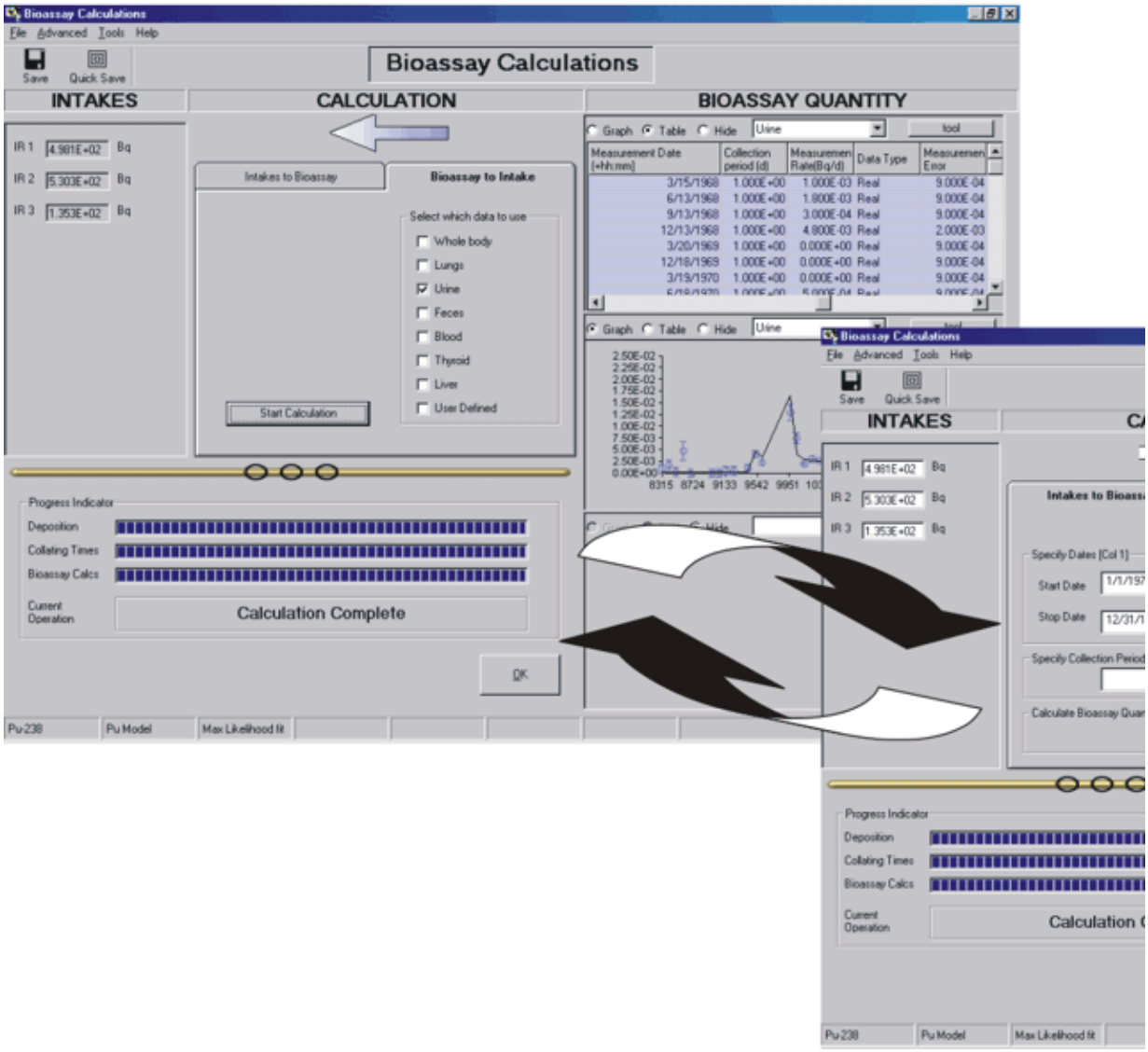
Bioassay Calculations Screen



The ***Bioassay Calculations Screen*** (Figure 4.1) opens when you *click* the **"Bioassay Calculations"** *button* (on the **Main Screen**).

The screen works as follows:

1. You *select* the direction of the CALCULATION in the **center** of the screen. This can be **from** BIOASSAY QUANTITY **to** INTAKE(S) - the default setting, or **from** INTAKE(S) **to** BIOASSAY QUANTITY.
2. The **calculated** (or **hypothetical**) values of INTAKE(S) are displayed on the **left**.
3. The **predicted** and/or **measured** values of the BIOASSAY QUANTITY are displayed on the **right**.

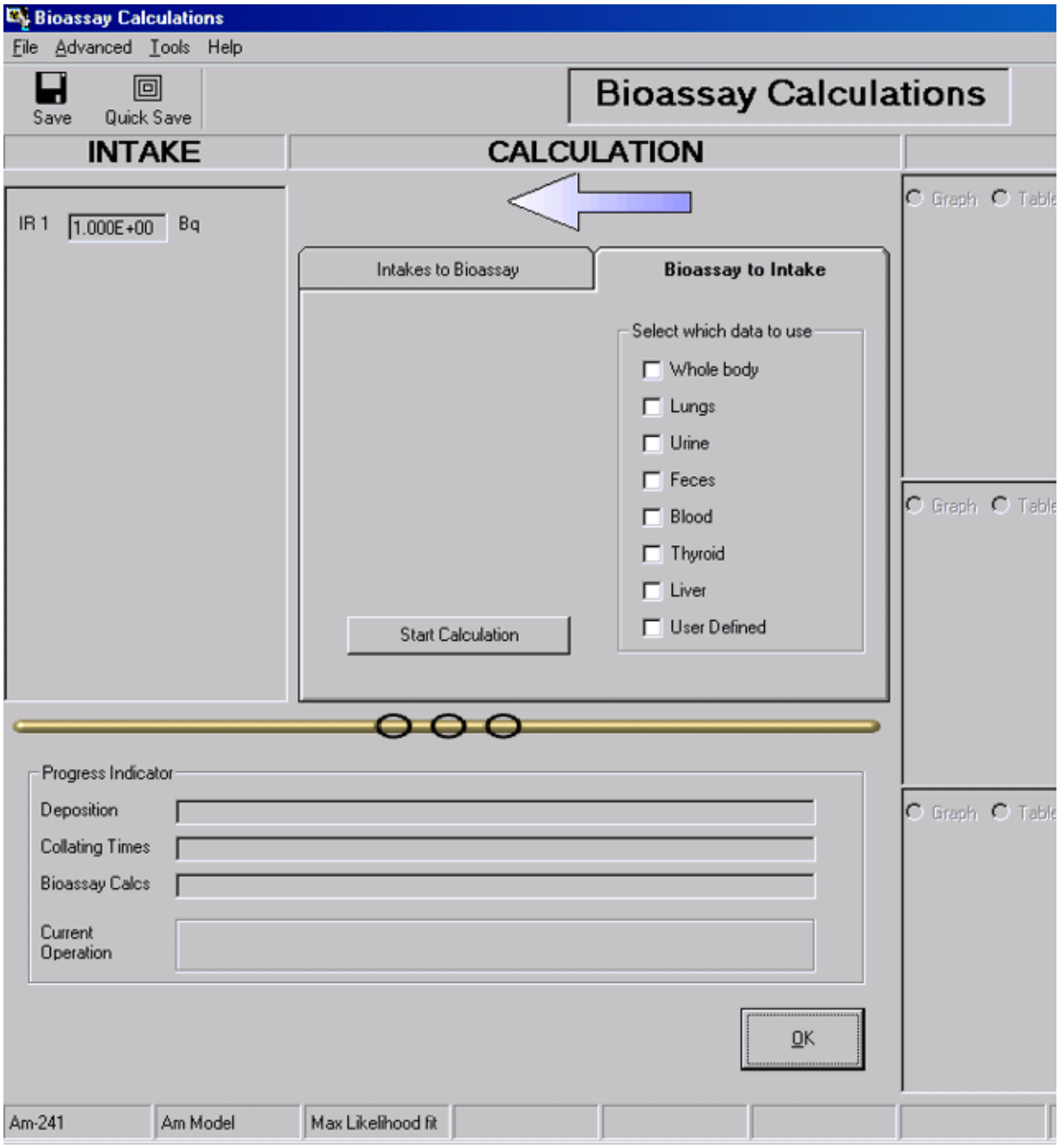


Figure 4.1. The **Bioassay Calculations** screen.

The screen is divided into these functional parts - from the top:

- Menu Bar.
- Short-cut Icon.

Main panel:

1. Intake sub-panel - left side
2. Calculation sub-panel - center
3. Bioassay Quantity sub-panel - right side.

Bottom left corner panel:

- Progress Indicator**.**

Bioassay Menus

The **Menu Bar**, shown at the top of the **Bioassay Calculations** window, gives the following options:

- File menu.
- Advanced menu.
- Tools menu.
- Help menu.

Bioassay File Menu

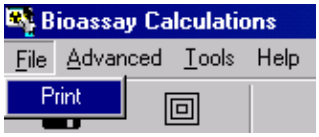


Figure 4.2. Drop-down bioassay **File** list box.

Click **File | Print** to send a screen dump of the displayed **Bioassay Calculations** screen to your Windows® printer - ***e.g.*** Figure 4.3.

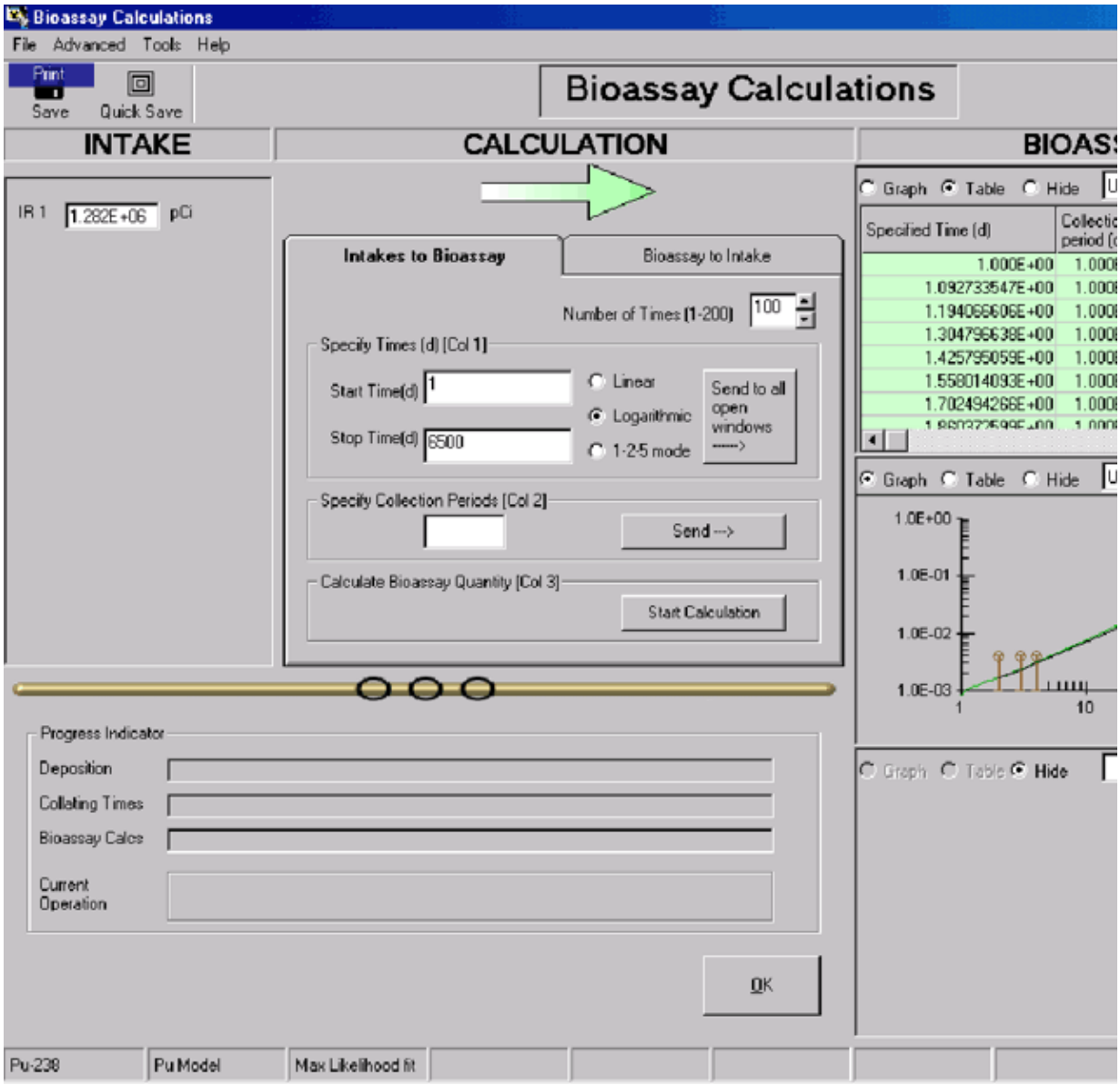


Figure 4.3. Printed screen dump of **Bioassay Calculations** screen.

Figure 4.3 shows the printed image of the **Bioassay Calculations** screen with the example parameter file "**USTUR0259.ix**" loaded.

