Rerum Naturalium Fragmenta

No. 403

PEREC for PC-DOS
Version 2.5
User's Guide

by

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Chapter 1
INTRODUCTION

PEREC is a system of computer programs for Prospect Evaluation. The core of the system consists of programs to calculate the expected amount of hydrocarbons in place by Monte-Carlo simulation.

Interactive menu options include programs for the entry of geological models, the validation of model parameters, and graphic display of the results. File index utilities help to locate, list or delete data files.

The package is set up to run on IBM PC compatible microcomputers. Not all such computers are equally suited for PEREC functions. Data entry and graphics are best on machines equipped with VGA, EGA or Hercules type displays.

The speed of computations can vary from machine to machine, and personal computers based on 80286 or 80386 chips are faster, and therefore more convenient to work with.

You can print a paper copy of the screen on most printers when the screen is displaying text. To get plots of graphic curves use the Hardcopy option presented in the menu.

Access to PEREC

Switch on the PC. You may be presented by an initial menu. If PEREC or PEGAS is among the options, chose it, otherwise

choose the option to exit to DOS, then the computer responds with the C> prompt.

On prompt > enter PEREC.

The PEREC menu appears, with 4 main options on the left side of the screen (Fig. 1).

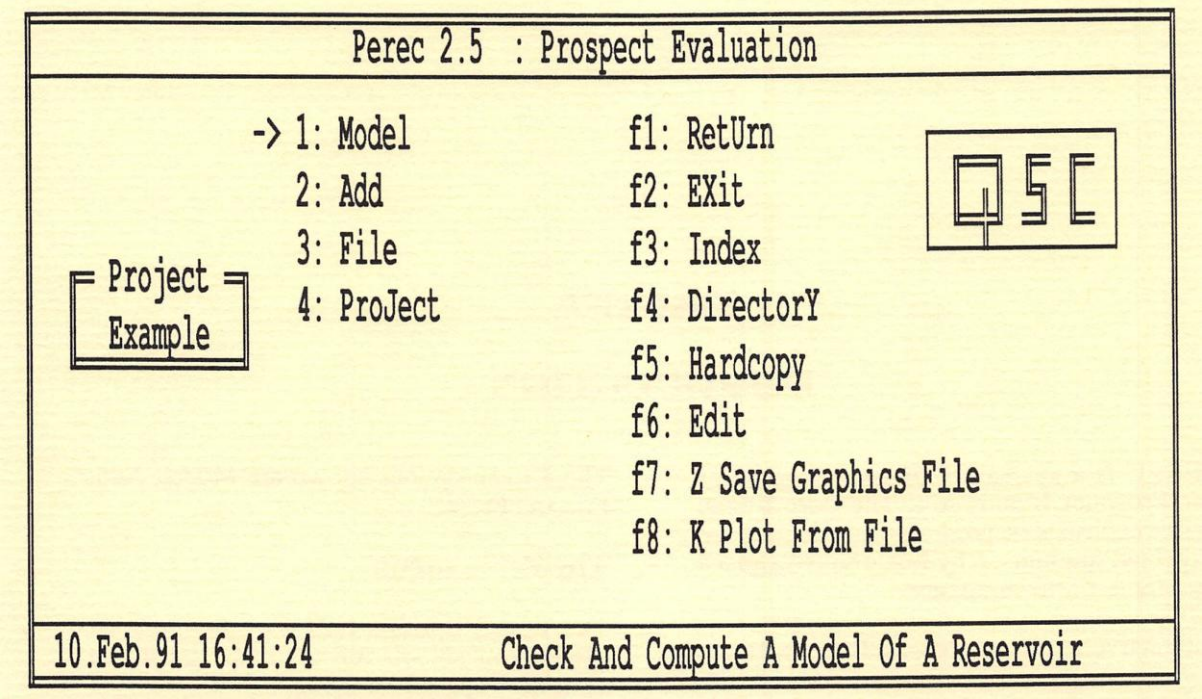

Fig. 1.1

The 4 main options shown are Model, Add, File and Project.

The Perec menu

The first 3 options lead to other menus. When you select one of these the menu system drops down a level to display the selected page of menu options.

Each menu has two columns, the first column lists the options specific to the menu, while the second column contains functions that are common to all menus.

Menu items can be selected by moving to the item using the arrow keys and pressing Enter. An item can also be selected by pressing the corresponding function key or number key or by pressing the highlighted letter and then pressing Enter.

When the program selected as a menu item has finished, PEREC returns to the menu page that was used last.

Project Selection

The Project option on the main menu allows you to enter a Project name. This can be an existing project or a new one. You can start a new project by entering a name of up to 8 letters or digits. To use an existing project, select it from the list of existing projects displayed in the left side of the screen. It is important to enter the correct project name as the data files are grouped by project code.

