LifeLine ™

Users Manual

LifeLine™ Version 1.0

Software for Modeling
Aggregate and Cumulative Exposures
to
Pesticides

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Users Manual for Version 1.0 of **LifeLine**™

Contents

FUNDAMENTALS

NOTE:
The first few times that you use the LifeLine™, it may be easiest to follow the sequence of steps outlined in this Manual and the online Help in the order that they are presented.

This Users Manual addresses Version 1.0 of the LifeLine™ software system for the evaluation of aggregate and cumulative exposures, doses, and risks associated with the use of a pesticide Active Ingredient. LifeLine™ is the first software for aggregate and cumulative exposure and risk assessment to be made widely available to all stakeholders and to the public at large. This is intended to be the first of many versions of the software, which will be developed in response to scientific advances and suggestions from the stakeholder community.

If you have comments or suggestions on the project, you may reach the development team at the LifeLine™ webpage

<div align="center">

http://www.hrilifeline.org

</div>

This site will also provide access to updates for the LifeLine™ program.

LIFELINE™ VERSION 1.0

The LifeLine™ software offers the first tool that can characterize population-based aggregate and cumulative exposures and doses,[1] and estimate the toxic risks associated with those exposures. The software allows you to characterize the aggregate and cumulative exposures and risks from pesticide residues in diet, residential uses, and tapwater related sources. The model provides a powerful tool to understand the relative contributions of these sources and how they vary across individual's lives.

Using this version, you can examine:

- The history of each individual's exposures to a pesticide from all sources;
- The patterns of exposure for a population over time;
- The distribution of exposure across a population at any age and season; and
- The corresponding risks for non-cancer toxic effects associated with those exposures, as well as the lifetime cancer risks.

No matter which perspective on the data you select, you are able to consider:

- The contribution of oral, inhalation, and dermal exposure routes to total exposure;
- Route-specific and systemic toxic risks;
- The contribution of food, tapwater, and residential uses to total exposure, route-specific risk, and systemic risk;
- Typical and maximum exposures and associated risks; and

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[1]   The model allows you to input data on absorption from the gastrointestinal tract, respiratory tract, and skin. When data are provided, the model will automatically track aggregate dose. If no data are provided, then the model will track exposures.

- Temporal averages of exposure[2] over any period of exposure between a single day and an entire year.

As with all exposure assessments, you are required to enter data specific to the active ingredients (AIs) being evaluated. In addition, you are required to enter values for key inputs to exposure equations. These inputs include the dermal transfer rates, hand-to-mouth event rates, clothing factors, and inhalation rates. You can modify the values of these inputs are not "fixed" in the model. The set of values that is shipped with the model has been developed by the LifeLine™ Group based on values used in the Draft residential SOPs from EPA's Office of Pesticide Programs, decisions made in recent REDs, and input from OPP staff. These values are contained in a file entitled Preliminary values based on professional judgement by the LifeLine™ Team. You should carefully review these values and determine if they are appropriate for your analysis.

AGGREGATE AND CUMULATIVE RISK

Assessments of cumulative risk involve the construction of models of response associated with exposures to multiple pesticides. One such approach, toxicity equivalents, normalizes exposures to a series of chemicals in terms of one standard or "index" chemical. The risk from the exposures is then defined in terms of the sum of the toxicity equivalents of the individual chemical. Cumulative exposure assessments can be evaluated using LifeLine™ Version 1.0.

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[2]   For this particular comparison, risk data are not relevant, as the toxic reactions associated with short-duration exposures are generally qualitatively different from those associated with longer exposures.

SYSTEM HARDWARE REQUIREMENTS

IBM-PC Compatible

- Pentium II, 300MHz or higher;

- A minimum of 128 megabytes of RAM;

- 120 megabytes of disk space for the system; and

- Up to one gigabyte of free space on the swap file's hard drive may be required depending on the amount of RAM your system has, how much of it is free, and the size of the analysis. The Food Residue Translator requires a swap file with a minimum of 300 megabytes on a computer with 128 megabytes of RAM.

You should remember that for a single individual, more than a million estimates can be generated in a lifetime (up to 35 route- and source- specific exposure estimates per day and more than 31,000 days in a lifetime of 85 years.) For a model run of 10,000 individuals, more than 10 billion estimates of exposure are determined. The faster the processor, higher RAM size and, the shorter the access time for the hard drive, the better the performance of the software.

SYSTEM BASICS

Aggregate and cumulative exposure and risk assessment addresses residues of one or more AIs in foods and tapwater, and in the home. This version performs this assessment through a series of linked but separate programs. These programs fall into three classes:

- **Enter or Edit Model Inputs,** where you supply the system with the data on residue levels and exposure parameter assumptions needed to conduct an exposure and risk analysis;

- *LifeLine^{TM} Model*, where most of the analytical work is performed; and

- *Risk-Dose-Exposure Reports*, where you review your results, determine which perspectives (from thousands of possibilities) provide the most informative description of your results, and save graphical and/or tabular reports of those analyses.

When you wish to assess a compound, you will begin by entering data using the input programs. Once the data are entered, you will run the *LifeLine^{TM} Model*. Following completion of the model run, you will use the *Risk-Dose-Exposure Reports* program to analyze the data.

Enter or Edit Model Inputs

ACTIVE INGREDIENT AND PRODUCT DESCRIPTIONS

This program allows you to describe features of a pesticide Active Ingredient (AI) that influence its exposure potential, to enter data on its toxicity under different exposure regimens, and also to describe the products that are used to control pests in residential settings. A series of "wizards" prompts you to describe the AI, the products that contain it, and the application methods by which each product is used to control particular pests in residential settings. The results are:

- A risk group file (*.rkg) used by the *LifeLine^{TM} Model*; and

- A report (paper or electronic) documenting your input data.

FOOD RESIDUE TRANSLATOR

This program allows you to integrate information on residues of an AI in agricultural commodities (RACs), food forms, processing factors, and crop usage. This program produces characterizations of the residues in foods as consumed. This unique capability allows you to determine how residues are likely to vary in actual foods. The output of this program can be viewed directly, printed as a report, and exported as a dBASE or Excel file. It is also used by the *LifeLine™ Model*. The design of this program allows the direct input of data or the use of properly formatted databases.

TAPWATER CONCENTRATIONS

This program supports the entry of distributions of the concentration of an AI across residences with different types of water supplies (public/private systems, private wells, or other sources) in each of four Census regions and four seasons and for both urban and rural settings.

ACTIVITY DESCRIPTION

This program allows you to:

- Select a set of one or more of the activities tracked in the National Human Activity Pattern Survey;
- Set the values of key exposure parameters associated with the activities as a function of the individuals' age; and
- Save your inputs as an activity description file for use in future assessments.

Main Program: The LifeLine Model

This program defines the exposed individuals and the daily doses they receive from each of sources. This program produces the large output files that describe the individuals' exposures and the factors used to determine these exposures.

Risk-Dose-Exposure Reports

This program translates very large tables of analytical results into more easily used "views" of the data. These can be examined as graphs or as tables. The graphs can in turn be saved as Windows metafiles, bitmaps, or JPEG files. The tables can be exported in either Excel or dBASE format.

USING THE SYSTEM TO GENERATE EXPOSURE ESTIMATES

The LifeLine™ software combines a series of activities (dietary, residential, and tapwater exposures) that have heretofore been conducted as independent assessments. The following sections provide a brief "guided tour" of the system.

This "tour" presupposes that you wish to evaluate all of the sources of exposure that are addressed by the system (food, tapwater, and residential pesticide use), and that you want to evaluate toxic risks associated with short-term exposures. This provides for a demonstration of all relevant software features and choices. If you only wish to address one or two source terms, you have the option of "turning off" sources when running the model and skipping the corresponding sections of this document.

The LifeLine™ system requires that the following programs be used in the

assessments of specific sources.

1. All assessments use *Active Ingredient and Product Descriptions* to enter data on the properties of the AI being assessed, including toxicity, of the AI under consideration. This program is also used to supply descriptions of the residential usage of your pesticide AI.

2. Assessments of <u>either</u> residential or tapwater exposures must specify the values for key exposure related parameters for different activities.

3. Assessments of food residues must use the *Food Residue Translator* to convert data on residues in commodities into data of residues in foods

4. Assessments of exposures from pesticides in tapwater must specify the appropriate distributions of concentrations to reflect inter residential variation in residues using the *Tapwater Concentrations* program.

5. Once you have entered the appropriate input data using these programs, the main *LifeLine Model* will analyze daily exposures for all selected sources for all relevant routes of exposure on every day of life of each individual in a population that you describe. As might be expected, this generates some extremely large data files. These are not easy to interpret without extensive experience in using large databases.

6. By using the program *Risk-Dose-Exposure Reports,* you can extract a set of focused views from the output files, each of which captures a particular perspective on the exposures and their associated risks. You may generate as many of these as seems appropriate, and display them in either graphs or tables

THE NEED TO DOCUMENT YOUR ANALYSIS (AUDIT TRAIL)

The *LifeLine Model* tracks each of the input files that were used in generating an analysis, including their location (drive and directory) and date and time of their last modification. When you save a report file, the information on these files (and on the underlying output files from the exposure analysis) is captured along with the data you are viewing.

To document an exposure or risk assessment, you must preserve the information in your input and output files. There are several ways to do this, which are addressed in **Documenting Your Analysis** at the end of each **Help** system and in Section E of the printed **Manual**.

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ACTIVE INGREDIENT AND PRODUCT DESCRIPTION
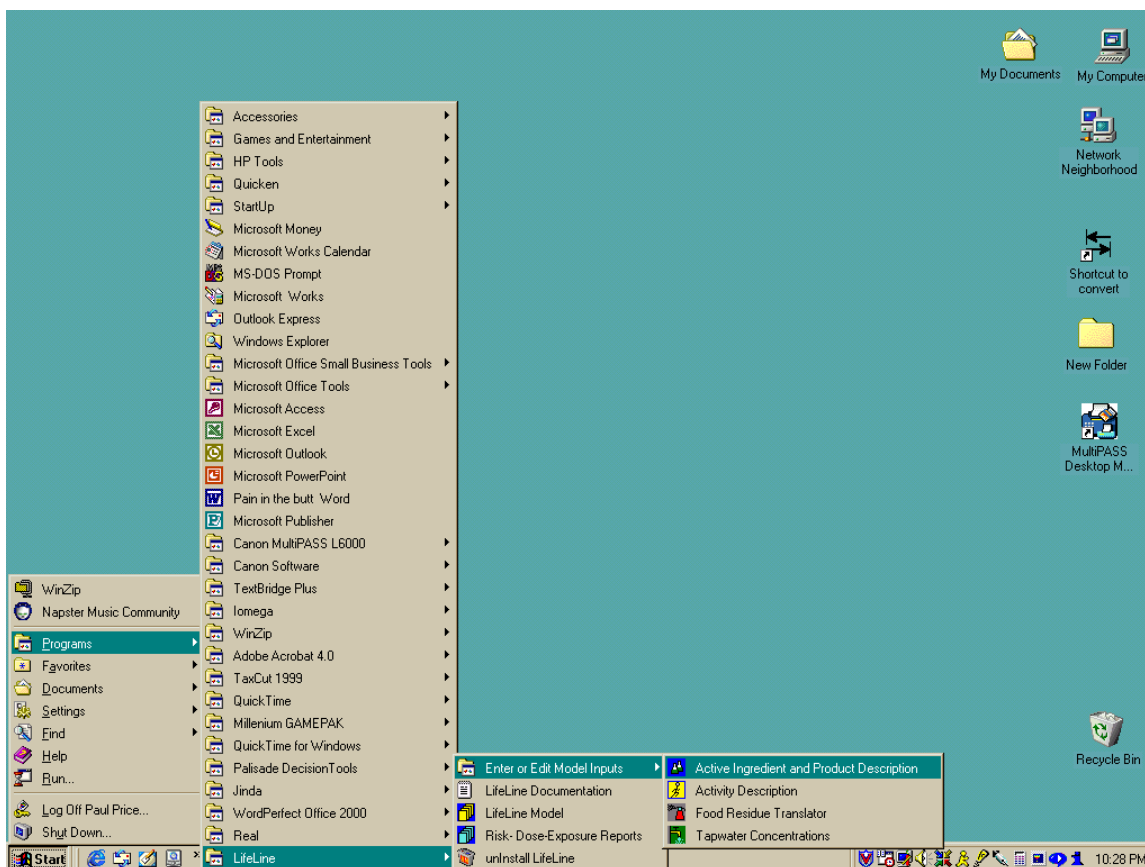
The *Active Ingredient and Product Description* program allows you to enter information on the chemical and toxicological properties of an AI and the residential products in which it is used. Other programs (described in later sections of the Manual) collect data on residues in agricultural commodities and in tapwater. The data you enter in *Active Ingredient and Product Descriptions* are captured in a special file, called a Risk Group file. The names of these files end with the extension *.rkg.

Unlike some existing residential exposure assessment methods, LifeLine™ evaluates the exposures to an AI from all pesticide products that contain the AI. Residential uses of an AI are described in terms of "end-use product equivalents" (EUPEs). A EUPE is one or more registered end-use products that have no significant differences in their formulations or method(s) of application, or pests controlled. The model is based on EUPEs to avoid problems where one active ingredient is used in a large number of identical commercial products. For example, there are a large number of 2,4 dichlorphenoxy acid plus fertilizer ("Weed and Feed") products for sale. All of which have the same amount of active ingredient and are applied in the same way. All of these products would be considered a single EUPE.

> **NOTE:**
> You must create a Risk Group file to describe your Active Ingredient, even if you are not specifying residential exposures. While data on residential use products are captured in this program, its primary function is the collection of key data on the AI under evaluation.

DATA (AND SPECIFIC FILES) REQUIRED

No file is required to begin the analysis. You may, however, open an existing risk group file (an example called ALPHA.RKG is shipped with the system), modify it, and save the results (either as a new risk group file with a different name, or replacing the original file

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WARNING:
If you modify a risk group file and save it with the same name, you will interfere with your ability to audit the results obtained using the original file.

When you start this program, it assumes that you want to create a new risk group

file, and automatically invokes the Active Ingredient Wizard. A wizard is an

automated series of screens that guides you through the process of entering data on

an AI. The Active Ingredient Wizard is described later in the **Help** system and in

this section of the **Manual**.

Wizard Operation
All wizards have the same basic control buttons:
Back:　　　Return to the previous page (not operational on the
　　　　　　first page of the wizard).
Next:　　　Proceed to the next window (will not be operational if

　　　　　　a mandatory field has not been completed).
Finish:　　Replaces Next on the last window of a wizard.
Cancel:　　Discontinue the wizard (losing any entered data) and
　　　　　　return to the main program window.

To load an existing file, click the *Cancel* button on the Wizard and then either

click on the open file folder icon in the Tool Bar

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or select *File/Open* from the Menu Bar.

All of the data on the Active Ingredient, EUPEs that contain it, and application methods for those EUPEs will be displayed in the summary table in the right half of the program window. By using the tree structure in the left half of the window and either the Tool Bar or the Menu Bar, you can:

- Add an Active Ingredient to the Risk Group (You can only add a single active ingredient to any Risk Group in this version. Future versions of LifeLine™ will allow you to enter data on a number of different AIs);

- Remove an Active Ingredient (This will delete <u>all</u> information for the active ingredient);

- Modify the data for the AI including;

  ⇒ Name, other identifying information, or description;

  ⇒ List of EUPEs that contain the Ail;

  ⇒ Physical/chemical properties of the AI; and

  ⇒ Toxicological data for the AI.

- Modify the description of a EUPE;

- Add or remove an application method for a EUPE; or

- Modify the properties of an application method for a particular EUPE.

Each of these options involves the use of a specific wizard.

ACTIVE INGREDIENT WIZARD

This wizard automatically opens when the program is started. It can also be invoked by highlighting the New Active Ingredient entry in the tree structure and choosing **Active Ingredient/Add** from the Menu Bar. Once an AI has been specified, this wizard can be invoked by clicking on the AI in the tree diagram on the left side of the main window, and then either clicking on the Erlenmeyer flask in the Tool Bar:

or choosing **Active Ingredient/Modify** from the Menu Bar.

This wizard has between four and eight component pages (the last four pages are optional, and correspond to different types of toxicological data that you may or may not wish to supply).

The first page, AI Identification, is concerned with identifying information, most of which is optional in this version (in future versions, it will support linkages to other databases). The second page, allows you to build a list of EUPEs for the active ingredient.[3] (Their properties are described elsewhere; see **Application Method for a EUPE**.) You can also modify this list using the Menu Bar. The third page, Physical-Chemical Properties, captures data that are necessary for predicting exposures and doses from the AI when used in residential settings or present in tapwater. The fourth page, Selecting Data on Toxic Chemicals, allows you to specify type of toxicity data (short, intermediate, or long-term data on non-carcinogenic effects and lifetime carcinogenic potency) you wish to enter for the

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[3]   If you are not evaluating residential uses of a pesticide, you may skip this window entirely.

AI, and the appropriate exposure durations for each.

AI Identification

This page of the wizard provides four data entry windows:

1. **Name.** This is the only mandatory field, and is supplied with a default value "Your Active Ingredient." Up to 50 characters may be used to name your Active Ingredient.

2. **Chemical Abstract Number.** This field is not currently formatted with dashes, but accepts up to 10 digits (i.e., for the pesticide Captafol, you would enter 2425061, not 2425-06-1). This field is optional.

3. **PC Code.** This field accepts up to 10 digits. This field is optional**.**

4. **Comments.** Up to 200 characters may be entered. Text is automatically wrapped within this box. This field is optional**.**

End Use Product Equivalents (EUPEs)

This window contains (at the top) a list of all the EUPEs currently associated with the current AI. If you are not evaluating residential exposures, this list may remain empty. You may delete any item in the list by clicking on it to highlight it, and then pressing the **Delete** key.

> **CAUTION:**
> If you delete a EUPE in this window, you will delete *ALL* information associated with it, including application methods and all the quantitative data associated with each.

The more fundamental operation is to add EUPEs to the list. You do this by typing in a name of up to 50 characters (replacing the default "Your product name,"

optionally specifying a "Registration number equivalent" of up to 11 digits, and clicking on the **Add** button.

NOTE:
You may add multiple EUPEs with the <u>same name</u> to one AI. However, this may complicate your ability to track the data entered on multiple EUPEs.

Physical-Chemical Properties

This is one of the more detailed windows in the Active Ingredient wizard. It contains three main sections, each of which <u>requires</u> numerical data relevant to calculating exposures to this chemical.

VOLATILIZATION FROM WATER

The top section of this window captures data that are needed to predict the volatilization of your AI from tapwater (for example, in a shower). When assessing exposures from tapwater you should enter the following data:

- **Henry's Law coefficient** (unitless form), which is the ratio of vapor pressure to water solubility, and reflects the steady state partitioning of a chemical between air and water at a given temperature. The unitless form of the Henry's Law coefficient can be obtained by dividing the Henry's Law coefficient (expressed in Atm-m^3 / Mol) by 41; or,

- **Water solubility** (in mg/l) and **vapor pressure** (in torr) independently, from which the model will calculate the Henry's Law Coefficient.

Each of these fields accepts numerical data as decimal values or as scientific notation (e.g., enter 5.3e-7 for 5.3 x 10^{-7}).

Because both vapor pressure and water solubility (and, consequently, the Henry's Law Coefficient) are temperature dependent, you should enter values that were measured or estimated at temperatures appropriate to the temperature of water used in showering or bathing (30- 50° C).

If you do not wish to evaluate indirect inhalation exposure to pesticide residues in tapwater, you should enter values for these parameters that will minimize volatilization (low values of **Henry's Law coefficient**).

DERMAL ABSORPTION FROM WATER

The central section of this window captures three physical-chemical properties that are used to characterize dermal exposure to a pesticide AI in tapwater (for example, during a shower or bath).

The parameters that are entered in this section are:

- **Octanol-water partition coefficient** (often referred to as K_{ow}), which is the (unitless) ratio of the solubility of the chemical in octanol and water (i.e., its partitioning between them under steady-state conditions); and
- **Molecular weight** (g/mol).

The system will estimate the value of the **Permeability coefficient** (K_p) based on the values of K_{ow} and molecular weight you enter. If you have data on the value of K_p for the AI, you may directly enter a value for the **Permeability coefficient** (cm/h).

If you do not wish to evaluate indirect dermal exposure to pesticide residues in tapwater, you should enter values for these parameters that will minimize volatilization (low values for K_p). These values will result in very low dose estimates and will essentially turn this route of exposure off but will not affect the estimate of exposure from ingestion of tapwater.

PARAMETERS FOR ROUTE-SPECIFIC ABSORPTION

This portion of the window allows you to enter compound-specific data on the extraction and absorption properties of the AI. These inputs are the fraction of the exposure that is absorbed and contributes to the total systemic dose. These inputs provide the basis for estimating the systemic dose that occurs as the result of an exposure. These inputs are:

- **Oral absorption** (unitless) this is the fraction of the ingested AI that is absorbed and becomes a systemic dose;

- **Inhalation absorption** (unitless) this is the fraction of the inhaled dose that is absorbed and becomes a systemic dose (also referred to as lung clearance); and

- **Dermal absorption** (unitless) this is the fraction of the dermal exposure that is absorbed and becomes a systemic dose. The portion of the AI that is retained in the skin should not be included in this fraction.