Bioassay Advanced Menu

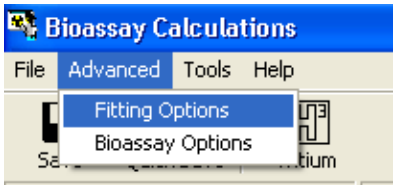


Figure 4.4. Advanced menu ***options for*** Bioassay Calculations**.**

The "Advanced" ***menu enables you to select from the following*** Advanced Dosimetry Options**:**

- Fitting ***- select from*** "Least Squares"**,** "Maximum Likelihood" ***(the default), or*** "Bayesian" fitting methods ***(Figure 4.5).***

- Bioassay ***- enable (Figure 4.6) the special feature to calculate*** ingrowth of Am-241 activity ***in the lungs from an intake of plutonium isotopes (containing a known fraction of*** ^{241}Pu ***activity).***

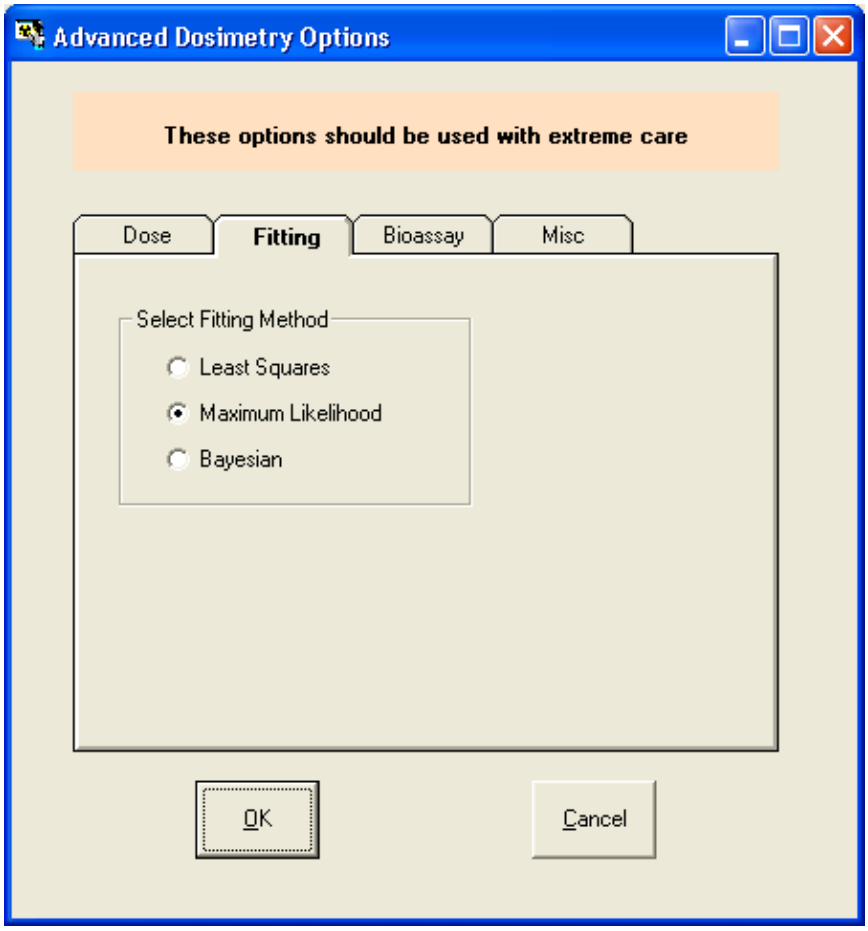


Figure 4.5. ***Selecting*** Fitting ***options in the*** Advanced Dosimetry Options window.

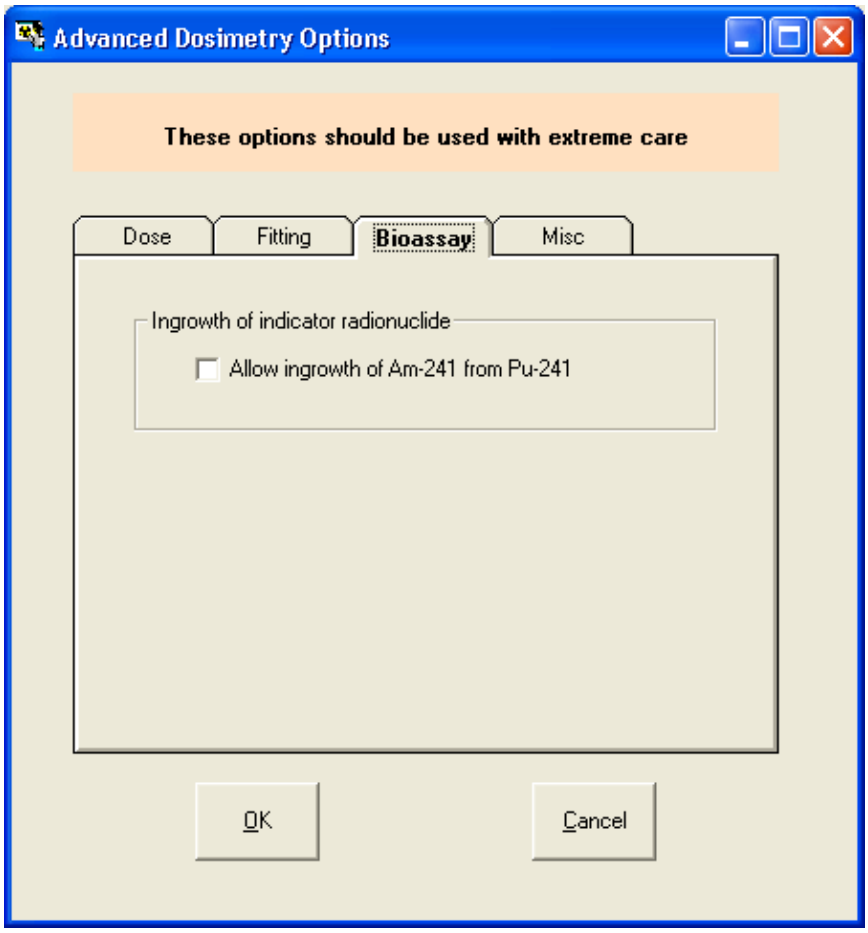


Figure 4.6. ***Enabling the*** Bioassay option ***to measure ingrowth of*** ^{241}Am ***activity (from*** ^{241}Pu***).***

Bioassay Tools Menu

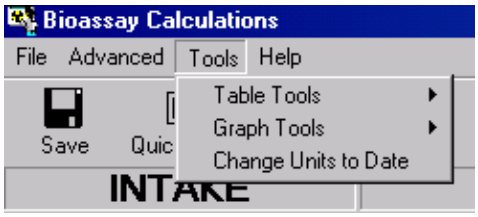


Figure 4.7. Drop-down ***Bioassay Tools*** list box.

The Bioassay Tools options are:

- ***Table Tools*** - Enable you to open the Table Tool (spreadsheet-like facility) to enter and/or edit bioassay data, sample time (or date), and sample duration (for urine and feces), for any ***one*** of the three ***Bioassay Quantity*** windows (see Figure 4.8).
- ***Graph Tools*** - Enable you to open the Graph Tool (graph editing facility) to specify how you want a graph to be displayed (ranges of the x- and y-axes, linear or logarithmic plots) for any ***one*** of the three ***Bioassay Quantity*** windows (see Figure 4.9).
- ***Change Units to Date*** - toggle instantly between ***Time Units*** of ***Date*** or ***Time (d)*** throughout the program (all three screens) - see Figure 4.10.

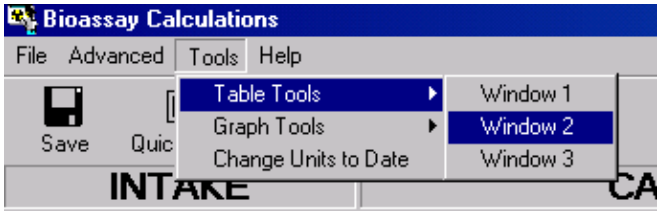


Figure 4.8. Drop-down list of ***Bioassay Quantity*** windows for using ***Table Tools***.

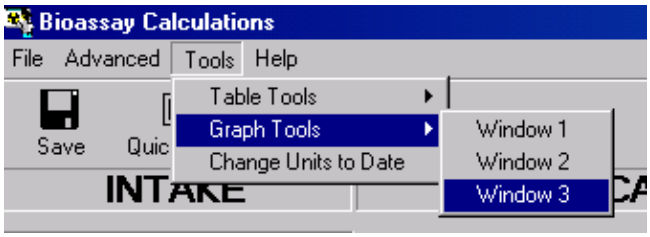


Figure 4.9. Drop-down list of ***Bioassay Quantity*** windows for using ***Graph Tools***.

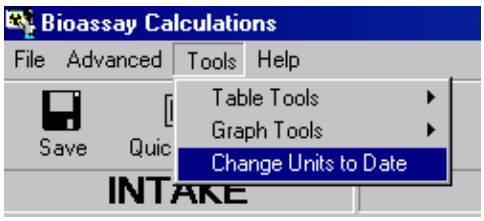


Figure 4.10. Toggle control to change the ***Time Units***.

Selecting "***Change Units to Date***" will switch the ***Time Unit*** shown in all ***Bioassay Quantity*** tables to ***Date (+hh:mm)*** - calendar ***Date*** plus two-digit ***Hour*** and ***Minute*** values (Figure 4.11).

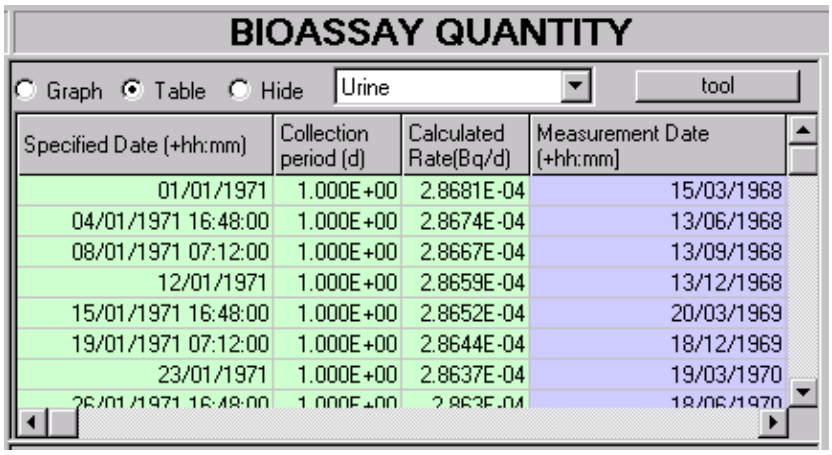


Figure 4.11. Displaying when samples were taken as a ***Date (+hh:mm)*** as the alternative to the default display of ***Time (d)***.

The label of the ***Change Time Units*** control will switch automatically once you make a change (Figure 4.12) - so that you can easily toggle back to the original ***Time/Date*** unit.

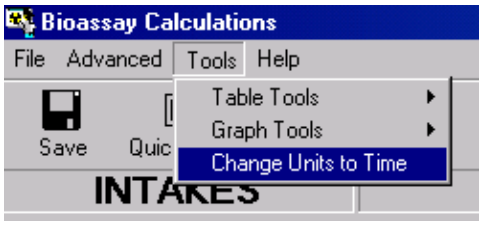


Figure 4.12. "***Change Units***" label switches automatically to enable toggling between ***Time*** and ***Date***.

Bioassay Help Menu

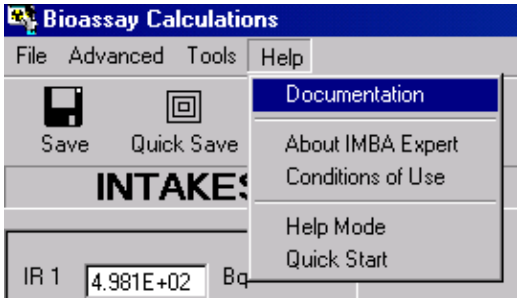


Figure 4.13. Drop-down **Bioassay Help** list box.

The **Help** features available from the **Help Menu** in the **Bioassay Calculations** screen are the same as those available from the **Main Screen** (Figures 3.13 through 3.16). So, while setting up **Bioassay Calculations**, you do NOT have to return to the **Main Screen** to access the **Help** features.

Data Housekeeping

The **Bioassay Calculations** screen is designed to:

1. Make it easy for you to Save your entered data at any stage of data entry.
2. Make it easy for you to Exit and return to the **Main Screen** (to revise **Model Parameters** and/or **Intake Regimes**) without losing any of your bioassay data.

Bioassay Save Icons

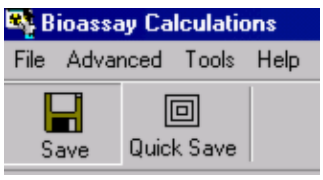


Figure 4.11. Bioassay Save icon.

Clicking the "**Save**" icon in the **Bioassay Calculations** screen saves all of the displayed values in the current **Parameter File** ("***.ix**"). You can do this at any time (except when *IMBA Professional* is performing a calculation), for example, at several points while entering a long series of bioassay data. When you exit the **Bioassay Calculations** screen (to return to the **Main Screen**), the **Parameter File** is automatically updated with all of the displayed data.

Clicking the "**Quick Save**" icon (Figure 4.12) saves all of the displayed values (and all other parameter values) in the default **Parameter File** (named "**Parameters.ix**").

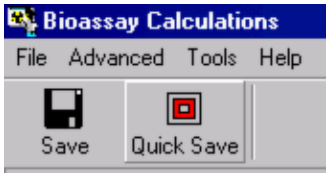


Figure 4.12. Bioassay Quick Save icon.

