities of the code

The macros are written in Visual Basic [2, 3]. As interface between the macros and user the Excel sheets (worksheets or charts) are used. The workbook for drawing with Excel consists of 8 sheets, listed in Table 1. Each sheet has a function, which is also described in Table 1. In the next paragraphs the sheets are described and how to enter the input data needed for macro execution.

Important: In Table 1 the sheets required for macro execution are shown. These sheets can be renamed only if the names are changed in the macro source. Any new worksheets or charts can be added to the workbook.

Table 1: The function of the sheets

Sheet name	Function	User can change
Input_data	for inputting data needed for macro execution	YES
Options	for saving program settings (options)	NO+
Inp_figure	for inputting figure text and boundaries	YES
Control	text for dropdown menus	NO
Temp	for saving and reading values needed for macro execution	NO
color	chart style saved on chart "color"	YES*
mono	chart style saved on chart "mono"	YES*
fig_small	chart style saved on chart "fig_small"	NO+

+ only when default style is changed
* when user change chart style

2.1 Worksheet "*Input_data*"

The worksheet *"Input_data"* is shown on Figure 1. Each cell used has a color depending on the function. The text input data are input in yellow cells, while their description is in light blue cells above, bellow or near yellow cell. The settings (options) are selected from drop down menus. Macros are run with the command buttons.

The text input is:

- the data filenames with pathname and file extension,
- the workbook name and path, in which the data and/or figures are saved (output workbook),
- header text for A4/letter sheet,
- x-axis boundaries for quick input (same boundaries for all figures),
- title and boundary worksheet name (the worksheet, worksheet name and text are input by the user).

Program settings are selected from 20 dropdown menus in column E. All settings can be saved with the command button *"Save all options"* and later retrieved by last, 21st dropdown menu. There are six option groups:

- **Mode** (the mode for reading data and plotting figures),
- **Boundaries** (specifying boundaries for x and y axis);
- **Text** (figure title, x- and y-axis title, the worksheet with figure text and legends);
- **Graphics** (style, format and figure type. For figure type *"small"* the number of figures in one row can be selected);

- **Data** (data type, title row, first and second row for axis title, first data row, number of rows to skip from bottom for plotting);
- **Program** (saved options).

Each group has its own color.

Macros are run with left mouse click of command button. Command buttons are within white box (column F) and are the following:

- **Run** (macro for reading data and creating figures),
- **Figure size** (macro for figure size),
- **Save user-defined chart type in template** (macro for saving chart style),
- **Save all options** (it saves all program settings, called also options).

Besides program settings and macros other possibilities are also check box for selection of logo and date to be printed in the left bottom corner of the figure and dropdown menu for paper size selection (A4 or letter).

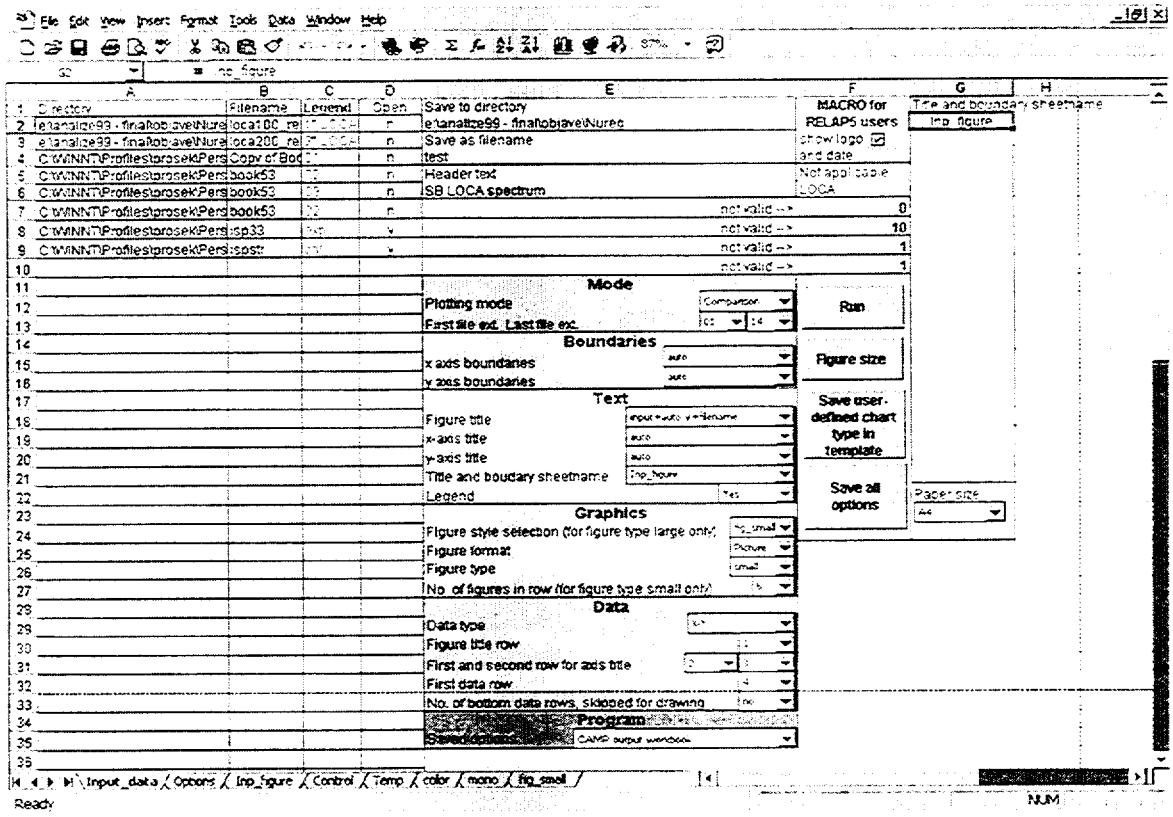


Figure 1: The worksheet "*Input_data*"

2.1.1 Input of text data

Data filenames. Information for filenames is input in yellow cells in columns A to C.

Full filenames are input different for plotting modes "*One curve*" and "*Comparison*".

For the plotting mode "*One curve*" pathname, filename and file extension are input separately in the columns with the name *"Directory"*, *"Filename"* and *"File extension"*; at

the end the user inputs also "Y" in the column "*Open (Y/N)*" (case insensitive) to open the data file. If the user does not input "Y", the data file is not opened nor figures are created.

The number of data file rows is limited to 100. Data files can have one independent variable (first column, usually time) and from one to nine dependent variables.

Another option is to compare plots. In such a case the plotting mode "*Comparison*" is selected. In the plotting mode "*Comparison*" different calculations are compared. The file extension is prescribed (sequential numbers from 01, 02,..,25). This numbers are used to input only one filename for data files (maximum 25) of the same calculation. In such a case, the C column ("*Legend*") is used to input legend names. Altogether 20 different calculations can be compared. The number of data files is selected by dropdown menus placed in cell E13. First dropdown menu is for selecting first data file extension and second for the last data file extension (first number 3 and last number 5 mean that selected filenames are "*file*".*03*, "*file*".*04* and "*file*".*05*). For inputting filenames little text is needed. In the plotting mode "*Comparison*" it is also possible to generate figures with one curve. This is very useful, when the files have different file extensions (instead of inputting 25 rows for loca.01, loca.02,..., loca.25 one row is sufficient when the plotting mode "*Comparison*" is selected and 1 for first file extension and 25 for last file extension).

Important: In the plotting mode "*Comparison*" the column C is used for legend names while in the plotting mode "*One curve*" for file extensions.

Output workbook. The path and filename of output file (workbook) are input in cells E2 and E4. Extension "xls" is added automatically, therefore file extension is not input.

The macro during execution opens new workbook or overwrites old workbook if the workbook with the same name exists. In the later case a backup copy is made (with file extension "xlk"). The user must save manually the new output workbook.

Important: If output workbook already exists, it must be saved under new filename (with command *SaveAs*), because in the opposite the original workbook is lost. Therefore the command SaveAs is recommended for saving.

Header text. In the cell E6 header text is input. The header text can be used for description of calculation or other.

x-axis boundaries. When the boundaries are the same for all figures (usually time), they are input in cells F7 to F10. In this way the user avoids time-consuming input of boundaries for each figure in the separate worksheets. This option is very useful when the user is interested to analyze certain time interval. This input works only for option "*quick input*".

Title and boundary sheet name. The user inputs the worksheet names. First new worksheet is created, then it is optionally renamed, and finally figure text and boundaries are input. Such worksheet can be used for figure text. However the worksheet name must be input in one of the cells from G2 to G21.

Legend. Legend is input in light yellow cells. In the plotting mode "*Comparison*" this is column C, while in the plotting mode "*One curve*" the cell F6. The color of cells is automatically changed to light yellow to denote that will be used as input.

2.1.2 Settings

There are 20 settings in 6 groups. Besides the mode also options for boundaries, text, graphics and data are available. In the last group are program settings, selected by the user previously. This setting is not used for macro execution but other settings can be selected by

this selection. The program settings are listed in Table 2. If the setting is not applicable in certain mode, N.A. is displayed and the default values are used during macro execution.

Table 2: Program settings

Name	Variable in the code	Options
Mode		
Plotting mode	kaz_primerjava	Comparison One curve
First file ext.	kaz_dat_z	from 01 to 25
Last file ext.	kaz_dat_k	from 01 to 25
Boundaries		
x-axis boundaries	kaz_x_m	auto input quick input
y-axis boundaries	kaz_y_m	auto input
Text		
Figure title	kaz_nap_t	auto input input+auto title input+auto x-axis title input+auto y-axis title input+filename* input+auto y+filename* no
x-axis title	kaz_nap_x	auto input input+auto no
y-axis title	kaz_nap_y	auto input input+auto no
Title and boundary sheetname	kaz_strip	the name of worksheets input into cells G2 through G21
Legend	kaz_legenda	Yes No
Graphics		
Style selection (for figure type large only)	kaz_stil	color mono
Figure format	kaz_pic	Picture Chart
Figure type	kaz_vel	large small
No. of figures in row (for figure type small only)	kaz_niz	from 1 to 6

Table 2: Program settings (continued)

Name	Variable in the code	Options
Data		
Data type	kaz_podatki	Y multiple X-Y
Figure title row	kaz_tr	from 0 to 10
First and second row for axis title	kaz_lfr, kaz_lsr	from 0 to 10
First data row	kaz_dfr	from 1 to 11
No. of bottom data rows, skipped for drawing	kaz_dskip	from 0 to 3999
Program		
Saved options	kaz_opcije	the name for options is prompted when running the button "**Save all options**"

* - filename or worksheet name

2.1.2.1 Mode

Plotting mode. With this option is selected to generate figures with one or multiple curves what mean comparison. The mode has influence on the naming of data files.

a) ***Comparison:*** This option enable comparison of calculations. Maximum number of calculations is 20 (arbitrary chosen with possibility to increase to 255). On the figure 20 curves are presented labeled with legend. If legend is not input, the legend names are determined by Excel (Series1, Series2,...,Series20).
For data files maximum 25 filenames can be input for one case. When option "*Comparison*" is selected, two dropdown menus can be used. With these dropdown menus the first file and last file extension are specified (from 01 to 25 is standard format of file extension).
The Microsoft Excel 97 limits the maximum number of charts (depending on the memory, but maximum 256 in one workbook). When the number of charts is greater, the solution is to put all charts on single worksheet and to select format "*Picture*" or to generate charts by pieces and save them in several workbooks.

b) ***One curve:*** It is intended to generate figures with one curve. The plotting mode is equivalent to the plotting mode "*Comparison*" with one data file, but the difference is that in this mode the filename is not prescribed.

First file ext. The user selects between a number between 01 and 25. First file extension must be smaller than last file extension, otherwise warning is displayed and the last file extension is set to the value of first file extension.

Last file ext. The user selects between a number between 01 and 25. Last file extension must be greater than first file extension, otherwise warning is displayed and the last file extension is set to the value of first file extension.