In each case, the entered parameter represents the fraction of an exposure quantity that is absorbed (unitless, $0 <= x <= 1.0$). Each of the fields will accept numbers in either decimal or scientific notation.

In assessments where the goal is to characterize exposures rather than the absorbed dose you should enter values of 1.0. The model will then estimate the amount of AI that reaches the body's boundaries. In the case of inhalation exposures, this is the total amount in the air that is inhaled. For oral exposures, it is the total amount of AI contained in materials that are ingested. For dermal exposures, it is the total amount of AI contained in materials that reach the skin.

The decision for entering values for absorption should be based on the nature of the risk that is being evaluated. Evaluations of portal effects should be based on exposure rather than absorbed dose. Therefore, assessments of portal effects should enter values of 1.0 for the absorption factors.

In assessments where risks are being to evaluated using measures of toxicity that are based on an <u>administered dose</u>, that occurs by the same route then the use of a value of 1.0 is also appropriate. In this case, the use of a value of 1.0 does not imply that the all of the exposure is absorbed. Rather, it indicates that a similar fraction of absorption occurred in the toxicity study and in the exposure.

In assessments, where toxicity data from one source is being used to evaluate exposures

That occur by a second route (route-to-route extrapolation in dose), then route specific data on absorption should be entered into the model.

Assessments of aggregate and cumulative dose calculated by LifeLine™ are based on the systemic effects of AIs and estimates of the total absorbed (or systemic) dose. When calculating aggregate and cumulative risks you should use the actual absorption values and should use estimates of systemic toxicity.

When values of 1.0 are used for the absorption factor the estimates of "total exposures" simply is a measure of the total amount of AI that reaches one or more boundaries of the individuals body. Such a measurement may or may not have any biological significance.

One of the remaining two parameters is specialized for a particular set of exposure-related behaviors, while the other is used to enhance processing efficiency of the LifeLine™ model through use of a "*de minimis*" screen on exposures.

- **Extraction coefficient** (unitless) reflects the efficiency that the AI is removed from an individual's hand, or other object, by saliva (for example, in hand-to-mouth behavior transferring a pesticide residue from a hand to an oral exposure); and

- **De minimis level** (unitless) represents the magnitude of reduction in available residues at which further calculation of residues is deemed unnecessary for exposure assessment. For example, at a value of 100 the remaining residue of n AI on a residential surface is no longer tracked once the concentration diminishes to one percent of the applied amount.

Selecting Data on Toxic Hazards

This screen allows you to specify which, if any, measures of toxic hazard you wish to supply for your AI, and the exposure durations that are appropriate for comparison for these toxic hazard data.

You may specify data on **non-cancer toxic hazards** for up to three different durations (short-term, intermediate-term, and/or long-term) by clicking the appropriate check boxes. You may also choose to supply data for evaluating the **carcinogenic risks** associated with average lifetime exposure to the AI. If you choose to enter the toxicity data, the wizard will then go on to additional windows that allow you to enter the data. If you do not enter data on the AI's toxicity then

LifeLine™ will only model estimates of exposure and dose and will not produce estimates of risk (MOEs, %RfD, or incremental cancer risk).

MINIMUM AND MAXIMUM EXPOSURE PERIODS

When you enter data on the non-cancer toxicity for a specific duration (short-term, intermediate-term, and/or long-term), you must indicate the minimum and maximum exposure averaging periods to which these data apply. Short-term toxicity will always apply to a duration of one day and can be applied to a maximum averaging period of 364 days. Long-term toxicity has a fixed maximum of 365 days and a minimum of two days. Intermediate-term toxicity may apply to any averaging period between two and 364 days.

The selected periods must be non-overlapping. In other words, if your short-term toxicity data are applicable for exposure averaging periods of up to 10 days, the minimum exposure-averaging period to which intermediate-term toxicity hazard data would be applicable is 11 days, and so forth. Non-selected toxicity durations do not affect this rule. For example, you could define short-term toxicity as addressing averaging periods between 1 and 182 days, while long-term toxicity covered periods from 183 to 365 days (assuming that you did *not* select intermediate-term toxicity).

NON-CANCER TOXICITY DATA

Once the duration and type of toxicity data is entered, the wizard will open one or more windows that will allow you to enter the actual data. The same format is used in each window to capture data:
- A toxicity spreadsheet;
- Description of the measure of toxicity; and
- The ages where the FQPA factor should be applied.

The pages differ only in the title at the top right that indicates duration of the hazard data (short, intermediate, or long-term) you are entering.

Toxicity Spreadsheet

This is spreadsheet consists of four columns and six rows. Each column corresponds either to a set of route-specific (oral, inhalation, or dermal) or systemic toxicity data. In each column, you enter four pieces of toxicity data (toxicity measure, uncertainty factor, modifying factor, and FQPA factor) that provides the basis for determining the reference dose (RfD) and the population adjusted dose (PAD).

For example, you may specify the following data for systemic toxicity in the short-term toxicity window:

- No Observed Adverse Effect Level (NOAEL) in milligrams per kilogram body weight per day;
- Uncertainty Factor (UF; unitless) that is based on the nature of the available toxicity data;
- Modifying Factor (MF; unitless) that is based on compound specific considerations; and,
- FQPA factor (unitless), that is based on specific toxicity concerns for children or women of childbearing age.

Based upon these data, the system will determine the values for the RfD using the formula:

$$RfD = Toxicity\ Measure\ /\ (UF * MF)$$

and PAD reflecting special concern for risks to children or from prenatal exposure using the formula

$$PAD = RfD\ /\ FQPA\ factor$$

The route-specific toxicity data should be based on the administered dose for that route. The route designations supplied in the table do <u>not</u> reflect the route of administration used in the underlying toxicology study, but rather address the <u>applicability</u> of the toxicology data to human health risk assessment. Data collected from a study using any route of exposure may be applicable to the assessment of toxic effects on a systemic basis, even when exposure occurs primarily by other routes.

The values of the systemic toxicity data can be estimated based on route specific data adjusted for the route specific absorption. Thus, if the toxicity measurement for the oral route is 10 mg/kg/day and the dose is understood to be well absorbed then the toxicity measurement will be the same for the systemic dose. For a poorly absorbed compound, the systemic toxicity would be higher than that indicated by the administered dose.

The values that you have entered into one cell can be copied and pasted to other cells. For example, if you wanted to specify the same values for both systemic and oral route-specific toxicity the values in the oral column can be copied and pasted into the systemic toxicity column.

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NOTE:
If you wish to evaluate risks that reflect exposures from multiple

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> routes of exposure, you <u>must</u> supply a corresponding data set for <u>systemic</u> toxicity.

Description of Toxicity Measure

The measure of toxicity used as the basis of the RfD and PAD can be a No Observed Adverse Effect Level (NOAEL), a Lowest Observed Adverse Effect Level (LOAEL), the dose that produces an effect in 10 percent of the exposed population (ED_{10}), or a Benchmark Dose. For each Toxicity Measure that you have entered, you have the option of changing the relevant description, using the drop lists in the box on the lower left of the page. These descriptions are not used in the assessment but are tracked in the model documentation.

FQPA Factor Maximum Age

Because the FQPA Factor used to determine the population-adjusted dose generally reflects developmental toxicity or the special sensitivity of children to the toxic effects of the AI, you have the option of specifying the maximum age at which this factor will apply. If you specify an age less than the lifetime being evaluated, the PAD will be applied up to the cutoff age, depending upon the sex of the person being modeled. After that age, the RfD will be applied in assessing noncancer risks. Because there may be concerns about differences between the sexes, or concerns about effects from prenatal exposures, separate ages may be specified for males and females.

The defaults provided are intended to apply the FQPA factor to exposures to males and female children and women of childbearing age.

CARCINOGENIC HAZARD DATA

Currently, EPA is evaluating cancer using two approaches a potency based approach and a margin of exposure (MOE) based approach. This page captures information on the "potency" of your AI as a carcinogen (i.e., how quickly risk increases with increasing dose), on the confidence that the AI is in fact carcinogenic in humans, and on the source of the assessment of carcinogenic hazard. Again, data are captured separately for route-specific hazards and for systemic hazard. As in the case of non-cancer assessments, the latter value is the key factor for evaluation of risk from aggregate exposure.

> **NOTE:**
> If you wish to evaluate carcinogenic risks using an MOE approach then the estimate of the LADD produced by LifeLine™ should be used derive the distribution of the MOE for the compound using the formula:
>
> MOE = Benchmark Dose/LADD
>
> This can be done by exporting the data on LADDs and performing the calculation using a spreadsheet.

The rate of increase in risk with increasing exposure is expressed as the slope of a function that is presumed to be linear at low doses. This Slope Factor (sometimes referred to as a q_1^* or q^*) is entered in the left column of the spreadsheet, in the appropriate row.

The data entered in the remaining columns are the rating of the data on carcinogenic potency and the system used in setting the rating. There are two parallel rating systems used to designate scientific confidence that a particular chemical is carcinogenic in humans. The USEPA uses letters as primary

designations, with numbers to indicate subdivisions, while the International Agency for Research on Cancer (IARC) uses the inverse approach. The categories are quite similar; the following table presents their general meaning, although there are subtle terminological differences.

Table .1. Weight of Evidence that a Compound is Carcinogenic in Humans		
Evidence	**EPA**	**IARC**
Known human carcinogen	A	1
Probable human carcinogen – human data	B1	2A
Probable human carcinogen – animal data	B2	2B
Possible human carcinogen	C	3
Not classifiable as to carcinogenicity	D	4
Evidence that not a carcinogen in humans	E	5

The middle column of the spreadsheet allows you to specify whether the source of the assessment of human carcinogenicity was EPA, IARC, or another source. The final column allows you to enter the designation of the weight of evidence. These data are not used in the determination of carcinogenic potency but is tracked and included in the model outputs.

Identifying EUPEs

This single-window wizard can be called by highlighting a EUPE in the tree diagram on the left side of the main window, and then either clicking on the yellow bottle in the Tool Bar:

or selecting **End use product equivalent/modify** from the Menu Bar.

The wizard presents the name and a Registration number (or its equivalent) for the selected EUPE. Either of these may be modified. While a EUPE may represent multiple products, LifeLine™ Version 1.0 only allows one number to be entered. While these names and numbers are not used in any of the dose or exposure calculations they are recorded in the outputs of the and are useful for tracking model results.

APPLICATION METHODS AND EUPES

Each EUPE must have at least one application method. Multiple application methods can be assigned to EUPEs that are applied in different areas (indoors, outdoors, etc) or are applied in more than one way.

Most of the critical information that is used to describe the potential for exposure and dose is captured in the description(s) of these application methods. Separate application methods are required for products that are used in different residential

settings. These settings (called Microenvironment Classes or ME Classes) are groups of residential locations or sites of pesticide usage. There are four ME classes in LifeLine™ Version 1.0; all indoor locations, outdoor turf, outdoors (non-turf), and pets.

The same wizard is used either to add a new application method to a EUPE, or to modify an existing description of an application method. If you wish to add a new application method, you click on the EUPE (bottle symbol)

in the tree diagram at the left of the main window, and then either click on the spray can

or select **End use product equivalent/Add application method** from the Menu Bar. If you wish to modify an existing method, click on the application method (spray can) in the tree diagram at the left of the main window and then either click on the spray can or select **End use product equivalent/Modify application method** from the Menu Bar.

Each application method is described in terms of:
- A single combination of physical form and application method used in a particular class of Microenvironment;
- The pests against which it is used in this form;

- The probability that the EUPE will be used to control a specific pest in an ME class; and

- Quantitative descriptions of applicator exposures and of amounts applied.

PHYSICAL FORM / APPLICATION METHOD AND ME CLASS

Each application method is assigned to a single combination of ME class, physical form, and application method taken from a list of 55 options. These options reflect a combination of:

- Four physical forms (dust/powder; granular; liquid; solid/collar);
- Nineteen application methods (hand, shaker can, bulb or bellows duster, drop spreader, belly grinder, rotary spreader, bomb, aerosol can, hand-pressurized pump sprayer, hose-end sprayer, trigger sprayer, dip, rinse, shampoo, directed-stream spray can, foam spray can, top spot, paintbrush, pour, and collar); and
- Four ME classes (indoor, turf, outdoors non-turf, and pets).

Because not all application methods apply to all physical forms or ME classes, the list of available types is shorter than would be expected from the combination of these lists. For example, hose-end sprayers are not used indoors, while top spot treatments and collars apply only to pets.

The system allows you to assign each EUPE any and/or all of these application methods, although it is unlikely that any actual product would apply to more than a three or four application methods. Each application method, however, can only be assigned once for a particular EUPE. If you have two application methods that differ in their quantitative descriptions (see below) but have the same physical form, application method and ME class applicability, they should be described as separate EUPEs.

PETS

Version 1.0 is limited to the assessment of exposures from the use of products on cats and dogs. It addresses applicator exposures and post-application exposures that occur by the dermal and incidental oral pesticide exposure pathways. The post-application exposures are assumed to occur because of direct contact with the pet. Indirect exposures to pesticide residues on objects or surfaces that occur as the result of pet contact with the surfaces or objects are not considered. In addition, this version does not address exposures from the application of pesticides to bedding areas and dog runs. The reason for this is the lack of data or an identified model on how individuals interact with bedding or dog runs.

Exposures to pesticides applied to bedding or dog runs that occur as a result of contact with the pets can, however, be evaluated. In this instance, you should enter the level of residue on the animal that occurs as a result of the use of the product on bedding or dog run.

On selecting an application method for pets, you will activate a drop-list that lets you select whether the EUPE / Application Method applies to either cats or dogs.

These choices are used to control the quantitative exposure to the pesticide following application. For a given mass applied to an animal, treatment of a dog results in a lower concentration of AI per given area of fur than the treatment of a cat. In contrast, a dog offers a larger surface area for exposure than does a cat. Version 1.0 assumes that cats weigh 10 lbs and dogs weigh 30 lbs. Application rates entered into LifeLine™ should be normalized to these pet weights.

COMMERCIAL APPLICATION

If you indicate that a particular application method for a EUPE is only applied by commercial applicators, the wizard will skip the screens that ask for information on **Pests and Pest-Specific Use Factors and Exposures from Application and Harvest**. Instead, you are presented with a window that asks the fraction of residences treated with the EUPE / Application Methods by region, for single- and multifamily homes.

Commercial Application Data

This window (the second window in the wizard if commercial application was indicated) contains two spreadsheets, each of which must be completely filled out. The upper spreadsheet asks for Use Factors (i.e., the probability that commercial application in this microenvironment uses this product and application method) for both single and multifamily homes in each of four Census regions.

The maximum value that can be entered for each cell is also displayed. For example, if a previously specified EUPE or application method had a Use Factor of 0.5 in the Northeast Region, the current EUPE / Application Method could not have a Use Factor greater than 0.5.

The lower spreadsheet asks for monthly use frequency data for both single and multifamily homes. Frequency can be expressed as a number greater than or less than one (the product being used more or less than once a month.) Separate values are entered for the warm season and cold season. The warm and cold seasons are based on the region of the residence using the following assumptions:

Table 2. Regional Market Share of EUPE	
Region	**Duration of the Warm Season**
Northeast	Mid-Spring to Mid-fall
Midwest	Mid-Spring to Mid-fall
South	All year
West	Spring, Summer, Fall

Within a season, uses are assumed to occur regularly. For example, if you enter the use frequency of twice a month for both the warm and cold season categories, LifeLine™ would assume that the pesticide would be applied approximately every 15 days around the year.

Non-Commercial Use: Pests and Pest-Specific Use Factors

In this window, you select the pest or pests that are controlled by this application method/EUPE (for non commercial products). For most application methods, you may select one or more of the 22 categories of pests. For pets, only fleas or ticks/chiggers may be selected (the other pests on the list do not specifically infest dogs or cats).

For each selected pest, you must specify a **use factor** that represents the probability that this application method of this EUPE will be used to treat that pest. For example, if your trigger-spray liquid is used in 50 percent of the homes that treat for roaches you would enter 0.5 for roaches.

The **maximum factor** column to the right displays the available use factor to be assigned, and reflects all existing descriptions of EUPEs and application methods. For example, if previously entered EUPEs and application methods had the following use factors for fleas:

    EUPE 1, application method 1   0.10

EUPE 2, application method 1　　0.15

EUPE 2, application method 2　　0.20

there would remain only a potential use factor of 0.55 for any other EUPEs and application methods. This would be displayed in the **maximum factor** column when entering the next EUPE or application method.

EXPOSURES FROM APPLICATION AND HARVEST

This window collects data on potential exposure from application of the EUPE with the selected type of application method. (Note: This screen will not appear for the bomb application method, which is assumed not to have applicator exposures; neither will it apply for commercial applications.) Two alternatives for entering applicator exposures are provided. You can select either method by means of radio buttons at the top of the window.

If you have access to the Pesticide Handler Exposure Database (PHED), and can identify a set of studies appropriate to your EUPE and application method, you can directly enter inhalation and dermal exposure values from the PHED system, using the units reported by that system.

- **Inhalation exposures** are specified in nanograms of AI inhaled per pound applied, and

- **Dermal exposures** are specified in micrograms of AI per pound applied.

If you do not have or do not wish to use PHED values, both **inhalation** and **dermal exposures** for applicators are specified as percentages (a number between 0 and 100).

For those application methods that fall in the ME class outdoors non-turf, the

Harvester dermal exposure field will be activated. Version 1.0 does not address this source of exposure and data entered into this field will not be used by the current model. However, future version of LifeLine™ will evaluate this source.

POST-APPLICATION RESIDUES

This window captures data on the amounts of the AI that enter the residential environment (released to indoor air or applied to indoor surfaces) from the use of the EUPE and the selected application method.

The amount released to air is specified directly as the **Concentration of the AI in air** in the microenvironment (in mg/m^3) immediately after any exclusion period associated with use (i.e., at the point where the first possible post-application exposure could occur). This only applies to the indoor microenvironment class. LifeLine™ Version 1.0, does not evaluate inhalation post-application exposures for pesticides applied to pets, turf, and "other outdoor uses".

The amount applied to a surface from a "crack and crevice", and broadcast use is entered by providing data on two factors the **Concentration of AI in each unit of the product** that is applied (i.e., mg per liter, per gram, per pound), and **Rate of product application** (e.g., liters per linear meter for a crack and crevice spray, pounds per square meter for a broadcast granular).

The amount applied to a surface from a "spot treatment" use is entered by providing data on three factors, **Mass of AI in each unit of the product** that is applied (i.e., mg per liter, per gram, per pound), the **Rate of product application** (e.g., liters per linear meter for a crack and crevice spray, pounds per square meter for a broadcast granular), and **Fraction of the area treated** (unitless, between 0 and 1.0).

The amount applied to a surface from the use of a bomb, you specify the **Maximum area** (m^2) treatable by a single container.

The final parameter is the **Minimum time for re-application** (in days). This parameter (defaulted to zero) is used to ensure that probabilistic methods do not result in predictions of re-use that are precluded by label conditions.

Post-Application Residue Declines

The final window captures data on the decay in total and dislodgeable residues on surfaces following application. This window is applicable (and appears) only for application methods that deal with turf, indoors use, or pets. The values that must be entered are different for each of these three sites of use.

For indoor applications, you specify:

- **Decline rate in dislodgeable AI mass on hard surfaces** (percent per day);
- **Decline rate in dislodgeable AI mass on soft surfaces** (e.g., carpets; percent per day);
- **Fraction of total AI mass that is dislodgeable from hard surfaces** (0-1.0); and
- **Fraction of total AI mass that is dislodgeable from soft surfaces** (0-1.0).

For turf applications, you must specify:

- **Decline rate in dislodgeable AI mass on turf** (percent per day);
- **Fraction of total AI mass that is dislodgeable from turf** (0.0-1.0);
- **Decline rate in total AI mass on turf** (percent per day); and
- **Decline rate in total AI mass in soil** (percent per day).

For pets, you must supply:

- **Decline rate in dislodgeable AI mass on the pet** (percent per day); and

- **Fraction of total AI mass that is dislodgeable from the pet** (percent per day).

Results

As you answer the questions in the wizards, you are constructing two views of your data:

- A **tree diagram** on the left side of the main window, that shows the hierarchy of Active Ingredients, EUPEs that contain each AI, and application method(s) that can be used with each EUPE; and

- A **table** of descriptive and quantitative data for the AI, each EUPE, and each application method.

The tree diagram allows in the entering and revising of data on an AI's EUPEs and their methods of application. The table is intended to allow a quick review of the values entered for an input and to serve as a summary. The table can be printed and included as part of the documentation of an analysis performed using LifeLine™.

Saving a Risk Group File

Once you have completed the description of an AI, its EUPEs, and their application methods, you must "save" your data. The act of saving the entered data creates a compact file of the inputted data that has been formatted for use by the *LifeLine Model* program. The output file is called a risk group file and the names of these files end with .rkg. These files will be saved in the location you specify. When you run the *LifeLine Model* program you will be asked to specify the risk group file that the *LifeLine Model* will use.

To save the risk group file, either click on the diskette button in the Tool Bar

or select **File/Save** or **File/Save as** from the menu bar. It is best to save these files in the default (\workgroup) directory, as that is where the *LifeLine Model* will first look to find them.

