APPENDIX A

DESCRIPTION OF PROBABILISTIC MODULE
USED TO EVALUATE DOSE DISTRIBUTION

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This appendix discusses the details of the probabilistic module used to evaluate dose distribution. The details presented include integration of the module with the RESRAD and RESRAD-BUILD codes, general navigation, and input forms.

A.1 INTEGRATION WITH RESRAD CODES

The probabilistic module is integrated into both the RESRAD and RESRAD-BUILD software packages. The system has been designed so that the details of file, data, and calculational modules are hidden from the user. The high-level details of this system are shown in Figure A.1. The user can start the programs, specify cases, and run the codes in a manner similar to the previous versions. The probabilistic module input is displayed through either the toolbar or by pressing the "F8" key when the windows focus is on a specific parameter. The output module is displayed through the menu. (See Figure A.2 for a diagram of this process.)

A.2 NAVIGATION

The procedures for using the probabilistic analysis module are as follows:

C Users run the standard software interface (RESRAD or RESRAD-BUILD) to set deterministic values for parameters not involved with probabilistic analysis.

C Probabilistic analysis is set by finding parameters in the standard interface and pressing the "F8" key. The probabilistic input window with four tab screens will appear.

C The parameter will be automatically added, with its default distribution, to the list of parameters for probabilistic analysis.

C If the probabilistic analysis is activated, after running the standard software, the probabilistic runs will begin.

C After the calculations are completed, the interactive output window will appear so tables and graphics can be created to display results. Access is available to both the textual report and the detailed data dump files.

The probabilistic modules have been designed to be flexible and quite independent of the original RESRAD or RESRAD-BUILD application, yet easily applied and integrated with the application and utilizing previously written software for Latin hypercube sampling (LHS) and correlation analysis.

The input window (see Section A.3) takes information from the default distribution database and from the user's commands to construct the list of parameters, their distributions and correlations, and general sampling options. At run time, the LHS code is activated to perform the sampling. The code is then run on these samplings, and the results are stored for incorporation into textual reports.