Closing the Bioassay Calculations Screen

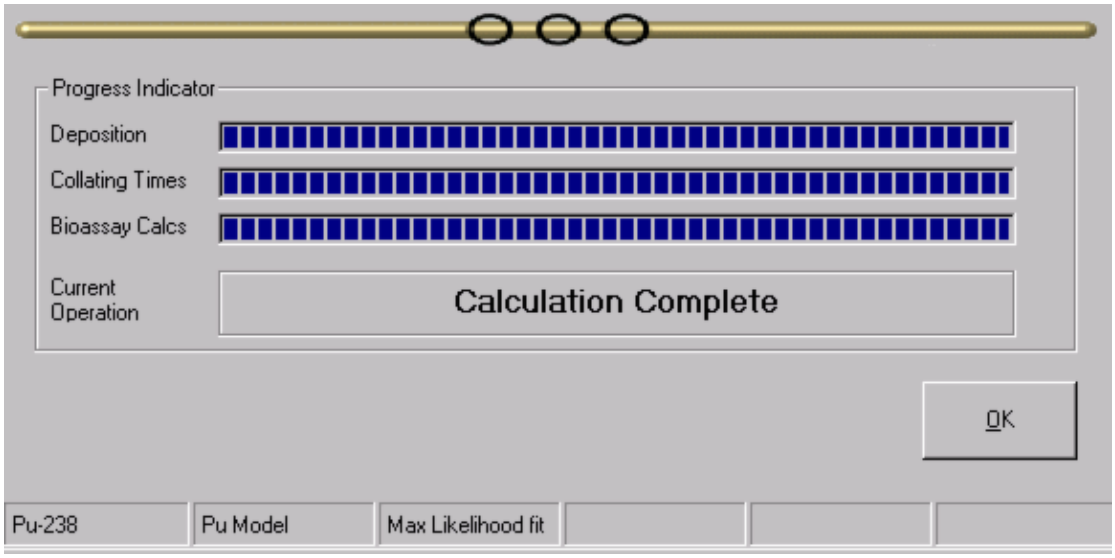


Figure 4.13. The "O**K**" button for closing and exiting the **Bioassay Calculations** screen.

You can return to the **Main Screen** at any time (except when *IMBA Professional* is performing a bioassay calculation) by clicking the "O**K**" button (bottom-left panel of the **Bioassay Calculations** screen - see Figure 4.13).

Warning: ***Using the "**OK**" button to close the** Bioassay Calculations ***screen leaves all of the values that were displayed (and the current values of non-displayed bioassay data) in*** memory***. It does NOT automatically*** save ***these values to the*** Parameter File***. You must choose to do this yourself - by*** clicking ***the "**Save**" icon. If you*** exit *IMBA Professional* ***without first*** saving ***the*** Parameter File***, any updated parameter values will be*** lost***.***

Tip: ***You can also*** exit ***the*** Bioassay Calculations ***screen by*** clicking ***the Windows® "**X**" in the top-right corner of the screen. Again, this leaves the bioassay data in*** memory***, but NOT*** saved ***to the*** Parameter File***.***

Performing Bioassay Calculations

All bioassay calculations are *run* from the **CALCULATION** panel - top-center of the **Bioassay Calculations** screen. The calculation can go in either direction:

1. From **right** to **left** - Bioassay Quantity (Measurements) to estimated Intake(s) - as indicated by a **blue** arrow (Figure 4.14).

2. From **left** to **right** - value(s) of Intake(s) to predicted Bioassay Quantity - as indicated by a **green** arrow (Figure 4.15).

The **arrow** colour indicates whether the bioassay data shown in a **Bioassay Quantity Table** are **measured** or **predicted** values, *i.e.*:

1. **Measured** bioassay values are always displayed on a **blue** background.

2. **Predicted** bioassay values are always displayed on a **green** background.

The same **colour coding** is used for a **Bioassay Quantity Graph**, *i.e.*:

1. **Blue** lines are used to join the values of a **Bioassay Quantity** that are **fitted** to the **measured** data.

2. **Green** lines join the **predicted** values of a **Bioassay Quantity**.

You can *toggle* the bioassay calculation in either direction, simply by *clicking* the **coloured arrow** (to reverse its direction) - or by *selecting* the required **index tab** ("**Intakes to Bioassay**" or "**Bioassay to Intake**").

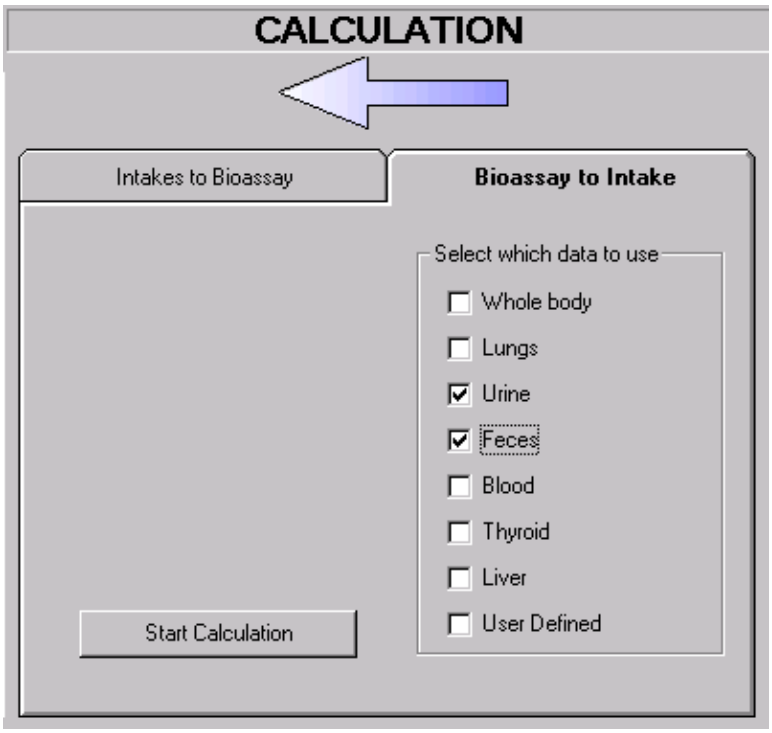


Figure 4.14. Bioassay calculation set as "**Bioassay to Intake**" and indicated by a **blue** arrow.

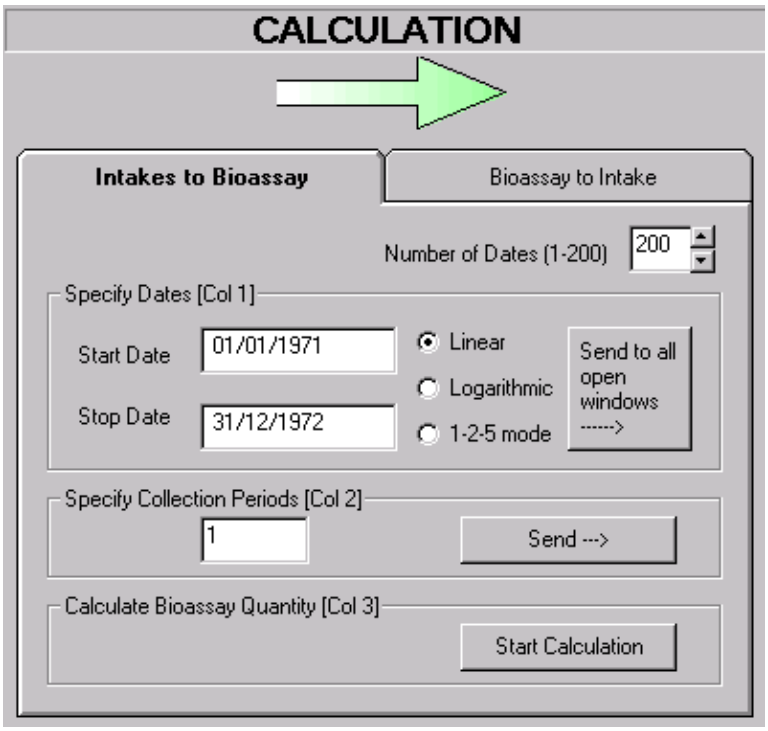


Figure 4.15. Bioassay calculation set as "**Intakes to Bioassay**" and indicated by a **green** arrow.

From Bioassay Measurements to Intake(s)

For a single intake (and a single set of bioassay data), provided that the time of the intake and the aerosol and absorption characteristics of the material are known, then calculation of the most likely amount of intake is simple and straightforward.
However, for multiple intakes (**Star Feature**) without precise knowledge of the times and nature of the intakes, estimating the intake amounts must be done by **iteration**. In general, this will involve:

- ***Defining*** a hypothetical set of parameter values to provide an **initial estimate** of the intake amounts.
- ***Examining*** the "goodness-of-fit" of the corresponding predicted bioassay quantity to the measured bioassay data.
- ***Refining*** the assumed values of unknown parameters (within realistic bounds).
- ***Calculating*** the resulting new estimates of the intake amounts.
- ***Re-examining*** the resulting "goodness-of-fit" of the predicted bioassay quantity.
- ***Repeating*** this iterative process until an adequate fit to the measured bioassay data is obtained (with justifiable parameter values).

IMBA Professional provides the computational tools needed to facilitate the iterative "fitting" process, while allowing you to control this by exercising your own judgment. You can switch very easily between estimating the intake amounts and graphically comparing the predicted and measured values, as you proceed through the iterative process of refining the assumed parameter values.

The following sections of the **User Manual** give **step-by-step** examples (with real data) of:

1. estimating a **single intake** at a known time and for known material characteristics;
2. estimating **three separate intakes** (**Star Feature**) with uncertain times of intake and material characteristics.
3. estimating an intake using **multiple bioassay quantities** (**Star Feature**).

These examples will introduce you to the main "built-in" features and functions of IMBA Professional that are provided for **bioassay analysis**. Or, you can "browse" through the Visual Tour of all features and functions available for bioassay calculations.

- **Example** of simple estimation of single intake.
- **Example** of iterative estimation of multiple intakes (**Star Feature**).
- **Example** of estimating intake using multiple bioassay quantities (**Star Feature**).
- **Visual Tour** of the Bioassay Calculations screen and its functions.

From Intake(s) to Bioassay Quantity

Calculation of the amount of a **Bioassay Quantity** as a function of the **Time** variable is used to:

- plan a **Bioassay Program** - by calculating the **expected amount** at prescribed **time points**;
- provide **fine time-resolution** in the **predicted bioassay quantity** for graphical comparison with the measured data - as an integral part of the **fitting procedure for estimating Intake(s)**.

The application of the "**Intakes to Bioassay**" calculation to the **fitting procedure** is illustrated in Figure 4.16. See also:

- the Example of a Single Intake Estimation;
- the Example of a Multiple (Iterative) Intake Estimation (**Star Feature**).
- the Example of Multiple Bioassay Quantities (**Star Feature**).

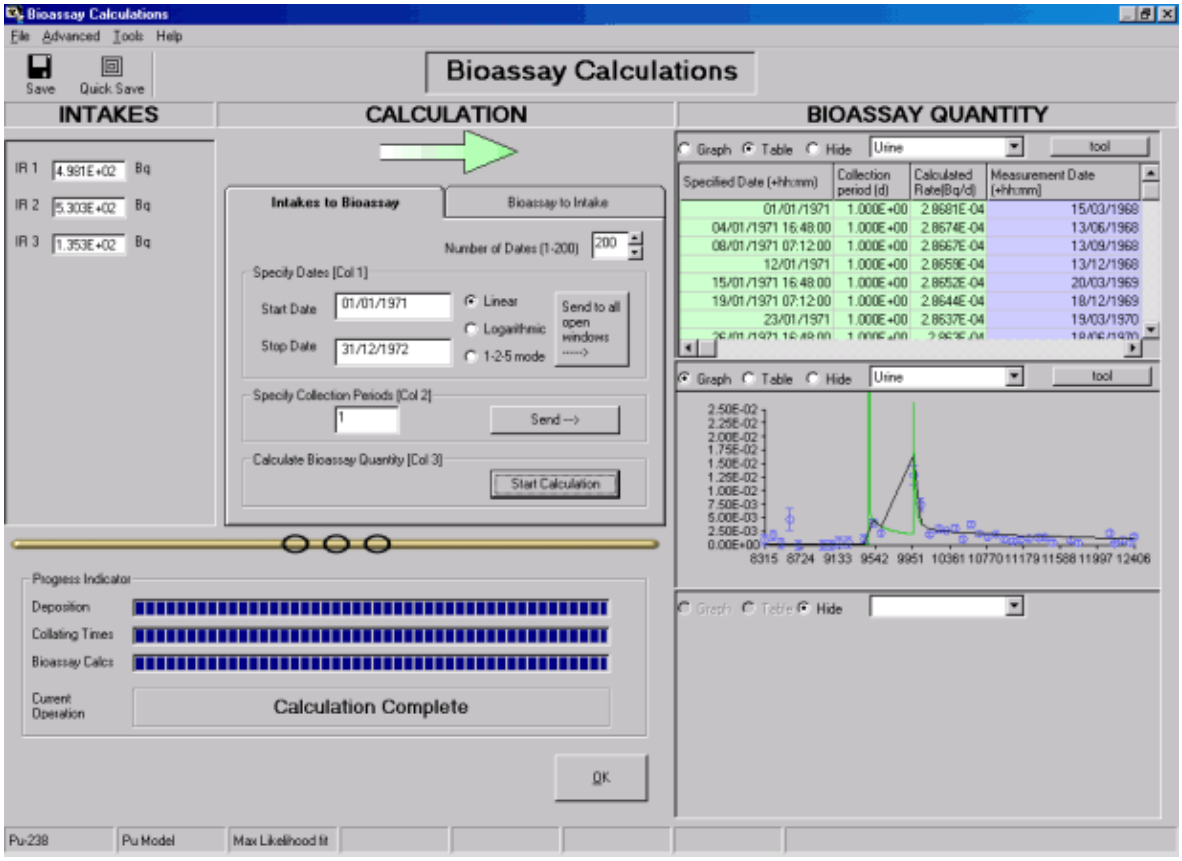


Figure 4.16. "**INTAKES**" sub-panel displays **Intake** amounts for up to 10 **Intake Regimes** (**IRs**).