> **NOTE:**
> Be SURE to save your entries as a *Risk Group File*. Unless you have saved the file, you will not be able to use this information in conducting an exposure or risk assessment.

Printing the Summary Table

The summary table that describes all of the information that you have entered regarding an AI, EUPE(s) and Application Method(s) can be printed as part of the "audit trail" of your exposure and risk analysis.

To print the table, either click on the printer icon in the Tool Bar,

or select **File/Print** from the Menu Bar. **File/Print Setup** in the Menu Bar can be used to adjust your printer to optimize printing of this file.

Exporting the Summary Table

In addition to saving your risk group (*.rkg) file in the internal format used by *LifeLine Model* and printing a paper copy, you may *export* the summary table in either Excel '97 or dBASE IV format for later use. For example, you may want to import an Excel spreadsheet into a final report to facilitate the "audit trail" of your analysis.

DEFINING THE EXPOSURE RELATED BEHAVIORS ASSOCIATED WITH SPECIFIC AGES AND ACTIVITIES
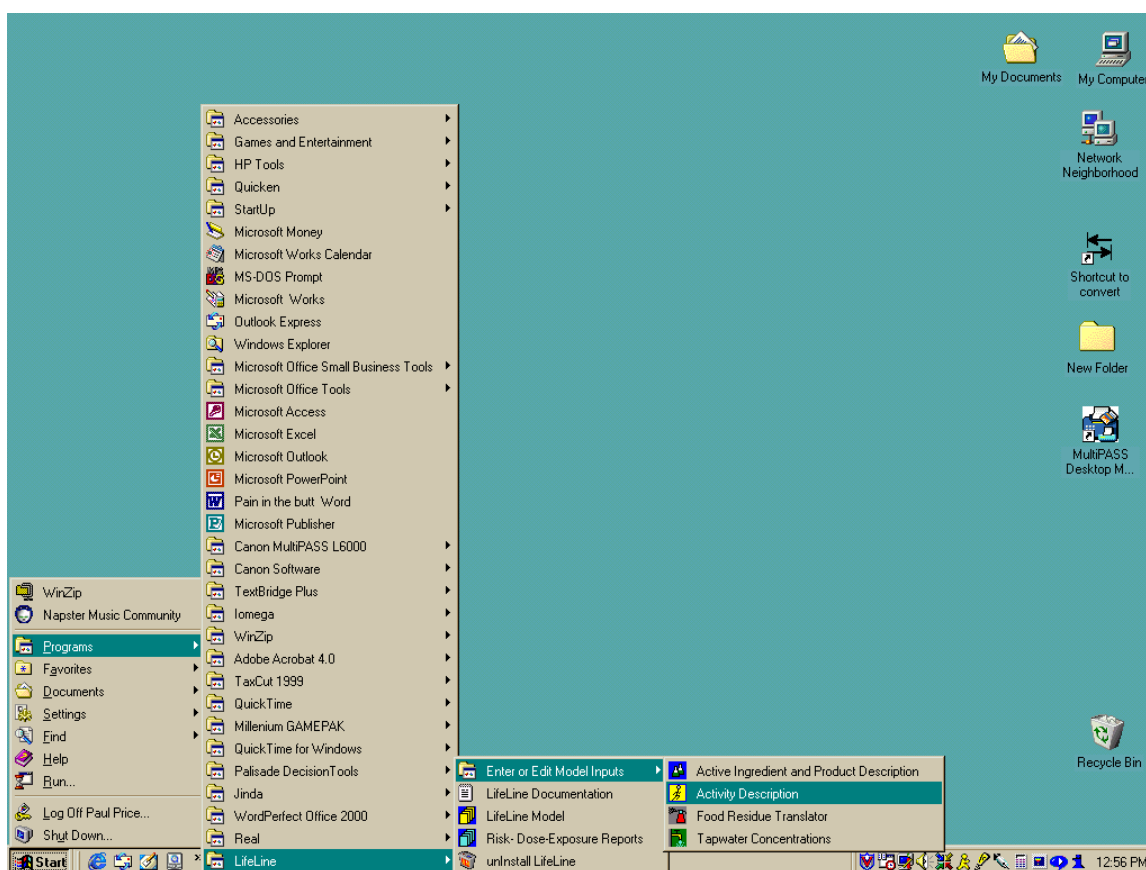
Residential exposure assessments construct estimates of exposure and dose based upon a series of exposure and dose equations. These equations require that values for the equation's inputs be defined. The values for some of the exposure factors are taken from data from various surveys or are entered by you using the various **LifeLine™** input programs. In this program, *Activity Description*, you assign values to certain inputs (or exposure factors) that characterize exposure related behaviors. These include:

- Breathing rate categories;
- Dermal transfer rates;
- Clothing factors;

- Hand to mouth event rates;
- Fraction of hand placed in the mouth;
- Replenishment factors;
- Soil intake rates; and
- Grass intake rates.

The values for these factors can be tailored to the specific macro activities defined in the National Human Activity Pattern Survey (NHAPS) and to specific ages.

To enter the values or to review or edit previously entered values for the exposure factors, you must run *Activity Description* program. This program has been designed to assign values to exposure factors to all activities (both residential and nonresidential). LifeLine™ Version 1.0, however, only addresses residential exposure. Future versions will address exposures that occur at non-residential locations.

DATA (AND SPECIFIC FILES) REQUIRED

No specific files are required to run this program. The *Activity Description* program exists to enter data on exposure factors, and the output of this program is an activity description file (*.acd). This file is used by the *LifeLine Model* program as the source of data on the exposure factors.

A set of initial values has been provided with the *Activity Description* program, in the file PRELIMINARY ASSUMPTIONS.ACD. This set of values was created based on the project development team's review of recent EPA guidance documents (EPA, 1999), the team members' professional experience, and historical practices in the field of exposure assessment. The values in this preset are intended to be "reasonable" worst case; they will overpredict exposures for most individuals. The values are based in part on the "default" assumptions used in the EPA guidance and SOPs. They have not, however, been developed by EPA nor is any endorsement by the Agency implied.

The data set is supplied for a number of reasons. First, because of the level of effort required to enter age-specific values for the large number of activities in the NHAPS record, new users would be required to spend hours entering values before they could actually run the model. Therefore, this set of values is intended to be a support for new users. Second, the values are intended to be reasonably conservative estimates of the range of values that could occur. Therefore, if you are attempting to perform analysis with the goal of being "protective" may find the values to be a useful starting point (or base preset) for developing their own set of

values (see below).

These assumptions may or may not be appropriate to your assessments of exposure and risk. You may have alternative goals for the assessment, which may influence your selection of values. In addition, new data, or alternative reviews of existing data, may lead you to adopting different values for one or more factors. You should develop your own set(s) of assumptions that are consistent with the available data and the goals of your assessment.

PRELIMINARY ASSUMPTIONS.ACD
This file is shipped with LifeLine™ Version 1.0 to provide an initial set of values for the exposure factors. These factors are offered as a set of plausible values that reflect historical practice. Because new data on exposure factors are constantly being published, and because the purpose of the assessment will vary from one application to another, the values in the file *PRELIMINARY ASSUMPTIONS.ACD* may or may not be appropriate for your assessment.

STRUCTURE OF THE PROGRAM

In the *LifeLine Model*, data on exposure factors are grouped by the location where they occur. These groupings are called Activity Categories. Data on the values of exposure factors for multiple **Activity Categories** (locations) are contained in a single **Activity Description File**. Version 1.0 of LifeLine™ addresses only activities that occur at the individual's residence (the residential activity category). The format that will allow the assessment of exposure at other locations has, however, been incorporated into the design of the *Activity Descriptions* program.

In an activity category, each of the activities that occur at that location is evaluated separately. Accordingly, the value for each of the exposure factors for an activity is assigned independently. In addition, the program allows you to specify how the

values for the exposure factors will vary across different ages. As a result, each activity category appears as a large table of activity-specific values for the exposure factors.

Creating an Activity Category

As noted immediately above, the current version of LifeLine™ only supports activity descriptions for residential settings. Correspondingly, only the **Residential Activity Category** is included in the file.

When you start *Activity Description*, you immediately launch a wizard that asks you to create a new activity category. It can also be invoked by highlighting the **New Activity Category** entry in the tree structure and choosing **Activity Category/Add** from the Menu Bar. Once an Activity Category has been specified, this wizard can also be invoked by clicking on the **Residential Activity Category** in the tree diagram on the left side of the main window, and then either clicking on the blue roof with figure in the Tool Bar:

or choosing **Activity Category/Modify** from the Menu Bar.

In the box at the top, you may specify a description of the nature of the assumptions that applies to all activity categories in this file (the default text that appears in this box **Your description**). This text is not used in the analysis but is there to assist you in documenting your analyses.

The second box allows the selection of the category for which you are describing activities. Since the current version of LifeLine™ only supports residential exposure a drop-box in the middle of the window only allow the selection of the residential category.

The final box allows you to select a "base preset" that will provide initial values for <u>every</u> activity in the category. . A base present is useful when you only wish to modify a few the values for a small number of factors or activities. You may select PRELIMINARY ASSUMPTIONS.ACD or any other set that you have previously saved as a base preset (see below).

Once your selections are complete, clicking on the *Finish* button will load the base preset values, and return you to the main program window.

Clicking on the **Cancel** button will also return you to the main program window; however, the tree structure on the left and the spreadsheet will be unchanged (if not base preset had been entered, the tree structure and spreadsheet will be empty).

Saving an Activity Category as a Base Preset

Once you have completed a description of an activity category, you have the option of saving your description as a "base preset" for future use. This is different from **saving an activity description file**, but can only be done once you have saved your description as an activity description file.

To save an activity category as a base preset:

- Make sure that you have saved the current values as an Activity Description (*.acd) file;

- Select **Tools/View/Edit list of available base presets** from the Menu Bar; and

- Click on the button marked **Add current description to catalog**.

Your description of the current Activity Category will appear in the list of available base presets.

NOTE:
If you attempt to use the same name for a description twice, the system will not overwrite the presets, but will tell you that you have already saved the current presets. To replace a named set of presets, you must first remove the existing named set (by highlighting it and clicking on the button marked **Remove description from catalog**) and then click on the button marked **Add current description to catalog**.

Loading an Activity Description File

If you have saved an activity description file, and wish to either review it or modify it for future use, you must either click on the open file (folder) icon in the tool bar

or use the **File/Open** command from the Menu Bar. This will present you with a list of all of the Activity Description (*.acd) files stored in the \RTL\Workspace directory. You may use this **File/Open** window as a browser window to locate Activity Description files in other directories or disks.

> **NOTE:**
>
> You do not need to open a saved file to use it as a base preset for a new Activity Category, providing that you have added the values to the list of base presets (see Saving an Activity Category as a Base Preset, above).

If you select the file *PRELIMINARY ASSUMPTIONS.ACD*, you will achieve nearly the same result as if you had selected the default choices in the wizard for *Creating an Activity Category*. The differences are that the spreadsheet in the main window will display the pathway and filename, and that the name of the Activity Category will be somewhat longer than the default **Your description**:

> *Preliminary activity descriptor values based on professional judgment and developed by the LifeLine Team.*

Modifying Activity Descriptions

Once you have either opened an activity description file or created an **Activity Category**, you are free to modify the values of one or more of the exposure factors and the ages to which the values apply, for one or more of the residential activities. To do this, you expand the tree structure on the left of the main window to show all of the individual activities, and either:

- Copy the set of values for the exposure factors for one activity and apply them to another activity or activities; or
- Edit the value of the exposure factors for an activity.

COPYING ACTIVITY DESCRIPTORS

Many different activity categories from NHAPS may have a similar potential to lead to exposure to pesticides. In order to facilitate the process of entering data on the more than 80 different activities, the system allows you to apply the set of one activity to other activities. To do this, click on the activity in the tree structure that you wish to copy to highlight it, and either click on the figure in the Tool Bar that is pushing on the side of its button:

or select **Activity/Copy descriptor values to other activities** from the Menu Bar.

Doing this calls up a single-window wizard. In the top half of this window is a spreadsheet that displays the current values for the selected activity. In the bottom half is a series of check boxes, one for each of the other residential activities in NHAPS. Clicking on each box will toggle a check mark on or off. Use these check boxes to indicate those activities to which you wish to assign the set of values given in the top half of the window.

After you have indicated all of the activities to which you wish to copy the description of the selected activity, clicking on the **Finish** button will complete the transfer and return you to the main program window.

EDITING ACTIVITY DESCRIPTIONS

Each quantitative description of an activity can be individually edited, by clicking on the activity in the tree structure, and either clicking on the figure in the Tool Bar that is touching its toes :

or selecting Activity/Modify descriptors from the Menu Bar.

This action calls up a wizard that allows you to change the existing values for this activity and edit the age ranges to which the values apply.

Changing the Base Preset for a Single Activity

The first window of this wizard allows you to select data for the activity from all of the available presets. Your choices in this window do not affect the description of any other activities. A checkbox at the top of the window is marked **Reset all existing descriptor values for the activity with the base preset values displayed in the table below**. Below this is a drop list with all of the available sets of presets. At the bottom is a list of the current parameters for the selected preset shown in the drop list. Changing the selection in the preset will change the values displayed at the bottom of the window.

By clicking on the checkbox, you can change the values for this activity to those of the same activity in any of the presets listed in the drop box. Because this will completely reset the description of the activity, if you click on the checkbox, the system will ask you to confirm your decision before proceeding.

Further Changes from Base Preset

If you have selected a new preset for your selected activity, an additional window appears in the wizard. It presents a radio button that asks you whether you have additional edits. If you select *no*, the *Next* button is replaced by a *Finish* button. If you select *yes*, you proceed to the window for editing age ranges.

Modifying Age Ranges

The descriptions of many activities will vary significantly with age. For example, *Active sports* means something very different for a 12-year-old than it does for an 80-year-old. Accordingly, the system allows you to create up to 85 different sets of values for an exposure factor for an activity (one for each year of age). In practice, most activities will require fewer descriptions covering broader age ranges.

In the second window of the wizard (the third if you have changed the base preset of the activity), you may redefine the age ranges for your selected activity. At the top of the window is an 85-year time line, with a red bar representing each transition from one age-specific pattern to the next. Blue bars indicate the beginning of the first range (birth) and the end of the last range (age 85). Using this window, you may do any of the following:

- You may move a transition age by dragging the corresponding red bar;
- You may subdivide an age range by double-clicking the time line in between bars; this will insert a new red bar; and/or
- You may combine two age ranges by double-clicking the red bar that separates them, causing the bar to disappear.

The age ranges resulting from your selections will be displayed in the table at the bottom of the window.

If you subdivide an age range, both resulting ranges will start with the same values as the original range. If you combine two age ranges, all parameter values for the combined age range will be cleared (even if the two ranges had the same value for a particular parameter).

Separate age categories are required whenever one or more of the factors change. For example, if the dermal transfer rate that applied to children aged less than six differed from that of older individuals, while a different clothing factor applied to children below age 2, then three age categories would be established: 0-2, 2-6, and 6-85.

Editing Parameter Values

Each activity requires you to provide values for eight exposure factors. These factors consist of one categorical value and seven numerical values. The exposure factors are as follows.

Activity class is a set of categories of general activity defined by Layton (1993) as part of an equation that predicts an individual's inhalation rate. The set of categories are:

> Rest
> Sedentary
> Light
> Moderate
> Heavy

A drop-list appears in the table that allows you to define which of the categories applies to each age range of the activity.

Dermal transfer factor (1/hr) is a value related to the dermal transfer coefficient

defined in EPA's Draft Residential SOPs.

The dermal transfer coefficient is defined as the mass of AI that reached the skin or clothing of an individual performing an activity in a given unit of time, divided by the dislodgable mass of AI contained in a given area of surface. The dermal transfer coefficient has units of cm^2/hr.

The dermal transfer factor used here is defined as the dermal transfer coefficient observed in a relevant study divided by the surface area of the test individual. In the dermal exposure equations, the dermal transfer factor is multiplied by each individual's surface area to produce a person-specific dermal transfer coefficient that is then used in the same way as in the Draft Residential SOPs.

Clothing factor (unitless), is a value between 1.0 and 0.0 that represents the fraction of the mass of exposure that actually reaches the individuals skin. At the maximum value, 1.0, the individual is assumed to be unclothed or the clothing is assumed not to prevent dermal exposure. At the minimum value of 0.0, the clothing is assumed to be a completely effective barrier to dermal exposure.

Hand-to-mouth frequency (events/hr) represents the average number of times each hour that an individual in a specific age range who is performing the activity places some portion of the hand the mouth.

Fraction of hand in mouth (unitless) is the estimate of the average fraction of the hand that is placed in the mouth by an individual in a specific age range who is performing the activity.

Replenishment ratio (unitless) is defined as the ratio of the average mass of AI on the surface of an individual's hand to the dislodgeable mass of AI on a residential surface the same size as the individual's hand. If one assumes that a dermal contact of a hand with a surface results in the complete transfer of the dislodgable fraction of an AI from the surface to the hand and that the hand re-contacts a fresh surface

between each hand-to-mouth event, then the value of the replenishment ratio will be 1.0. If it is assumed that the hand repeatedly enters the mouth with out being "replenished" by a contact to a fresh surface, then a value of less than 1.0 should be used.

Soil intake (mg/hr) is the mass of soil consumed per hour. The factor is only used in those activities that occur in outdoor locations.

Grass intake (cm^2/hr) is the area of grass consumed per hour. The factor is only used in those activities that occur in outdoor locations.

At the top of this wizard window is a button (**View base preset descriptor values** or **View your descriptor values**) that toggles the display of parameters at the bottom between the values that you are currently editing and the presets that you selected earlier (either in this wizard or for the Activity Category as a whole). You may use the copy (Control-c) and paste (Control-v) commands to fill in the values in the edit table. You may also copy values from other tables or from Excel spreadsheets. You must complete the table of parameter values in order to activate the **Finish** button and exit the wizard. You may also choose to cancel at any time.

SAVING AN ACTIVITY DESCRIPTION FILE

Once you have completed your revisions of the exposure factor values for the activity descriptions, you may save your values as an *Activity Description* (*.acd) file. Unless you save such a file, none of the information that you entered will be used (or usable) in exposure assessments. Moreover, as noted above, saving this file is a prerequisite to making the data in the file available as a preset for selection as a base set in future uses of this program.

NOTE:

Be <u>SURE</u> to save your entries as an Activity Description File. Unless you have saved the file, you will not be able to use this information in conducting an exposure or risk assessment.

To save the activity description file, either click on the diskette icon in the Tool Bar:

or select **File/Save** or **File/Save as** from the menu bar. It is best to save these files in the default (\workgroup) directory, as that is where the *LifeLine Model* will first look to find them.

PRINTING THE SUMMARY TABLE

The summary table that describes all of the information that you have entered regarding a set of residential activities can be printed as part of the "audit trail" of your exposure and risk analysis.

To print the table, either click on the printer icon in the Tool Bar

or select **File/Print** from the Menu Bar. **File/Print Setup** in the Menu Bar can be used to adjust your printer to optimize printing of this file.

EXPORTING THE SUMMARY TABLE

The table of activity parameters may also be exported as either an Excel '97 or dBASE IV format file. To do this click on any cell of the spreadsheet. This will activate the *Export Report* option under *File* in the Menu Bar. Clicking on this option calls up a dialog that allows you to select the directory in which the data should be saved (the default is the \RTL\Workspace directory), to specify a name for the file, and to choose Excel or dBASE format. Again, these files may be useful for incorporating into your risk assessment report, and establishing an "audit trail" for your analysis.

THE FOOD RESIDUE TRANSLATOR (DEFINING RESIDUES FROM THE FARM GATE TO THE PLATE)
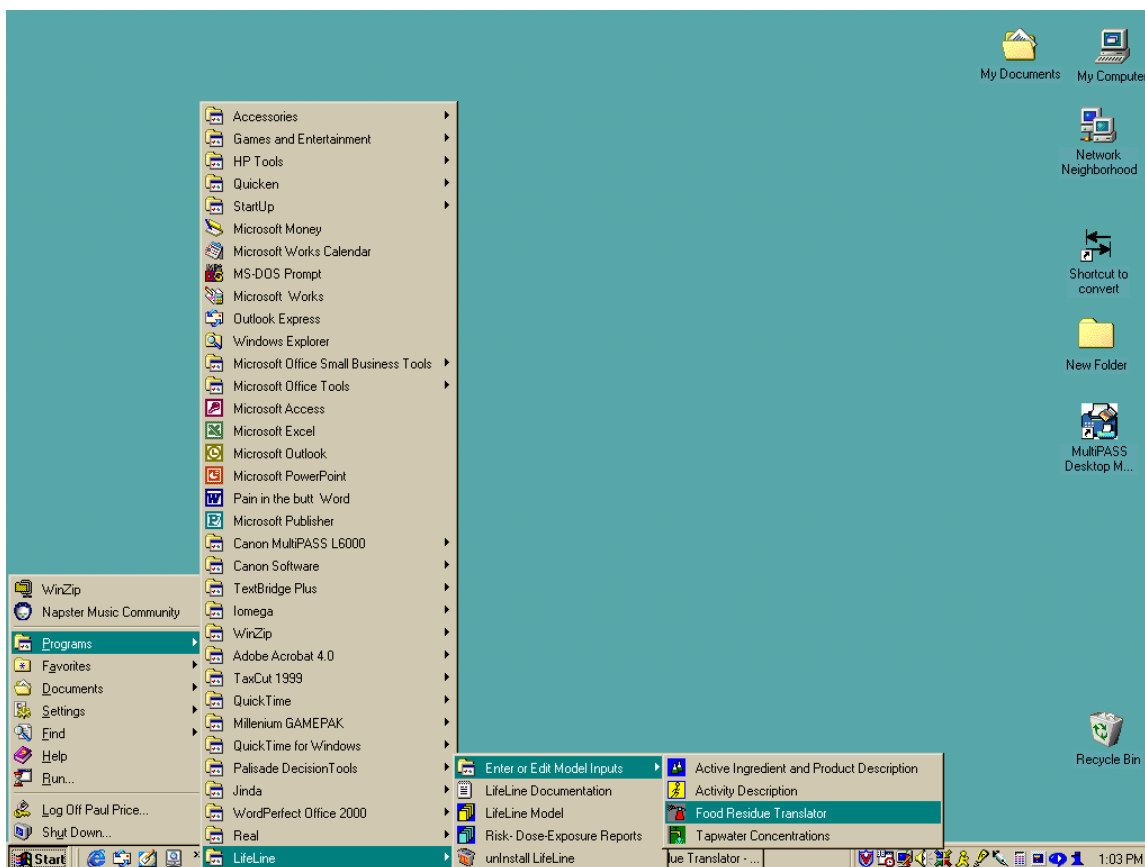
The purpose of this program is to create a file of residues on food, as eaten, to be used in the assessment of human exposure to dietary residues. This food residue file is named using the suffix .res and will be imported into the *LifeLine Model* program that calculates the daily exposures for each person in the population of interest.