A.3 INPUT WINDOWS

A.3.1 Sample Specifications

The user is allowed to specify details of the sample generation (Figure A.3). Included in this
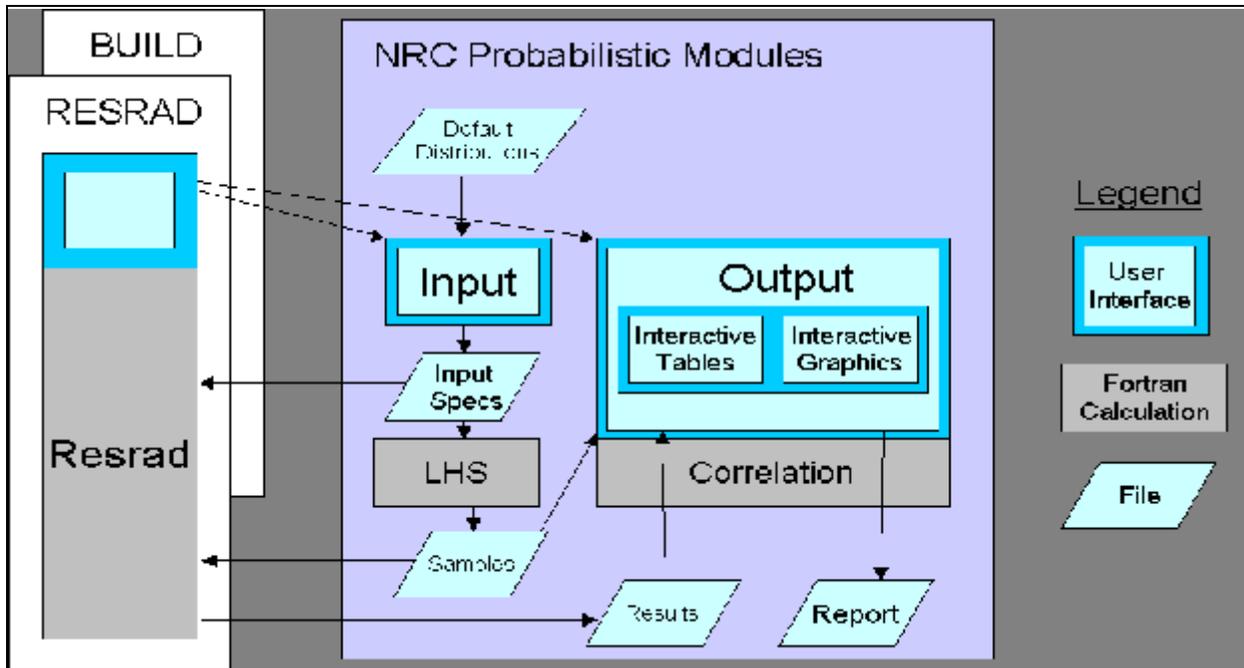
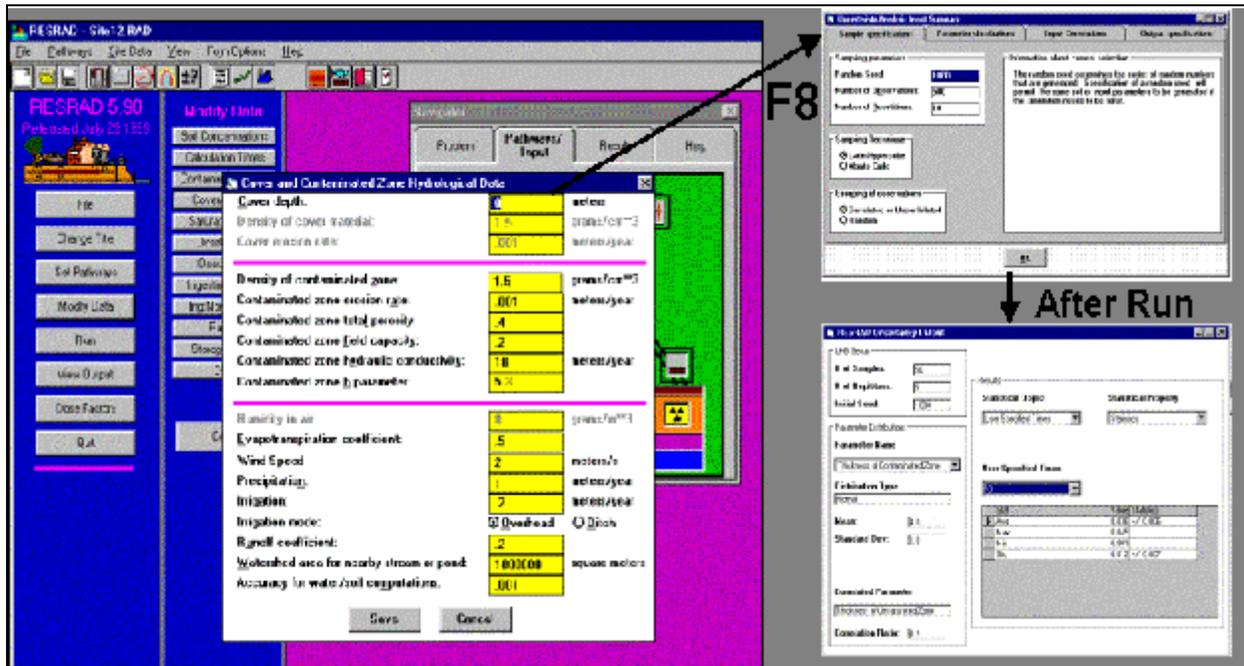**Figure A.1 Integration of Probabilistic Modules with RESRAD/RESRAD-BUILD Codes**