2.1.2.2 Boundaries

For each figure it is necessary to select the x- and y-axis boundaries. One option is to specify the boundaries by user and another is to leave Excel to automatically select the boundaries.

x-axis boundaries. There are three options, how to input boundaries for x-axis:

a) auto: Boundaries selected by Excel automatically.

b) input: To input the x-axis boundaries on the worksheet with figure text and boundaries (see "*Title and boundary sheetname*", page 8) for each figure.

c) quick input: The values for x-axis boundary (minimum and maximum scale, major and minor unit) are input in cells F7 to F10. These values are used for all figures.

y-axis boundaries. There are two options, how to input boundaries for y-axis:

a) auto: Boundaries selected by Excel automatically.

b) input: To input the y-axis boundaries on the worksheet with figure text and boundaries (see "*Title and boundary sheetname*", page 8) for each figure.

2.1.2.3 Text

Each figure may have figure title, x-axis title and y-axis title. This titles can be input by user on title and boundary worksheet (see "*Title and boundary sheetname*", page 8) or to be read automatically from data file (in case of RELAP these are component names), with option to define the title rows. Another option is to combine titles from worksheet "*Title and boundary sheetname*" with titles from data files.

Figure title. There are eight options.

a) auto: It means, that figure title is read from data file. In data settings it is selected the row with figure title. When comparing the results the title from first data file and data worksheet is used, respectively.

b) input: The figure titles are input on title and boundary worksheet (see "*Title and boundary sheetname*", page 8) in column C. First figure title is input in second row, second figure title in third row etc.

c) input+auto title: Same as "*input*" with additional figure title in parenthesis read from data file. This option is useful when figure title is not displayed along y axis and information is desired on figure.

d) input+auto x-axis title: Same as "*input*" with additional x-axis title in parenthesis read from data file. This option is useful when x-axis title is not displayed along x-axis and information is desired on figure.

e) input+auto y-axis title: Same as "*input*" with additional y-axis title in parenthesis read from data file. This option is useful when y-axis title is not displayed along y-axis and information is desired on figure.

f) input+filename: Same as "*input*" with additional filename. This option is useful when information about filename is desired on figure.

g) input+auto y+filename: Same as "*input*" with additional y-axis title in parenthesis read from data file and filename. This option is useful when information about filename is desired on figure.

h) no: Figure has no figure title.

x-axis title. There are four options.

a) auto: It means that x-axis title is read from data file. In data settings are selected two rows (or one) from which x-axis titles are read. If "no" is selected this means no text

for x-axis title. In the case of more curves the x-axis title is read from first data file only and first worksheet, respectively.

*b) **input:*** The x-axis titles are input on worksheet with titles (see "*Title and boundary sheetname*", page 8) in column A. First x-axis title is input in second row, second x-axis title in third row etc.

*c) **input+auto:*** Combination of "*auto*" and "*input*" options. After x-axis title from worksheet with titles the x-axis title from file in parenthesis is written.

*d) **no:*** Figure has no x-axis title.

y-axis title. There are four options.

*a) **auto:*** It means that y-axis title is read from data file. In data settings are selected two rows (or one) from which y-axis titles are read. If "no" is selected this means no text for y-axis title. In the case of more curves the y-axis title is read from first data file only and first worksheet (for data stored on worksheets).

*b) **input:*** The y axis titles are input on worksheet with titles (see "*Title and boundary sheetname*", page 8) in column B. First y-axis title is input in second row, second y-axis title in third row etc.

*c) **input+auto:*** Combination of "*auto*" and "*input*" options. After y-axis title from worksheet with titles the y-axis title from file in parenthesis is written.

*d) **no:*** Figure has no y-axis title.

Title and boundary sheetname. For inputting the values default sheet "*Inp_figure*" is provided. First row describes the variable that may be input while next sequential rows are for inputting values. For details see Section 2.3.

New worksheets are simply created by inserting a new worksheet, and then values are input as described above. At the end the worksheet may be renamed and the worksheet name must be input in one of cells from G2 to G21. The worksheet name will then appear in the drop down menu (in cell E21) and can be selected from the list. In total 20 worksheet names can be input. The worksheet names can be input or deleted by user. It is also recommended to copy first row from worksheet "*Inp_figure*" to new inserted worksheet.

Important: After drawing figures worksheet "Figure_list" is generated with the titles and boundaries to be used for figures. Therefore it is recommended to draw figures with "auto" options for titles and boundaries and then from the list create a title and boundary worksheet.

Legend. There is option to display legend or no. For plotting mode "*One curve*" legend name is input in cell F6, while for plotting mode "*Comparison*" in the column C. When plotting mode is changed warning is displayed with information about legend names (number, name and location).

Plotting mode "One curve": In plotting mode "*One curve*" legend is input in cell F6. If the cell is empty, the legend name is defined by Excel automatically in case of data type "*Y multiple*". If data are "*X-Y*" type, the legend name is equal to the name of worksheet with data.

Plotting mode "Comparison": In plotting mode "*Comparison*" the legends are directly input for "*Y multiple*" data type (legends in column C). The first legend is the value with the first "Y" in column D, second with the second "Y" etc. If cells are empty, Excel defines the legend names. For "*X-Y*" data type the comparison is possible only for data stored on worksheet. The legend name is equal to the worksheet name by default (since no input for data filenames is required). To indirectly define the legend the user can rename the data worksheets appropriately and then generate figures.

2.1.2.4 Graphics

The user can choose between different chart styles, figure formats and types of figures. If the figure type is "*small*" (mean multiple figures on the worksheet), the user can define the number of figures in one row on the screen (n=1,2,...6). At the same time on the A4/letter landscape page n times n figures will be printed. The chart style is defined on chart sheets as described in Section 2.6. The chart can be designed free by user, however it is necessary to save chart style (see Section 2.1.3.3).

Style selection. For figure type "*large*", it can be selected "*color*" or "*mono*" chart style, while for "*small*" figure type the default style is "*fig_small*".

a) ***color:*** It means "*color*" chart style on worksheet "*color*", which will be described later. The option is not applicable for figure type "*small*", which has by default "*fig_small*" chart style.
b) ***mono:*** It means "*mono*" chart style on worksheet "*mono*", which will be described later. The option is not applicable for figure type "*small*", which has by default "*fig_small*" chart style.
c) ***fig_small:*** It means "*fig_small*" chart style on sheet "*fig_small*". The option is not applicable for figure type "*large*".

Figure format. The user can select between "*Picture*" and "*Chart*" figure format. If figure format "*Picture*" is chosen, the figure is no more linked with the data and figure titles and boundaries cannot be changed in Excel.

a) ***Picture:*** Excel figure is converted from "*Chart*" to "*Picture*" in order to reduce space, but in such a case the links with data are lost. The advantage of "*Picture*" format is that Excel can generate more figures with "*Chart*" format before Excel message "Not enough memory" is displayed (when figures placed on one worksheet). How to generate figures on one worksheet see Section 2.1.3.1. The program is arbitrary limited to maximum 600 figures.
b) ***Chart:*** This is normal Excel figure format, which can be edited after generation.

Figure type. The user can select between "*large*" and "*small*" figure type. The difference is that each figure of type "*large*" (the figure can be very small) is printed on its own sheet (from chart or worksheet) while in case of "*small*" up to 36 figures can be printed on single landscape A4/letter sheet.

large: Each figure is on its own chart or figures are placed on worksheets printed on separate A4/letter sheets.

small: With the command "*Read data and create figures*" 9 figures are generated on one worksheet. The number of figures is equal to the number of dependent variables in the columns on the worksheet. If there is only one dependent variable on the worksheet one figure will be generated. With the command "*Create figures from data*" all figures are generated on one worksheet. However when printing from 1 to 36 figures will be printed on single A4/letter sheet, landscape oriented, depending from "*No. of figures in row*" setting.

No. of figures in row. The user can select from 1 to 6 figures in one row. On A4/letter sheet, landscape oriented from 1 to 36 (6 times 6 matrix) figures are printed. The chart style from worksheet "*fig_small*" is valid for matrix 3 times 3, when at scaling the font sizes are default values from the program (matrix different from 3 times 3).

2.1.2.5 Data

For data there are five settings: "*Data type*", "*Figure title row*", "*First and second row for axis title*", "*First data row*" and "*No. of bottom data rows, skipped for drawing*".

Data type. The user can select between "*Y multiple*" and "*X-Y*" data type.

Y multiple: The data of "*Y multiple*" data type have in the first column independent variable and in the next columns dependent variables (maximum 9 for reading). The "*Y multiple*" data type preparation is described in Section 3.2. The data of "*Y multiple*"type with one independent variable are equal to data of "*X-Y*" type, but there are differences when reading data and generating figures (see Table 3).

X-Y: The data of "*X-Y*" data type have one independent and one dependent variable. More detail description of "*X-Y*" data type is in Section 3.3.

Important: At the first moment it seems that there is no difference between reading one variable with the "*Y multiple*" or "*X-Y*" data type option. However, the difference is in the data stored on the worksheet. For the "*Y multiple*" data type with data stored on one worksheet is independent only the variable in column A and all dependent variables have the same number of data. On the other hand, for "*X-Y*" data type each dependent variable has its own independent variable (odd column are independent variables and even columns dependent variables). This means that each pair of variables can have different number of data. Also when reading data with "*Y multiple*" and "*X-Y*" on common sheet only first 10 and 2 columns are stored on worksheet by default, respectively.

Figure title row. The user can select numbers from 1 to 10. If user selects "no" this mean, that there is no data row with figure titles. The values from 1 to 10 means the row with figure titles in data file (5 mean the fifth row). This value must be specified when auto (or combination with auto) option is selected.

First and second row for axis title. The user can select numbers from 1 to 10. If user selects "no" this mean, that there is no data row with axis titles. The values from 1 to 10 means the row with axis titles in data file (6 mean the sixth row). It is possible to select two rows (for example one for variable name and another for units).

First data row. This is very important information. The user can select between 1 and 11. This means that maximum number of header rows is ten. If user selects 1 it means that all rows are data. In such case all title rows must be set to "no" otherwise warning is displayed and execution terminated. The values from 1 to 11 means the first row with data in data files (11 means the eleventh row).

Important: This input datum is important both for reading and drawing. For reading it is important because macro checks if data in that row really exists. For drawing it is important because based on this datum the range for drawing is determined. Wrong information for first data row can cause wrong execution of the macro or error termination.

No. of bottom data rows, skipped for drawing. The user selects number between 1 and 4000 and "no". Option "no" means that no data rows are skipped for drawing. The number means the number of rows to be skipped. This option prevents macro execution from interruption if any text rows follow data rows (numeric values).

2.1.2.6 Program

Saved options. In the drop down menu the saved combinations of options can be selected. To save a new combination of settings the user first selects settings and then save them with command button "*Save all options*". This last setting is not used for macro execution but for selecting the first 20 settings, which are used during macro execution (see Figure 1).

Important: The saved options are assigned when a drop down menu is activated and a combination is selected. If the user further change the settings they may differ from the saved settings even if it is displayed that certain combination is selected.

2.1.3 Macros

Macros are run with left mouse click. The command buttons are in white box in column F. The command buttons to run the macro are: "**Run**", "**Figure size**", "**Save user-defined chart type in template**" and "**Save all options**".

2.1.3.1 Button "**Run**"

With command button "**Run**" the main drawing macro is run to read the data, read the data and create figures or create the figures. For reading data and creating figures there are two commands which are different by inserting the data on worksheet and locations for figures. After clicking the button "**Run**" the dialog box shown on Figure 2 is displayed. Options are the following:

- Read data (Command 1),
- Create figures from data (Command 2),
- Read data and create figures (Command 3),
- Read data + Create figures from data (Command 4 – combination of first and second command).