Utility functions

Functions appearing in the second column are Return, Exit, Directory, Index, Hardcopy and Edit. Return is the option to return to a higher level menu. Exit is the way out, when finished with PEREC, you can select Exit to take you to the DOS prompt.

Directory & Index

The Directory option presents a list of projects on the screen. The Index option lists the models in the current project, showing when each model was last edited, validated and computed.

Plotting

Every time the program produces screen graphics it records the plot data in a file. The Hardcopy option in the second column of the menu sends the plot file to the printer.

Temporary plot files can be saved to permanent files for later use by the Save Graphics File option. Such saved files can be plotted using the Plot From File option. You can use these two options in case the plots are generated on a machine not connected to a high quality (e.g. laser or ink-jet) printer. The plot file can be saved to a floppy disk for transfer to a PC connected to a high quality printer.

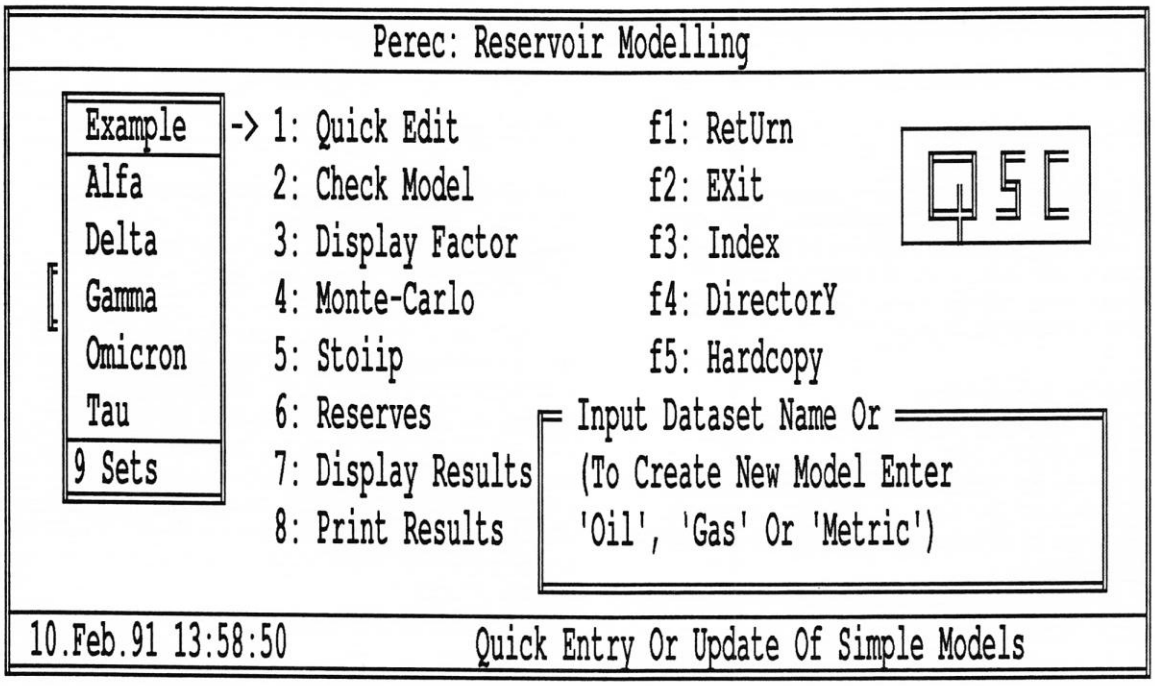

Fig.2.1

Chapter 2
EDITING

From the main menu select the Model option. The Model menu will be displayed.

The Quick-Edit and Edit options on this menu can be used to enter or modify reservoir model data. When you select either of these the program will first ask for an input file. If you want to start from scratch specify Oil, Gas or Metric as input.

Choosing an input file (or Oil, Gas, or Metric) sets the initial state of the work file.

The Oil option starts editing by filling the work-file with a default template containing the usual set of geological factors applicable to oil reservoirs. The Gas option uses a similar template for gas reservoirs.

Each of these options asks for a name for the file to save the edited model to. When you start editing from scratch, the list of existing files presented on the left of the menu is just a reminder of names already used.

If you are editing the contents of an existing model file, the edited data will either be used to update the same file or saved under a different name. Both the input and the output file can be selected from the list presented on the left side of the menu.

Quick Editing

The quick editing option can be selected to edit simple models. All the editable data in the model are presented on the same screen and for the rest, defaults are used. In particular, geological factors will be treated according to the number of values entered:

A factor with 2 values is modelled with uniform (rectangular) distribution. If a factor has 3 values it is modelled with triangular distribution. Factors of 4 or 5 values are treated as cumulative with each value having the same probability. Where only one value is given the value is used as a constant multiplier.

If an existing detailed model is edited by the Quick Edit option, all items not shown on the screen will be replaced by defaults.