Figure A.2 Diagram Showing User's Access from RESRAD Interface (left) to Probabilistic Input Window (upper right) and Probabilistic Output Window (lower right).
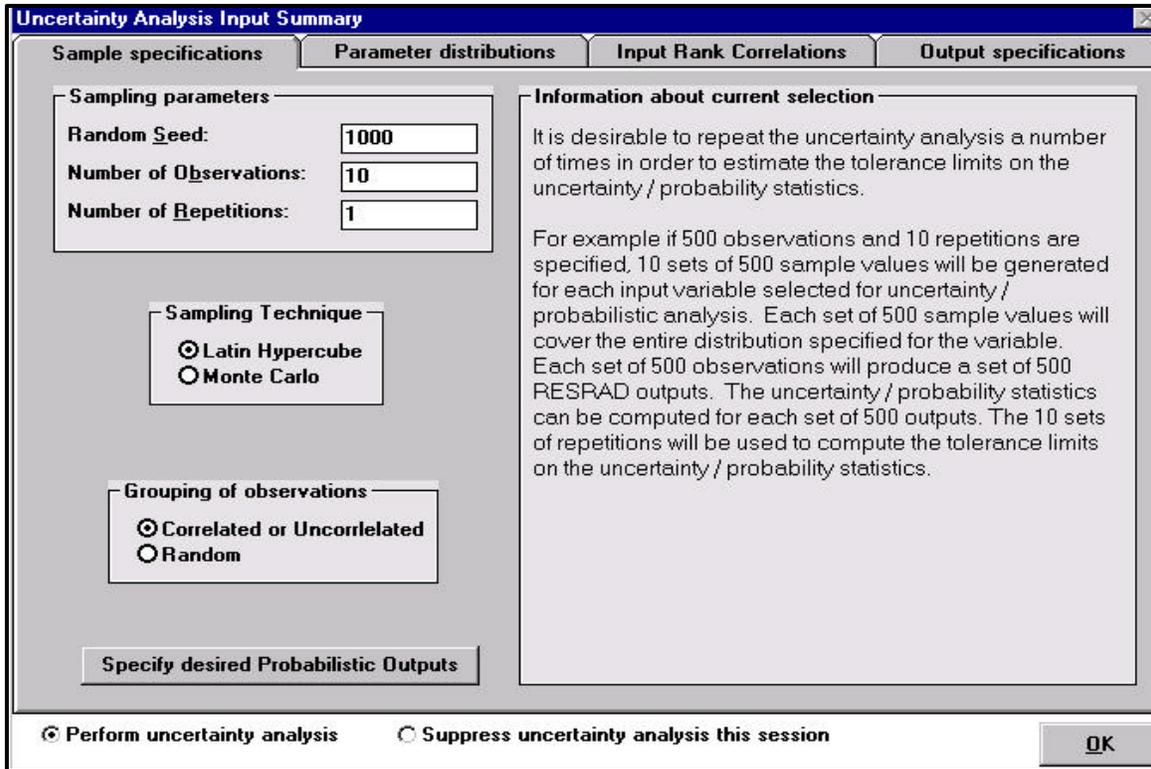
Figure A.3 Probabilistic Analysis Sample Specification

specification are the beginning random seed, the number of observations and repetitions, the sampling technique, and the grouping of observations. Detailed information about these options is displayed on the right-hand side of this window as the user navigates through the options. Usually the user will be concerned with the number of observations and repetitions.

Sampling Technique: The LHS option will split the distribution to be sampled into a number of equally probable distribution segments (the number is equal to the desired number of observations) and will obtain one sample at random from within each segment. This procedure ensures that the samples cover the entire range of the distribution. The Monte Carlo option will obtain the specified number of samples randomly from within the whole distribution.

Grouping of Observations: Correlated or uncorrelated grouping will order the samples for each variable so that (1) the correlations between the specified variables are as close as possible to the specified input correlations, and (2) the correlations between the variables that are not specified to be correlated will be as close to zero as possible. Random grouping will group the variables in the order that they were obtained. It is possible that some of the variables so sampled will be correlated just by chance.