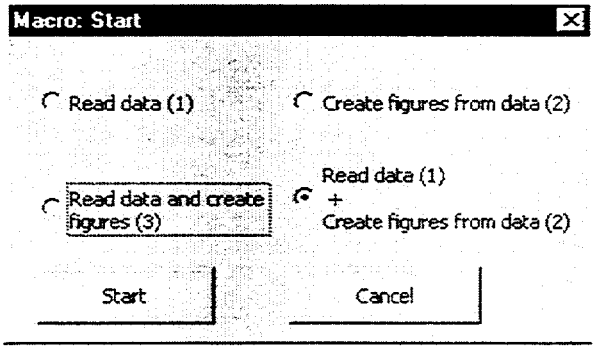


Figure 2: Dialog box for command selection

The execution of the commands depends on the data type, plotting mode and figure type as shown in Table 3. Depending on the combinations the location of data in the workbook, location of figures (chart or worksheet) and cells to input legend are changed. When the data type is "*Y multiple*" function all four commands. When the data type is "*X-Y*" Command 3 is disabled and Command 4 works only in the plotting mode "*One curve*". Limitation for Command 3 is intentional to prevent situation with one figure on a sheet and data files with one dependent variables stored each on their own sheet. In the plotting mode "*Comparison*" with data type "*X-Y*" function only Command 2 because it is not expected that the filenames with one dependent variable will differ only by extension. Nevertheless it is able by proper combination of reading and drawing (Command 1 and Command 2) and manual renaming of

worksheets to get all options. It is expected to prepare the data of type "*X-Y*" manually (by the user) or read them in the plotting mode "*One curve*".

Important: It is important to note that for data of type "*Y multiple*" the result is the same with mode "*One curve*" or "*Comparison*", the difference is only in the location of stored data in the workbook and in inputting legend names.
Important: In the case of data with one independent and one dependent variable and the same number of data rows any data type can be chosen ("*Y multiple*" or "*X-Y*").

Table 3: Data and figure location and legend input as a function of data type, plotting mode and figure type when running commands

Data type	Plotting mode	Command	Data (location)	Figure type (location)		Legend (input)
				small	large	
Y multiple	Comparison	1	option[1]	N.A.	N.A.	N.A
		2	N.A.	one worksheet[2]	option[3]	column C
		3	own worksheet	more worksheets[4]	own chart	column C
		4	one worksheet[5]	one worksheet[2]	own chart	column C
	One curve	1	option[6]	N.A.	N.A.	N.A
		2	N.A.	one worksheet[2]	option[3]	cell F6
		3	own worksheet	more worksheets[4]	own chart	cell F6
		4	own worksheet	one worksheet[2]	own chart	cell F6
X-Y	Comparison	1* (W 201)	X[7]	X[7]	X[7]	X[7]
		2	N.A.	one worksheet[2]	option[3]	automatic[8]
		3* (W 203)	X[7]	X[7]	X[7]	X[7]
		4* (W 205)	X[7]	X[7]	X[7]	X[7]
	One curve	1	option[9]	N.A.	N.A.	N.A
		2	N.A.	one worksheet[2]	option[3]	cell F6[11]
		3* (W 204)	X[7]	X[7]	X[7]	X[7]
		4	one worksheet[10]	one worksheet[2]	own chart	cell F6[11]

[1] each data file inserted on separate worksheet or data files of the same calculation inserted on common worksheet
[2] all figures placed as an embedded objects on a worksheet "Fig_small"
[3] all figures placed as an embedded objects on a worksheet "Fig_large" or each figure placed on a separate chart
[4] worksheet names are "Fig_small_1", " Fig_small_2", ..., " Fig_small_20"
[5] data files of the same calculation inserted on common worksheet
[6] each data file inserted on separate worksheet or data files of the same calculation inserted on common worksheet "*Data*"
[7] X means that command is not executed
[8] the legend name is the name of worksheet with stored data

(9) each data file inserted on separate worksheet or all data files inserted on common worksheet "*Data*"
(10) all data files inserted on common worksheet "*Data*"
(11) if the cell is empty, the legend name is name of worksheet with stored data
• in parenthesis the warning (W) number is specified. For details refer to Section 5.1.

Read data. The macro will insert the data from input data filenames on worksheets. In the plotting mode "*One curve*" the data files of "*Y multiple*" data type are inserted on a separate worksheets where the data filename is assigned to worksheet name or data files of the same calculation are inserted on common worksheet with worksheet name "*Data*". In the plotting mode "*Comparison*" for "*Y multiple*" data type each data file is inserted on separate worksheet (worksheet name is data file name) or data files of the same calculation are inserted on common worksheet with name equal to common data filename without extensions plus first and last data file extension (for example "local.02-04" when "local" is common filename and first file extension is "02" and last file extension is "04"). On the screen the dialog box "Data for one case on one sheet?" is displayed (see Figure 3). With mouse the user selects option "Yes" or "No" and then clicks button "Continue". If "Cancel" button is clicked the execution is terminated.

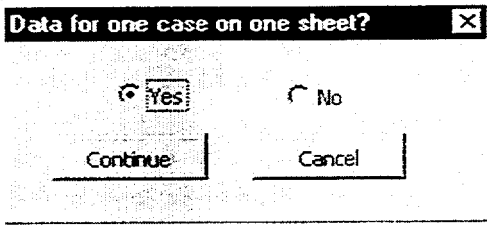


Figure 3: Dialog box for data location of "*Y multiple*" data ("*Comparison*")

In the plotting mode "*One curve*" the user chooses between inserting all data files on common worksheet "*Data*" or to insert each data file on a separate sheet. On the screen the dialog box "Data on one sheet?" is displayed. With mouse button "Yes" or "No" or "Cancel" is clicked. If button "Yes" is clicked, data are stored on the same worksheet. In the program it is assumed that each dependent variable has the same dependent variable. If this is true the user can click this button. In the opposite button 'No' is clicked and each data file is stored on separate worksheet. When button »Cancel« is clicked, the execution is terminated.

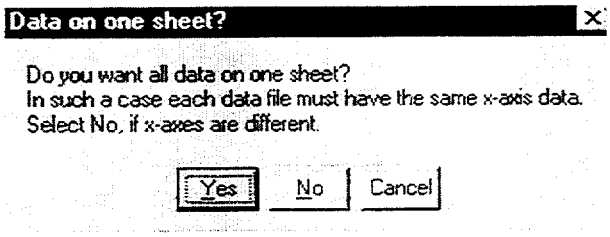


Figure 4: Dialog box for data location of "*Y multiple*" data ("*One curve*")

Tip: For reading data files the plotting mode "*One curve*" is used when the filename is free. If the user wants to compare curves, it is recommend to insert data files on common worksheet. In the next step the figures are generated with command "*Create figures from data*" in the plotting mode "*One curve*" or "*Comparison*".
Important: The plotting mode "*One curve*" is for reading more general than the plotting mode "*Comparison*". However it requires more input.

Create figures from data. The macro will generate figures for open workbook when in the cell **E4** on worksheet "*Input_data*" the opened workbook name without extension is input. More workbooks can be open at the same time. However figures are generated only for the workbook specified in the cell E4.

Data type "*Y multiple*": If the plotting mode "*One curve*" is selected, the macro generates figures with one curve for data stored on all worksheets. If the plotting mode "*Comparison*" is selected, the data can be stored in the 20 worksheets for which the curves are compared. If there are more than 20 worksheets in a workbook the figures will be generated for the first 20 worksheets. Further, each worksheet can contain 256 columns where first column is independent variable and other columns are dependent variable. Besides the worksheets with stored data are allowed only worksheets created by macro automatically. Other non-data worksheets must be deleted.

Data type "*X-Y*": If the plotting mode "*One curve*" is selected, the macro generates figures with one curve for all worksheets with stored data. Maximum number of dependent variables is 128 what gives 256 columns (maximum number limited by Excel). If the plotting mode "*Comparison*" is selected, maximum is 20 worksheets with stored data. If more than 20 worksheets in a workbook the figures will be generated for the first 20 worksheets. On each worksheet maximum number of columns is 256, odd columns are independent variables and even columns are dependent variables.

Good property of this command button is that data can be prepared in advance. The only requirement is to have data in columns. Acceptable data format is described in Section 3.

For maximum number of figures in a workbook refer to Excel limitations in Section 5. This limitations are not applicable for "*Picture*" figure format with figures embedded on common worksheet (at figure type "*large*" the button "Yes" is selected, when dialog box "*One sheet for figures*" is displayed). In this case all figures are placed on one worksheet what makes printing easier (arbitrary limitation is 600 figures). The worksheet names are "*Fig_large*" and "*Fig_small*" for figure types "*large*" and "*small*", respectively.

The command "*Create figures from data*" can be run more times (for example generates both "*small*" and "*large*" figures. If chart exists the warning is displayed that it already exists and the letter A will supercede the chart name (Warning 12). To continue macro execution button <Enter> must be pressed. When figures are located on the worksheet, the Warning 10 (for "*large*") and 11 (for "*small*") is displayed that worksheet must be renamed or deleted by the user manually.

Important: Option "*One sheet for figures*" is recommended when the user wants to have all figures on one worksheet because of printing.

Read data and create figures. The macro read the data files and store the data on worksheets and create figures. The data from data file are always stored separately on their worksheet. The plotting mode "*One curve*" differs from "*Comparison*" for one curve in that data filenames may be free. In the plotting mode "*Comparison*" the filenames are prescribed what reduce the possibility to compare different data (for example different calculations).

For figures of type "*small*" the figures generated from data stored on the worksheet will be placed on separate worksheet. For figures of type "*large*" each figure will be placed on separate chart. If the user wish to define the location of data and figures in the output workbook, the data must be read separately and then the figures are generated.

Important: This command works only for "*Y* multiple" data.

Read data + Create figures from data. This command first executes "*Read data*" command and then "*Create figures from data*" to save time when there is no need to edit data. The command differs from "*Read data* + Create figures from data" as shown in Table 3. When data are "*X-Y*" type and mode is "*Comparison*" the command is not executed.

Important: All figures of type "*small*" are always placed on one sheet what simplifies printing. The advantage compared to printing multiple sheets is in duplex printing.

2.1.3.2 Button "**Figure size**"

This button sets the figure size on charts "*color*" and "*mono*", i.e. for figures of type "*large*". In our case the figure size is outer border of object copied to some application (for example wordprocessor Word). The advantage of fixed figure size is that defined font size for the report can be assigned to figure if original figure is not scaled.

Plot area size, font size, font type, color, line style, color and weight, titles position, legend position, grids etc. are defined by user.

Important: After any modification the chart style must be saved in template with command button "*Save user-defined chart type in template*" in order to be used for figure style.

2.1.3.3 Button "**Save user-defined chart type in template**"

To modify the chart style the figures on "*color*", "*mono*" and "*fig_small*" sheets are modified and then command button "*Save user-defined chart type in template*" on worksheet "*Input_data*" is clicked by mouse. It is recommended to save original chart style before new chart style is saved. The chart style must be saved under same name as chart ("*color*", "*mono*" or "*fig_small*"). Chart styles are for Windows NT 4.0 (for personal computer) saved in the file (if path was not set otherwise at Microsoft Office97 installation):
C:\Program Files\Microsoft Office\Office\ Xlusrgal.xls

Important: When the drawing program is first run in Excel (after the workbook for drawing with Excel is opened), **it must be first run macro with command button** "*Save user-defined chart type in template*" placed on worksheet "*Input_data*" to save the chart style in template *Xlusrgal.xls*. If macro is not run the warning will be displayed.

The chart style can be saved manually. First Excel is run, then it is opened workbook for drawing with Excel, one by one the charts "*color*", "*mono*" and "*fig_small*" are selected and on each chart the following commands are performed:

The chart is selected, right mouse button is clicked and we select "Chart Type", then tab "Custom Types". On tab "Custom Types" the option button "User-defined" is selected, then the command button "Add" is clicked, and in the textbox "Name" the chart name is inputted (for example "*color*"). If the above mentioned chart styles would not be added in template, the macro execution will be terminated because of missing chart style.

2.1.3.4 Button "**Save all options**"

By clicking macro button "*Save all options*" the 20 settings listed in Section 2.1.2 (except last "*Saved options*") are saved. When the command button is clicked, the dialog box is displayed to input the name of the collection of settings. These settings are stored on

worksheet "*Options*". The skilled user can directly change the values on worksheet "*Options*". Second possibility is to change the setting and then again store the settings on the worksheet with command button "*Save all options*" under same name. The macro will prompt the user to overwrite the old settings.