The Food Residue Translator accepts user inputs (data, defaults or assumptions) such as residues in agricultural commodities [RACs], data on percent crop treated, and processing factors that apply to various food forms of any RAC. These inputs are used together with the recipe file (also called translation file) contained within the program to generate estimates of the possible residues in foods as consumed (e.g., beef stew). The ability to view these distributions of residues in foods "at the plate" is a capability provided for the first time by the software. Before proceeding to the exposure and risk assessment, the assessor now has the opportunity to review these food residue distributions and consider if the results are consistent with what is known about residue occurrence in these foods.

Another feature of this software is the ability to use seasonal information about pesticide use practices, seasonal-specific residue information and seasonal-related food technology practices. This yields an estimate of seasonal variation in food residue concentrations that may be due to seasonal differences in sources of particular commodities (e.g., commodities that are imported at particular times of year), or that are grown in different regions with different pest pressures in different seasons. This feature can significantly improve the characterization of seasonal variation in food related exposures.

TYPE AND FORMAT OF DATA REQUIRED FROM THE USER

No specific files are required. Because of the size of the data that are available for certain AIs and groups of AI. The program allows you to input data using a dBASE format file that can be created using dBASE or EXCEL.

To run this program, you must have information about residues occurring "at the farm gate" in or on the agricultural product at the some level of precision (Crop Group, Raw Agricultural Commodity (RAC), or Food Forms of a specific RAC).

The system also accepts data on the probability of use of the pesticide (e.g., percent crop treated during a season or annually), and on processing factors (up to six separate factors for any Crop Group, Commodity, or Food Form) that may modify the residue values as the commodity travels through the food technology process toward the dinner plate.

HOW TO ENTER DATA

NOTE TO THE NEW SOFTWARE USER:
To assist you in learning the operation of this program, you may wish to use one of the example files of commodity residue data shipped with the system (PS*.RES) and work through the Demonstration Case on the software CD. Your practice inputs and outputs may be saved, for subsequent modification or reuse, as a *.res file. The practice case encourages the new software user to become familiar with the LifeLine™ features that allow you to print tabular reports of your inputs and the corresponding outputs, as well as to export these reports in either Excel or dBASE formats.

The *Food Residue Translator* allows you to enter data in two ways.

Option 1. Manual Data Entry Using the Spreadsheets Provided by the *Food Residue Translator*

Option 1 is to enter the data manually. This approach is useful if there is only a small amount of data to be entered. You can call up a display of one of three spreadsheets. You may enter residues, data on probability of use, and processing factors directly into the corresponding spreadsheet, for crop groups, commodities (RACs), or food forms of a specific RAC. A brief set of instructions appears on top of the display when you first call the program (or specify a new file) to assist in entering the data.

Option 2. Importing Data Files for Residues, Probability of Use, and Processing Factors

Option 2 is to import a data file with the necessary data on residues, probability of use, and processing factors. This approach is more practical for AIs with a large number of uses. The Food Residue Translator accepts files in dBASE format. Detailed instructions for this feature are provided below under "Option 2".

OPTION 1. MANUAL DATA ENTRY USING THE SPREADSHEETS PROVIDED BY THE FOOD RESIDUE TRANSLATOR

This is a straightforward, if potentially lengthy, matter of typing in values. It is important to pay attention to three things:

- The indicated season (or annual data) for which you are entering data;
- The level at which you are specifying data (Crop Group, Commodity, or Food Form); and
- Which of the three spreadsheets (residue, use probability, processing factors)

you have activated and into which are you entering your data.

Data entered at the cell level can be copied and deleted using the **Edit/Copy**,
Edit/Cut and **Edit/Paste** menu options. Ranges of cells can be deleted or copied
by blocking the range and using the same menu options.

The **Edit/Insert Cell** and **Edit/Delete Cell** menu options also allow you to shift
cells left (i.e. cell deletion) or shift cells to the right (i.e. cell insertion.)

Selecting a Spreadsheet and View

Viewing Commodity Residues, Use Probability Factors, or Processing Factors

The main display of the system will only show one of the three spreadsheets for
data entry at a time. Thus, you may enter commodity residues (at the farm gate),
use probability factors, or processing factors. To select the data entry spreadsheet
that you want, either click on the corresponding icon in the Toolbar:

 Erlenmeyer flask = residues

 flow diagram = processing factors

 percent sign = use probability factors

or use the **View** option on the Menu Bar.

Annual or Seasonal Data

A key decision is whether to enter annual or seasonal data (whether for residues,

processing factors, or use probability). The default on startup is annual data. By clicking on a seasonal button in the Tool Bar:

Annual | Spring | Summer | Fall | Winter

or by choosing a season under the **View** option on the Menu Bar, you can select any one of the four seasons, as well as annual.

<u>Viewing or Hiding Codes</u>

Each Crop Group, RAC, and Food Form has both a name and a numeric code assigned to it. The numeric codes are used internally in the program, for efficiency in processing data. You may either display or hide these codes in the spreadsheets, by selecting or deselecting the **Codes** option in **View** on the Menu Bar.

<u>Changing the Level in the Hierarchy</u>

When the program is opened, Crop Groups[4] are displayed. This enables you to specify residue data for an entire Crop Group, which will then be applied to all Raw Agricultural Commodities (RACs) of that group for which specific residues have not been supplied. For example, if you specify residues for "Citrus Fruits," these would apply to all commodities in that Crop Group- Grapefruit, Lemon, Lime, Orange, and Tangerine.[5]

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[4]   EPA has grouped crops by virtue of their botanical similarities that may be relevant to distribution, metabolism and retention of pesticide residues. Some data developed from study of one crop within a group may be extrapolated to apply to all members of that crop group.

[5]   EPA Commodity definitions include several forms of each of these fruits.

Alternatively, the Crop Group display can be expanded to show its member commodities, so that residue data can be entered for a specific commodity and commodity parts[6] (e.g., Orange Peel). To expand any Crop Group, click on the row number at the very left of the spreadsheet, then either click the apple button on the Button Bar:

or use *View/Commodity* in the Menu Bar.

In a similar fashion, an individual Commodity display can be expanded to show the Food Forms of that RAC. For example, selecting the row for Orange Peel and clicking on the saucepan button:

will display the five food forms expected to exist for Orange Peel (canned:cooked, raw:dried, raw, cooked, baked).

Either operation can be reversed. To collapse these displays, select the row for the RAC or Crop Group, and use either the corresponding Button Bar or *View* in the Menu Bar to hide Food Forms or RACs, respectively.

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[6]   Pesticide residues may segregate into selective parts of a crop. Also, different crop parts may travel through different subsequent food technologies. Thus, residue estimations and formal regulatory Tolerances may be either established for the intact whole commodity or established separately for the crop subparts.

Entering Residue Data

Residue values may represent the residue expected to exist at the point of agricultural production, at some point post-harvest, at some point along the food processing path or at the point of purchase or consumption. The value(s) you use may be single values representing an average, maximum, legal Tolerance (or Maximum Residue Level) or any other point value you wish to use. Alternatively, you may use a distribution of values that represent these same kinds of points of progress of the RAC toward the consumed food.

Note that you may provide one set of residue value(s) to represent the entire year and all sources of the RACs being considered. Alternatively, you may provide a separate set of value(s) to represent each of the seasons. This may be preferred if the crops originate in different geographies, depending on the season. Different geographies may present different pest pressures, pesticide use policies or competing pest management practices. Even within a single growing region, seasonal variation in pest pressure and pest management practices may exist.

For any Crop Group, RAC, or Food Form, you simply type in a residue value into the first (or next empty) cell in the corresponding row of the residue spreadsheet, and press **Enter**, beginning with the column labeled "Res.#1." By using the arrow keys or **Tab**, you can move to the next column and enter a second residue, and so forth.

If "no residue" is expected to occur in or on the RAC, you must decide how to represent that situation in the data entry. Your choices include:[7]

- Entering a zero. This usually implies that absolutely no residue exists, also

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[7]   US EPA Office of Pesticide Programs provides guidance for how these choices are applied for regulatory purposes. See http://www.EPA.gov/oppts for relevant policy documents.

implying that the pesticide was not used on any part of the RAC available to the consumer;

- Entering some numerical value at or below the test method's Level of Quantification or Level of Detection; and

- Entering one or more values derived from mathematical models that predict to the residue values below the sensitivity of the test methodology.

Thus, the entry of residue values may be designed to reflect seasonal or annual residue expectations at any point in the food technology chain, and with or without regard to pesticide use or residue decline. You are encouraged to annotate the analysis to record their choices of data and procedures employed.

> **NOTE:**
> If you enter one or more zeroes as residues for a Crop Group, RAC or Food Form, LifeLine™'s Food Residue Translator will ignore any information supplied for that Crop Group, RAC or Food Form about pesticide use probability or processing factors. This avoids "double counting" of use probability data or residue dissipation factors. Appearance of the zeros implies that these considerations are implicit in the residue value entered here.

Entering Data on Probability of Use

Probability of Use of a pesticide reflects the actual agricultural science employed at the growing site. Such real-life choices are influenced by pest pressure, season, contractual obligations between grower and buyer, competing chemical or non-chemical pest control options, regulations at point of production or product destination, and other professional judgments. The single value entered into this spreadsheet reflects consideration of all of these factors, synthesized into a single probability value for the total year, or for any separate season of the year.

This spreadsheet works just as the residue entry spreadsheet for viewing levels of detail, (i.e., Crop Group, RAC, or Food Form). Enter a single value for any season (or annually). Thus, for example, if only half of the orange crop used in making Orange Juice Concentrate were treated with an AI, you would enter 0.5 in the

corresponding row.

If values are not supplied for the probability of use, the system assumes that the residue value(s) you supplied incorporate(s) any available information on probability of use.

Entering Data on Processing Factors

Processing Factors represent the change in the concentration of the pesticide in the RAC or Food Form as it moves from the farm gate toward the dinner plate. These may be simple processes such as washing or storing for some time. Even these simple processes may change the pesticide residue in or on the RAC. There are many processing technologies employed in modern food production. Each may influence the residue concentration.

The Processing Factors spreadsheet in the Food Residue Translator provides six possible factors for your use. You may use one or more of these or create your own category. To do so, go to the **Tables/Processing factor description** option in the Menu Bar. This option (active only when the Processing Factors spreadsheet is displayed) will call up a table where you may replace any of the existing names with your new process names. While you may enter a very lengthy name, only about 16 characters will appear in the table.

The operation of the Processing Factors Spreadsheet is very similar to those for Residues and Probability of Use, and the selection of rows and expansion or collapse of the hierarchy is identical, as is the entry of values for any of the six possible factors.

The EPA Office of Pesticide Programs has published a listing of "default processing factors" for selected food forms of RACs. These default factors are provided within the LifeLine™ information base in the file named FACTORS.DBF. To import this file within the Food Residue Translator, select **File/Import Residue Factors** from the menu bar and go to the **HRI/Rtl** directory to select the FACTORS.DBF file. The default processing factors will appear in the "Others" column (last column) of the Processing Technologies options within the Processing Factors screen of the Food Residue Translator.

Note:
Import these files before entering residue or Use Probability data, or append the .dbf file into your master .dbf data file, as described below.

OPTION 2. IMPORTING DATA FILES FOR RESIDUES, PROBABILITY OF USE, AND PROCESSING FACTORS

You may prefer to create an electronic file in lieu of direct manual entry. This is an obvious advantage if the data have already been stored electronically. Accordingly, LifeLine™ supports data entry by means of an electronic (dBASE format) file.

A single file is used to import data on residues, probability of use, and processing factors. Although the information captured is primarily numeric, it is supplied as text strings. The fields for this database are as follows:

Table 3. Structure of Residue, Use, and Processing Input File				
Field	**Type**	**Length**	**Values**	**Notes**
Crop Group	Character	2	Code	Mandatory
RACcode	Character	3	Code	
Foodform	Character	2	Code	
Coverage[1]	Character	1	Code	Season code (or annual)[2]
Residue	Character	10	ppm (mg/kg)	
Pfactor1	Character	6	unit less	
Pfactor2	Character	6	unit less	
Pfactor3	Character	6	unit less	
Pfactor4	Character	6	unit less	
Pfactor5	Character	6	unit less	
Pfactor6	Character	6	unit less	
Upfactor[3]	Character	6	0-1(unit less)	

The first three fields require the entry of numeric codes:

- Crop Groups codes can be read off of the system spreadsheets and are also found in the system database *RTCGROUP.DBF;*

- Commodities codes are in *RTRAC.DBF; and*

- Food Forms codes are in *RTFFORMS.DBF*

NOTE:

While codes for Crop Groups and Commodities are unique, those for Food Forms are not (i.e., the same Food Form could apply to more than one Commodity). Each record in this database must have values for Crop Group of interest; Food Form Data must have both Crop Group and Commodity.

Each record in the database should represent a single residue, use probability factor, or set of processing factors. Care should be taken in entering the latter two types of values, as only a single value is used for each Food Form, Commodity, or Crop Group addressed. In the case of multiple entries of such records, only the last item in the file is retained.

TIP:

You do not need to build this database from scratch. An easy shortcut is to use the spreadsheets in the program to enter a single residue for each Crop Group, Commodity, or Food Form of Interest. Then click the **Reports (File)/Export commodity residue/factors** option in the Menu Bar to save a "template" for your database. After adding the records of residues, you can then import this database.

If you use a tool other than dBASE to make these changes, additional steps in may be required. For example, in Excel, the following steps should be performed to ensure that the data are entered correctly.
   1. Open the dBASE file;
   2. Make your additions / changes, Note the number of the new last row;
   3. Go back to the top of the sheet;

> 4. Select **Insert/Name/Define** in the Menu Bar;
> 5. Click on **database**;
> 6. Correct the number of the last row and click <u>OK</u>; and
> 7. Save the spreadsheet as a dBASE file.

Residues for a Food Form (within a Crop Group / Commodity)

To specify residues for a particular Food Form of a particular Commodity within a Crop Group, you would enter *n* records containing the following data:

- Cropgroup (mandatory);

- Raccode (if left blank, residue is assigned to the Crop Group);

- Foodform (if left blank, residue is assigned to the Commodity [or Crop Group if no Commodity is specified]);

- Coverage (mandatory: controls assignment to particular season or annual file); and

- Residue (mandatory; units of ppm (mg/kg)).

<u>All other fields in these records are left blank.</u>

Probability of Use for a Commodity

To specify probability of use for a particular Commodity, you would enter a single record with the following data:

- Cropgroup (mandatory);

- Raccode (if left blank, probability of use is assigned to the Crop Group);

- Coverage (mandatory: controls assignment to particular season or annual file); and

- Upfactor (must be between 0 and 1).

<u>All other fields in these records are left blank.</u>

Note that Food Form is not generally of interest when assigning data on probability of pesticide use.

Processing Factors for a Commodity / Food Form

To specify processing factors for a particular Commodity / Food Form, you would enter a single record with the following data:

- Cropgroup (Mandatory);

- Raccode (Mandatory);

- Foodform (If left blank, factors are assigned to all Food Forms of the Commodity that do not have individual values assigned.); and

- Coverage (Mandatory: Controls assignment to particular season or annual file).

 ⇒ Pfactor1 (Any nonzero value is valid, blanks are ignored [treated as 1.0]);

 ⇒ Pfactor2 (Any nonzero value is valid, blanks are ignored [treated as 1.0]);

 ⇒ Pfactor3 (Any nonzero value is valid, blanks are ignored [treated as 1.0]);

 ⇒ Pfactor4 (Any nonzero value is valid, blanks are ignored [treated as 1.0]);

 ⇒ Pfactor5 (Any nonzero value is valid, blanks are ignored [treated as 1.0]);
 and

 ⇒ Pfactor6 (Any nonzero value is valid, blanks are ignored [treated as 1.0]).

All other fields in these records are left blank.

Hierarchical Data Sets

Just as in the case of manual entry, data can be supplied in this file using the hierarchical structure (Crop Group, Commodity, and Food Form). To enter data for all Food Forms of a particular Commodity, you should leave the Foodform field blank. To enter data for all Commodities in a particular Crop Group, you should similarly leave the Raccode field blank.

The nature of the data will influence the level in the hierarchy at which you specify them. As in the case of on-screen data entry, when both generic and specific data are supplied, the specific data take precedence, and generic data are used when no specific data are available. For example, you might specify one set of residue data that would apply to the Commodity "raspberries," and a different set of data for the Crop Group "small fruits and berries." In this case, the Crop Group values would be applied to all members of the Crop Group <u>except</u> raspberries. The specific data entered for raspberries would take precedence over the generic data for the Crop Group.

In general, the strategy for entering values at more general levels of the hierarchy depends upon how many of the subsidiary values will be affected. If a residue file is applicable to only two Commodities in a Crop Group with two dozen members, it is clearly more efficient to repeat the data entry than to specify empty distributions for all the Crop Group members for which it does not apply. Making such choices requires you to be familiar with the structure of EPA's Commodity Vocabulary, as well as with the use of the AI you are evaluating.

SAVING RESIDUE, USE PROBABILITY AND PROCESSING FACTOR INFORMATION

Once you have entered data on commodity residues (at Crop Group, RAC and/or Food Form levels), you can save these data for subsequent use in the Food Residue calculation or for modification later in time. Click on the icon in the Button Bar:

or use the **File/Save** or **File/Save As** options in the Menu Bar.

This will save your input data in a form that you can recall for future analysis in the *Food Residue Translator*. To access this file later, Select **Open Residues/Factors** in the Menu Bar.

CALCULATING FOOD RESIDUES FROM COMMODITY INFORMATION

The information applied to the screens for Residue, Probability of Use and Processing Factors supports calculation of the possible residues that could exist on food "as eaten" and reported eaten by respondents in the 1989-1991 Continuing Survey of Food Intake by Individuals (CSFII)[8].

You initiate this analysis clicking on the plate button on the Tool Bar:

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[8]   All appropriate databases will be updated when the joint USDA-USEPA Translation Files become available for the 1994-1996 CSFII and ancillary children's dataset.

or by selecting **Residues/Translate Commodity Residues to Food Residues** in the Menu Bar.

When the system has finished calculating the resulting food residues, it displays them on screen.

In order to perform this analysis, the system uses all of the information provided by the user as described above and a set of "Recipe" Files (in the future to be called Translation Files). These Recipe Files indicate the mass proportional contribution of all ingredients for each food reported as being consumed in the CSFII survey

The system calculates residues in foods by randomly selecting a residue value from the appropriate residue distribution for each ingredient in the food (created from the residue, use and processing factors data), and calculating a net residue in the food based on the residue in each ingredient and its mass contribution to the food. For example, if only one RAC (with a residue of 0.10 mg/kg of the AI) contributed any residue in the ingredients in the food, and it represented five percent of the mass of the food, the food would have a residue of 0.005 mg/kg of the AI.

Single values for the food residues will result if only single values were supplied for all RAC residues. If distributions of residues were provided for RAC(s), distributions of food residues will result. Up to 10,000 residues are calculated for each food residue distribution. From this distribution, a probability density

function is determined to yield a characteristic residue value for each percentile of the distribution. These probability density functions are used in analyses of potential dietary exposures.[9] The resulting exposure analysis reflects the true distribution of the original distribution of residues. Thus, if the distribution is heavily populated with low residue values and contains only a few high values, the probability of drawing a high residue value for use in the exposure assessment will be accordingly small.

SAVING CALCULATED FOOD RESIDUES

The potential food residues calculated by the Food Residue Translator can be in a form that will be used by LifeLine™ to calculate exposure via the diet. Click on the icon in the Button Bar

Or use the **File/Save** or **File/Save As** options in the Menu Bar.