Am-241 As Indicator Of Plu-241

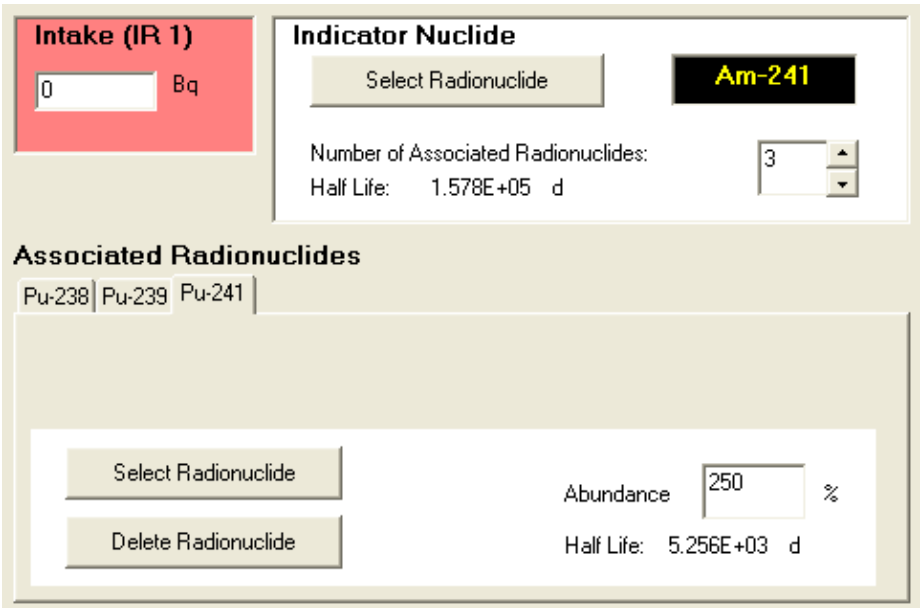


Figure 4.17. Combination of 241**Am** as the Indicator Nuclide and 241**Pu** as an Associated Radionuclide.

Important: ***The*** Abundance ***of each*** Associated Radionuclide ***is defined as the fraction of the activity of the*** Indicator Nuclide***. In the current version of*** IMBA Professional Plus ***you can define the*** Abundance ***separately for each individual intake (at the time of each intake). Alternatively, you can define a single*** Abundance ***(or set of isotopic ratios) to apply at t = 0, in common for all intakes – see Figure 4.18.***

In cases where inhalation of relatively insoluble forms of plutonium has occurred, and the inhaled plutonium contains a significant amount of ^{241}**Pu**, higher sensitivity for lung counting can often be achieved by measuring the activity of the ^{241}**Am** progeny (59.5 keV and 35.7% abundance γ**-ray**) rather than the low-energy and low-abundance **L X-rays** emitted by ^{239}**Pu** (and ^{238}**Pu**). For particulate material retained in the respiratory tract, it is reasonable to assume that the absorption of ^{241}**Am** (from the particle matrix) will occur at the same rate(s) as that of the plutonium isotopes. Thus, the ^{241}**Am** activity measured in the lungs should be a good indicator of the parent ^{241}**Pu** activity, and thus the total retained plutonium activity. However, account must be taken of the 14-y decay half-life of ^{241}**Pu**, and the subsequent in-growth of the ^{241}**Am** activity. IMBA Professional Plus includes a special tool to enable this decay and in-growth to be accounted for automatically. Thus, measurements of ^{241}**Am** activity in the lungs can be used to calculate the total lung retention of a defined mixture of plutonium isotopes.

In order to activate this special tool, it is first necessary to define ^{241}**Am** as the Indicator Nuclide and ^{241}**Pu** as an Associated Radionuclide (Figure 4.22). The tool can be activated (Figure 4.23) from EITHER the Main Screen ("**Advanced | Advanced Dosimetry Options**" menu) OR the Bioassay Calculations Screen ("**Advanced | Bioassay Options**" menu).

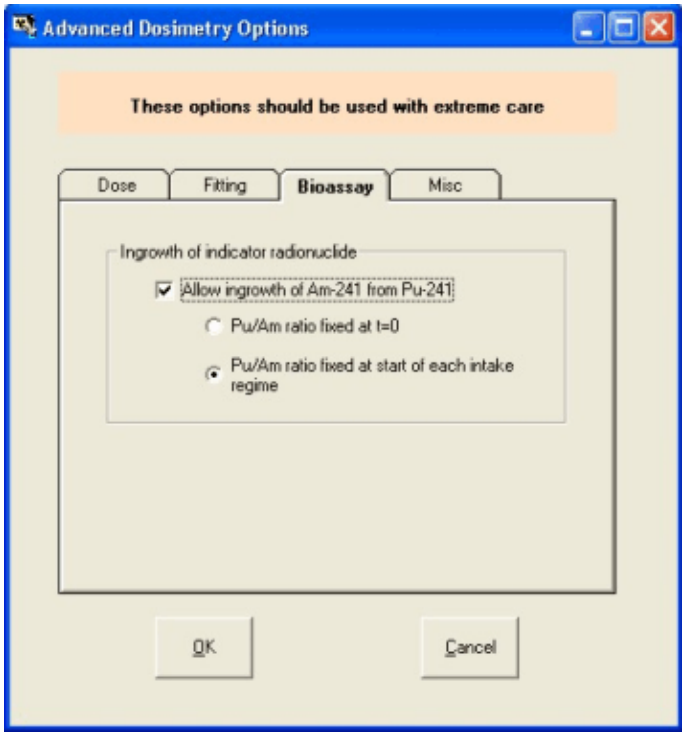


Figure 4.18. Bioassay option to track "in-growth" of ^{241}**Am** as the Indicator Nuclide for ^{241}**Pu** in the lungs.

For a worked example of how to use this "241Am ingrowth" tool, see "Example Cases - Bioassay: Case of Am-241 In-growth".

Important Note: IMBA Professional Plus also calculates the in-growth of ^{241}Am from ^{241}Pu in all systemic organs. However, this calculation assumes that the ^{241}Am produced from decay of ^{241}Pu in systemic organs has the same biokinetic behavior as the parent ^{241}Pu (i.e., the ^{241}Pu **Associated Radionuclide**).

Using the Table Tool for Data Entry

Note: This topic is part of **both** the **single intake** and **multiple intakes** examples. For brevity, only the **single intake** data are illustrated.

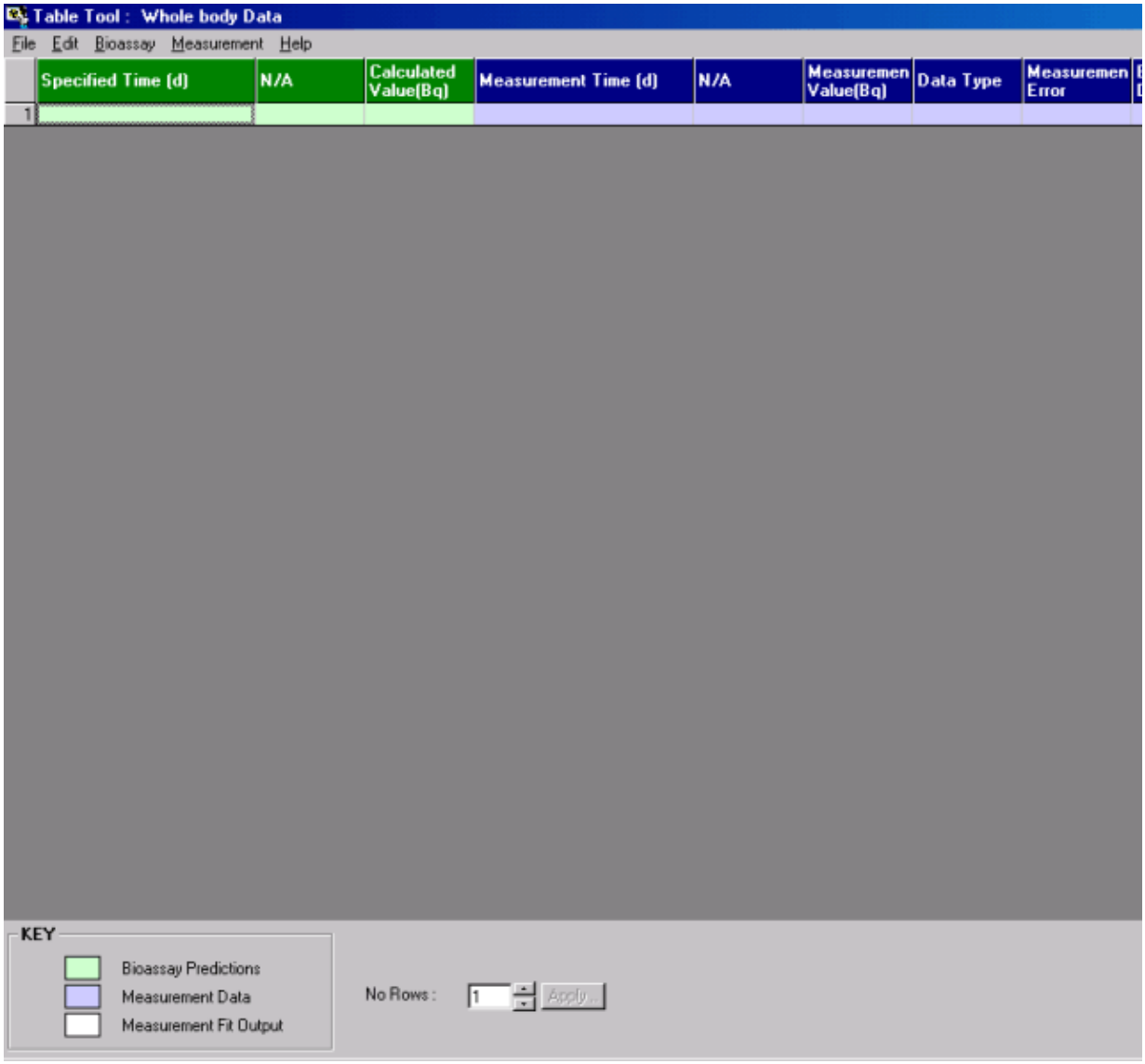


Figure 7.1. Table Tool before data entry - with "Whole body" as the Bioassay Quantity.

The **Table Tool** shows all of the data columns (without you having to scroll left and right). When you open this [from a **Bioassay Quantity (BQ)** window], the **Table Tool** will display the same number of rows as the **BQ** window. When opened with a New (blank) Parameter File, the **default single row** is displayed. Your first task is to open up enough rows to hold all of the **measured bioassay data** that you want to analyse. In the whole-body measurement example for ^{60}Co (Single Intake example), there are **8** values of whole-body activity. So, in that case:

- Ensure that you are opening the **Table Tool** from a **Bioassay Quantity** window that is set to show a Table of "**Whole body**" data.
- Enter "**8**" in the "**Number of Rows**" dialog box (bottom panel, left-of-center) - see Figure 7.2.
- Click the "**Apply**" button to the right of the dialog box.