2.1.4 Other

2.1.4.1 Date and time

When check box is selected, located in cell F3, IJS-RED logo with date and time is shown on the figure in left bottom corner. The position of text box and font size is fixed and can be changed inside the code only.

2.1.4.2 Paper size

For selection of paper size is intended the dropdown menu in cell G23. This option is applicable only when figures are put on single worksheet. There are two options: A4/letter format (210 x 297 mm) or letter format (21.59 x 27.94 mm). The paper is oriented landscape. Before printing all this settings can be changed by user.

2.2 Worksheet "*Options*"

On this worksheet in each row one collection of settings is stored. First row is description row, the rows 2 to 31 are for storing the collections of settings (options) as shown in Table 4.

Table 4: List of settings, stored on worksheet "Options"

Column number	Option
1	Option group name
2	x-axis boundaries
3	y-axis boundaries
4	Figure title
5	x-axis title
6	y-axis title
7	Style selection (for figure type large only)
8	Plotting mode
9	First file ext.
10	Last file ext.
11	Figure format
12	Figure type
13	Data type
14	Title and boundary sheetname
15	No. of figures in row (for figure type small only)
16	Legend
17	Figure title row
18	First row for axis title
19	Second row for axis title
20	First data row
21	No. of bottom data rows, skipped for drawing

2.3 Worksheet *"Inp_figure"*

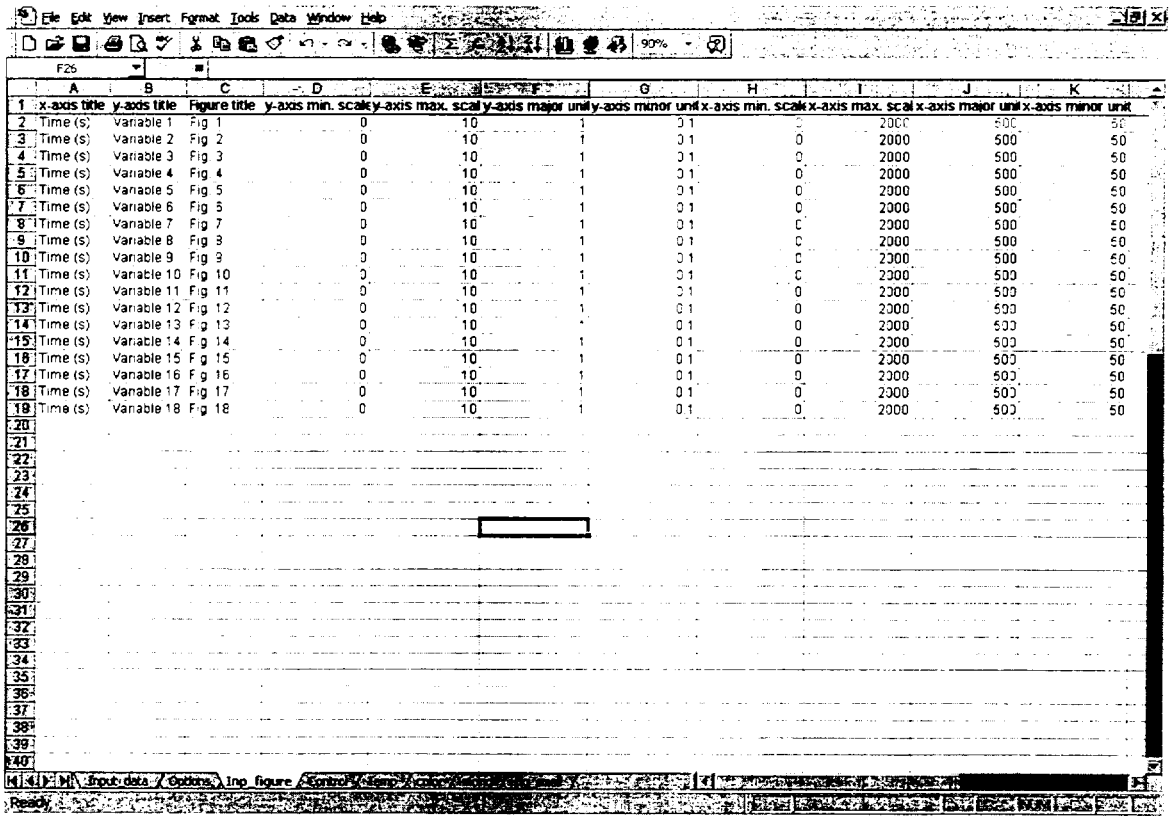
On the worksheet "*Inp_figure*" shown in Figure 5 the titles and boundaries are input. To use the titles and boundaries for figure generation, in the drop down menu "*Title and boundary sheetname*" the worksheet must be selected (for example "*Inp_figure*") and option "*input*" for titles and boundaries. How to create new worksheet with titles and boundaries, see 2.1.2.3. If the cell is empty, the title is not shown on the figure. If one of the boundaries is missing all boundaries for that figure are determined automatically by Excel.

Table 5: Description of columns for figure input data

Column name	Description
x-axis title	title on x axis
y-axis title	title on y axis
Figure title	figure title
y-axis min. scale	lower y axis boundary
y-axis max. scale	upper y axis boundary
y-axis major unit	major unit on y axis (axis text)
y-axis minor unit	minor unit on y axis
x-axis min. scale	lower x axis boundary
x-axis max. scale	upper x axis boundary
x-axis major unit	major unit on x axis (axis text)
x-axis minor unit	minor unit on x axis

For each figure these 11 data must be input in the row. For 9 figures 9 rows must be input. The order of the titles is the same as order of the figures. Figures of type "*large*" are placed on charts 01, 02,..,N, if N is the figure number. Figures of type "*small*" has in the plotting mode "*One curve*" before the number (file extension of strip file) the preceding text "Fig_small_"; for data from first worksheet the figures are therefore placed on worksheet "Fig_small_01", for data from second worksheet on worksheet "Fig_small_02" etc. In the plotting mode "*Comparison*" all figures of type "*small*" are embedded on worksheet "*fig_small* " and are named 01, 02,...N, where N is the number of figures.

Important: The sequence of titles is the same as figure sequence. This is very important when figures are generated with command "*Create figures from data*". For this command the recommended option for titles is "auto" (titles are stored (or can be entered) with data).



	x-axis title	y-axis title	Figure title	y-axis min. scale	y-axis max. scale	y-axis major unit	y-axis minor unit	x-axis min. scale	x-axis max. scale	x-axis major unit	x-axis minor unit
2	Time (s)	Variable 1	Fig 1	0	10	1	0.1	0	2000	500	50
3	Time (s)	Variable 2	Fig 2	0	10	1	0.1	0	2000	500	50
4	Time (s)	Variable 3	Fig 3	0	10	1	0.1	0	2000	500	50
5	Time (s)	Variable 4	Fig 4	0	10	1	0.1	0	2000	500	50
6	Time (s)	Variable 5	Fig 5	0	10	1	0.1	0	2000	500	50
7	Time (s)	Variable 6	Fig 6	0	10	1	0.1	0	2000	500	50
8	Time (s)	Variable 7	Fig 7	0	10	1	0.1	0	2000	500	50
9	Time (s)	Variable 8	Fig 8	0	10	1	0.1	0	2000	500	50
10	Time (s)	Variable 9	Fig 9	0	10	1	0.1	0	2000	500	50
11	Time (s)	Variable 10	Fig 10	0	10	1	0.1	0	2000	500	50
12	Time (s)	Variable 11	Fig 11	0	10	1	0.1	0	2000	500	50
13	Time (s)	Variable 12	Fig 12	0	10	1	0.1	0	2000	500	50
14	Time (s)	Variable 13	Fig 13	0	10	1	0.1	0	2000	500	50
15	Time (s)	Variable 14	Fig 14	0	10	1	0.1	0	2000	500	50
16	Time (s)	Variable 15	Fig 15	0	10	1	0.1	0	2000	500	50
17	Time (s)	Variable 16	Fig 16	0	10	1	0.1	0	2000	500	50
18	Time (s)	Variable 17	Fig 17	0	10	1	0.1	0	2000	500	50
19	Time (s)	Variable 18	Fig 18	0	10	1	0.1	0	2000	500	50

Figure 5: The worksheet "*Inp_figure*"

2.4 Worksheet *"Control"*

On this worksheet there are numeric values of settings, which are selected before macro start and are needed for macro execution and cells with text for dropdown menus. The values are linked therefore great attention must be paid when modifying values. In the first row there are settings, listed in Tables 2 and 4. In the second row are values of variables (switches) from the code (see Table 2). From the fifth row down there are in the cells options for drop down menu lists (see Table 2). The names can be modified by the user, because the names have no influence on macro execution (for first option the value of switch is one, for the second two etc.). With renaming also this manual for drawing with Excel program should be modified accordingly.

Important: The names are normally changed when translating to another language.

2.5 Worksheet *"Temp"*

This worksheet is for temporary reading and storing data during macro execution and may not be modified unless for further development of this program for drawing. Besides temporary values there is text in Slovene and English, for translation from one language to another and opposite.

Important: Modifying the worksheet "*Temp*" can cause error in macro execution.

2.6 Charts "*color*", "*mono*" and "*fig_small*"

On the charts "*color*", "*mono*" and "*fig_small* " are placed original chart styles, which are needed for macro execution. The chart styles "*color*" and "*mono*" are for generating figures of type "*large*", and the chart style "*fig_small*" is default chart type for figures of type "*small*". All chart styles can be modified. For modifying the chart style Excel is used. The user can modify line type, color and weight, font size, type and color, legend position etc.

3. Data preparation

When reading with "*auto*" the ASCII data must have one of the described data format ("*Y multiple*" or "*X-Y*"). If data are not in one of these formats, the user must prepare them. The figures are then created with command "*Create figures from data*".

3.1 General requirements for data

For normal macro execution the data must have correct data format. Inserting of data on the worksheets is following: the data files are opened, the text delimiter is space (or consecutive spaces). When preparing ASCII data the user must take into account the following:

- The figure titles will be read from data files if they will have same spaces (or consecutive spaces) as numeric data. The exception is title row. This means that one word can be used for one variable. In the title row may be as much as possible words. However, it must be taken into account the limitation for text length on the figure.

The titles from data file will be read correctly only if the user will input correct values for *figure title row*, *first and second row for axis title*, *first data row* and *no. of bottom data rows, skipped for drawing* settings.

Important: If data are of other format as described above, the user must prepare the data manually and to store them on the workbook to assure the correct macro execution. When preparing data on worksheet, the only requirement for text is to store text in the right cells.

3.2 "*Y multiple*" data preparation

The "*Y multiple*" data can have up to ten heading rows with consecutive 4000 data rows. The columns are separated with space (or consecutive spaces).

The first ten heading rows can be used one for figure titles and two for figure axis titles (for example variable name and unit). The heading rows can be skipped. For further details refer to Section 2.1.2.5. Table 6 shows the data file stored in the workbook with one independent and nine dependent variables. In this case three rows are heading rows and the fourth row is first data row. There are ten columns with independent variable in the first row and dependent variables in the next nine rows.

Table 6: Required format of "*Y multiple*" data

	independent variable	1. dependent variable	2.dependent variable	3. dependent variable	4. dependent variable	5.dependent variable	6. dependent variable	7. dependent variable	8.dependent variable	9. dependent variable
row 1		RELAP5/MOD2/36.5NEKMBE1E99/Jul21								
row 2	TIME	TEMPF	TEMPF	TEMPF	TEMPF	TEMPF	TEMPF	TEMPF	TEMPF	TEMPF
row 3	0	80010000	80020000	80030000	80040000	80050000	81010000	81020000	81030000	81040000
row 4	0	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 5	9.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 6	19.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 7	29.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 8	39.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 9	49.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 10	59.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 11	69.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 12	79.92	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2
row 4003	10200	561.4	561.4	561.4	561.4	561.4	561.2	561.2	561.2	561.2

The input figure title row in the first row is "RELAP5/MOD2...". In the second and third row are stored axis titles. The first figure x-axis and y-axis title would be "TIME 0" and "TEMPF 80010000", respectively. First column (variable TIME) is independent variable and

the other columns are dependent variables. The first data row is fourth and there is 4000 data. For "*Data*" group the settings would be as shown in Table 7.