To access this file later, use the *File/Open* command in the Menu Bar or the file folder opening icon in the Button Bar.

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[9] A detailed description of the mechanism of the creation of the density function and resulting representative residue values can be found in the technical documentation that is provided with the Version 1.0 software.

SUMMARY REPORTS OF RESULTS

This program generates four basic report files[10]. The first two record the information you supplied to the system and refer to the commodities at the farm gate or somewhere in the food processing chain. The second two are products of the Food Residue Translator calculations and refer to the potential residues in foods as eaten, using the information supplied about the commodities, use and processing. These files are:

1. A list of Crop Groups, Commodities, and Food Forms for which you specified data, including:
   - an ID [see next bullet],
   - the designation of season (or annual),
   - the residue value if single, or the notation "dist" if a distribution was specified,
   - any applicable processing factors, and
   - the relevant use probability factor, if any;
2. A table of residues corresponding to each ID (crop group/commodity and food form codes and season help identify the distribution):
   - the second value in this table (after the codes) is the number of zeroes,
   - subsequent values are non-zero residues;
3. A list of foods with at least one non-zero residue (and the corresponding residues); and
4. A table of the top 10 percent of food residues (i.e., the residues observed in the top 10 percent of foods on the basis of maximum observed residue within the distribution).

These reports are displayed as spreadsheets and may also be printed or exported for application to other data-utility files such as EXCEL.

Generating a Report

Each of the four report options is listed under **Reports** on the Menu Bar (if you have not yet calculated food residues, only the first two report options are available). When you click on the report option of interest, the system will generate the corresponding report and display it as a spreadsheet.

The default view is to substitute the report window for the input spreadsheet that was displayed immediately prior to report generation. Only a single report is

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[10]   In addition to the system file *.res that is used by LifeLine™, and has been designed for operational efficiency rather than external viewing.

available at any one time. Generating a second report will overwrite the first report (but not the input spreadsheets). To switch back to the input spreadsheet, click on a season.

CAUTION:
Changing the **View** options while displaying a report will cause the report to be overwritten by the new display. The report will then have to be generated again for display, printing, or export.

Printing a Report

Once you have generated and displayed a report, the **Print** and **Print Preview** options under **File** on the Menu Bar become active, and you may print out the report for review or use (for example, in establishing an "audit trail" for your analysis). **Print Preview** will first prompt you with a menu for the printer to which the report will be directed, and then display the report as it would appear under the settings currently applied to that printer.

Exporting a Report

The currently displayed report may also be exported as either an EXCEL '97 or dBASE IV format file. When a report is displayed, the **Export Report** option under **File** in the Menu Bar becomes active. Clicking on this option calls up a dialog that allows you to select the directory in which the report should be saved (the default is the \RTL\Workspace directory), to specify a name for the file, and to choose Excel or dBASE format. Again, these files may be useful for incorporating into your risk assessment report and establishing an "audit trail" for your analysis.

DESCRIBING EXPOSURE FROM PESTICIDES IN TAPWATER
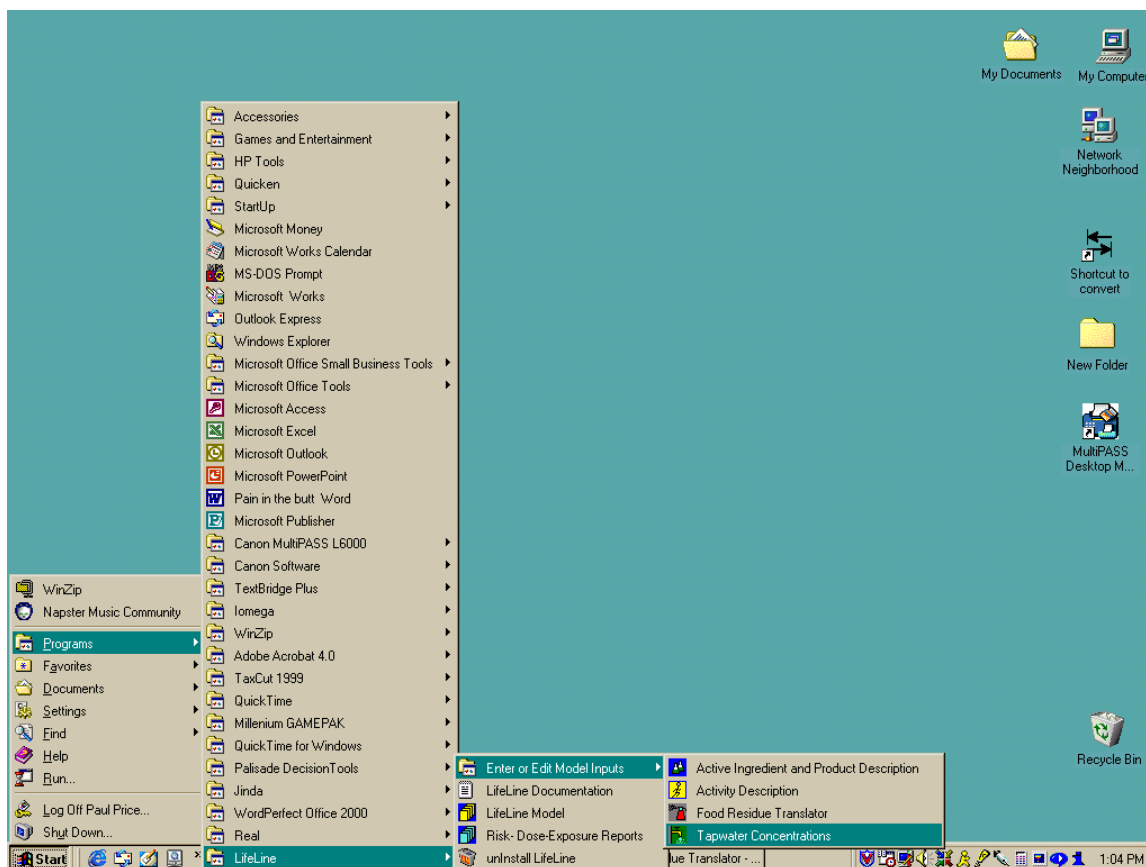
Assessing pesticide exposure from tapwater contamination using LifeLine™ requires you to enter information on the distribution of residue levels across the nation's residential water supplies. Specifically, the model requires data on the distribution of residue concentrations in each residence's tapwater supply, as a function of Census region, season, and type of domestic water source. Separate distributions are required for each of:

- Four seasons;
- Four Census Regions;
- Three water source types (public or private system, private well, other); and
- Two settings (rural and urban).

While the system is designed to accept a separate residue distribution for each combination of the factors above, residue distributions can be copied from any water source to one or more of the others.

Residue data are entered using a format similar to the format used in *@Risk* or *Crystal Ball* for entering an empirically defined distribution. This format requires you to specify a minimum (0th percentile) and maximum (100th percentile) concentration, and the concentrations that correspond to selected percentiles of a cumulative probability distribution for intermediate values. Up to 50 concentrations and corresponding percentiles can be specified. The model takes these data and performs a linear interpolation between the points on the distribution.

Using this format, you can enter data from empirically or parametrically defined distributions. Parametrically defined distributions can be entered by generating values for select percentiles of the cumulative distributions using Excel or other spreadsheet programs.

DATA (AND SPECIFIC FILES) REQUIRED

To specify a set of tapwater concentrations of a pesticide for use in exposure and risk analysis, you must already have specified a risk group (*.rkg) file that contains basic information on the active ingredient(s) [AI(s)] that you are evaluating. (This file also contains information on residential use products containing this AI.). When you open the Tapwater Concentration Model, you will be asked to specify the risk group file to which the tapwater data will be linked.

Each tapwater concentration file must be linked to a single risk group file. You may also create multiple tapwater concentration files that link to the same risk group file. However, in any one analysis, only one of the files can be used.

You will use *Tapwater Concentrations* to create a file with information on the concentrations of your AI. This tapwater concentration file (*.twc) is used in subsequent exposure analyses, and may be opened within *Tapwater Concentrations* to use as the basis of other such files.

Linking Tapwater Concentration Files to a Risk Group

The Tapwater Concentrations program is implemented as a series of wizards that modify the file contents. The main window of the program consists of a tree structure representing different water supplies, and a spreadsheet showing the concentration data that have been entered for those water supplies. Highlighting a water supply in the tree structure and using the Toolbar or Menu Bar options activates the different wizards.

When you start *Tapwater Concentrations*, you immediately activate a single-

window wizard that allows you to specify the risk group (*.rkg) file to which these concentrations in tapwater apply.

You may either type in the full path name for the file in the window provided (e.g., C:\HRI\RTL\WORKSPACE\ALPHA.RKG), or you may use the **Browse** button to find the file you want. The default directory for both risk group and tapwater concentration files is \HRI\RTL\WORKSPACE, but you may store and retrieve these files from any directory.

After you have selected your risk group file, the **Finish** button on the wizard becomes active. Clicking on this button will close the wizard, and call up the main program window.

TAPWATER CONCENTRATIONS WINDOW: TREE DIAGRAM AND CONCENTRATION SPREADSHEET

All of the information that you enter in this program is stored on a spreadsheet, which is presented for viewing on the right side of the main program window. When you have completed data entry, you may save or print these results. You need to click on the spreadsheet to activate the Print menu option. On the left side of the main window is a tree structure that depicts the various types of water supply for which you may specify data. The tree structure also directs access to the data entry wizards.

Tree Structure Choices

As noted above, water supplies can be characterized in terms of four variables (yielding 96 different water supplies). These have been organized into the following hierarchical structure:

1. Risk Group

2. Census Region

   (Four regions: Northeast, Midwest, South, West)

3. Water Supply Type

   (Three types: Public or private system, individual well, other)

4. Season/Urbanization Combination

   (Eight combinations: such as spring urban, summer rural, etc.)

The selection of a risk group has been described above. Once you have selected a **risk group**, you may only change your selection by opening a different tapwater concentration file (using the **File/New** or **File/Open** commands on the Menu Bar, or the corresponding icons on the Toolbar.)

View Risk Group

This option is selected by highlighting the risk group at the top of the Tree Structure and then either clicking the icon (Erlenmeyer flask with a magnifying glass) on the Toolbar:

or choosing **Risk Group/View** from the Menu Bar.

When you do this, you will start the program **Active Ingredient and Product Descriptions**. Then you can open the risk group that you have named.

Select Risk Group

This option is available only if you have not yet selected a risk group (for example, if you started the program and then clicked the **Cancel** button in the risk group wizard). You activate it by clicking on the Erlenmeyer flask in the (empty) tree structure called **No risk group selected.**

and then either clicking the Toolbar button with multiple flasks

or choosing **Risk Group / Select** from the Menu Bar. This calls the single-window wizard described above under **Linking Tapwater Concentration Files to a Risk Group**.

Entering / Modifying Distributions of Tapwater Concentrations

Once you have selected a risk group (causing the tree structure of water sources to be completed), you are able to enter or modify a distribution of concentrations for any of the 96 types of water supplies addressed by the system.

To do this, you must expand the tree (by clicking on the small boxes with "plus"

signs) for one or more regions and for one or more source types (public/private system, well, or other). This displays a set of eight combinations of season and urbanization.

By clicking on a single water supply category (e.g., spring urban values for public/private systems in the Northeast), you activate the controls that call the wizard for modifying or copying the distribution of concentrations for that water supply type. The Toolbar icon for modifying concentrations is a calendar with a water droplet

Selecting **Water Source / Modify contamination** from the Menu Bar has the same effect. The wizard that is called up by either of these actions contains two windows.

NUMBER OF PERCENTILES, MINIMUM AND MAXIMUM CONCENTRATIONS

In the first window of this wizard, you will specify concentrations that are entered as the minimum (0th percentile) and maximum (100th percentile) values and the number of intermediate percentiles for which you wish to specify residue concentrations. For example, if you wanted to specify only maximum and minimum values, you would set this value to zero; if you wanted to specify maximum, minimum, and a concentration that corresponds to a single cumulative percentage, you would specify one. If you wanted to specify decile values, you would specify nine. You may specify any number between 0 and 50.

The maximum concentration must be equal to or greater than then minimum

concentration and you cannot enter concentration values for any percentile that are smaller than the minimum value or larger than the maximum values that you have specified.

SPECIFYING CONCENTRATIONS FOR CUMULATIVE PERCENTILES

Once you have specified the number of percentiles, and the maximum and minimum concentrations, clicking the **Next** button brings you to the second and final window of this wizard. On the left of the window is a column of percentiles and corresponding concentrations. You may enter the percentile and the corresponding residue concentration directly into this table. The minimum and maximum residue concentrations entered in the previous window are shown at the top and bottom of this table. These values cannot be edited in this window; you can; however, use the **Back** button to return to the prior window and edit the concentrations for the maximum and minimum in that window.

On the right of the second window is a slide control that provides an alternative to typing in percentile values. Move the slide to the desired percentile value (the arrow keys on the keyboard give more precision than is possible with the mouse), click on the appropriate percentile cell in the left half of the table, and click the button marked **Update current cell**. The value shown above the slide control will be entered into the cell.

The system requires (and will notify you if you attempt otherwise) that both percentile and concentration values be entered in a ascending order. For example, the 25th percentile must be below the 20th percentile in the table, and so forth. Similarly, the concentrations must be entered so that the concentrations corresponding to higher percentiles are larger than those assigned to smaller percentiles. You may use any desired spacing for the percentile values. For example, you might choose to enter the 50th, 75th, 90th, 95th, 97.5^{th}, 99th and 99.9^{th}

percentile concentrations in order to more accurately capture the shape of the cumulative distribution at the upper end.

Once you have completely specified your cumulative percentile table, the **Finish** button on the wizard becomes active, and you may click it to return to the main window and view your values in the spreadsheet.

Once you have specified concentrations for a water supply type, the icon in the tree structure changes color (from yellow to red) to indicate that non-zero residue data have been entered into the distribution for this water supply type.

Copying Distributions of Tapwater Concentrations

Entering concentration distributions for 96 distinct water supply types can be time-consuming, particularly when multiple sources have identical or similar concentration distributions.

In order to facilitate data entry, the concentration distribution for any water supply type may be copied to one or more of the remaining types of water supply. Thus for, example, if you know that you want to specify decile values for all public/private water supplies, you could specify them for one, and copy the values to the others.

To copy the values for a water supply type to other types, click on the type that has the values to be copied in the tree structure, and then either click on the dropper icon in the Toolbar:

or choose **Water source / Copy contamination to other source** from the Menu Bar. This calls a single-window wizard.

At the top of the window, the cumulative distribution of concentrations for the selected water source type is displayed (as a check so that you can be sure of the values that you are copying). At the bottom of the window is a list of the other 95 water source types to which you might wish to copy these values. Clicking on the checkbox next to any water source type will toggle a checkmark on (or off, on a second click). As soon as at least one checkbox is clicked, the **Finish** button becomes active (the **Cancel** button is always active).

When you have finished indicating all of the water source types to which you wish to copy the indicated data, click on the **Finish** button. You will return to the main window, and the values will be copied to the corresponding locations in the spreadsheet. As in the case of direct entry of values, the tree structure icons of those water source types to which values have been copied will have changed from yellow to red.

SAVING A TAPWATER CONCENTRATION FILE

In order to use your tapwater concentration data, either in the main analysis or as the basis of further files of tapwater concentrations, you must save the file. Either the diskette (save) icon in the Toolbar:

or the **File / Save** or **File / Save As** options in the Menu Bar allow you to save your file. **Save As** allows you to specify your own file name rather than the default

file names (RTTAPW#.TWC) provided by the system.

PRINTING THE SUMMARY TABLE

If you click any of the cells on the spreadsheet that appears in the main window to the right of the tree structure, you will be able to select the **File/Print** option on the Tool Bar. Using this option, you can print a hard copy of the summary of the tapwater data used in the model. This print out of the tapwater data can be an important part of the "audit trail" of your exposure or risk assessment.

To print the table, click on any cell in the spreadsheet and either click on the printer icon in the Tool Bar,

or select **File/Print** from the Menu Bar. **File/Print Setup** in the Menu Bar can be used to adjust your printer to optimize printing of this file. **File/Print View** allows you to preview the hard copy prior to printing.

EXPORTING THE SUMMARY TABLE

The table of tapwater concentrations may also be exported as an electronic file in either an Excel '97 or dBASE IV format file. When the spreadsheet is selected, the **Export Report** option under **File** in the Menu Bar becomes active. Clicking on this option calls up a dialog that allows you to select the directory in which the file should be saved (the default is the \RTL\Workspace directory), to specify a name for the file, and to choose Excel 97 or dBASE format. Again, these files may be useful for incorporating into your risk assessment report and establishing an "audit trail" for your analysis.

THE LIFELINE MODEL: CHARACTERIZING DAILY EXPOSURES OVER THE ENTIRE LIFETIMES OF POPULATIONS AND INDIVIDUALS
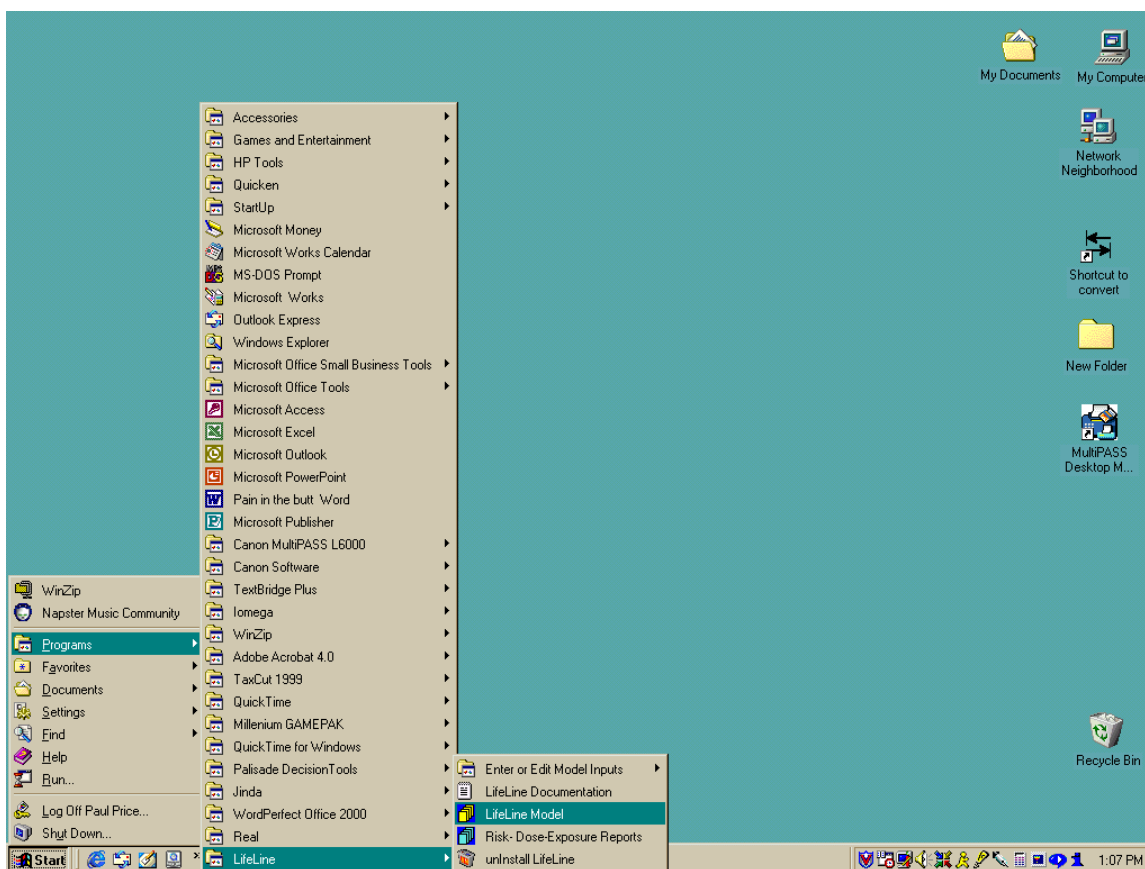
This program is the "heart" of this suite of software programs. It creates the

exposure histories of statistically representative individuals that make up a user-defined population. These histories define the daily exposures that occur on each day of each individual's life from birth to any desired age, addressing where each individual lived, what she or he ate, what she or he did, and how those actions brought her or him into contact with pesticides from any or all of the three sources addressed by the model: pesticide residues in diet, the residential environment, and tapwater supplies.

The program allows you to tailor the assessment to the sources and populations of interest. The output of the *LifeLine Model* program is a series of files that describe each individual's exposures over his or her entire lifetime. These files are used to assess the individuals' doses and risk in the final program *Risk–Dose-Exposure Reports*. In addition, the output files can be directly analyzed using spreadsheet or data base programs.

DATA (AND SPECIFIC FILES) REQUIRED

The data files that are required by the *LifeLine Model* depend upon the nature of the analysis that you are performing.

All analyses require that you provide a Risk Group file. Risk Group files are created using the *Active Ingredient and Product Description* program shipped with LifeLine™, and have the file extension **.rkg*. Risk Group files contain the toxicological and physical/AI data on your Active Ingredient (ai), as well as data related to residential uses. The *LifeLine Model* program prompts you to designate which risk group file to use in your analysis and shows the Risk Group Files that have been defined.