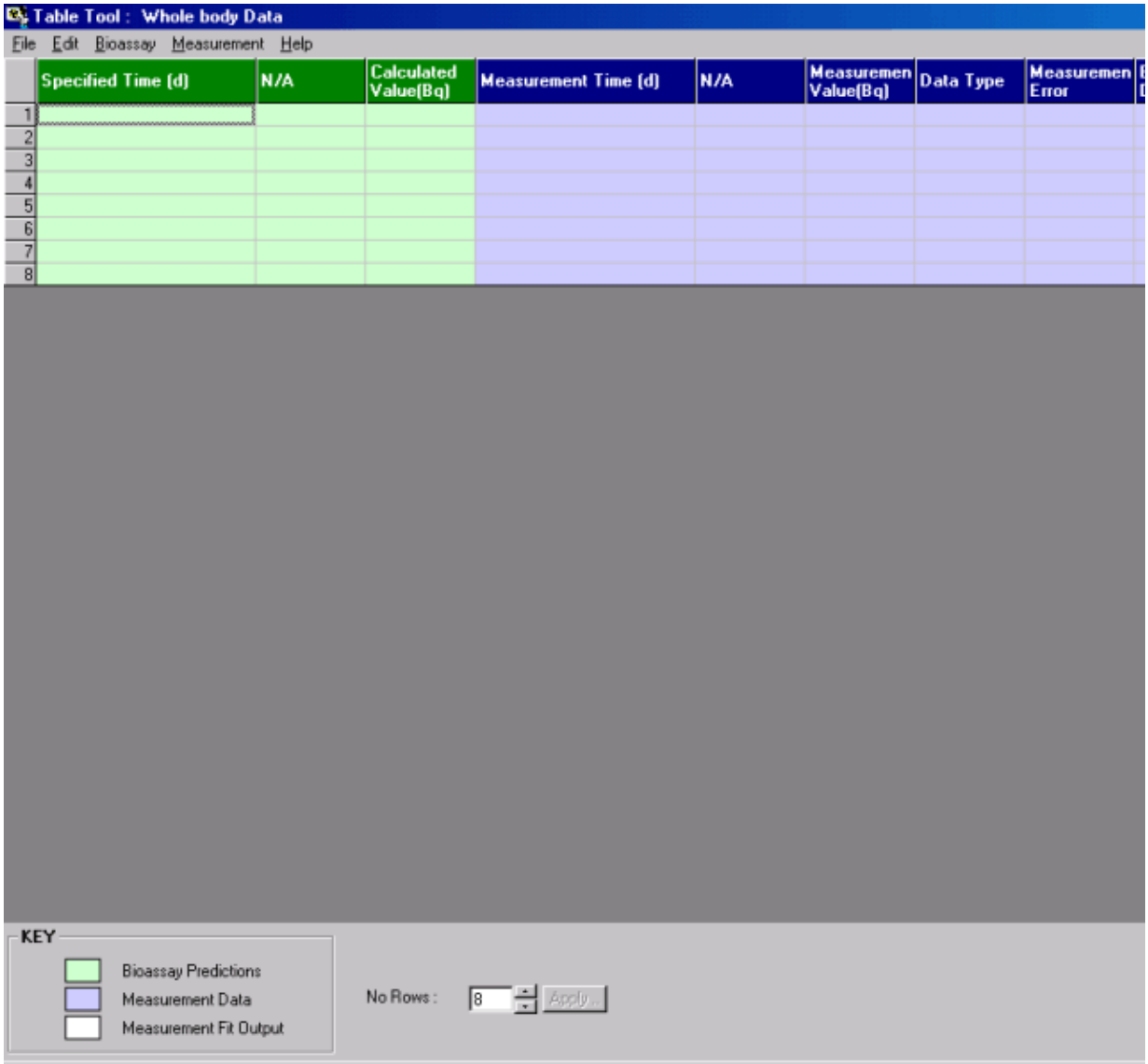
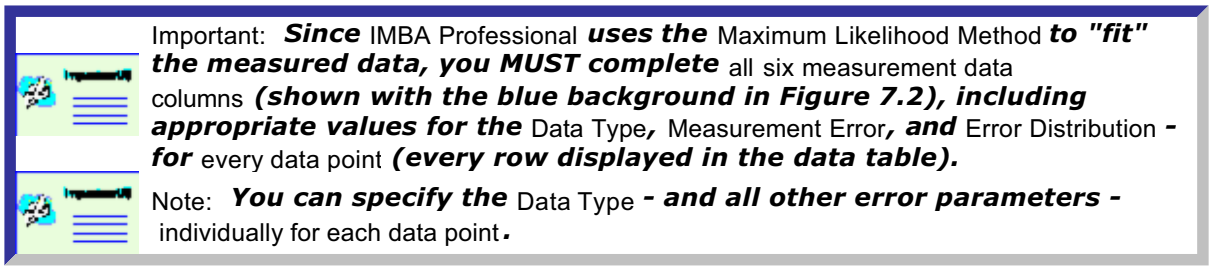


Table 7.2. Table Tool with **8** rows opened.

The data to be entered (in the columns with blue background shown in Figure 7.2) are:

1. **Measurement date** (plus optional **hh:mm**).
2. **N/A column** - leave this blank - a "**Collection period**" is **Not Applicable** for whole-body activity.
3. **Measurement value (Bq)**.
4. **Data Type** (**< LOD**, **Real** or **Excluded**).
5. **Measurement Error** - value of the measurement error.
6. **Error Distribution** - type of error distribution (**NORM** or **LOGNORM**).



Important: ***Since*** IMBA Professional ***uses the*** Maximum Likelihood Method ***to "fit" the measured data, you MUST complete*** all six measurement data columns ***(shown with the blue background in Figure 7.2), including appropriate values for the*** Data Type***,*** Measurement Error***, and*** Error Distribution ***- for*** every data point ***(every row displayed in the data table).***

Note: ***You can specify the*** Data Type ***- and all other error parameters -*** individually for each data point***.***

You have three **options** for entering the **measured bioassay data**:

1. Type this in manually (cell by cell - or block of cells).
2. Copy a block of data into the **Table Tool** from a Windows® application using the Windows® clipboard.
3. Read the data into the **Table Tool** from an external file.

Data validation

Data validation is first performed automatically in the **Table Tool** after the "**OK**" button is clicked. While validation is being performed, the mouse pointer displays an hourglass icon. For large data sets, a status bar is displayed (Figure 7.3). The validation tests performed are:

1. Data in columns is assumed to be part of a continuous set of data - and scrutinised by the validation procedure from the first (top) cell until an empty cell is encountered.
2. Any cell data encountered after an empty cell is ignored by the validation process.
3. The validation routine will halt at the first cell encountered in the data grid that contains invalid data. A message box is displayed, and the offending cell is highlighted.

The criteria for invalid data are:

1. Non-numerical data in cells expected to contain numerical input.
2. Data that cannot be converted to a valid date/time value in cells expected to contain date/time.
3. Columns for "**Collection Period**" are validated only for urinary or faecal bioassay quantities.

If the data validation is successful, the mouse pointer icon reverts to the default, and the **Table Tool** form is hidden.

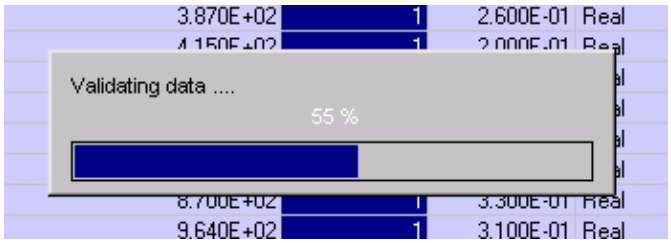


Figure 7.3. Data Validation.

Tip: The "**validation**" feature, whereby IMBA Professional ignores all data entered below an "**empty**" cell, allows you to enter additional information relating to a dataset (but not part of the analysis) - below the data set.

A second, more rigorous, validation is performed automatically before any calculation, to ensure that all data values are sensible.

Select one of these options to:

- Proceed to **Step #8** in the **single intake** example ("**Graphing the Data - Single Intake**");
- Proceed to **Step #10** in the **multiple intake** example ("**Graphing the Data - Multiple Intakes**").

Or:

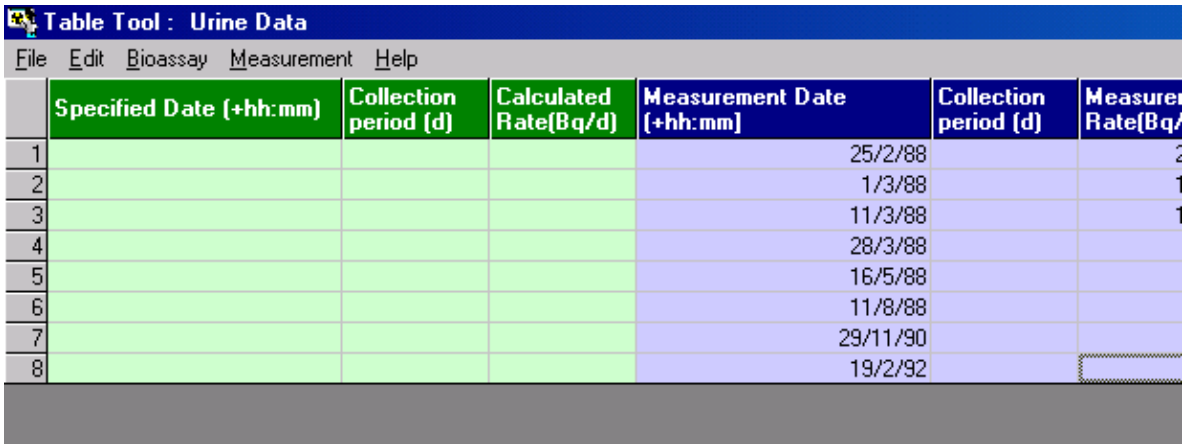
- Return to the **case description** and list of steps for the **single intake** example.
- Return to the **case description** and list of steps for the **multiple intakes** example.

For a comprehensive **catalog** of the features and functions of the **Table Tool**, see Visual Tour of the Table Tool.

Manual Data Entry

Data Columns ## 1 and 3

In this example, the bioassay data to be analysed are comprised of **8** paired values of **Measurement date** and **Whole-body activity (Bq)** - see **Table 1** in Example of Single Intake Estimation. Each pair of values can be typed directly into the **first** and **third** column, respectively, of the **measurement data table** (Figure 7.4).

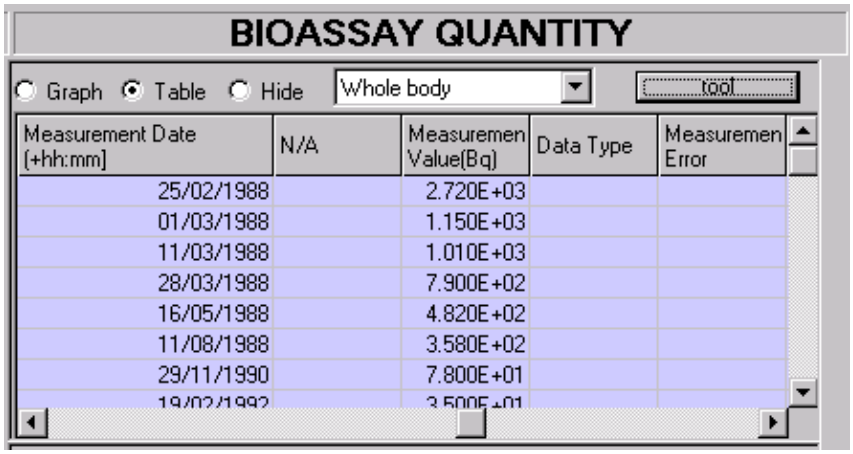


	Specified Date (+hh:mm)	Collection period (d)	Calculated Rate(Bq/d)	Measurement Date (+hh:mm)	Collection period (d)	Measurer Rate(Bq/
1				25/2/88		2
2				1/3/88		1
3				11/3/88		1
4				28/3/88		
5				16/5/88		
6				11/8/88		
7				29/11/90		
8				19/2/92		

7.4. Typing paired values of **Measurement date** and **Measurement value** into the **Table Tool**.

Tip: All common keyboard and mouse functions, e.g., Backspace, arrow keys, highlight, Delete, ^C (Copy), ^V (Paste), will work during manual data entry.

If you now click "**OK**" (bottom right-corner of the **Table Tool**) to return to the **Bioassay Quantity** window - and scroll to the right - you will see the values that you have entered displayed in the table (Figure 7.5).



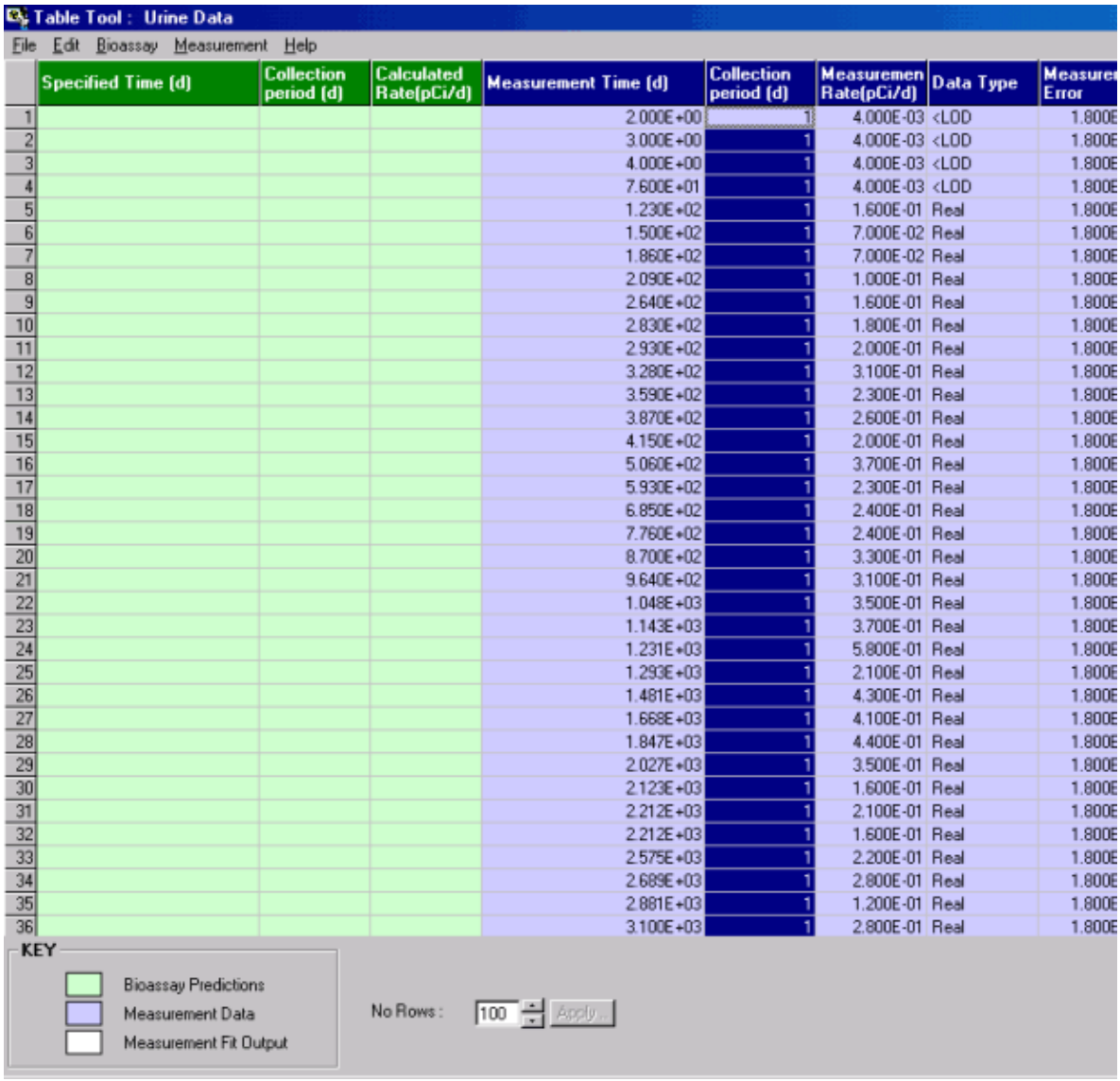
Measurement Date (+hh:mm)	N/A	Measuremen Value(Bq)	Data Type	Measuremen Error
25/02/1988		2.720E+03		
01/03/1988		1.150E+03		
11/03/1988		1.010E+03		
28/03/1988		7.900E+02		
16/05/1988		4.820E+02		
11/08/1988		3.580E+02		
29/11/1990		7.800E+01		
19/02/1992		3.500E+01		

Figure 7.5. Values entered in the **Table Tool** are automatically displayed in the corresponding **Bioassay Quantity** window.