A.3.2 Parameter Distributions

The parameter distribution tab screen allows the user to view and edit all currently specified parameter distributions for probabilistic analysis (Figure A.4). The parameters are listed in the left frame. The detailed distribution properties are shown in the right frame.
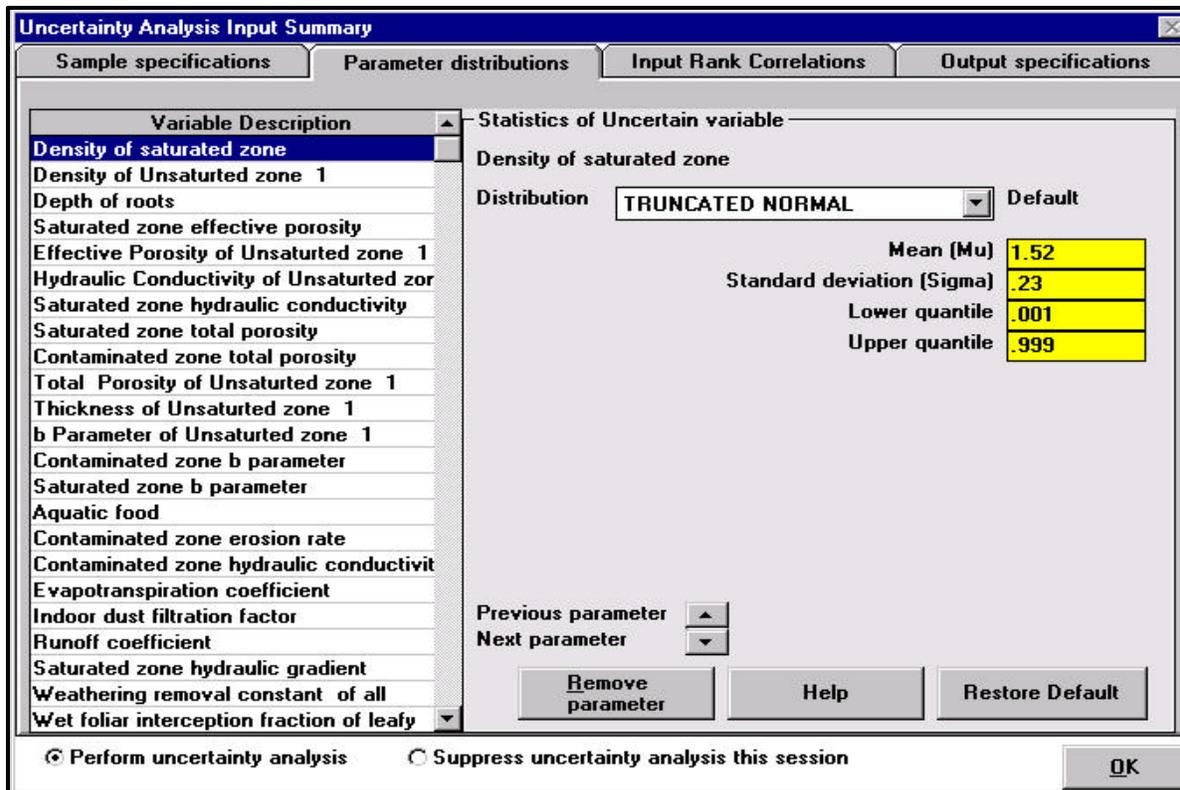
Figure A.4 Specified Parameter Distributions for Probabilistic Analysis

Navigation: Navigation to other parameter distributions is achieved by either clicking on the parameter on the left side or using the "Up-Down" arrow control on the left side.

Parameter List for Probabilistic Analysis: The list of the currently chosen parameters is shown on the left in a three-column table displaying the variable description, variable name in the code, and the distribution type. If the user clicks on any element in the row, complete distribution properties for the variable will appear for review and edit on the right.

Statistics of Uncertain Variable: The properties involved are the distribution type, shape parameters concerning the specific distribution type, and upper and lower truncation bounds. In the particular example shown in Figure A.4, the shape parameters are for the normal distribution, that is, the mean and standard deviation. If the

user wishes to accept the default distribution for this parameter, the "Default for assumptions" can be selected. These assumptions also include those specified on the "Sample Specification" tab that are beyond the input specifications of the deterministic RESRAD codes. The user can also remove the parameter from further probabilistic consideration by clicking the "Remove Parameter" button.