If you model exposures from residues in food (dietary analysis), you must identify a Dietary Residue file. These files are created using the *Food Residue Translator* program shipped with LifeLine™, and have the file extension **.res*. Dietary Residue files contain data on the distributions of pesticide residues in or on foods as they are consumed. The *LifeLine Model* prompts you to supply this file and show Dietary Residue files that have been previously created.

If you model exposures from residential pesticide use, you should provide an Activity Description file. These files are created using the *Activity Description* program shipped with LifeLine™, and have the file extension **.acd*. These files provide values for the exposure-related behaviors associated with each of the residential activities in NHAPS. The program prompts you to designate which activity description file to use and shows Activity Description files that have been previously created. If you do not specify a file, the *LifeLine Model* program will use the file PRELIMINARY ASSUMPTIONS.ACD shipped with the system (the system includes a warning before this happens).

If you model exposures from tapwater, you must provide a Tapwater Concentration file. These files are created using the *Tapwater Concentration* program shipped with LifeLine™, and have the file extension **.twc*. These files contain data on the variation in tapwater concentrations for different types of residences. The program prompts you to supply a tapwater concentration file, and shows Tapwater Concentration files that have been previously created. If you do not select a file, the system will not model any exposures from tapwater.

A detailed description of the input files, and the ways to create or modify them, is provided in preceding sections of this tutorial. Eliminating tapwater sources or dietary sources removes the need for the corresponding files. All analyses, whether or not they involve residential sources, require a Risk Group (**.rkg*) file. If

residential sources of exposure are to be considered, this file must contain descriptions of the residential products containing the AI.

The main display of the *LifeLine Model* lists the files that have been selected as the basis for running the analysis in the window at the bottom of the display. This display window indicates the filename, path, and the date and time of the last modification to each of the files. This is important for the "audit trail" of your analyses. The date and time of the most recent modifications are provided to allow you to track which version of a file was used in the analysis.

> **TIP:**
> Modifications of the input files (i.e., risk group files, food residue files, activity description files, and tapwater concentration files) will not take effect when the *LifeLine Model* is in operation. These files are loaded either just before or immediately after selecting **Analysis Preferences**. If you wish to modify these files (or select alternative files) after starting an analysis with the *LifeLine Model* program, you must return to the **Analysis Preferences** step after saving the new versions of these files. Risk group files need to be loaded by using **File/Open**.

Structure of Program Choices

There are five numbered buttons on the main display of the *LifeLine Model* program. Each of these buttons represents a step in the running of the program, beginning with your selection of the type of analysis and ending with the activation of the *Risk-Dose-Exposure Reports* program that allows you to easily explore the results of the analysis. These steps are designed to be addressed in sequence. Each step becomes active when a preceding step has been completed. You can; however, go back to a previous step and change your inputs and decisions entered during those steps.

Interface buttons 1 and 2 set the conditions for your analysis, button 3 starts the simulation running, and buttons 4 and 5 provide for viewing and/or storing the results of that simulation.

SETTING UP THE ANALYSIS

The first two interface buttons, **1. Analysis Preferences** and **2. Population Characteristics**, define the exposure assessment problem. Which sources of exposure? Over what durations of time? And for which population?

Button 1. Analysis Preferences

Clicking on **1. Analysis Preferences** opens a new window. This window has been subdivided into four basic areas, represented by a tabbed interface. The first tab, "General" allow you to select the sources to be addressed, data files to be maintained, and fundamental descriptions of the population (or individual) to be characterized. The remaining three tabs address the options for modeling dietary patterns and residential activities, and selecting exposure durations to be evaluated.

GENERAL

Sources and Aggregation

One of the first choices you will want to make is to specify the sources of exposure that will be evaluated in your model run. Checking the appropriate "check" boxes in the upper left box of this tab allow you to select any combination of dietary (food), residential use, and tapwater-based exposures.

The selection of the diet and residential sources are straightforward (see table 4.1). The selection of tapwater exposure, however, is more complex. Tapwater exposures draw upon data that are also used to characterize dietary and residential exposures. Further, tapwater exposures can occur from both oral and non-oral exposures. LifeLine™ Version 1.0 allows you to either to investigate all routes of tapwater related exposures, to examine only the oral route, or to examine only non-oral exposures.

In this version, both dietary and residential activity files are required if a **complete** evaluation of tapwater is to be generated. To reflect this dependency, the tapwater checkbox is positioned differently from those for dietary and residential exposure.

This reflects the fact that tapwater exposures draw upon data in that is also use to characterize dietary and residential exposures.

If you wish to run the *LifeLine Model* program only for tapwater exposures, and to examine all routes of exposure, you must place checks in the boxes for all three sources and provide risk group files and dietary residue files with zero values. This can easily be done by creating risk group files with no data on residential products and creating dietary residue files with no residue data. A dietary residue file that only includes zero levels of residues (NULL.RES) is included in the files shipped with LifeLine™.

If you only wish to evaluate the oral (direct ingestion) routes of exposure you should place checks only the dietary and the tapwater boxes. If you only wish to evaluate the non-oral exposure (dermal and inhalation exposures during showering and bathing) then you should place check only the residential and the tapwater boxes. Table 4 provides a description of how each combination of sources should be modeled.

Table 4. Modeling Specific Source(s) with the *LifeLine Model* Program	
Source	Procedure
Diet	Place a "check" the Dietary box and provide the appropriate *.rkg and *.res files
Residential	Place a "check" the Residential box and provide the appropriate *.rkg file
Tapwater (oral route only)	Place "checks" in the Dietary and Tapwater boxes and provide .rkg, .twc, and NULL.RES files (*.rkg file does not contain any residential uses)
Tapwater (oral, dermal, and inhalation routes)	Place "checks" in the Dietary, Residential, and Tapwater boxes and provide the appropriate *.rkg, *.twc files and the NULL.RES file (.rkg file does not contain any residential uses)
Dietary and Residential	Place "checks" in the Dietary and Residential files and provide the appropriate *.rkg and *.res files
Diet and	Place "checks" in the Dietary and Tapwater boxes and provide

Tapwater	the appropriate *.rkg. *.res, and *.twc files
Residential and Tapwater (with oral tapwater)	Place "checks" in the Dietary, Residential, and Tapwater boxes and provide the appropriate *.rkg, *.twc files and the NULL.RES file
Residential and Tapwater (without oral tapwater)	Place "checks" in the Residential, and Tapwater boxes and provide the appropriate *.rkg and *.twc files.
Diet, Residential, and Tapwater	Place "checks" in the Dietary, Residential, and Tapwater boxes and provide the appropriate *.rkg, *.twc, and *.res file

Exposure Analysis Files

Version 1.0 of LifeLine™ provides estimates of exposure, dose and risk. This version also allows you to generate up to five "exposure analysis" files, each of which provides additional detailed data on the characteristics of modeled persons, including their activities, diets, and homes during each day of their lives. These files provide a rich record for the "audit trail" of your analysis and allow you to independently calculate the exposures and doses that the model estimates.

In general, the more exposure analysis files that you choose to generate, the more informative your results. Creating these files, however, will increase the length of time necessary to model a given number of individuals. This loss of analytical speed occurs because of the time required to save the files to the hard drive of your computer. In addition, these files are stored in a format (dBASE) that is easy to process and examine outside the software, but requires additional time for formatting and storage.

There are four Exposure Analysis files that provide data on the exposed individual:

     LIVES.DBF

     DIET.DBF

     RACTIV.DBF, and

RESPUSE.DBF

The file LIVES.DBF can be created for any analysis performed with LifeLine™. This file documents the physiological characteristics of each individual modeled, as well as the location and characteristics of the residences of those individuals.

The second file, LIVES.DBF, can be created for analyses that include dietary sources. This file identifies the daily dietary record from the USDA's 1989-91 Continuing Surveys of Food Intakes by Individuals (CSFII) used to simulate each individual's dietary exposures on the last day of each season of the individual's life and the data extracted from that record that were used in the analysis.

The last two files, RACTIV.DBF and RESPUSE.DBF can be created for analyses that include residential sources. The file RACTIV.DBF identifies the activity record from the National Human Activity Pattern Survey (NHAPS) used to simulate each individual's residential exposures on the last day of each season of the individual's life and the data extracted from that record that were used in the analyses.

The file RESPUSE.DBF identifies the pest pressure record from the National Home and Garden Pesticide Use Survey (NHGPUS) used to simulate pesticide usage in each individuals residence and the data extracted from that record used in the analysis.

Reset Random Number Seed for Each Life

This checkbox, located just below the **Sources and Aggregation** section, forces the random number seed to be reset after each individual is modeled. The box should always be checked when evaluating a fixed number of years of life; failure to check this could result in improper characterization of individuals.

Population Mode and Size

This allows you to define the size of the population to be modeled. Small populations (or single individuals) may be informative for identifying features of exposure that are highly correlated with age, or for "piloting" different sets of exposure assumptions as described above. Larger populations will produce more stable estimates of the range of exposures that might occur across the population.

In selecting population size, it is important to bear in mind that for each individual modeled, from 31,000 to more than 1,000,000 exposure estimates could be generated during the course of a lifetime of 85 years. The length of the time to perform the analysis may take from a few minutes to an overnight analysis, depending on the size of the population, the length of the life spans you wish to model, and selected model options.

As the size of the population increases, however, the size of the output files becomes very large. This size can be a problem for computers with smaller hard drives. In addition, the large size of the files can make accessing the files very cumbersome.

> **TIP:**
> The *LifeLine Model* is a computationally intensive system. In order to minimize the length of time to run the model you may wish to evaluate smaller sized populations when performing your initial analyses. Once you have determined the ages and seasons of interest you may wish to model larger sized populations.
>
> If you are running a large number of individuals, only run the averaging periods and ages of interest. If exposure analysis files are not required, they should be turned off.

Mortality Evaluation

The *LifeLine Model* allows you to model the duration of individuals' lives in two ways. The system uses life expectancy data provided by the National Center for Health Statistics to determine the length of any individual's life. As a result, an analysis that begins with 10,000 may only consist of 7,000 individuals who reach age 70. This better reflects the anticipated exposures of a real population.

For some purposes, it may be more appropriate to assume that all individuals live for a full lifetime. LifeLine™ Version 1.0 also supports this option. If you wish to evaluate carcinogenic risk you must specify "Evaluate Full Lives" and the "Number of years in a full" window must have a value of 70 years or greater.

> TIP:
> The Mortality Evaluation control can be used to limit the ages of the population considered in the analysis. For example if you are only interested in children then you can used the "Number of years in a full" window to specify that the analysis only model the first 12 years of the individual's lives.

DIETARY

The second tab controls how dietary records are selected for an individual. There are three components to this:
- How often a new record is selected;
- Whether database "weights" are used in selecting records; and
- The criteria used to match dietary records to demographic characteristics of the individual being modeled.

Selection Frequency (Dietary)

This control allows you to specify how the daily dietary exposures are determined over a season. The current model provides two options. The "Every season of every year" option models an individual's daily dietary exposure over an entire season using a single record. The "Daily" option models an individual's dietary exposures over a season by selecting a different dietary record each day from a set of similar individuals.

While neither of these options is likely to be an accurate reflection of actual behavior, they provide a basis for limiting the uncertainty that arises from the use of short term data to model seasonal exposures. Please refer to the *Technical Manual* for an additional discussion of this issue.

Database Weights

For a variety of reasons, including non-response and incomplete response, the CSFII data do not fully match the intended target population. To compensate for this, weights were provided, so that the data <u>in aggregate</u> can be used to model this target population.

The LifeLine™ system supports the use of CSFII weights (specifically, the three-year, three-day weights), but it is generally inadvisable to do so. Please refer to the *Technical Manual* for an additional discussion of this issue.

Basis of Matching Dietary Data to Modeled Individuals

In the *LifeLine Model*, each individual is modeled by selecting records from the CSFII from individuals with similar characteristics. Version 1.0 determines the group of similar individuals by selecting records from individuals with similar ages that were taken during the same season. These factors were found to be the critical determinants of dietary patterns in analyses of the CSFII data. Additional information on this issue is presented in the *Technical Manual*. Future versions of LifeLine™ will allow matching based on other criteria such as sex, region, or socioeconomic status. As the current version only selects the dietary group based on age and season only one selection is allowed.

RESIDENTIAL

This tab allows you to choose how residential activity records are sampled and to review or modify default assumptions regarding applicator activity and room dimensions within a home.

Selection Frequency

This control allows you to specify how NHAPS records are used to determine daily residential exposures over a season. The current model provides two options. The *"Every season of every year"* option models an individual's daily residential exposure over an entire season using a single pair of NHAPS records. This pair consists of a single weekday record and a single weekend day record. The single weekday record is used to model all of the weekdays in the season. The single weekend day record is applied to all weekend days. The "Daily" option models an individual's residential exposures over a season by selecting a different NHAPS record each day from a set of similar individuals.

While neither of these options is optimal, they provide a basis for limiting the uncertainty that arises from the use of short-term data to model seasonal exposures. Please refer to the *Technical Manual* for an additional discussion of this issue.

Relationship of Activity to Application

Any activity in a home on the day when a pesticide application occurs may occur either before or after that application, with significant consequences for the exposures that would be predicted to result from that activity. In addition, the product may be applied by someone other than the person being modeled.

The first window allows you to specify a probability that a reported activity on the day of application occurred before or after application. The default value is 0.5 (equally likely that the activity preceded or followed application). This value may be set anywhere between 0 (the activity preceded the application - application followed the activity) and 1.0 (the application preceded the activity).

The second and third options address the difference in sex-specific patterns of pesticide use. Data from NHGPUS suggest that females are more likely to be applicators for residential pesticides used indoors, while males are more likely to be applicators for residential pesticides used outdoors. In the second window, you can specify the probability that the applicator indoors was female (the default value is 0.7). If this value is set to 1.0, males are assumed never to be the applicator for indoor applications; if it is set to 0, males are always the applicators. The third window offers a parallel choice for outdoor applications. The default in this case is a probability of 0.7 that the *male* will be the applicator outside. If it is set to 0, only females will be assumed to be applicators outside, etc.

Room and Hallway Dimensions

Available databases allow one to address the size of a home and the rooms in it, but not the relative dimensions of those rooms. The system automatically assigns relative sizes to different rooms (proportions of total floor space). This section allows you to specify the general assumptions regarding room dimensions and hallway dimensions. In general, this will be of greatest importance in evaluating crack and crevice pesticide use. The longer and narrower a room or hallway, the greater is its ratio of perimeter to floor area. The default dimensions (width:length) for rooms are 2:3, while for hallways they are 1:10.

AVERAGING PERIOD / TOXIC HAZARD

The final tab allows you to enter your choices for averaging period. This tab also allows you to review the toxicity data that will be used to assess risk for each selected averaging time. As noted briefly above, the system supports evaluation of different exposure durations. These work as follows. If you have selected a 7-day and a 30-day averaging period then on any given day, the system generates three different exposure estimates. Thus, for oral exposure, the system would determine the:

- Oral exposure on that day (the 1-day exposure);
- Average oral exposure for that day <u>and the preceding six days</u> (the 7-day average exposure); and
- Average oral exposure for that day <u>and the preceding 29 days</u> (the 30-day average exposure).

Similar estimates would be generated for residential, diet, tapwater, and aggregate exposures.

This option allows the exposure evaluation (and subsequent risk characterization) to be freed from the arbitrary distinction into "acute," "subchronic," and "chronic" categories, and to be matched to the actual time-dependence of toxic effects that are seen with the particular AI.

As an aid to this matching, the bottom of this tab contains a display of the toxic hazard data that are available from the currently selected Risk Group file. For each of the three possible types of toxic hazard (short, intermediate, and long-term), the range of relevant exposure averaging periods is displayed, as is the availability of route-specific and/or systemic toxicity data. The display indicates whether data are

sufficient only for an MOE analysis or for evaluating percent of the RfD.[11]

You may also choose to evaluate an averaging period where there are no available toxicity data. In this event, you will be able to evaluate exposures and/or doses for this averaging period, but you will not be able to assess risks.

DATA FILES REQUESTED

If you have included dietary exposures, the system requires you to specify the name of the *.res* file containing food residues before you continue. Select the appropriate file, based upon the work you have done with the *Food Residue Translator* system.

If you have included residential exposures, the system requires you to specify the name of the *.acd* file containing quantitative activity descriptions before you continue. If you do not specify a file that you have constructed with *Activity Description*, the system will give you a warning message, and then will use the default values supplied with the system.

If you have included tapwater exposures, the system requires you to specify the name of the *.twc* file containing distributions of tapwater concentrations of your AI before you continue.

Button 2. Population Characteristics

Once you have defined your analysis, you can define the modeled population based on their permanent demographic features. You may limit your analysis to a specific: Sex, Race, Ethnicity, or Socioeconomic status (income quartile)[12]

or any combination of these factors.

LifeLine™ does not allow for a specification of the modeled population based on factors that change over an individual's life, such as region, setting, housing type, water supply, season, day of the week, or the individual's age. The impact of these factors can, however, be investigated after the model is run. Using the *Risk –*

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[11]   The display does not indicate the availability of data on carcinogenic hazard, as these are not relevant to the selection of exposure averaging periods, but rather are always applied to Lifetime Average Daily Dose.

[12]   Technically, this last is not a permanent characteristic of an individual. In practical terms, it tends to remain relatively stable for an individual's entire lifetime. Future versions of LifeLine may include the changes in socioeconomic status.

Dose- Exposure Report program and by analyzing the output files it is possible to determine the impact of each of these factors alone or in combination with one another.

After you have described the population, the system loads the appropriate data files for the analysis and population that you have described (e.g., data on growth, mortality, residential characteristics, etc.)

Button 3. Running the Simulation

After population is defined, the **3. Start Analysis** button becomes active. Clicking on this button begins the generation of individual life exposure histories, which continues until all daily exposures have been modeled for the whole population.

> **TIP:**
> The *LifeLine Model* is a computationally intensive system. You should strongly consider not running any programs during the analysis of large populations. Screen savers should be turned off during analysis with this version.

While the program is running, the program displays selected characteristics of each modeled individual. A counter displays the day being modeled (and life year) of each individual, and a second counter displays the total number of person-days that have been modeled thus far. A progress bar indicates the percentage of the total number of specified person-days that has been modeled.

When the last day of the last modeled individual has been assessed, the system displays the message:

Analysis Completed. Ready to generate report files

What the *LifeLine Model* has done during its analysis is simulate the exposure histories of each individual. The exposure estimates from this have been saved as a

dBASE file in a temporary file location. The file is entitled *EXPOSURE.DBF* and the data in it can be analyzed and extracted using spreadsheet or database software. The program has also created the Exposure Analysis Files specified in the analysis preferences.

The **4. View Analysis Results** and **5. Generate Reports** buttons become activated at this point, as does the menu option **Lives/Move exposure analysis files to a folder of your choice.**

It is recommended that you save the model's output for later analysis (see **Viewing and Saving Outputs** below). The reason for this is that when the program is re-run all of the exposure analysis files from the previous model runs will be lost (see above).

Button 4. View Analysis Results

This button presents the contents of the exposure analysis files for:

- Each individual (permanent characteristics); and
- Each year in an individual's life.
    - ⇒ Body dimensions (annual);
    - ⇒ Residence characteristics (annual);
    - ⇒ Dietary data selected (seasonal); and
    - ⇒ Activity records selected (seasonal).

The completeness of this display depends upon the number of exposure analysis files that have been generated. If none of these files were created, this window will appear blank and a warning will appear.

This display does <u>not</u> contain any information about exposures. Rather, it presents

data that were used to calculate those exposures. You must use Button **5. Generate Reports** option to view the exposure estimates or use other software to analyses the output files of the program.

Exposure analysis files may be extremely useful in determining the factors that are driving exposures or risks. Because they are overwritten with each new analysis, provision has been made for saving a copy in a folder you designate. Use the **Lives/Move exposure analysis files to a folder of your choice** option in the Menu Bar to do this. You will be prompted with the name of a text file to be stored in \My Documents (you may want to change to another folder or create one). This text file contains the current date and time for future reference. Use any file name you wish and click on Save. (If you keep the extension .TXT, it will facilitate examining the file with Notepad or a similar program). Not only will the time stamp file be saved but all exposure analysis files created last will also be copied from the system folder to the chosen folder. A progress bar will display the status of the copying procedure.

Button 5. Generating and Viewing Reports

By clicking on the final button, **5. Generate Reports**, you call up a separate program for *post-hoc* analysis, *Risk-Dose-Exposure Reports*. This program has its own **Help** system and section of the printed **Manual**.

MODEL OUTPUTS

The contents of EXPOSURE.DBF are the collected exposure histories of a population. Where the population is has been carefully designed to be a statistical representation of the population you defined in the **Analysis Preferences** and **Population Characteristics** steps of the *LifeLine Model* program. These population exposure histories can be visualized as a series of "exposure surfaces," in which the x-dimension is age, the y-dimension is the individual, and the z-dimension is exposure. A separate surface would exist for each exposure metric (e.g., seasonal average daily oral exposure, seasonal maximum 7-day exposure from residential uses, etc.) you defined in the **Analysis Preferences** step. Depending upon the availability of data on toxic hazards in the Risk Group file, an even larger number of surfaces may exist for measures of risk (e.g., both MOE and percent RfD presentations of most exposure metrics).