Entering a new reservoir

When you are entering a new reservoir data set, select Oil, Gas or Metric as input. They differ only in the initial contents of the work file. The choice reflects the units in which the results will be reported: barrels, cubic feet or cubic metres. Certain data fields are loaded initially with typical parameters for oil reservoirs (Oil, Metric) or gas reservoirs (Gas). In any case the displayed entries can be modified by the user.

Names of model files

The editor program will prompt for a file name of up to 8 characters. The name may be the abbreviation of prospect & reservoir - this will be the name under which the data set is stored.

Each reservoir needs a new file; and if a reservoir contains both oil and gas, these should be put in separate files, too.

The file name should consist only of letters, digits and the characters &, -, !. No internal blanks are permitted.

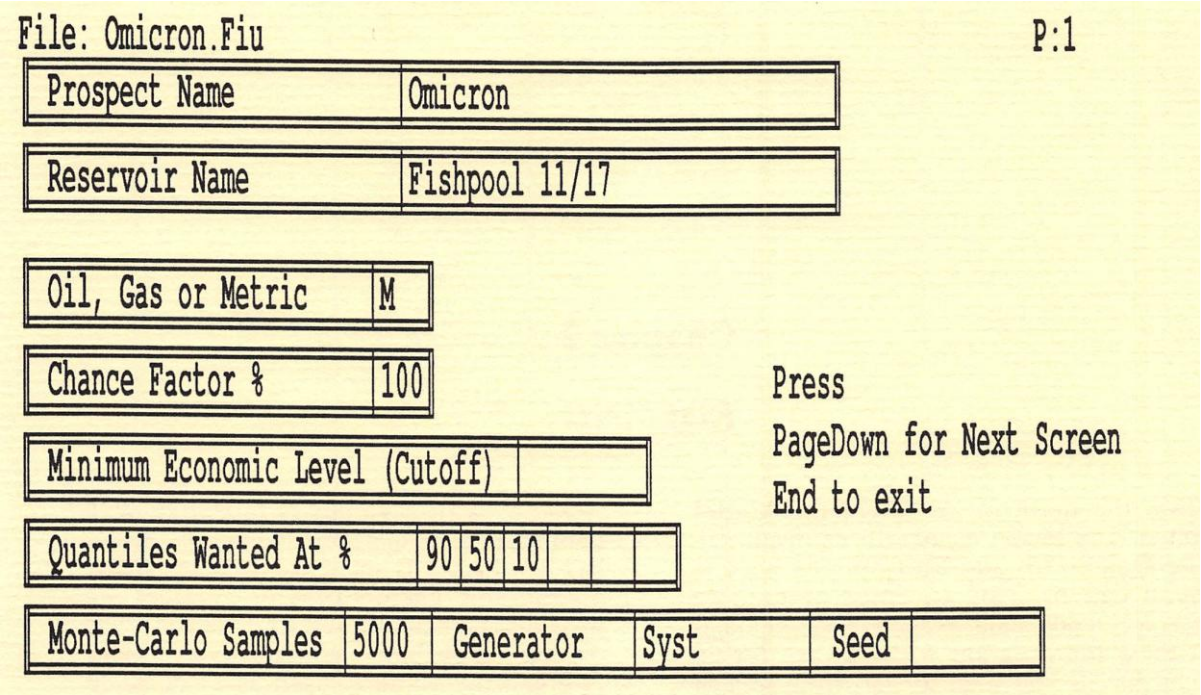

Fig. 2.2

The Editor program

Model parameters are entered more or less in the same order as they appear in the printed PEREC summary listings. (See example in Chapter 4).

The first screen presented by the editor shows general reservoir parameters. Each of the following screens contain parameters of a single geological factor e.g. gross rock volume or porosity. You can move about the screen by using the arrow keys and so type the values into the boxes. Pressing Enter takes you to the

next data field, pressing the Tab key moves back to the preceding field.

You can move between screen pages by pressing the Page Down or the Page Up key.

When entering data in a box you can overtype existing, displayed information.

Reservoir parameters

The first screen of the model data file is devoted to general Reservoir description.

The first two items to type in are Prospect name and Reservoir name. Both can be up to 20 characters long and should be entered in the form which you wish to appear on the plots and listings. You can use upper or lower case letters or other printable characters, the restrictions on model file naming do not apply.

Oil or Gas : enter Oil, Gas or Metric. This determines the units in which the results will be reported. If you enter Metric in the box then the results are reported as million cubic metres, otherwise as million barrels or billion cubic feet.

Chance factor: enter as a percentage.

Values to compute

Values to be computed and displayed as numerical results can be specified in the following fields of this screen.

To specify an economic cut-off, enter the value in the units of the computed results e.g. million barrels of oil. The program w: compute the chance of finding a volume bigger than this and also the average of all values above the cut-off.