Table 7: Selected options for "*Y multiple*" data presented in Table 6

Option name	Value
Data type	Y multiple
Figure title row	1
First and second row for axis title	2 and 3
First data row	4
No. of bottom data rows, skipped for drawing	0

Important: If the data were not generated with RELAP5 "strip" (ASCII format of data file with results in columns) the data format must be checked. The data group settings must be correctly input otherwise the figure generation may fail.

3.3 "*X-Y*" data preparation

The "*X-Y*" data have one independent and one dependent variable. The columns must be separated with space (or consecutive spaces) otherwise the data file is not correctly read. This data file can be read also with "*Y multiple*" setting but some other functions would be lost which only "*X-Y*" setting has (see Table 3).

In the heading rows (up to 10 rows) the user can select one row for figure title row and two rows for axis title rows. The heading rows can be skipped. For further detail refer to Section 2.1.2.5.

Table 8: "*X-Y*" data

	independent variable	dependent variable	
row 1	(s)	(kg)	
row 2			
row 3			
row 4	Time	Mass	
row 5	Title 1		
row 6		0	0.00E+00
row 7		5	0.00E+00
row 8		10	0.00E+00
row 9		15	0.00E+00
row 10		20	0.00E+00
row 11		25	0.00E+00
row 12		30	0.00E+00
	.....		
row 4005		20000	0.00E+00
row 4006	non- data row		

An example of "*X-Y*" data is shown in Table 8. The fifth row is figure title row and the title is "Title 1". The fourth and first rows are axis title rows where the x-axis title is "Time (s)" and y-axis title is "Mass (kg)". The sixth row is first data row. There is 4000 data. The 4006th row must be skipped for drawing. The settings for "*Data*" group are shown in Table 9.

Table 9: Selected options for "*X-Y*" data presented in Table 8

Option name	Value
Data type	X-Y
Figure title row	5
First and second row for axis title	4 and 1
First data row	6
No. of bottom data rows, skipped for drawing	1

4. Output workbook

All results of drawing with Excel program are stored in output workbook. These are mainly data stored on worksheets and created figures placed on charts or worksheets. Additionally three worksheets are inserted (by Command 3 and Command 4), one is "*Output*", where input data from worksheet "*Input_data*" are stored (see Table 10), the second is "*Figure_list*", where information regarding figures is stored (see Table 11) and the last is "*Legend*". If only Command 1 is executed worksheet "*Output*" is created. If only Command 2 is executed "*Output1*", "*Figure_list*" and "*Legend*" are created. These worksheets are added for archiving purposes and for later figure modifications as well as for generating information to be input on "*Inp_figure*". The user can change automatically selected titles or boundaries. On the worksheet "*Output*" (or "*Output1*") all information from "*Input_data*" is stored, including program settings, for regenerating figures if needed. The difference between worksheet "*Output1*" and "*Output*" is that in the worksheet "*Output1*" the data filenames are replaced with worksheet names (the figures are created from already opened workbook with worksheets) which are listed in column C while columns A and B are empty.

An example of output workbook is shown in Appendix A.

Table 10: Input data used for program execution archived on Worksheet "*Output*"

Column no.	Name	Description
1	Directory	data file path
2	Filename	data filename (without extension)
3	File extension	name of extension
4	Output filename	output workbook path and filename
4	Name of data sheet(s)	worksheets with stored data
4	Date and time	the date and time of importing data
5	Options group	see Table 2
5	Header text	text in header when printing "*small*"
6	Seq.no.	see Table 2
7	Option	see Table 2

Table 11: Information about generated figures stored on worksheet "*Figure_list*"

Column no.	Name	Description
1	Figure location	chart or worksheet with embedded chart
2	Label	by default "Figure"
3	Fig. no.	seq. number of figure
4	x-axis title	title on x axis
5	y-axis title	title on y axis
6	Figure title	figure title
7	y-axis min. scale	lower y axis boundary
8	y-axis max. scale	upper y axis boundary
9	y-axis major unit	major unit on y axis (axis text)
10	y-axis minor unit	minor unit on y axis
11	x-axis min. scale	lower x axis boundary
12	x-axis max. scale	upper x axis boundary
13	x-axis major unit	major unit on x axis (axis text)

Table 11 (Continued)

Column no.	Name	Description
14	x-axis minor unit	minor unit on x axis
15	Data for curve no. 1	worksheet, data range and legend for figure
16	Data for curve no. 2	worksheet, data range and legend for figure
...	...	
24	Data for curve no. 20	worksheet, data range and legend for figure

The figures of type "*large*" are placed on charts "01", "02", do "nn", where nn is number of all figures. If figures of type "*large*" are placed on single worksheet, the worksheet name is "*Fig_large*".

The figures of type "*small*" are always placed on worksheet "*Fig_small*" with exception for command "*Read data and create figures*" (function only for "*Y multiple*" data), when for each data file the figures are placed on separate worksheet. The worksheets names are "*Fig_small_01*", "*Fig_small_02*",..., "*Fig_small_nn*", if nn is the number of data files.

Important: When generating figures of type "*small*" there is option to have in one row from 1 to 6 figures (see Section 2.1.2.4), which can be also printed in such layout. By this the maximum is 36 figures on single A4/letter sheet.

5. Program limitations

Macros stored in workbook for drawing with Excel are written generally, however the Excel 97 limitations were taken into account. Therefore the maximum number of worksheets and charts is as much as allowed by memory or as limited by Excel 97. Each figure of format "*Chart*", embedded on worksheet counts same as chart sheet.

The first action to reduce the number of worksheets or charts is to store data on common worksheets and place charts on one worksheet. However as figures of format "*Chart*" count same as chart sheet the format "*Picture*" must be selected to have large number of figures (arbitrarily limited to 600 figures).

If the number of worksheets or charts or embedded charts on worksheets is greater than limitation by Excel 97, the execution is terminated and the dialog box "*Not enough memory*" is displayed or Excel application interruption dialog box "*Application error*". In such a case the application must be closed and Excel must be run again.

To prevent too frequent interruption of the program because of errors in input data the warnings (messages) are built into the program to stop the execution and display the reason. If termination with system message appears the most probable reason is wrong read or prepared data. In such a case it is recommended to check the data (see Section 3). At unexpected error during execution the Visual Basic window is opened. To quickly leave the window press keys <Alt Q>.

5.1 Built-in warnings

There are 33 built-in warnings, which are described below.

Important: Warning is displayed when an error in a certain procedure occurred. In some special cases the reason may be other as displayed.

1. *Warning 1: Maximum 20 curves can be compared. Other curves will not be plotted.*
   Explanation: The number of curves on one figure is limited to 20. If there is more variables there will not be presented on figure.

2. *Warning 2: Title and boundary sheetname is not specified. Specify the sheet or select "auto" or "no" for titles!*
   Explanation: When boundaries and titles are used from worksheet the worksheet name must be specified. How to create such worksheet see Section 2.1.2.3, and how to prepare the data see Section 2.3.

3. *Warning 3: Sheet 'worksheet' with titles does not exist! Specify the sheet or select auto or no for titles.*
   Explanation: Worksheet with titles and boundaries was wrong specified. Select the worksheet which exists or create new worksheet (see Section 2.1.2.3).

4. *Warning 4: Workbook with the name 'workbook name' is already opened! Rename or close the workbook or run the command 'Create figures from data'!*
   Explanation: The workbook is already opened therefore new workbook cannot be renamed to the existing workbook name.

5. *Warning 5: Worksheet "worksheet name" already exists. The data file "filename" will not be opened again!*
   Explanation: The worksheet in the output workbook already exists which means that the data file with the same name was already imported into the worksheet by the

program. This warning also prevents different data files with the same filename to be stored under same worksheet name.

6. *Warning 6: Error in module for reading data! Execution terminated.*
Explanation: These mean that data the macro execution was terminated because of error in module for reading data.

7. *Warning 7: First filename extension = N1 is greater than last filename extension = N2. Correct!!!*
Explanation: First file extension is greater than last file extension. A new value of file extension must be selected.

8. *Warning 8: Filename 'filename' does not exist! Execution terminated.*
Explanation: Data file does not exist. Check the path and filename plus extension.

9. *Warning 9: Directory 'path' does not exist! Execution terminated.*
Explanation: The path does not exist. A path of existing folder must be input.

10. *Warning 10: Worksheet with 'large' figures of name –'worksheet name'- already exists!!! Execution terminated! Rename or delete the worksheet.*
Explanation: For figures of type large the worksheet already exists therefore execution is terminated. The worksheet must be renamed or deleted.

11. *Warning 11: Worksheet with 'small' figures of name –'worksheet name'- already exists!!! Execution terminated! Rename or delete the worksheet.*
Explanation: For figures of type small the worksheet already exists therefore execution is terminated. The worksheet must be renamed or deleted.

12. *Warning 12: Figure –'chart name'- already exists!!! Do you want to continue and plot the figure with the name 'chart name'?*
Explanation: The chart exists however the execution can be proceeded. A letter A is added before the chart name. Such a situation could appear when the command "*Create figures from data*" is run consecutively for figures of type large located on chart sheets.

13. *Warning 13: User-defined chart type added to template!!!*
Explanation: This is the message for the user that the template was saved and the work can be continued.

14. *Warning 14: Title row number must be smaller than first data row number! Title row number is N1. First data row number is N2.*
Explanation: This warning is related to data description. First data row must be greater than figure title row. The selected settings must be changed to fulfill the above requirement. It is assumed that heading rows must be before data rows. For more information about data preparation see Section 3.

15. *Warning 15: First axis title row number must be smaller than first data row number! First axis title row number is N1. First data row number is N2.*
Explanation: This warning is related to data description. First axis title row must be smaller than first data row. The selected settings must be changed to fulfill the above requirement. It is assumed that heading rows must be before data rows. For more information about data preparation see Section 3.

16. *Warning 16: Second axis title row number must be smaller than first data row number! Second axis title row number is N1. First data row number is N2.*

Explanation: This warning is related to data description. Second axis title row must be smaller than first data row. The selected settings must be changed to fulfill the above requirement. It is assumed that heading rows must be before data rows. For more information about data preparation see Section 3.

17. *Warning 17: Title row number must be different from axis title row numbers!*
Explanation: This message is intended to prevent duplication of information on figure.

18. *Warning 18: Number of data for plotting is smaller than 1. Check data or skip less data rows! Number of data rows is N1. Number of skipped data rows is N2.*
Explanation: For generating the figure at least one row of data is needed. Information is displayed when too many data rows are skipped or the data file has empty rows.

19. *Warning 19: Check path for output workbook: 'filename'. Execution terminated.*
Explanation: The directory to save output workbook does not exist or is currently unavailable. The folder must be created or renamed or the user must wait for network connections.

20. *Warning 20: First data filename extension must be smaller or equal to last data filename extension.*
Explanation: Last file extension is greater than first file extension. A new value of file extension must be selected.

21. *Warning 21: At least one data file must be selected to open (column D, select Y).*
Explanation: The commands "Read data", "Read data and create figures" or "Read data + Create figures from data" may be run when at least one data file to be open is input and is selected to be open.

22. *Warning 22: Error during writing on sheet 'Output'. Execution aborted.*
Explanation: This warning prevents abortion of the macro and gives information that error occurred when macro is storing information on worksheet "*Output*". The user must identify the reason with Visual Basic debugger. This warning may appear also when the workbook with data is not correctly prepared.

23. *Warning 23: Execution terminated because style is missing. Run macro 'Save user-defined chart type in template'.*
Explanation: When guideline in Section 2.1.3.3 is not used such a message is displayed in order to prevent macro abortion when macro is run and the chart style does not exists.