A.3.3 Input Rank Correlations

The input correlations tab screen allows the user to view and edit all correlations between input parameters for probabilistic analysis (Figure A.5). The paired parameters with non-zero correlations are listed in the left frame. Correlations can be modified, added, or deleted in the right frame.
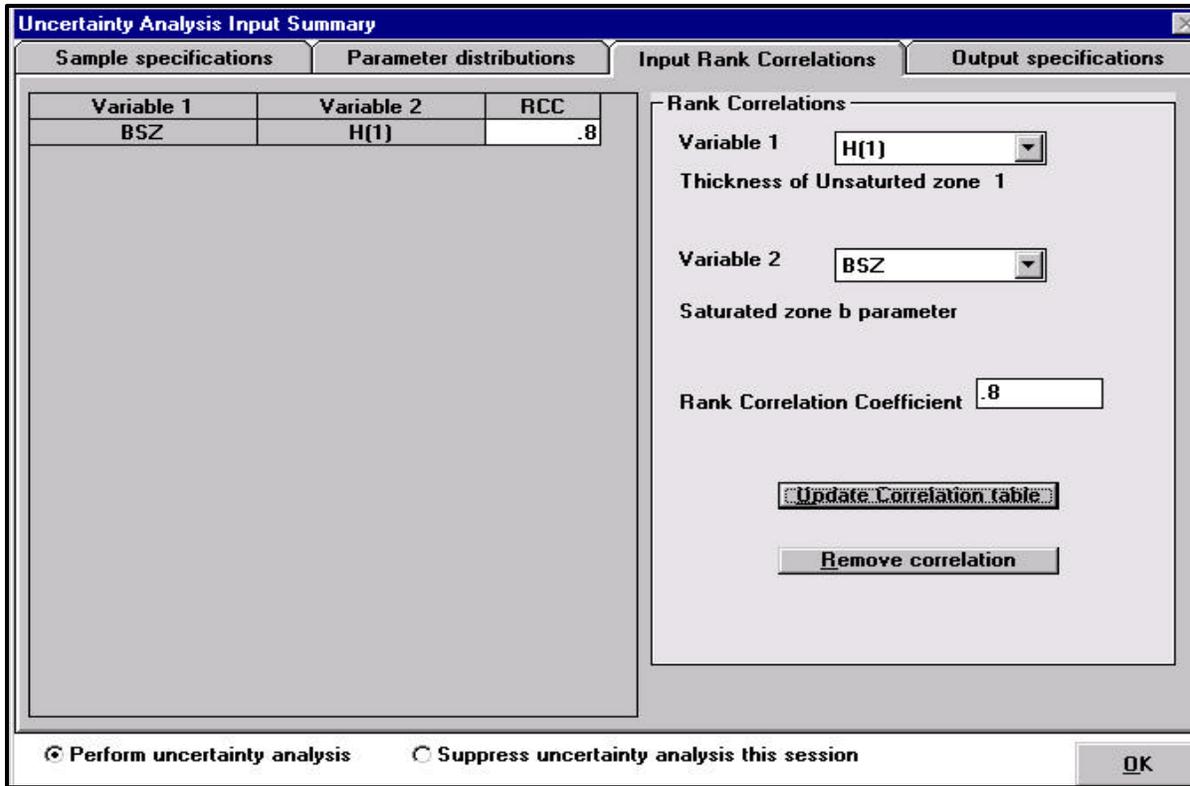
Figure A.5 Specified Input Rank Correlation for Probabilistic Analysis

Navigation: The user can select an existing correlation pair by clicking on its row in the left frame. New pairs are chosen on the right side by selecting the two variables. The edits in this frame are incorporated after clicking the "Update Correlation Table" button. The pair is removed by selecting the "Remove Correlation" button.

Parameter List for Correlation: The currently chosen pairs of parameters are listed in the left frame in a three-column table that shows the variable names in the code and the correlation coefficient.   If the user clicks on any element in any row of the table, the correlation can be modified or deleted in the right frame. The

range of correlation coefficient is –1.00 to 1.00. The correlation for all pairs not specified here is assumed to be 0.0. The user can check the results of the sampling correlation after the run has been completed. Full descriptions of the variables can be seen in the right frame. If more parameters are chosen for correlation than fit in the window, the left side becomes a scrolling table.

Correlation Edit: The two parameters in the correlation and the correlation coefficient are shown and editable in the right frame. The user can also remove the parameter from further probabilistic consideration by clicking the "Remove Correlation" button.