Up to 6 quantiles e.g. P90, P50, ... can be requested. (The usual set is P90, P50, P10). If these fields are left blank only the unrisked average and the expectation curve will be computed.

Simulations

You can specify the number of simulations as a number between 500 and 10000. It should be a multiple of 500. The default value set by the Quick Editing option is 5000. Computing more simulations increases precision but requires more time. (This is discussed in more detail in chapter 4.)

You can choose between various methods of generating random numbers for the simulation runs and you can also specify an initial seed or randomisation. To use the default seed leave the box empty or enter a zero. To specify a different seed enter a suitable odd number as seed. If you want randomisation enter 2 in the 'seed' box. Quick Edit is using the default random number generator ('System') with the default seed and no randomisation.

Factor parameters

A factor is any geological parameter you wish to include in the reservoir model (see Chapter 3). While the number of factors used and their names can be entered at the users discretion,

there is a template of suggested factors when entering a new oil or gas data set.

For oil reservoirs the template consists of gross rock volume, net/gross ratio, porosity, oil saturation, formation volume factor and recovery (See Example).

For gas reservoirs the factors in the template are gross rock volume, net/gross ratio, porosity, gas saturation, gas expansion, and recovery. If needed, factors can be added to or deleted from the set, just as in modifying.

Up to 12 factors can be entered, one by one. Each new factor is entered on a new screen page. For each factor enter its name, units, probability model, dependencies and parameter values.

The name of the factor can be up to 20 characters long. Spelling is generally not important as the name is only used for identification - longer names can be abbreviated. The two exceptions are the Formation Volume factor (can be entered in
full or abbreviated to FVF) and Recovery (enter in full) which have to be recognised by the Monte-Carlo program.

Units and conversions

Enter the unit of measurement for factor values abbreviated to 4 characters. The specification of unit is important for rock volume and for percentage values only.

If gross volume is given in thousands of acre feet, enter TACF (capital letters). Otherwise, volume data input are assumed to be in million cubic metres. TACF is the default unit of gross

rock volume when a new oil or gas reservoir is entered. If the unit of a factor is % (percent sign) values will be divided by 100. If a unit is not specified (blank) or any other than TACF or % then the values will be used as entered.

Internally, all computations are done in millions of cubic metres and automatically multiplied by a conversion factor to give results in million barrels (oil) or in billion scf (gas) if required.

Probability distribution model

Enter the letter code of the distribution model as follows:
D - Discrete
U - Uniform
T - Triangular
C - Cumulative
E - Frequency
N - Normal
L - Log-normal
A - Best Fit
B - Beta
X - Explicit Normal
Y - Explicit Log-normal
Z - Explicit Beta

These are discussed in detail in Chapter 3.

Parameter values

You can enter up to 12 pairs of representative values with associated probabilities. These are the numbers describing the prob-

ability distribution model and are to be entered according to the requirements of the particular model chosen.

Prospect: Omicron
Reservoir: Fishpool 2/10

Oil or Gas: Gas

Geological Factors

Name	Units	V A L U E S				
Gross Rock Volume	MCUM	350	550	650	750	
Net/Gross Ratio	%	66	77	88		
Porosity	%	7	12	18		
Gas Saturation	%	80	85	90		
Gas Expansion		260	270	280		
Recovery	%	20	26	30		

Fig.2.3

Dependencies

Known dependencies between factors can be specified by filling these fields of the screen. For example, if Oil Saturation depends on Porosity then enter Porosity in the Dependency box of the factor screen of Oil Saturation. Each dependency relationship is entered only once. It should be entered under the factor that comes later in the list.

In the next box enter the strength of dependency as a number between -10 and +10. Here +10 corresponds to total positive

dependency, -10 to total negative dependency. 0 means no dependency (i.e. the factors are independent) - same as leaving the entry blank. Example: If the dependency between Porosity and Gross volume is weakly positive, it can be entered as +3.

Saving the model

Press End when the editing is done and the program will save the file and return to the editing menu.

The newly entered or modified data are kept in a work file till the (successful) completion of editing and only then are written to the 'new' file. If the program is aborted by Control-Break then file will be left unchanged.

Modifying an existing file

Proceed as for entering 'new' data but specify a file created previously as input file.

Next, enter the name of the 'new' (output) file if different. Entering the same file name again will cause the old file to be overwritten with the updated contents.

The modify/update option is often used to change perhaps a single entry in a model. For this reason the option is also included in the minor options of all menus.

Changing the model parameters in the file will obviously invalidate the results previously computed so the program recalculates the computed values when it saves the updated file. If the

modified file has a different name then the original file will still hold its results.

On saving the edited file the program will validate the factors for consistency, if necessary, it will fit probability distributions to the factors and then compute STOIIP and reserves.