24. *Warning 24: Each data file can be opened only once. Select 'Y' only once for file 'filename'.*
Explanation: The data file is already inserted on worksheet. Each data file can be inserted only once since worksheet names are data filenames.

25. *Warning 25: Maximum number of columns allowed is 256. N columns were tried to be put on one worksheet.*
Explanation: Maximum 256 columns are allowed in Excel therefore reduce the number of data files to be opened at one macro run.

26. *Warning 28: Error!!! Cannot rename to already existing sheet 'worksheet name'.*
Explanation: When data file is stored on the workbook with name of data file it cannot be read again therefore the macro is terminated. The worksheet must be renamed or deleted or the data file is not opened at later reading. Already stored data on worksheets can be used or saved even if execution is terminated.

27. *Warning 29: Column C is now legend. Be careful, first legend is legend with first 'Y' in column D, second with second 'Y' in D etc. The legends are:* (the legend list is displayed on the screen, see Figure 6). *Selected cell is "Cn".*
Explanation: Column C has two functions, as legend in the plotting mode "*Comparison*" or extension in the plotting mode "*One curve*". This warning is just to remind the user what are legend names and in which cells are specified.

28. *Warning 30: Be careful, cell F6 is now legend.*
Explanation: In the plotting mode "*One curve*" legend is input in cell F6. For details see Section 2.1.2.3. This warning is just to remind the user.

29. *Warning 201: Only mode 'One curve' can be used for reading data.*
Explanation: For "*X-Y*" data the plotting mode "*Comparison*" cannot be used (see Table 3).

30. *Warning 202: Excel workbook name does not exist.*
Explanation: The specified output workbook is not opened. The workbook must be opened or created or check the workbook name.

31. *Warning 203: Only mode 'One curve' can be used for reading data and plotting figures. Perform read and plot separately!*
Explanation: For "*X-Y*" data and the plotting mode "*Comparison*" the Command 3 cannot be used (see Table 3).

32. *Warning 204: X-Y data, therefore button not applicable for reading data and plotting figures. Select button 'Read data + Create figures from data'.*
Explanation: For "*X-Y*" data and the plotting mode "*One curve*" the Command 3 cannot be used (see Table 3).

33. *Warning 205: Only mode 'One curve' can be used for reading data and plotting figures. Perform read and plot separately!*

34. ***Explanation**: For "X-Y" data and the plotting mode "Comparison" the Command 4 cannot be used (see Table 3).*

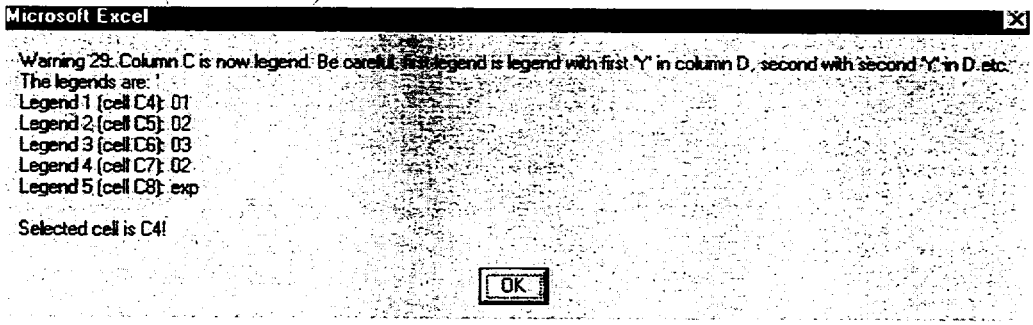


Figure 6: Dialog box for Warning 29

6. Literature

[1] D. M. Schinedr, K. L. Wagner, W. H. Grush, K. R. Jones, Nuclear Plant Analyzer, Vol. 1 to 3, NUREG/CR-6291, INEL-94/0123, Idaho National Engineering Laboratory, 1995.

[2] Help from Visual Basic in Excel 97, Microsoft Office 97.

[3] Microsoft Office 97 / Visual Basic language reference, Volume 2: Microsoft Excel Language reference, Microsoft Corporation, ISBN 1-57231-339-0, Washington, Microsoft Press, 1997.

7. Index

APPENDIX A

A AN EXAMPLE OF OUTPUT WORKBOOK GENERATED BY THE PROGRAM

In this appendix is shown the output workbook with worksheets, created at running command 4 (*"Read data + Create figures from data"*), when data shown in Table A-2 and input data shown on Figure A-1 were used. For titles the worksheet *"Inp_figure"*«, shown on Figure A.2 was used while figure style used is shown in Figure A-3. The worksheets created are listed in Table A-1 and shown in Figures A-4 through A-9. Finally, on Figure A-10 an example of figures imported into Word 97 is shown.

Table A-1: List of worksheets which were created in workbook "Output workbook.xls" after running the Command 4 (Read data + Create figures from data)

Figure no.	Worksheet name	Worksheet function
A-4	loca100_rep.02-03	worksheet with stored data for case 1
A-5	loca200_rep.02-03	worksheet with stored data for case 2
A-6	Fig_small	worksheet with figures of type "small"
A-7	Output	worksheet with data input on worksheet "Input_data"
A-8	Figure_list	worksheet with information, used for figure creation
A-9	Legend	worksheet with legends

Table A-2: Data files in ASCII format

Data file: loca100_rep.02

RELAP5/MOD2/36.5	NEKMBE1E				99/Jul21				
TIME	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR
0	610	611	612	613	614	615	616	617	618
0.	310.0	159.0	159.0	158.0	66.30	66.30	49.25	49.25	62.30
9.920	314.6	157.8	157.8	157.2	65.54	65.31	49.22	49.22	62.50
19.92	313.2	157.8	157.8	157.2	65.42	65.19	49.22	49.22	62.36
29.92	311.3	157.8	157.8	157.2	65.38	65.15	49.22	49.22	62.27
.....									
1.0200E+04	187.3	61.78	61.78	120.0	43.72	39.04	49.22	49.22	23.21

Data file: loca100_rep.03

RELAP5/MOD2/36.5	NEKMBE1E				99/Jul21				
TIME	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR
0	619	620	621	622	623	624	625	626	627
0.	100.0	100.0	69.35	69.35	65.30	65.30	18.80	100.0	100.0
9.920	100.0	100.0	68.60	68.58	65.29	65.29	18.69	100.1	99.99
19.92	100.0	100.0	69.27	69.26	65.29	65.29	18.59	100.1	99.99
29.92	100.0	100.0	69.35	69.34	65.29	65.29	18.65	100.1	99.99
.....									
1.0200E+04	100.0	100.0	66.01	66.55	65.29	65.29	90.25	1.825	0.

Data file: loca200_rep.02

RELAP5/MOD2/36.5	NEKMBE1E				99/Jul21				
TIME	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR
0	610	611	612	613	614	615	616	617	618
0.	310.0	159.0	159.0	158.0	66.30	66.30	49.25	49.25	62.30
9.920	314.6	157.8	157.8	157.2	65.54	65.31	49.22	49.22	62.50
19.92	313.2	157.8	157.8	157.2	65.42	65.19	49.22	49.22	62.36
29.92	311.3	157.8	157.8	157.2	65.38	65.15	49.22	49.22	62.27
.....									
1.0200E+04	212.5	18.55	18.55	120.0	54.74	55.17	18.87	18.68	0.

Data file: loca200_rep.03

RELAP5/MOD2/36.5	NEKMBE1E				99/Jul21				
TIME	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR	CNTRLVAR
0	619	620	621	622	623	624	625	626	627
0.	100.0	100.0	69.35	69.35	65.30	65.30	18.80	100.0	100.0
9.920	100.0	100.0	68.60	68.58	65.29	65.29	18.69	100.1	99.99
19.92	100.0	100.0	69.27	69.26	65.29	65.29	18.59	100.1	99.99
29.92	100.0	100.0	69.35	69.34	65.29	65.29	18.65	100.1	99.99
.....									
1.0200E+04	74.59	74.59	66.36	67.47	10.96	10.12	1.9134E-02	6.260	0.

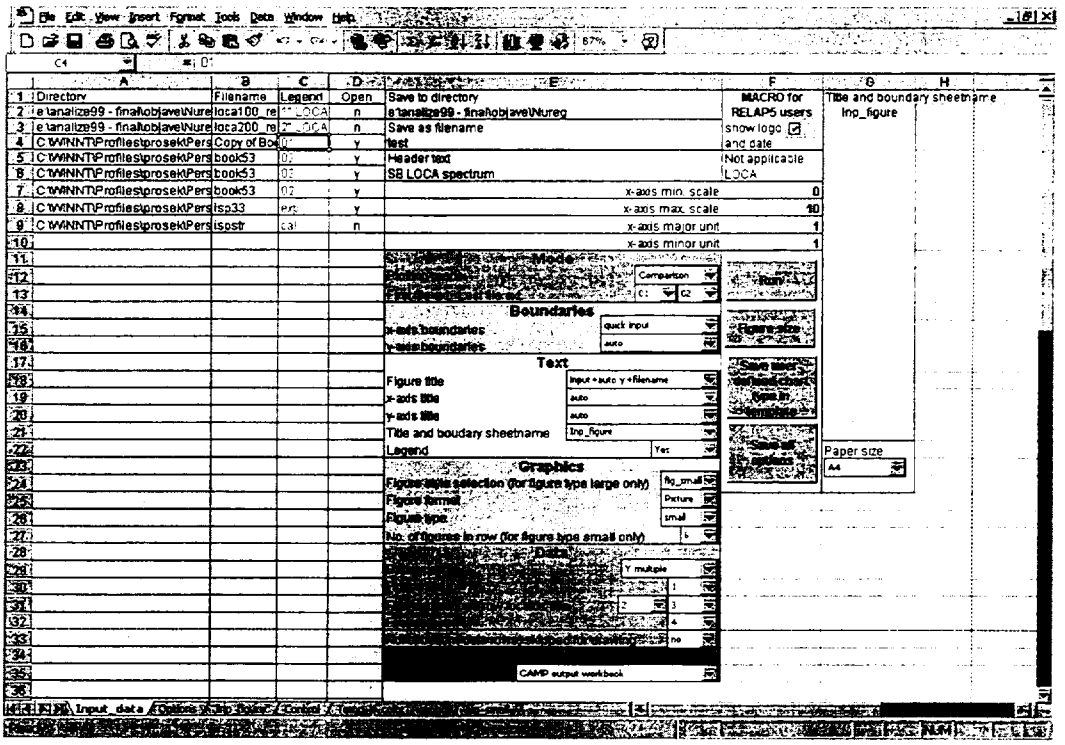


Figure A-1: Worksheet "Input_data"

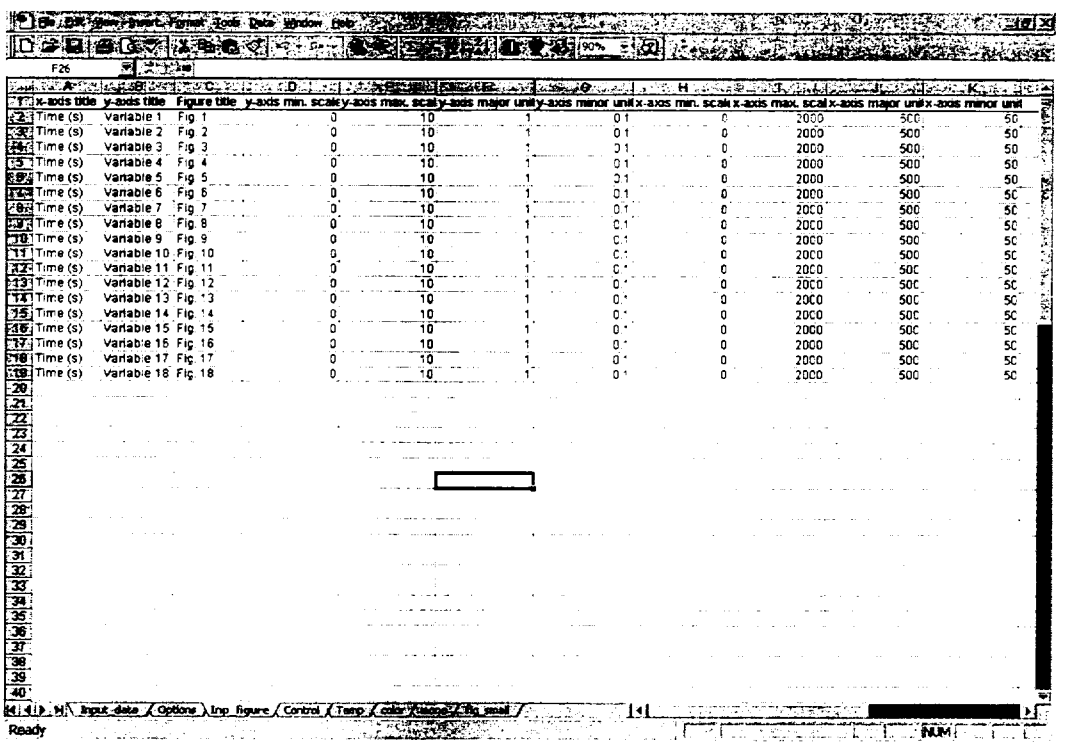


Figure A.2: Worksheet "Input_figure"