Data Column #2

In this example, the **Bioassay Quantity** is "**Whole body**", so **Data Column #2** is not applicable ("**N/A**"). In this case, the *IMBA Professional* data validation procedure automatically ignores any entries in this column.

If, however, the **Bioassay Quantity** is an **excretion rate** (urinary or faecal), it is necessary to enter the "**Collection Period**" for each sample (**Measurement Value**). The **Table Tool** then provides a **short-cut** for entering repetitive values, e.g., the common collection period of "**1 d**". You simply highlight the whole **column** of cells, and type "**1**" - Figure 7.6.



	Specified Time (d)	Collection period (d)	Calculated Rate(pCi/d)	Measurement Time (d)	Collection period (d)	Measuremen Rate(pCi/d)	Data Type	Measures Error
1				2.000E+00	1	4.000E-03	<LOD	1.800E
2				3.000E+00	1	4.000E-03	<LOD	1.800E
3				4.000E+00	1	4.000E-03	<LOD	1.800E
4				7.600E+01	1	4.000E-03	<LOD	1.800E
5				1.230E+02	1	1.600E-01	Real	1.800E
6				1.500E+02	1	7.000E-02	Real	1.800E
7				1.860E+02	1	7.000E-02	Real	1.800E
8				2.090E+02	1	1.000E-01	Real	1.800E
9				2.640E+02	1	1.600E-01	Real	1.800E
10				2.830E+02	1	1.800E-01	Real	1.800E
11				2.930E+02	1	2.000E-01	Real	1.800E
12				3.280E+02	1	3.100E-01	Real	1.800E
13				3.590E+02	1	2.300E-01	Real	1.800E
14				3.870E+02	1	2.600E-01	Real	1.800E
15				4.150E+02	1	2.000E-01	Real	1.800E
16				5.060E+02	1	3.700E-01	Real	1.800E
17				5.930E+02	1	2.300E-01	Real	1.800E
18				6.850E+02	1	2.400E-01	Real	1.800E
19				7.760E+02	1	2.400E-01	Real	1.800E
20				8.700E+02	1	3.300E-01	Real	1.800E
21				9.640E+02	1	3.100E-01	Real	1.800E
22				1.048E+03	1	3.500E-01	Real	1.800E
23				1.143E+03	1	3.700E-01	Real	1.800E
24				1.231E+03	1	5.800E-01	Real	1.800E
25				1.293E+03	1	2.100E-01	Real	1.800E
26				1.481E+03	1	4.300E-01	Real	1.800E
27				1.668E+03	1	4.100E-01	Real	1.800E
28				1.847E+03	1	4.400E-01	Real	1.800E
29				2.027E+03	1	3.500E-01	Real	1.800E
30				2.123E+03	1	1.600E-01	Real	1.800E
31				2.212E+03	1	2.100E-01	Real	1.800E
32				2.212E+03	1	1.600E-01	Real	1.800E
33				2.575E+03	1	2.200E-01	Real	1.800E
34				2.689E+03	1	2.800E-01	Real	1.800E
35				2.881E+03	1	1.200E-01	Real	1.800E
36				3.100E+03	1	2.800E-01	Real	1.800E

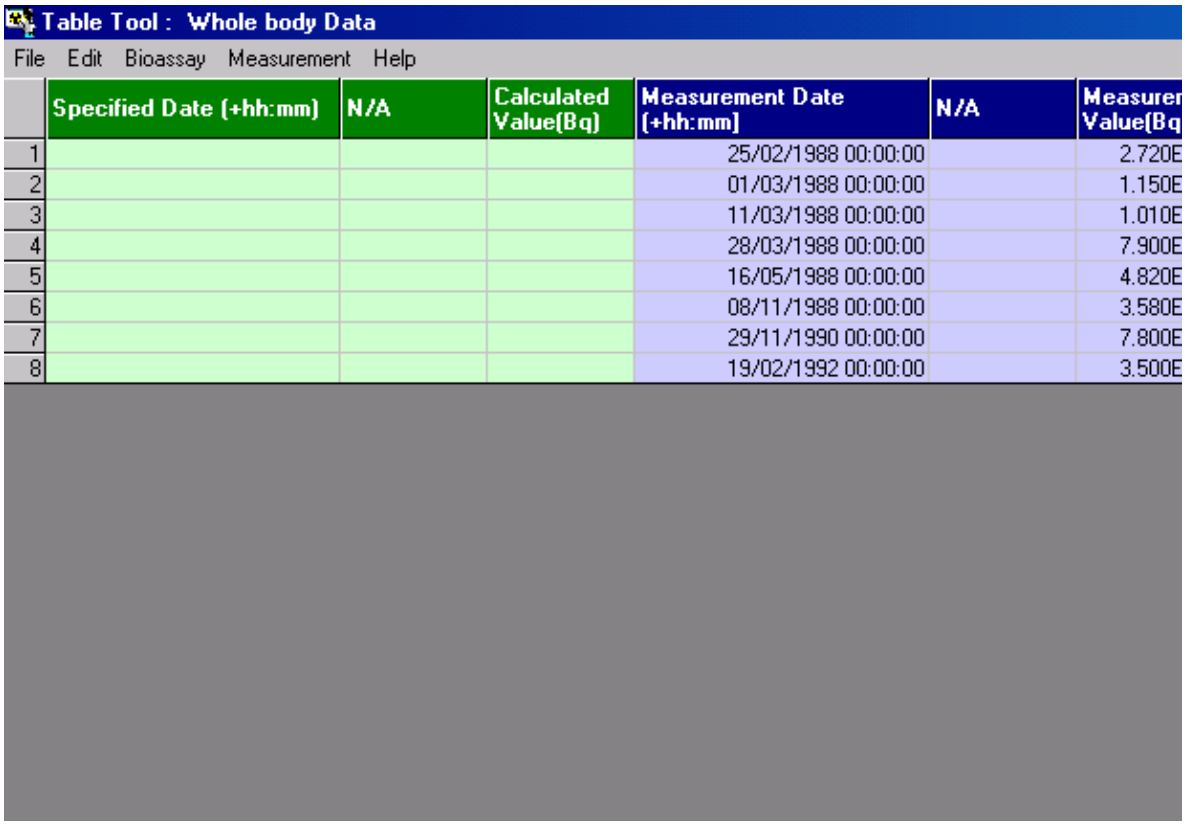
Figure 7.6. Entering the same value in a highlighted block of cells.

Tip: Highlight ***the*** whole ***data column with a single click - by*** right-clicking ***the column*** heading ***- "***Collection Period (d)***" in this case.***

Data Column #4

In this example, all **8** measured values are "**Real**" data, i.e., **finite** measured values. Therefore, "**Real**" must be entered in all cells of the fourth data column. *IMBA Professional* provides a further **short-cut** for doing this in the **Table Tool** (Figure 7.7):

- highlight the whole of the fourth data column;
- right-click on any highlighted cell - the drop-down menu will automatically appear (Figure 7.7);
- select "**Real**" from the drop-down menu.



	Specified Date (+hh:mm)	N/A	Calculated Value(Bq)	Measurement Date (+hh:mm)	N/A	Measurer Value(Bq
1				25/02/1988 00:00:00		2.720E
2				01/03/1988 00:00:00		1.150E
3				11/03/1988 00:00:00		1.010E
4				28/03/1988 00:00:00		7.900E
5				16/05/1988 00:00:00		4.820E
6				08/11/1988 00:00:00		3.580E
7				29/11/1990 00:00:00		7.800E
8				19/02/1992 00:00:00		3.500E

Figure 7.7. Drop-down menu for entering the "**Data Type**."

This will enter "**Real**" in all of the highlighted cells (Figure 7.8).

Measurement Date (+hh:mm)	N/A	Measuremen Value(Bq)	Data Type	Measuremen Error	Error Distribution
25/02/1988 00:00:00		2.720E+03	Real		
01/03/1988 00:00:00		1.150E+03	Real		
11/03/1988 00:00:00		1.010E+03	Real		
28/03/1988 00:00:00		7.900E+02	Real		
16/05/1988 00:00:00		4.820E+02	Real		
08/11/1988 00:00:00		3.580E+02	Real		
29/11/1990 00:00:00		7.800E+01	Real		
19/02/1992 00:00:00		3.500E+01	Real		

Figure 7.8. Entering the "**Data Type**" in all cells of data column #4.

Data Column # 5

In this example, there are **no explicit measurement** errors. However, in order to apply the **Maximum Likelihood Method** to "**fit**" the data, an explicit **error weighting** MUST be defined for every data point. Again, *IMBA Professional* provides a **short-cut** for doing this in the **Table Tool**. This gives you the option of applying:

- a **Uniform Absolute** error;
- a **Uniform Relative** error;
- a **Square Root** error.

In this example, the measured values vary over a large range (from 2720 Bq to 35 Bq). For accurate dosimetry, it is as important to "fit" the small values, as it is to fit the initial high values. In this case, it is reasonable to apply a **Uniform Relative** error to all data points. To do this you simply:

- highlight the whole of the fifth data column;
- right-click on any highlighted cell;

- select "**Generate Errors**" - Figure 7.9.

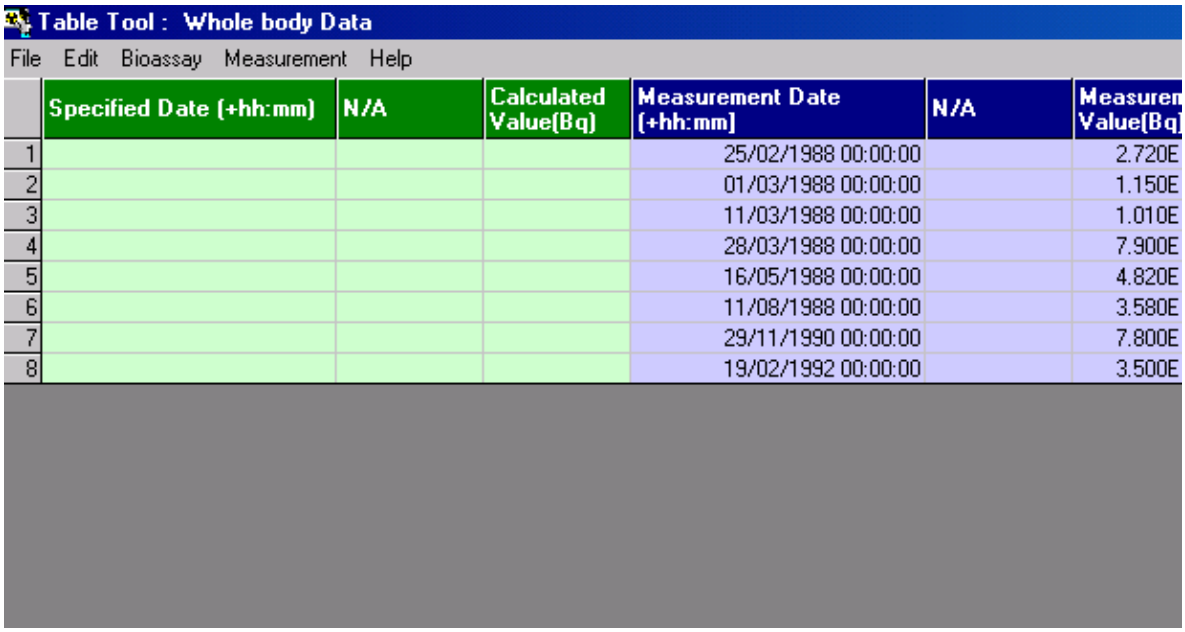


Figure 7.9. Drop-down menu to "**Generate Errors**."