One drawback to this approach is size of *EXPOSURE.DBF*. The size of the file can easily exceed 100 megabytes for larger populations. In order to avoid generating files that could overload older computers and would be difficult to access on newer computers because of their size. Version 1.0 calculates but does not save the dose estimates for each day. Instead, the model saves the average exposure for each year and season and the maximum dose that occurs on any day in a season for each year and season. This reduction of the data saved results in more than a 45-fold reduction in *EXPOSURE.DBF*.

Figure 1 presents a description of the data generated (daily estimates of exposure for each day of a season represented by the individual diamonds.) and the data saved (the average of the daily exposures and the highest daily dose represented by the two lines).

Daily Doses (not Saved) and Maximum and Average Dose (Saved)
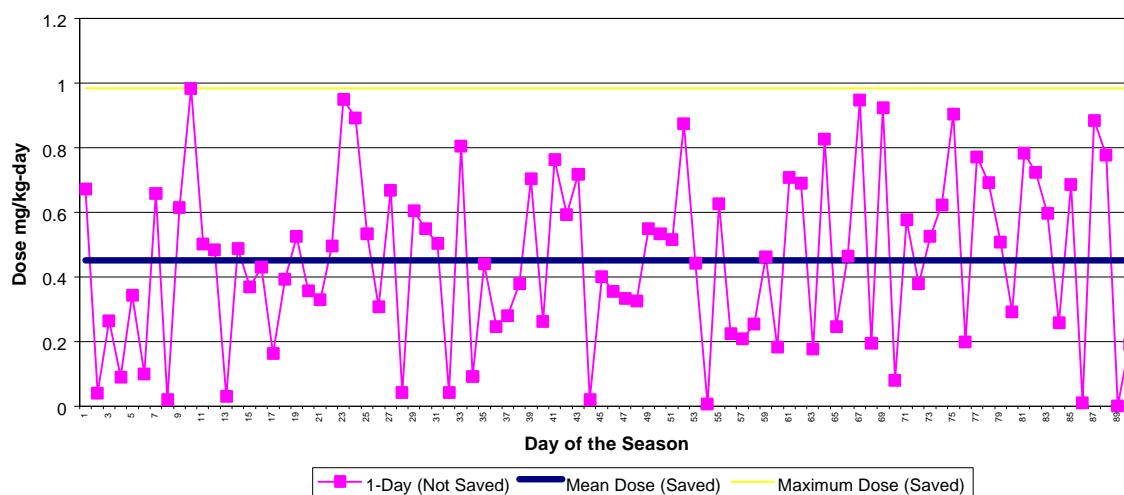
PERFORMING A CUMULATIVE EXPOSURE AND RISK ASSESSMENT WITH LIFELINE™ VERSION 1.0

Assessments of cumulative risk involve the determination of aggregate exposures to multiple AIs. One approach to modeling cumulative risk; however, is to normalize exposures to multiple AIs to a single index AI. This approach results in the exposures to multiple AIs being converted to an equivalent set of exposures to a single AI. The net effect of this process is to convert the more complex cumulative risk assessments to the aggregate assessments that Version 1.0 of LifeLine™ was designed to perform.

This "normalization" approach for modeling cumulative risks has been called a "toxicity equivalent" (TEQ) or "risk potency factor" (RPF) approach. Under this approach, an exposure to any AI operating by a common method of action is converted to an equivalent dose of an index AI by the use of risk potency factors (RPFs). If the potential for exposure is quantitatively similar for each AI, it is possible to use the RPFs to convert the level of residues in diet, tapwater, and in the residential environment to equivalent residues of the index AI.

This approach of converting the residues of multiple AIs to equivalent residues of a single index AI can be applied to all three sources of exposure (diet, residential use, and tapwater) addressed by the system. As discussed in the following sections, the process of entering the equivalents into LifeLine™ will be different for dietary, tapwater and residential sources.

DETERMINING "EQUIVALENT" RESIDUES

As discussed in the chapter on the *Risk–Dose–Exposure Report* program. LifeLine™ Version 1.0 determines the aggregate risk based on the estimate of the aggregate systemic dose. This dose is defined as the sum of the absorbed doses that occur for all routes of exposure. The simplest way of characterizing cumulative risk is to establish a single set of RFP values that normalize systemic doses of the various AIs to the equivalent systemic dose of the index AI.

It is also possible to perform route specific cumulative assessments. These assessments can take advantage of the LifeLine™'s ability to track and integrate route specific exposures from multiple sources. Under this approach, route-specific RFPs can be used to weight exposures and route specific toxicity data can be used to characterize the cumulative risk that occurs from those exposures.

ENTERING APPROPRIATE TOXICITY DATA FOR A CUMULATIVE RISK ASSESSMENT.

Using the toxic equivalency approach, all of the exposures have been converted to equivalent doses of the index AI. Therefore, to perform a cumulative risk assessment you should enter appropriate toxicity data on the index AI using the *Active Ingredient and Product Description* program.

As noted above, values of the RPFs used to convert the residue data of the different AIs to the index AI may vary with the duration of exposure. Thus, RPFs values developed based on studies of the relative potency of the different AI for one-day exposures the may or may not be applicable to longer durations. Because

of the potential for different RPFs, cumulative risk assessments should be limited to the duration of exposure that are comparable to those in the studies used to set the RPF values.

ENTERING "EQUIVALENT" RESIDUE DATA INTO A CUMULATIVE DIETARY ASSESSMENT

When entering data on multiple AIs in the food chain for a cumulative risk assessment, you must address the co-occurrence of each AI in a sample representing a RAC/Food Form combination (or applied at any higher level in the hierarchy):

All residue data on each AI being evaluated should be converted to the equivalent concentrations of the index AI. Where residues from multiple AIs occur on a RAC, the concurrent residue concentrations of each AI <u>in each sample</u> are first converted to equivalent concentrations of the index AI. These concentrations are then summed to give the total index equivalent concentration <u>in each sample</u>.

The distribution of these equivalent concentrations should be entered using the procedures described in the chapter of this Manual describing the *Food Residue Translator*, and an appropriate file of residue distributions in foods (*.res) created.

ENTERING "EQUIVALENT" RESIDUE DATA INTO A CUMULATIVE TAPWATER ASSESSMENT

The process used when entering tapwater residue data for multiple AIs in a cumulative risk assessment is similar to that used for entering data on residues in diet. All tapwater residue data on each AI being evaluated should be converted to the equivalent concentrations of the index AI.

Where residues from multiple AIs occur in the same type of water supply (surveys of water systems that measured the levels of residues for multiple residues or watershed models could be used to predict concurrent levels of multiple AIs), the concurrent residue concentrations of each AI in each sample are first converted to equivalent concentrations of the index AI. These concentrations are then summed to give the total index equivalent concentration in each sample. (Again, where residues in a sample are limited to a single AI, no summing is required.)

The distribution of these concentrations should be entered using the procedures described in the chapter of this Manual describing *Tapwater Concentrations*, and an appropriate file of residue distributions in water supplies (*.twc) created.

ENTERING "EQUIVALENT" RESIDUE DATA INTO A CUMULATIVE RESIDENTIAL PESTICIDE ASSESSMENT

A different process is used in entering data into the residential assessment than for the assessment of exposure from tapwater and dietary residues. Residential exposures are evaluated on a product-by-product basis that allows each AI's products to be entered separately, as follows:

First, you must identify each product that contains one or more of the AIs being assessed. You then enter data on each product using the *Active Ingredient and Product Description* program.

Where a product contains a single AI then the data on the concentration of AI in air, the concentration of AI in the applied product, and where applicable, the harvester dose, are entered in unit equivalents of the index AI.

Where a product contains more then one AI, then both AIs are converted to their equivalent amounts of the index AI and summed to give a total index AI equivalent in the product. This estimate is then used to determine the concentrations in air, in the applied product, and the harvester doses. Once data on all of the products are entered, a *.rkg file is created and used in the cumulative assessment.

ANALYZING YOUR RESULTS USING THE RISK-DOSE-EXPOSURE REPORTS (RDEP) PROGRAM
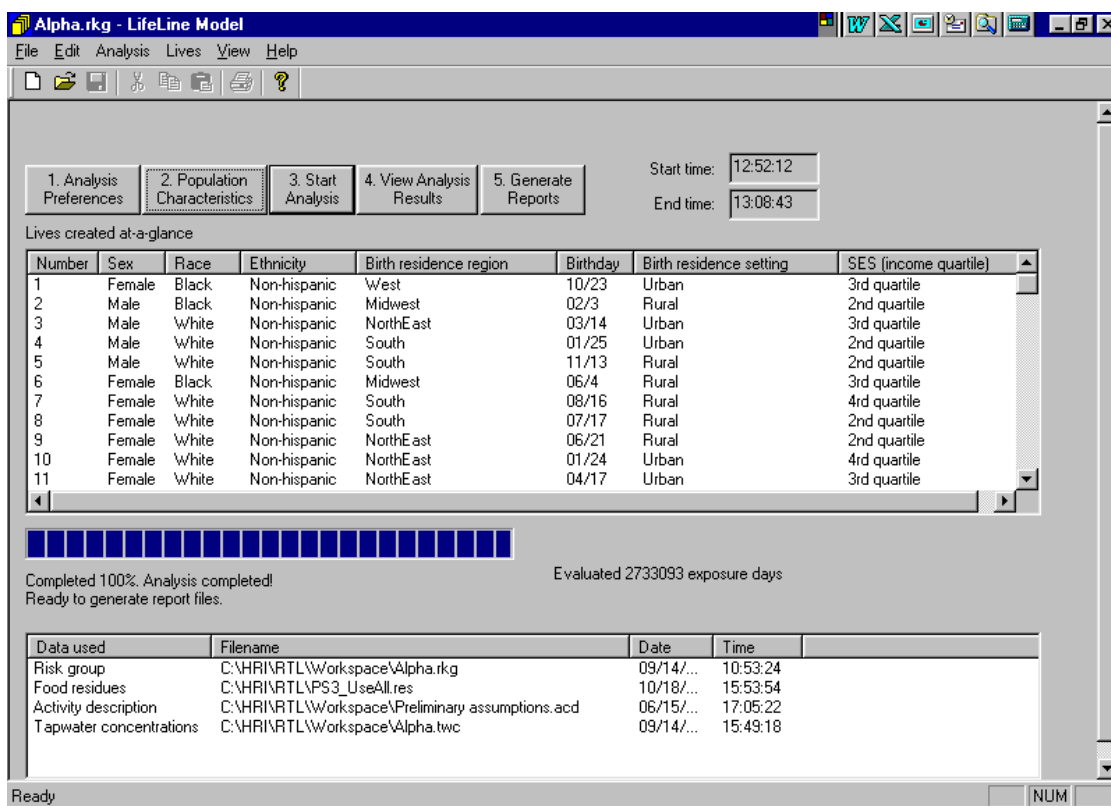
The *Risk-Dose-Exposure Report (RDER)* program can be accessed in two ways. It is represented by a button on the *LifeLine Model* main interface, button **5. Generate Report** and it may be called directly from the Windows 95/98 Program Menu **Risk-Dose-Exposure Reports** in the same program group as other system files.
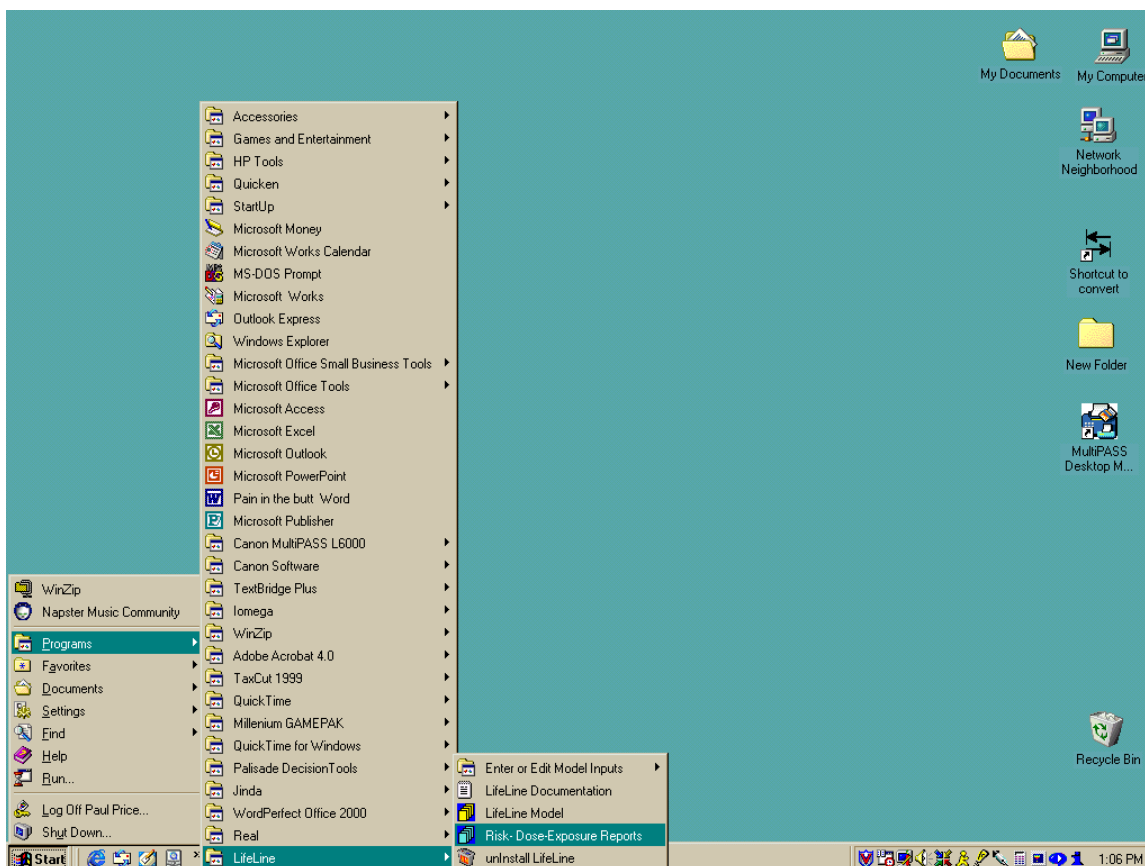
DATA (AND SPECIFIC FILES) REQUIRED

The *RDER* program creates "views" of an extremely large file of exposure estimates produced by the *LifeLine Model* (EXPOSURE.DBF). This latter file, which often runs to many megabytes, contains seasonal summary data for every exposure metric for every individual. The entire purpose of the *RDER* program is to extract portions of this massive file and organize the data into more familiar (and useful) presentations. These presentations can be expressed as graphs or as tables. The graphs and table can in turn be exported to other programs. Unless EXPOSURE.DBF has been created, however, the *RDER* program will not function.

The contents of EXPOSURE.DBF are the collected exposure histories of a population. Where the population is has been carefully designed to be a statistical representation of the population you defined in the **Analysis Preferences and Population Characteristics** steps of the *LifeLine Model* program. These population exposure histories can be viewed as a series of "exposure surfaces," in which the x-dimension is age, the y-dimension is the individual, and the z-dimension is exposure. A separate surface would exist for each exposure metric (e.g., seasonal average daily oral exposure, seasonal maximum 7-day exposure from residential uses, etc.) you defined in the **Analysis Preferences** step. Depending upon the availability of data on toxic hazards in the Risk Group file, an even larger number of surfaces may exist for measures of risk (e.g., both MOE and percent RfD presentations of most exposure metrics).

RDER program allows you to summarize these data, taking either a longitudinal perspective (individual or population values over time), or examining the pattern of exposures in the population at a particular age and season.

Last-Generated Exposure File (Default)

When you start *RDER*, you can immediately create a view of the EXPOSURE.DBF file that was created by the last run of the *LifeLine Model*. The controls to generate these views will apply to the results of the last run of the model, unless you have specified a previously saved file as the starting point for your views.

Previously Saved Reports

If you have saved a report (i.e., a file with extension *.rtl) created by this program (see below), you may use the **File/Open** option in the Menu Bar or click on the open file folder icon in the Toolbar

 to open the file for review, printing, or (if the source files still exist, see **Exposure Files and the Browse Function**) further analysis.

Exposure Files and the Browse Function

The default location for EXPOSURE.DBF is the \RTL directory, where the results of the most recent model run with the *LifeLine Model* will be located. It is possible, however, to utilize the results of previous runs of the *LifeLine Model*, if you have used the option (described in the *LifeLine Model* program, see **Viewing and Saving Outputs**, Section C.5.) to copy them to another location. The **Select exposure analysis folder** button at the bottom of the left panel of the *RDER* program allows you to select the location of the files that you will use to generate your views. This feature is also important if you have saved a report file from *RDER* program (*.rtl file; see below) and wish to recall it for further analysis.

THE DISPLAY

The program presents a "split window." On the left side of the display is a set of controls in a tabbed interface that allows you to describe the view (a table or graph) that you want to create. On the right side is a window that displays the table or graph that you have created. The Toolbar and Menu Bar contain controls that define the view.

A separate Toolbar is activated whenever a graph is displayed, and shown in the graph window. This toolbar allows you to control the appearance of the graph. For example, you may select linear or logarithmic spacing of axes, display of symbols, trend lines, or both, etc.

Because the generation of views is now interactive, there is <u>no permanent </u>copy of any view you generate <u>unless you explicitly save or export</u> the view that you have generated. You need generate permanent files only for those views that you

consider important, but you must take affirmative action to make those files.

BASIC VIEWS

The views that are generated by this program (whether tabular or graphical) can each be viewed as a cell in a table with four rows and four columns, as shown in Table 5. Each row is a view type, and each column is a set of data series to include. Every view can be presented either as a table or as a graph.

Table 5. Basic Views Offered by the Risk-Dose-Exposure Report Program				
	Data Series			
View Types	Total vs. Routes	Total vs. Source Terms	Average vs. Max.	Compare Durations
Individuals Over Time	Yes	Yes	Yes	Yes
Population–Typical Over Time	Yes	Yes	Yes	Yes
Population at Specific Time	Yes	Yes	Yes	Yes
Cancer (Lifetime Average)	Yes	Yes	Yes	*No*

As discussed above, the first view type slices the population exposure surfaces described in EXPOSURE.DBF parallel with the age axis, resulting in *n* different

exposure histories for the *n* individuals modeled. The third option slices the surfaces perpendicular to the age axis. This results in up to 340 different distributions (85 years by 4 seasons) of doses in the population. The second option integrates the data perpendicular to the age axis. (The cancer option inherently averages over time).

View Types

When viewing individuals over time, the view contains the data from all seasons from the start and end ages selected by you. This view, which is the most detailed, allows you to "scroll through" a series of individual exposure histories, noting how each individual's pattern of exposures changes over time.

When viewing population-typical values over time, the system first integrates the population at each point in time to produce a representative value (e.g., population mean). The view then displays the changes in that value as a function of age and season.

When viewing the population at Time X, the system displays the individual values for every member of the modeled population at an age and season (e.g., winter of the 45th year of life) that you select.

When viewing cancer (LADD or corresponding risk), the system first calculates the Lifetime Average Daily Dose for every individual. It displays either that dose or the corresponding cancer risk. <u>The risk option is only applicable when fixed lifetimes of at least 70 years have been evaluated in the exposure assessment</u>.

Data Series

For each of the three basic view types, you have the choice of the same four basic data comparisons:

- Comparing route-specific (oral, inhalation, dermal) exposures to total exposure for a particular time frame and exposure type (e.g., seasonal average one-day exposure);

- Comparing source-specific (food, tapwater, residential) exposures to total exposure for a particular time frame and exposure type (e.g., seasonal average one-day exposure);

- Comparing the average and maximum values seen for a particular duration and route or source of exposure (e.g., one-day oral exposures)[13]; and

- Comparing exposure durations for a particular exposure type (e.g., seasonal average oral exposure).

For the first three options, either exposure/dose or risk metrics may be employed. Because the last option would in many cases involve the comparison of qualitatively different risks only exposure views are supported.

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[13]   This presents slightly different data when population values are being presented than when individual values are presented. In the latter case, you will see either the maximum seasonal value for each individual, or the average seasonal value for each individual. In the former case, you will see either the maximum value for the population or the average value for the population, but each individual contribution to that population value is the average seasonal value for the person.

Multiple Views

For any one of these twelve basic varieties of view, numerous specific instances might be of interest. For example, if we consider only the third view type (population cross-section) for route-specific comparisons, there are 340 possible combinations of age and season, up to five possible exposure durations (1-day, 7-day, etc.) and either seasonal averages or seasonal maxima that could be selected, for a total of more than 2,700 views of the same basic type (more if both exposure and risk are considered). The system allows you to generate, view, and save or export as many of each type of view as desired.

SELECTING VIEW OPTIONS (CONTROLS ON THE LEFT SIDE OF THE INTERFACE)

Selecting the Location of Exposure and Exposure Analysis Files for Report Generation

The default setting for this program is to base views on the EXPOSURE.DBF from the most recent analysis performed with the *LifeLine Model* Program [see Last-Generated Exposure File (Default)]. These files will be saved in the \RTL directory, and will have overwritten any previous versions of those files in that directory.

The *LifeLine Model* allows you to copy these files to a different directory, so that running new analyses will not destroy the results of previous analyses (see **Exposure Files and the Browse Function**). If you have saved an analysis, you may use either the saved analysis or the results from the most recent analysis

performed with the *LifeLine Model* program (or both) to generate views.