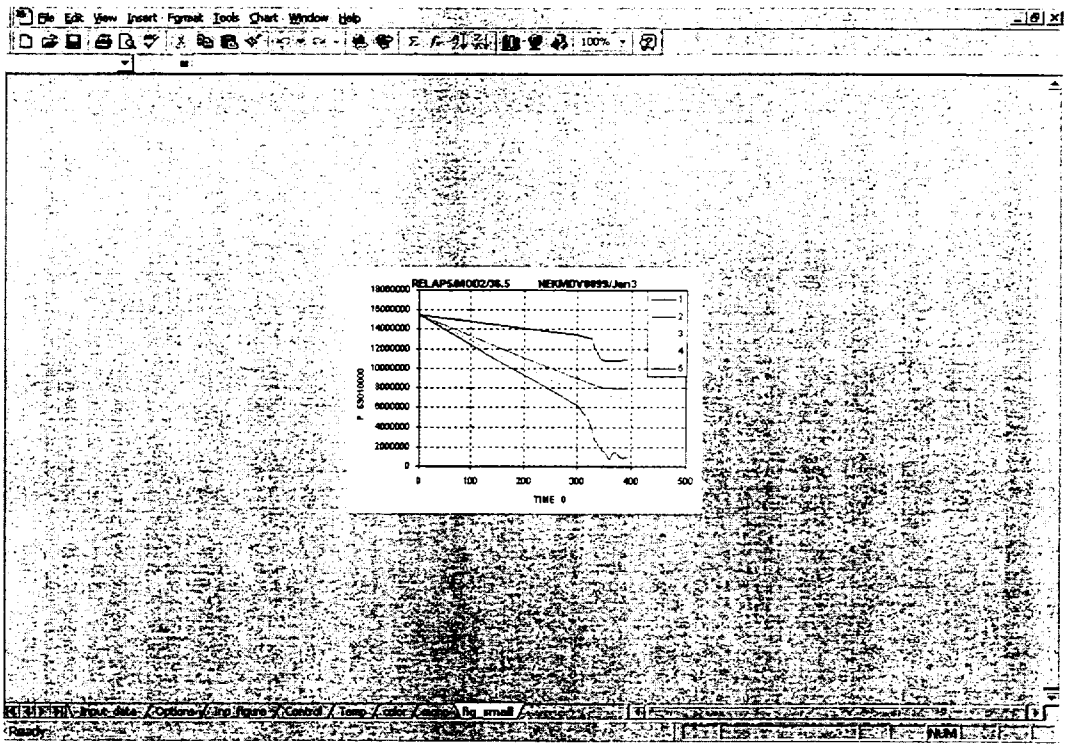


Figure A-3: Worksheet "Fig_small"