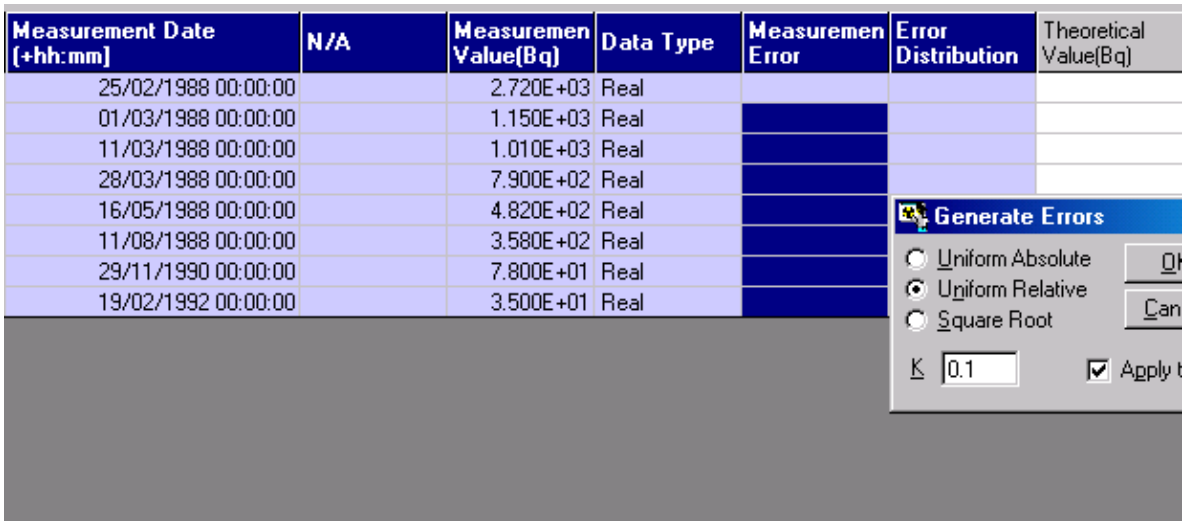


Figure 7.10. The "Generate Errors" window.

In the "generate Errors" window:

- "**Uniform Relative**" error is set by default - or select alternative;
- "A**pply to all**" measurement values is set by default - or un-check to apply to a selected range of measurement values;
- the value of the "**Error Constant**" ("**K**") must be entered.

For a **Uniform Relative** error, the chosen value of "**K**" (when applied to ALL measurement values) has no effect on the fitted value - since all data points are given a proportional error-weighting. "**K**" can be any **non-zero** value. The value "**0.1**" is a convenient **default**. (Figure 7.10).

When you click the "**OK**" button to apply your selected value of "**K**" you will be warned that "**This will overwrite the measurement errors**" - and you will be given an opportunity to change your mind (Figure 7.11).

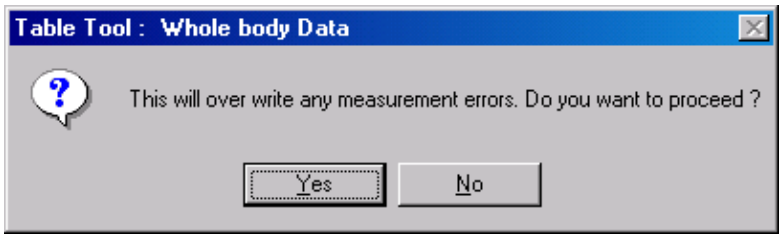


Figure 7.11. **Warning** message before overwriting measurement errors.

Data Column #6

The final data column defines the type of **Error Distribution** for each error value. This is either:

- **NORM** - normal (Gaussian), or;
- **LOGNORM** - lognormal.

To enter the type of **Error Distribution** for all **8** error values (Figure 7.12):

- highlight all of the cells in data column #6 - this will automatically display the **Error Distribution** menu;
- select "**NORM**" - to specify a **Normal** error distribution for all errors.

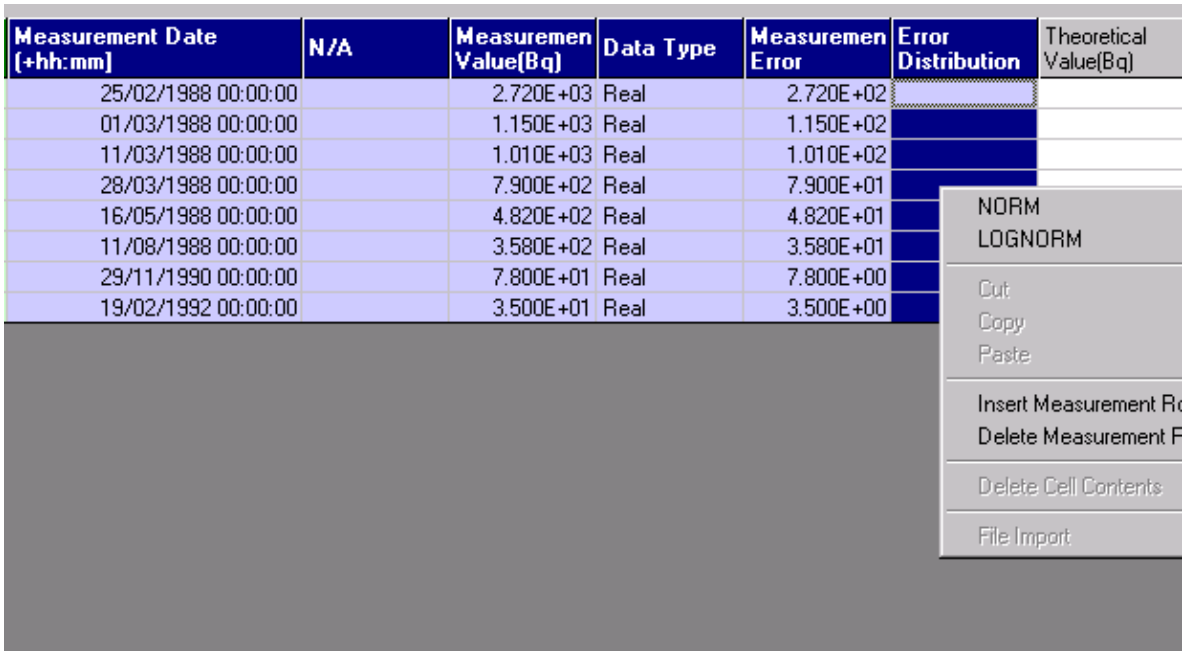


Figure 7.12. Selecting a **Normal** distribution for each error value.

"**NORM**", signifying a "**Normal**" distribution of errors, will then be entered automatically in all highlighted cells of data column #6 (Figure 7.13).

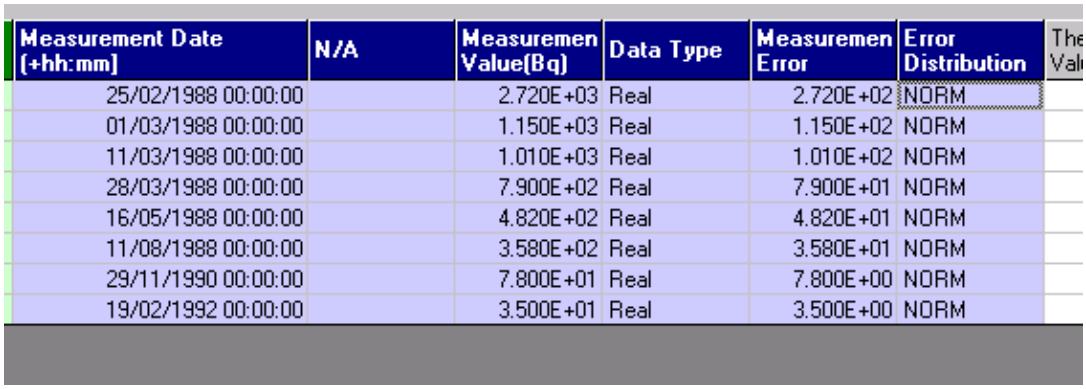
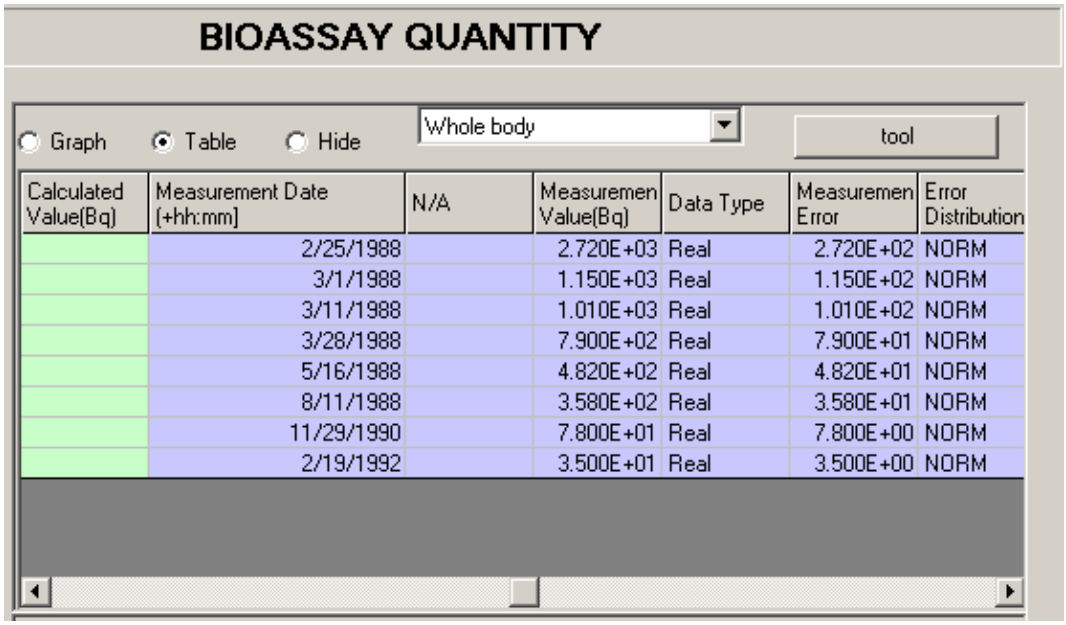


Figure 7.13. Completed measurement data in **Table Tool**.

Completed data table in Bioassay Quantity window

Figure 7.14 shows the resulting completed **table of measurement data**, as it appears in the corresponding **Bioassay Quantity** window.



Calculated Value(Bq)	Measurement Date (+hh:mm)	N/A	Measuremen Value(Bq)	Data Type	Measuremen Error	Error Distribution
	2/25/1988		2.720E+03	Real	2.720E+02	NORM
	3/1/1988		1.150E+03	Real	1.150E+02	NORM
	3/11/1988		1.010E+03	Real	1.010E+02	NORM
	3/28/1988		7.900E+02	Real	7.900E+01	NORM
	5/16/1988		4.820E+02	Real	4.820E+01	NORM
	8/11/1988		3.580E+02	Real	3.580E+01	NORM
	11/29/1990		7.800E+01	Real	7.800E+00	NORM
	2/19/1992		3.500E+01	Real	3.500E+00	NORM

Figure 7.14. Completed **Bioassay Quantity** table of data.

Tip: Right-clicking on any cell in the data table enables you to "**Insert**" or "**Delete**" a **whole row** of measurement data. This automatically **opens** a new "blank" row (below the row that you clicked on), or **deletes** the row that you clicked on, respectively. This does NOT interfere with any rows of values in the first three columns of the **Table Tool** (with green background), which relate to the "**predicted**" bioassay values. The "green" and "blue" columns of the **Table Tool** operate independently.

Example of Single Intake
This completes **Step #7** in the **single intake** example - using **manual data entry**:

- Proceed to the next step - plot a Graph of your data.
- Return to the **case description** and list of steps.
- Check out how to enter data using the Windows® Clipboard.

Example of Multiple Intake
This completes **Step #9** in the **multiple intake** example - using **manual data entry**:

- Proceed to the next step - plot a Graph of your data.
- Return to the **case description** and list of steps.
- Check out how to enter data using the Windows® Clipboard.

Using the Clipboard

You can very easily *enter* your bioassay measurement data into the **Table Tool** using the Windows® clipboard:

1. *highlight* the required column(s) of data in your source Windows® application (Figure 7.15);

2. *copy* the highlighted block of data;
3. *open* the **Table Tool** for the appropriate bioassay quantity;
4. *click* on destination cell for the copied data block - this will automatically show the "**Paste**" menu (Figure 7.16);
5. *paste* the block of data.