To change the EXPOSURE.DBF and the Exposure Analysis Files used to generate views, you click on the **Select Exposure Analysis Folder** button at the bottom of the view generation options window (left side of the screen). Immediately above this is a window showing the current location being used for these files.

When you click on the **Select Exposure Analysis Folder** button, you call up a standard window that displays the contents of the currently selected directory. A drop list allows you to navigate between folders until you find the one where the exposure analysis files of choice reside.

By selecting a directory that has your saved exposure and exposure analysis files and clicking on the **Open** button, you will change the location used by the program to generate views. The system will warn you if you attempt to select a directory that does not contain such files, and will not change the model output directory.

NOTE:
If you are displaying a view, and change the directory for output files, and the system either cannot find exposure analysis files in the specified directory or finds files that do not correspond to the report file, the button labeled **Create Report with Current Options** is replaced by a warning that the displayed report was not based upon the files contained in the new directory. To generate a report, you must either use the **Select Exposure Analysis Folder** button to return to the appropriate directory, or create a new file (by clicking on the blank sheet in the Toolbar or choosing

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File\New from the Menu Bar.)

You can access additional information about the exposure analysis files being used through the **View/Exposure analysis information** menu option.

Basic View Types

The *RDER* program interface uses four tabs to distinguish between the three basic view types described above (**individuals over time**, **population** (summary over time), (population at a) **specific time** (age and season), or **cancer**). These are located near the bottom of the view generation options window, just above the window that displays the location of the model output files. You select one of the three view types by clicking on the corresponding tab.

Overall View Options

The view options offered by the tab for each of the three view types are fundamentally very similar. The most options are offered in the first tab **Individual Exposure Histories Over Time**. The other view types have fewer options. The following discussion will discuss the selection of options for the first view, noting differences in the other view types where relevant.

GENERATING A TABLE OR GRAPH

At the top right of the view generation options window is a box labeled **View**, containing radio buttons **Data** or **Graph**. The former will lead to a tabular display, the latter to a graphical display of the same data. The same effect can be produced by clicking on the table and graph icons in the Toolbar, or by choosing **View/Spreadsheet** or **View/Graph** in the Menu Bar.

> **IMMEDIATE RESPONSE:**
> Unlike the other selections, these radio buttons will automatically toggle the display between a table and graph. To activate other changes in the report, you must click on the **Create an Exposure Analysis…** button after making your selections.

BASIC VIEW OPTIONS

Once you have selected <u>one</u> of the three basic types of view (the tabs), you must choose one of the four basic view options (source contributions, route contributions, average vs. maximum, and comparison of averaging periods). The other options that you have are affected by the choice that you make here.

> **REMEMBER:**
> When population data are displayed across time,
> **Average** refers to the mean population value of the seasonal average data.
> **Maximum** refers to the highest value seen in the population of the data for <u>seasonal average for each individual</u>.
>
> When individual data are shown, the average is the individual's average value for the season, and the maximum is the highest value seen for that individual in that season.

<u>Data Item</u>

This set of radio buttons allows you to switch between exposure/dose views and risk views (either MOE or Percent RfD in the first three tabs, and excess risk in the **Cancer** tab). The particular risk options that are functional will depend upon the availability of corresponding toxic hazard data. If data are not available, the options will be grayed out.

For example, if you have no intermediate or long-term toxicity data, and want to view an exposure-averaging period that is longer than the maximum for short-term toxic hazard data, you will only be able to create exposure views, and not risk views. Similarly, if you have only specified NOAELs (or similar) for a particular type of toxicity, you will be able to generate an MOE analysis, but not a percent RfD analysis.

If you have full toxic hazard data for any route (but not all), you can display the corresponding risk report for either the all sources or all routes comparisons, even though these may be incomplete. Similarly, if you are considering a single source term that has multiple exposure routes associated with it, you may evaluate risks that are supported for any relevant route. If, however, you are viewing a single route (for example, in the **Average vs. Maximum** option), only the analyses supported by hazard data for that route will be available.

NOTE:

This version of LifeLine™ determines aggregate risk based on the systemic (absorbed) dose that occurs as the result of multiple routes of exposure to one individual on one day.

A second type of risk aggregation seeks to sum the risk that occurs from both systemic and route-specific toxicity (portal effects). An example of such aggregation of risk might include skin irritation from dermal exposure, loss of lung capacity from inhalation, and

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kidney effects resulting from oral exposure. LifeLine™ does not attempt to aggregate such risks. Doing so requires very strong policy assumptions that are best addressed in another context. The system does produce outputs that can be used in such assessments, but does not automate them.

<u>View Time Frame</u>

This option is independent of the basic view option. For the two longitudinal views, it specifies the starting and ending age and season. For the cross-section, or interindividual variation, of the population (**Population Exposure Profile at a Point in Time**), it specifies the age and season for which the population data are displayed.

Choices for Each View Option

<u>Route Contributions</u>

This option generates a comparison of Total exposure to oral, inhalation, and dermal exposure for any selected metric.

When this option is selected, you must choose:

- The exposure duration periods of the data (i.e., daily, or any longer window that you may have specified in setting up your analysis); or
- Whether to display seasonal average data or the seasonal maximum value.

Note: For views dealing with the population over time, all displays involve seasonal averages, rather than seasonal maximum.

CAUTION:
Seasonal maximum values are calculated independently for each route, source, and exposure duration window. When running a

comparison of routes or sources, for example, you should be aware that the maximum value for a particular route or source may represent a different day than the maximum value of the other routes or sources displayed, or from the corresponding total exposure maximum.

CAUTION:
It is very important to bear in mind that the total, oral, inhalation, and dermal route risks reflect <u>independent </u>estimates of toxic hazard, and therefore may not be directly comparable. For example, a dermal risk may represent mild skin irritation while an oral or total risk is based on systemic liver effects.

SOURCE CONTRIBUTIONS

This option generates a comparison of Total exposure to food, tapwater, and residential exposure for any selected metric.

When this option is selected, the subsidiary options are the same as those for route contribution comparisons. You must choose:

- The exposure duration period for which to display data (i.e., daily, or any longer window that you may have specified in setting up your analysis); and / or

- Whether to display seasonal average data or the seasonal maximum value (see notes and warnings above).

SEASONAL AVERAGE VS. SEASONAL MAXIMUM

This option addresses the comparison of seasonal average values and maximum seasonal values for a particular metric. Accordingly, the choice of displaying average or maximum values is no longer offered (both are displayed). You must, however, specify:

- The exposure duration period for which to display data (i.e., daily, or any longer window that you may have specified in setting up your analysis); and

- The particular exposure metric for which you wish to compare seasonal average and maximum seasonal values: total, oral, inhalation, dermal, food, tapwater, and residential.

NOTE*:*
When looking at the entire population at a particular point in time, selecting this basic view option activates a checkbox labeled "Create subsidiary report file." If you check this option, the system will automatically capture (from the Exposure Analysis files) a description of the diet and activities that were recorded on the day on which the selected metric was recorded, for the

individual with the highest average value and for the individual with the highest maximum value:

- CSFII records for the individuals (CSFII identifier, food names and amounts consumed)
- NHAPs records (weekday or weekend)
- Residence description

These data are added to the view spreadsheet that is created (considerably expanding the size of that spreadsheet).

If you elected not to generate the corresponding exposure analysis file(s), these additional data are not available for incorporation into your report.

You must choose:

- The exposure duration period for which to display data (i.e., daily, or any longer window that you may have specified in setting up your analysis); and
- The particular exposure metric for which you wish to compare seasonal average and maximum seasonal values: total, oral, inhalation, dermal, food, tapwater, and residential.

ALL EXPOSURE DURATION PERIODS

This option compares the estimates of dose for different averaging periods for a specific age and season. In generating views of this type, you must specify:

- The particular exposure metric for which you wish to compare seasonal average and maximum seasonal values: total, oral, inhalation, dermal, food, tapwater, and residential; and
- Whether to display seasonal average data or the seasonal maximum value (see notes and warnings above).

This option is not relevant when considering population values over time

As noted above, <u>risk metrics are not supported for this view</u>, because it would involve a quantitative comparison of qualitatively different risks.

DISPLAYING A VIEW

Once you have specified the options for your next view, you can click on the button labeled **Create an Exposure Analysis View with Current Options**, located at the top left of the view generation options window.

When you do so, the system will replace the display on the right with a new view reflecting the options that you have selected.

> **NOTE:**
> It is important to bear in mind that the **Print** and **Export** commands described below apply only to the currently displayed graph or table. In addition, you must actually click on the graph or one of the cells in the table in order to print or export.

General Viewing Controls

You can use the radio buttons in the view generation options window, the graph and spreadsheet icons in the Toolbar

and the **View/Spreadsheet** and **View/Graph** options in the Menu Bar to switch

between graphical and spreadsheet views of your selected view.

Some views also entail multiple views. For example, when viewing individuals over time, there is a separate graph and spreadsheet for each individual. When viewing source contributions, route contributions, or different averaging periods for a population, there is a separate view for the average and maximum values for the population. The **Next/Previous** function in the Report menu option allows you to change between these multiple displays in a view.

The Tool Bar contains two buttons with arrowheads:

 pointing left (**Previous**) and pointing right (**Next**)

There are also **/Next** and **/Previous** options under **View** in the Menu Bar. To activate these options, you must click on the graph or spreadsheet being displayed.

In addition, you can display the view for a specific individual with the **Report/Go to person** menu option. This is only applicable to the **Individual Over Time** view.

Spreadsheet Viewing Controls

When a spreadsheet is being displayed, you have the option of changing the font, font style (e.g., bold, italic), and font size. To do so, you click on the spreadsheet, and then select **Spreadsheet/Font** from the Menu Bar. Available fonts, styles, and sizes are displayed in a dialog box.

For spreadsheets that contain the data for a population at a particular point in time, you also have the option of sorting data based on total exposure (or its corresponding risk estimate). This option only applies to views of exposure or risk by route or source (i.e., those views that include total exposure and some other metric of exposure).

This option, called by clicking the "1 2 3" button on the Toolbar

or by choosing **Spreadsheet/Sort on total** from the Menu Bar, will affect the display of both the spreadsheet and its associated graph.

Split-Screen Display

For both the spreadsheet and the graph display, you may choose to split the display window horizontally, so that you may display two different views of the spreadsheet or graph (this part of Risk-Dose-Exposure Reports does not support simultaneous displays of the graph and the spreadsheet - see box on multiple windows below). For example, you may want to compare displays of the same data on linear and logarithmically spaced axes.

You activate the split-screen display by using your cursor to drag the screen divider (normally positioned at the very top of the screen) to your desired position. By dragging the divider back to the top of the display, the split-screen function is deactivated.

Graph Viewing Controls

For many purposes, you may wish to change the appearance (but not the content) of a view graph. A special Tool Bar is displayed with the graph that allows you to do this. The available options are described here. In some cases, calling one option will also provide access to a set of tabs that address other options as well. In other cases, only the specific Tool Bar button provides access to the option.

A brief description of each Tool Bar icon is presented here. If you want to be sure what a button does, place the cursor arrow over it. After about one second, the description of the button pops up.

Graph Style

The Graph button

controls the most fundamental aspects of graph appearance:

- <u>Whether to show data using symbols, lines, and or "sticks"</u> (a vertical line from the data value to the x-axis). While the default is to use lines, many users prefer to mark individual data points with symbols.

- <u>Whether to use linear or logarithmic coordinates for the graph axes.</u> Because exposure and risk values may vary over several orders of magnitude, the logarithmic presentation of the y-axis can be very informative. Logarithmic spacing of the x-axis (which either represents time or persons) does not make any particular sense.

SHOWING / HIDING DATA

For views of exposure by route and by source, the default display includes total exposure as well. In some cases, this can obscure the comparison of contributions by different sources or routes. The button marked with a spreadsheet allows you to toggle these values on or off.

This button also allows you to turn off gridlines (that continue the y-axis tickmarks across the full width of the graph).

SHOWING / HIDING GRIDLINES (AXIS)

This button, marked with a numbered grid, allows you to turn off gridlines (that continue the y-axis tickmarks across the full width of the graph).

It also allows you to toggle the display of total exposure on or off.

FONTS

This button, marked with a lowercase and uppercase "A,"

allows you to control the font size for the labels on the graph. You control the text to be modified by clicking the corresponding radio button. You may then select a

different typeface (from those listed in the drop list box), turn text effects (bold, underline, italic) on or off, and scale the font larger or smaller. (The selection of a particular point size is not supported.)

The "smart scale" checkbox will automatically adjust your font if it is too large to fit in the designated area.

MARKERS

This button, marked with a pale green "x,"

allows you to change the size, color, and shape of any data marker that you are using.

First, use the little graph with the black pointer arrow to select the marker that you wish to modify. The number of the selected marker set will be displayed below the graph (unfortunately, the current properties of the marker are not displayed).

Then you may change the color, pattern, symbol, and size of the selected marker. If you have lines displayed (see above), you may also make them either thick or patterned. The **Reset All** button at the top right of the control tab affects color, pattern, and shape, but not size.

BACKGROUND

This button (yellow graph icon)

allows you to apply styles (colors, backgrounds, borders, and shadow effects) to the areas used for titles, the legend, and the graph. You may also specify a background color (or bitmap) for the entire graph window.

Investigating Data Points in a Graph

If you are curious about a particular value in the graph, you may click on it. The nature of the point (e.g., the route, source, etc.) is displayed, along with the x- and y-values for the point, in a pop-up box. If you want to hide this box, switch to the table view and then back again, or click on the control panel on the left side of the display.

PRINTING A VIEW

Both tables and graphs may be printed directly, either by clicking on the printer button in the Tool Bar

or by selecting **File/Print** from the Menu Bar. These commands apply to whatever graph or table is currently being displayed. **Print Preview** will first prompt you with a menu for the printer to which the view will be directed, and then display the view as it would appear under the settings currently applied to that printer.

Print Setup (also under **File**) controls the basic specifications of your printer.

SAVING A REPORT OR EXPORTING A VIEW

There are two different ways to save any report that you have created. The **Save** and **Save As** options save your report in an internal format (an *.rtl report), which can later be opened with the program. Saving an *.rtl file will also save the folder name, date and time information for the files used to create the report, so that further views can be created (assuming that these underlying files have not been overwritten or otherwise destroyed; the system provides a warning for this scenario). You may also export the files in formats suitable for use by external software systems.

Saving an RTL File

To save your current report in the format used internally by LifeLine™, either click on the diskette icon in the Toolbar

or choose **File/Save** or **File/Save as** on the Menu Bar. You will be shown a dialog box that prompts you for the name of the file (the file type is fixed as *.rtl), and allows you to select the directory in which to save the file (the default is \RTL\WORKSPACE). This option saves both the spreadsheet and graph forms of the file. Files saved in this manner can be displayed again using folder icon

or the **File/Open** option in the program.

The system provides a warning about the link between the view in the .rtl file and the underlying exposure analysis files.

Exporting View Files

The **Save** and **Save As** functions save your report (and pointers to its source data) in an internal format that provides for efficient plotting. For other purposes (e.g., creating formal reports), it may be more useful to save these data in a common exchange format. LifeLine™ supports the export of both the graphical and spreadsheet displays produced by *RDER*. Export of spreadsheets and graphs is, however, independent. Saving a graph will not save the corresponding spreadsheet, nor vice versa.

If a graph is being displayed (and is selected)[14], the **File/Export Graph** option on the Menu Bar is active. If a spreadsheet is being displayed (and is selected), the **File/Export Spreadsheet** option is active.

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[14] 　　　If the desired export option is not active but the correct display is showing, click on the spreadsheet or graph to activate the display.

Exporting Graphs

Graphs (but not tables) may be exported as picture files (Windows metafiles, bitmaps, or JPEG files) for incorporation into documents, later printing, etc. To export a graph, choose **File/Export graph** from the Menu Bar. This will call up a window that will prompt you to supply a name for the file and to select which of the three export formats you wish. It will also display all files of that type in the \HRI\RTL\Workspace directory. As in the case of file opening, you may change the directory or drive for exporting.

Exporting Spreadsheets

Spreadsheets (but not graphs) may be exported as an Excel spreadsheet or dBASE IV format file. To export a spreadsheet, choose **File/Export Spreadsheet** from the Menu Bar. Clicking on this option calls up a dialog that allows you to select the directory in which the view should be saved (the default is the \RTL\Workspace directory), to specify a name for the file, and to choose either Excel or dBASE format.

DOCUMENTING YOUR ANALYSIS (CREATING AN AUDIT TRAIL)

INTRODUCTION

The output of any exposure or risk analysis is meaningless without information on the data and assumptions that were used to generate it. LifeLine™ is structured to allow you to document your inputs, to identify the survey data used in each exposure estimate, and to provide you with detailed information on each individual's exposure, dose, and risks.

This built-in documentation does not relieve you, the assessor, of your responsibility to fully document your analysis. Each component program of LifeLine™ software allows you to print hard copies of your inputs and to export electronic files to Excel or dBASE. However, the generation of output reports is dependent upon maintaining accurate files that represents the data you used in you assessments. If these files are overwritten, you will not be able to generate further outputs.

WHAT EXPOSURE.DBF CAPTURES

The main output of the *LifeLineÔ Model* is the dBASE file EXPOSURE.DBF. This file captures exposure (dose) data only. The file is very large, because it captures seasonal average and seasonal maximum data for every year of each modeled individual's life, and because there are multiple exposure metrics (routes, sources, and time frames) as described above.

What the main file does *not* capture, however, is either the user-supplied data and assumptions used in the analysis (e.g., the chemical properties and toxicity data for the AI or the quantitative descriptions of activities) or the intermediate conclusions of the analysis (e.g., the house in which a given modeled individual was living, or her activity patterns or diet). The information on the user-supplied data and assumptions is stored in the four input files used in the analysis:

- Risk Group File (*.RKG);
- Activity Description File (*.ACD);
- Commodity and Food Residue File (*.RES); and
- Tapwater Concentration File (*.TWC).

The data on the intermediate conclusions are stored in the four exposure analysis files that you can generate when you conduct your analysis:

- Person demographics and residential characteristics (LIVES.DBF);
- Dietary daily doses (DIET.DBF);
- Residential activities (RACTIV.DBF); and
- Residential pesticide use (RESPUSE.DBF).

It is essential to maintain the input files in order to replicate your analyses. Consequently, all input files are essential to your "audit trail." The exposure analysis files are informative about the factors that underlie your predictions of exposure and risk, but are not essential to an "audit trail."

NOTE:

LifeLine™ is a <u>probabilistic</u> exposure analysis system. This means that each run, even with identical inputs, produces a unique pattern of outputs. For large sample sizes, the results of multiple runs will be very similar. Small sample sizes, however, may yield very different results for different runs.

PRESERVING YOUR INPUT FILES

Fundamentally, the best way to preserve your input files is to <u>not overwrite</u> any input file that has been used in the analysis. If you want to modify an input file (for example, to conduct a "what-if" comparative analysis), use a different filename when saving the file.

Printing and Exporting Files

Each of the programs that allow you to generate or edit an input file supports both the printing of the file [or corresponding report file(s)] and the export of the file to Excel or dBASE format. Specific instructions are provided with the description of each component program.

It is good practice to create both hardcopy and export files for each of your input files whenever you conduct an exposure or risk analysis using LifeLine™.

Preserving Your Results

After you have conducted an analysis, you can save all of the output information that you generated by moving the corresponding files to a directory other than the LifeLine™ working directory. The *LifeLineÔ Model* provides a tool for this specific purpose. This is necessary because the system uses certain output filenames every time it is run [and consequently overwrites the corresponding file(s)].

Once you have generated the (tabular or graphical) views of your results that you believe are most informative, you can also save them, export them, or print them as well. Instructions for doing so are provided in the section that describes the *Risk-Dose-Exposure Reports* program. Each saved (as opposed to exported) report contains pointers to the input files that were used to generate it. Again, it is good practice to save all of the important views of your results, while printing or exporting these views may help in the creation of your exposure / risk analysis report.

MINIMUM REQUIREMENTS FOR AN "AUDIT TRAIL"

Obviously, the more information that is saved from any analysis, the better suited it is to subsequent evaluation and confirmation. Because of the immense amounts of data generated by a probabilistic analysis of exposures to each member of a population over a lifetime, however, there is an incentive not to save every input and output developed as a particular exposure and risk analysis evolves.

For any analysis that is to be presented outside the group involved in generating it, however, the contents of the following files must be preserved (either saved, printed, or exported):

- The Risk Group (*.RKG) file that describes the fundamental characteristics of the Active Ingredient;
- For analyses that include dietary exposure, the Residue (*.RES) file, or the reports that describe its inputs and outputs;
- For analyses that include residential exposure, the Activity Description (*.ACD) file (residential pesticide use data will be captured in the Risk Group file); and
- For analyses that include tapwater exposure, the Tapwater Concentration (*.TWC) file.

Instructions for saving and/or printing and exporting each file are presented in the section that describes the corresponding program.

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[14]   Coverage assigns the Probability of Use factor to the season(s) to which it applies

[14]   0 = annual, 1 = spring, 2 = summer, 3 = fall, 4 = winter

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[14]   Upfactor means the Probability of Use factor