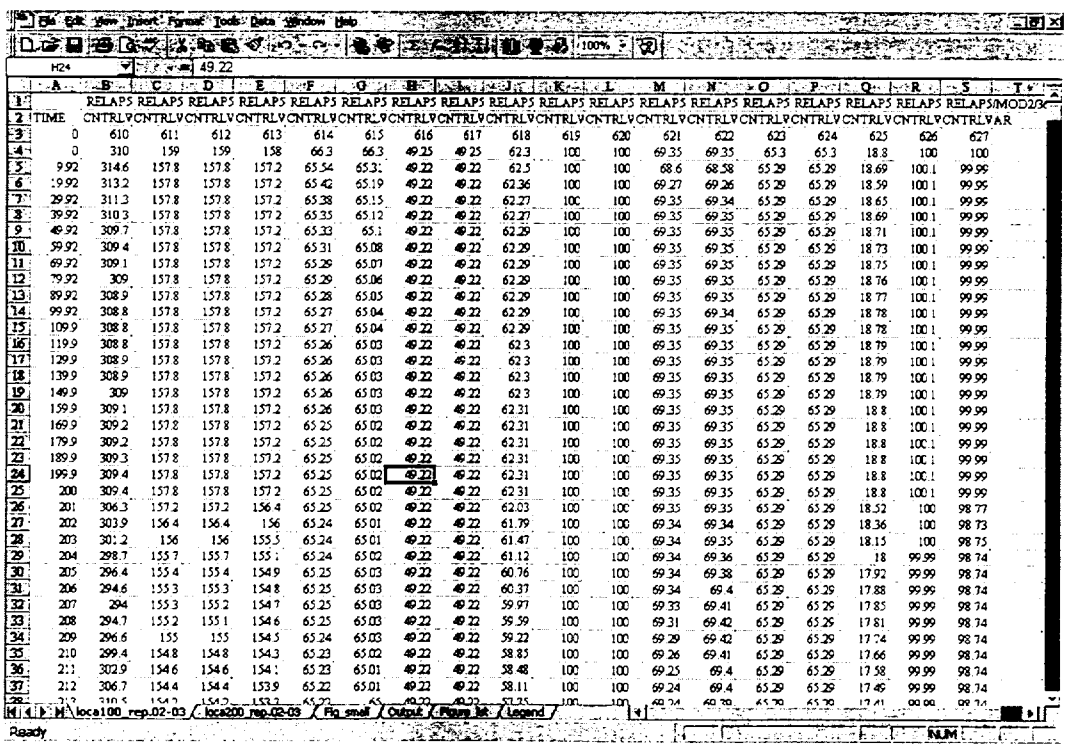


Figure A-4: Worksheet "loca100_rep.02-03" with data for case 1

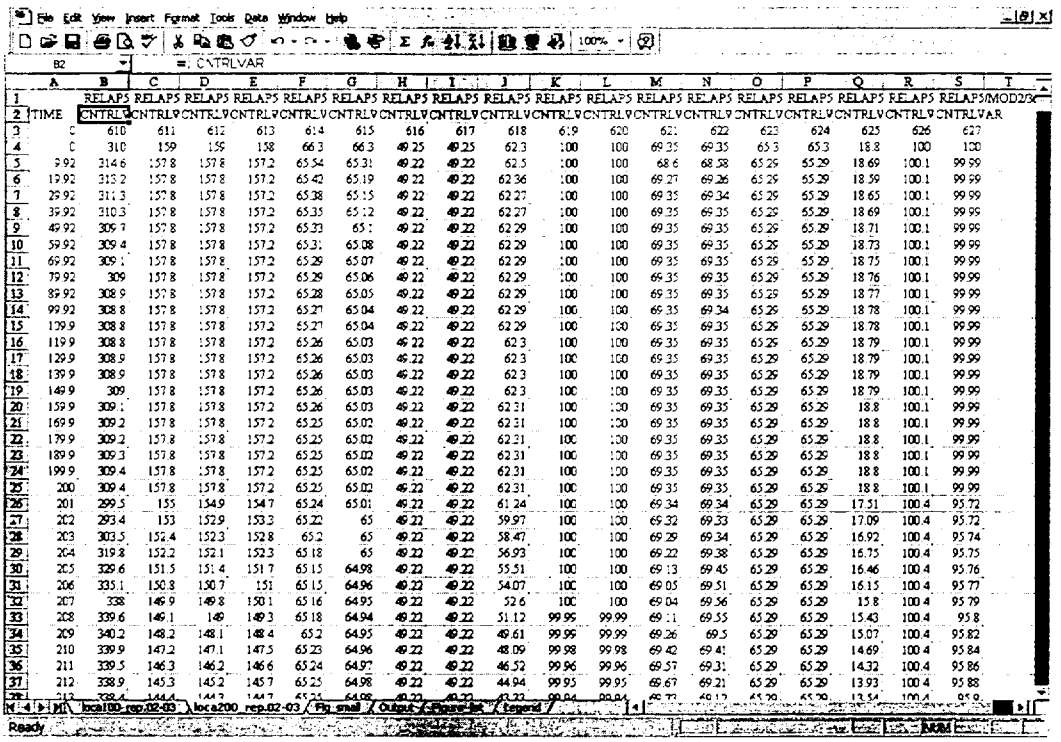


Figure A-5: Worksheet "loca200_rep.02-03" with data for case 2

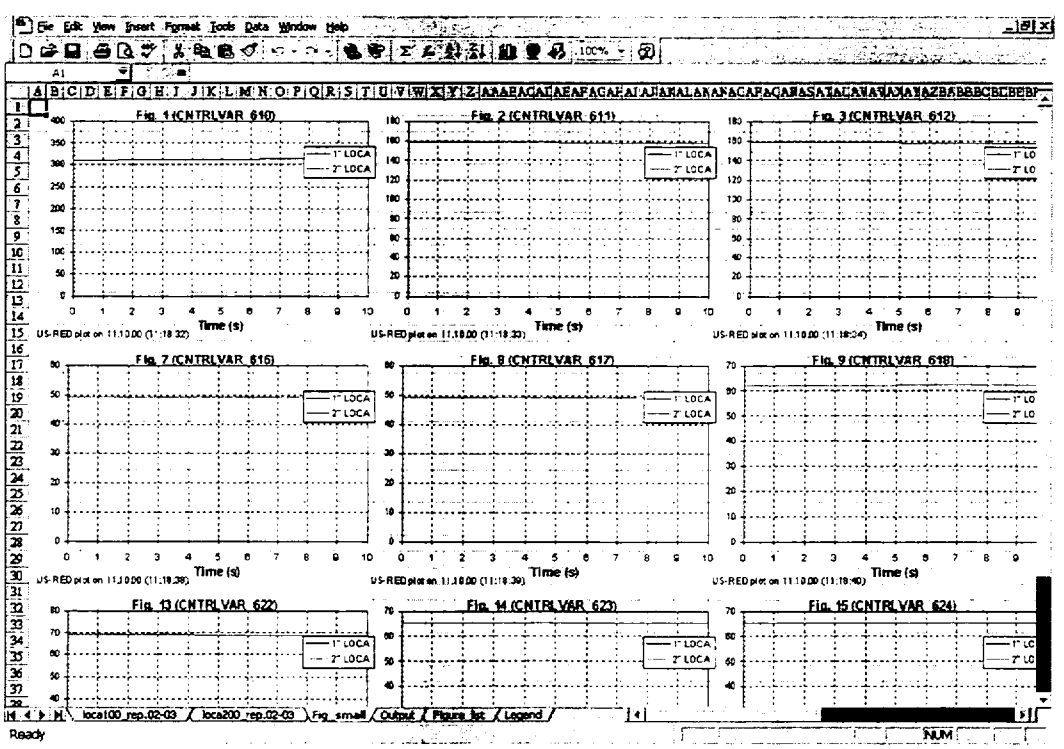


Figure A-6: Worksheet "Fig_small" with charts

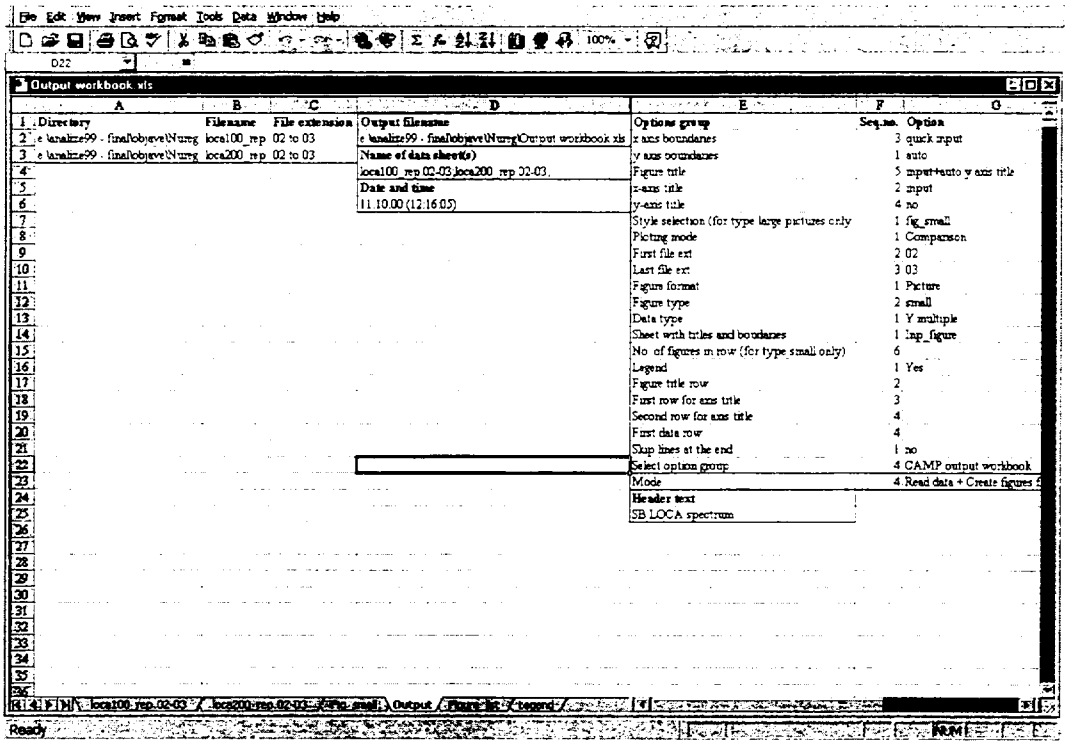


Figure A-7: Worksheet "Output" with input data

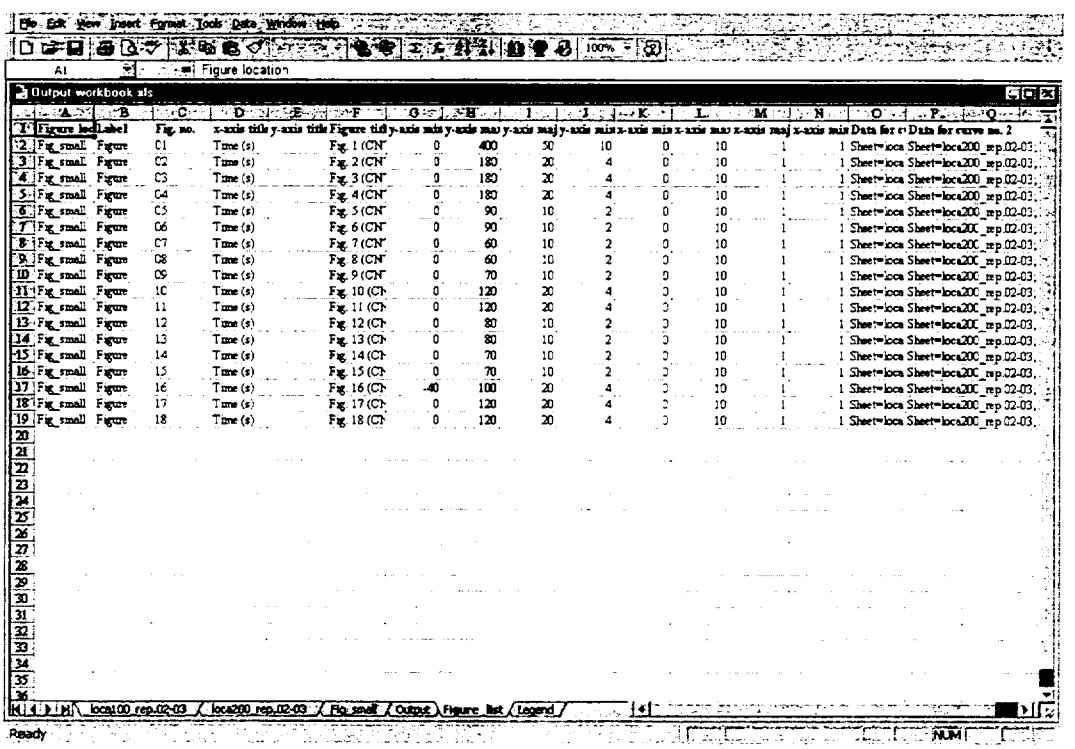


Figure A-8: Worksheet "Figure_list" with information about Charts

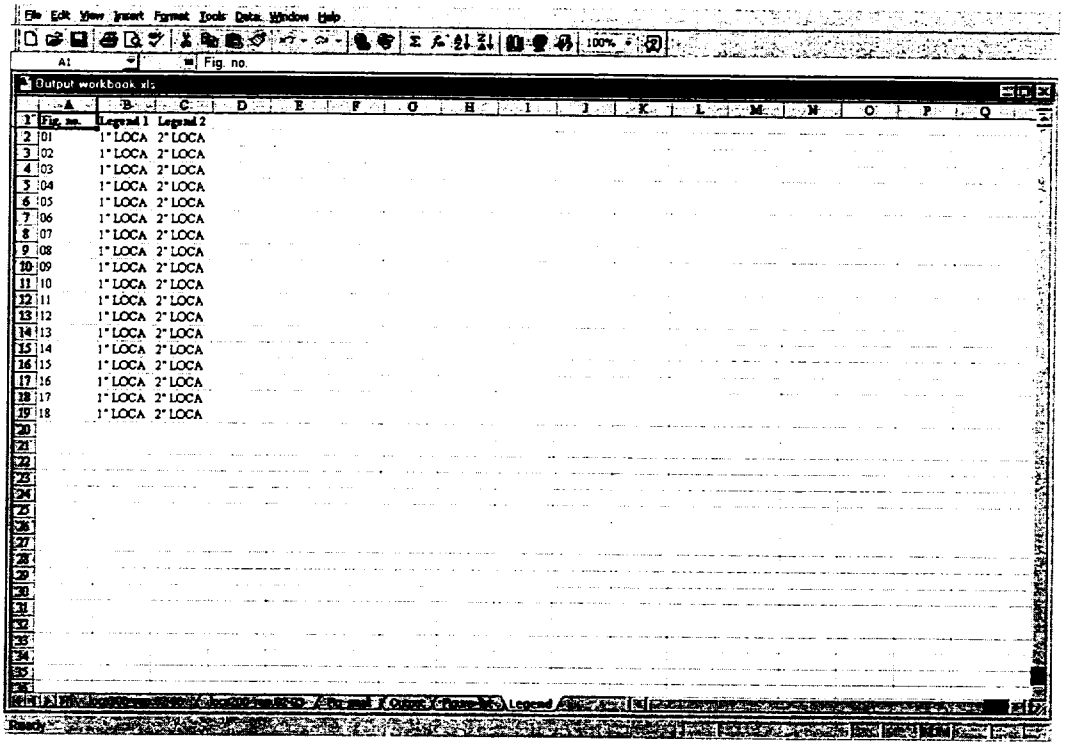


Figure A-9: Worksheet "Legend" with legend names for figures

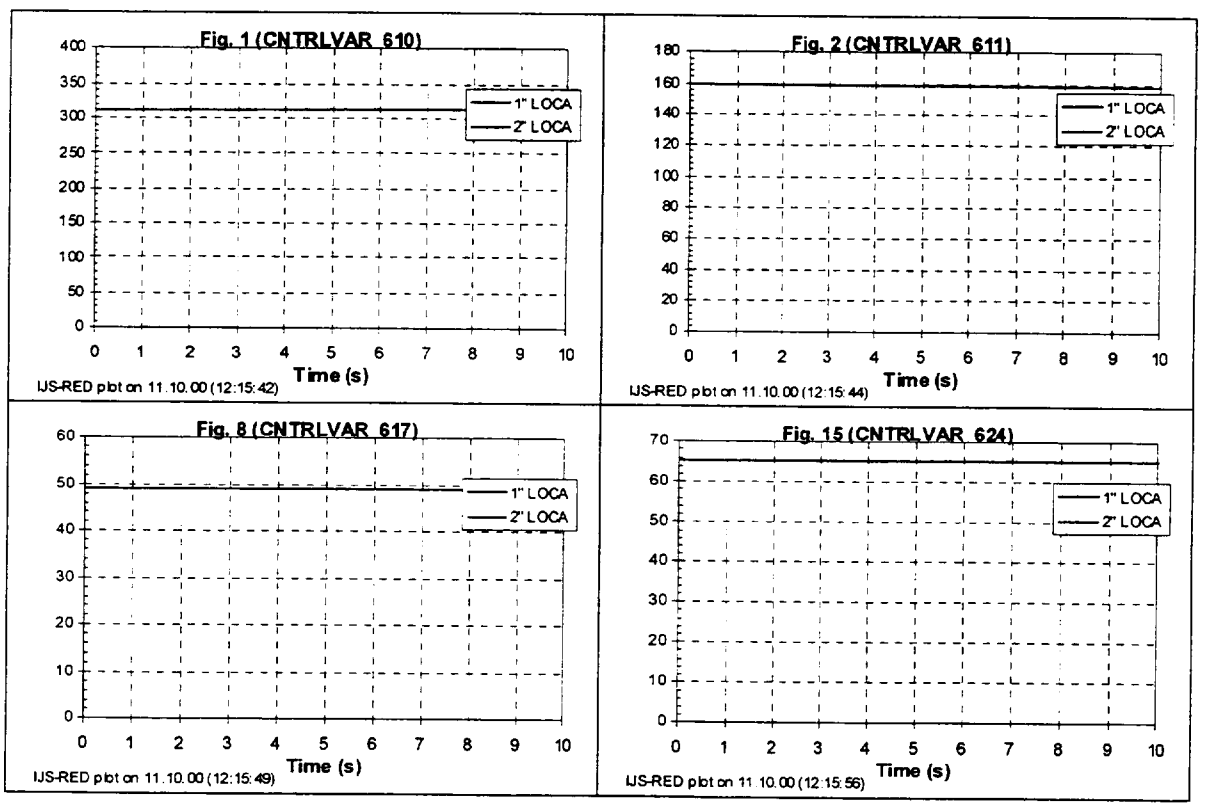


Figure A-10: Charts exported in Word

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

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BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

Worldwide research is conducted to show how to reduce the user effects on safety analysis in the nuclear engineering field. It was shown that user effects could be reduced with automatic display of the result. Therefore a program was developed for automatic creation of figures with Microsoft Excel 97 with capability to present single curve or multiple curves. Primarily the program was developed for the RELAP5 users. However, due to flexibility it can be used for graphic presentation of severe accident or user developed codes when the output is in columns and ASCII format. The testing of the tool showed that figures can be quickly and easily created. The tool conforms also to quality assurance requirements, because all input data used are archived. Additionally a figure list is created including titles, boundaries, ranges of cells for plotting, etc. A huge number of quickly generated figures enable detail analysis of certain phenomena, thereby improving the quality of the analysis.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

RELAP5/MOD3
Post-Processor

13. AVAILABILITY STATEMENT

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14. SECURITY CLASSIFICATION

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unclassified

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unclassified

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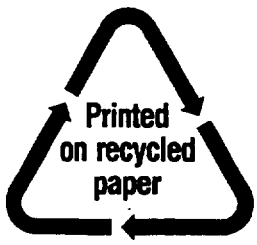

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