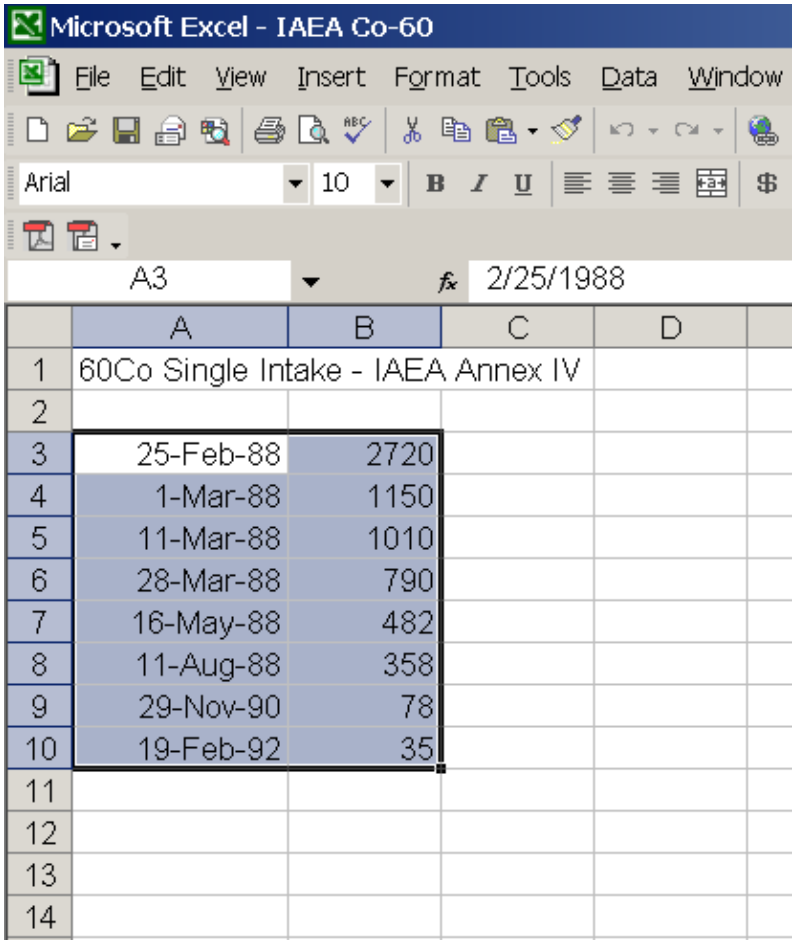
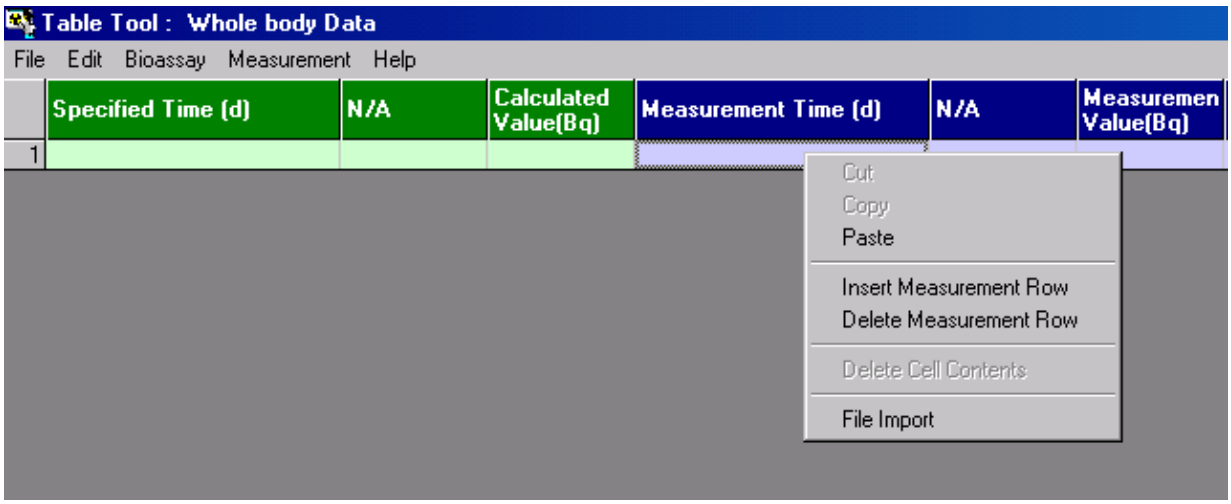


Figure 7.15. Highlighting a block of data in Microsoft Excel spreadsheet for copying to the Windows® clipboard.



7.16. Clicking on the **destination** cell in the **Table Tool** shows the "**Paste**" menu.

To *paste* the block of data from the Windows® clipboard to the destination cell in the **Table Tool**, you can use:

- the "**Paste**" *button* on a Microsoft Office-type keyboard;
- **^V** (control paste);
- "P**aste**" in the drop-down menu (Figure 7.16).

You will see the following **Warning** notice (Figure 7.17). If you click "**Yes**", the **Table Tool** will *open* a sufficient number of rows (below your insertion level) to accommodate your pasted data (Figure 7.18).

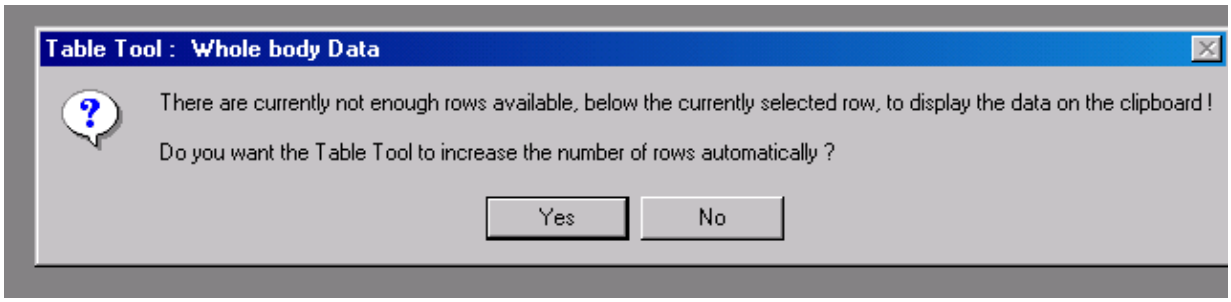
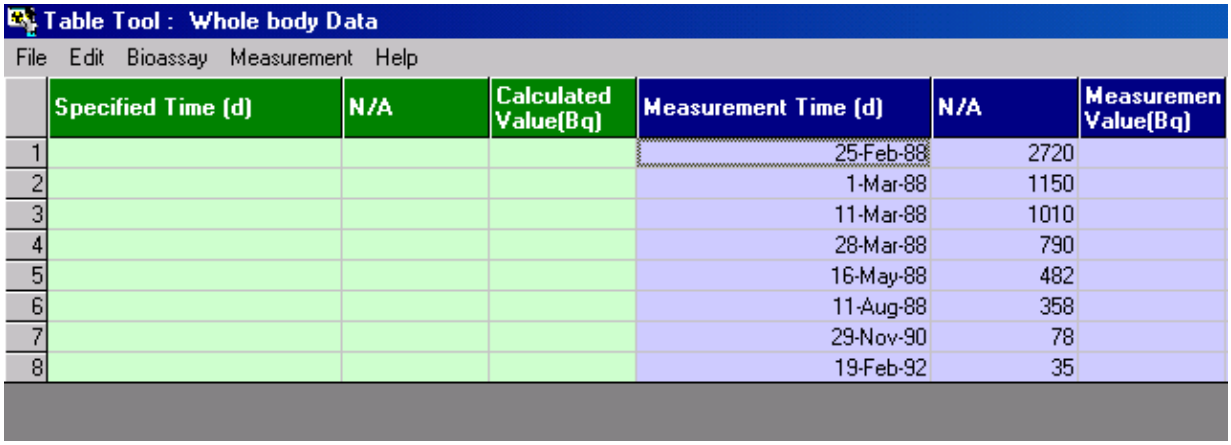


Figure 7.17. Warning notice.



	Specified Time (d)	N/A	Calculated Value(Bq)	Measurement Time (d)	N/A	Measuremen Value(Bq)
1				25-Feb-88	2720	
2				1-Mar-88	1150	
3				11-Mar-88	1010	
4				28-Mar-88	790	
5				16-May-88	482	
6				11-Aug-88	358	
7				29-Nov-90	78	
8				19-Feb-92	35	

Figure 7.18. Block of data *pasted* into the destination cell (top-left) of the **Table Tool**.

Notice in Figure 7.18 above, that the **measurement values** were pasted into the next column to the right of "**Measurement Date (+hh:mm)**." In this case, they need to be *moved* (manually) to the correct "**Measurement Value (Bq)**" column:

- *click* on the "**N/A**" (incorrect) column heading - to *highlight* the **whole** column of data to be moved;
- *right-click* on any highlighted cell - the "**Cut/Copy**" menu will appear (Figure 7.19);
- *click* "Cut" - this will put the column of data into the clipboard;
- *click* the "**Measurement Value (Bq)**" column heading - this will *highlight* all of the "target" cells in this column;
- *right-click* on any target cell - the "**Paste**" menu will automatically appear (Figure 7.20);
- *click* "**Paste**".

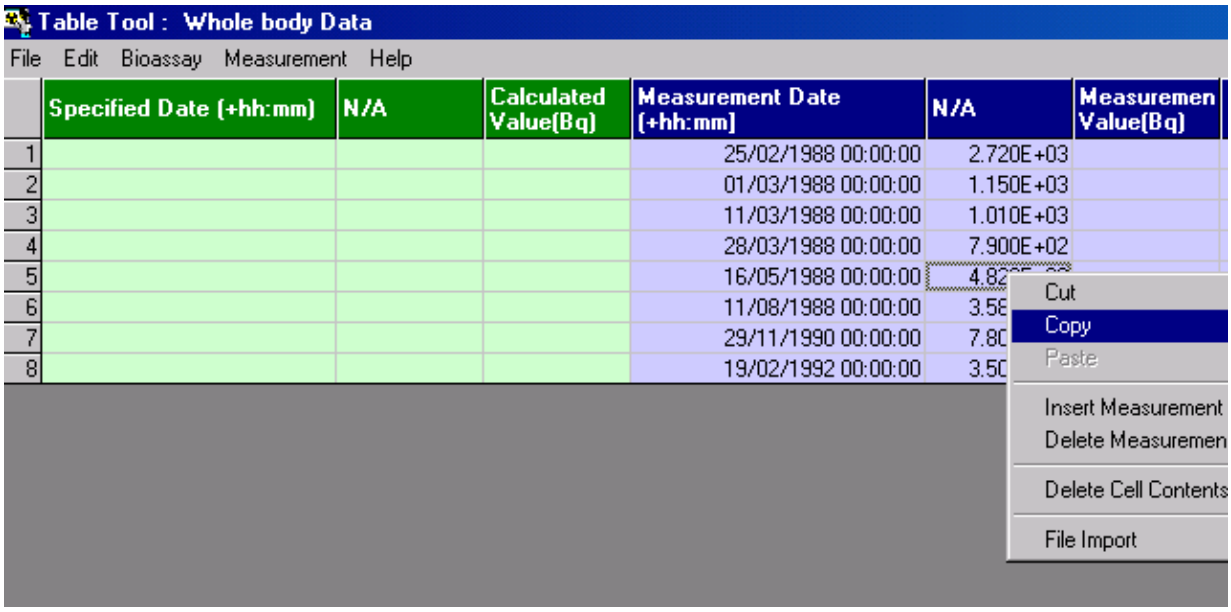


Figure 7.19. Moving a column of data in the **Table Tool**.

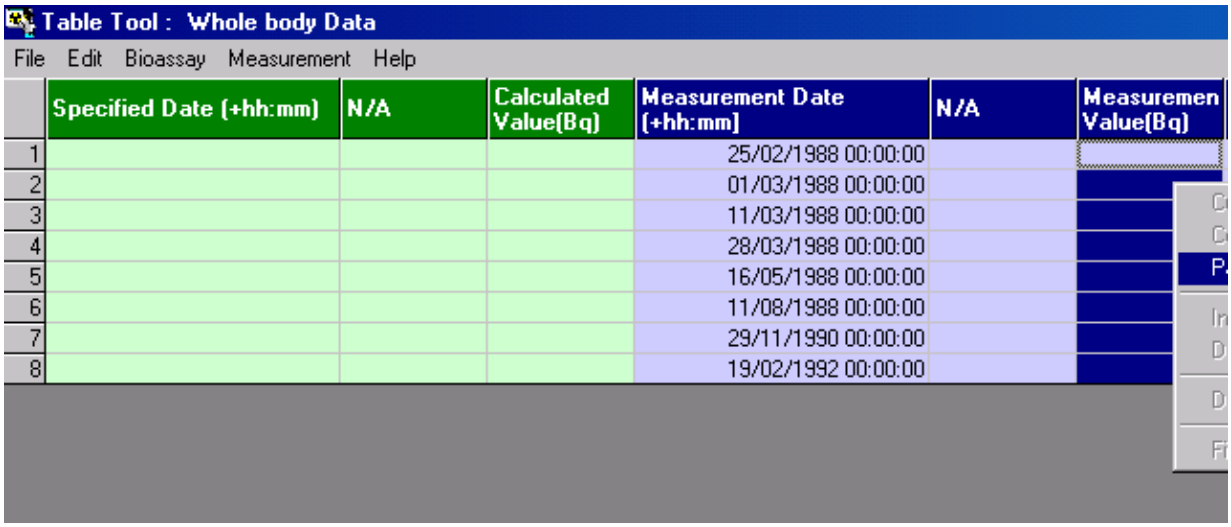


Figure 7.20. Pasting data to the target cells.

Key Tip: The drop-down menu that appears when you *right-click* anywhere in the **Table Tool** is "**context sensitive**" - *i.e.*, it automatically shows you only those options that are applicable to the *clicked* cell.

Completing the remaining data columns (## 2, 4, 5 and 6)

Enter the data required for the **remaining four columns** (blue background) using the **tools** already described to facilitate manual data entry. These columns are:

- **Collection Period (d)** - this is not applicable (**N/A**) for **Whole Body** as the bioassay quantity.
- **Data Type** - either < LOD, Real or Imaginary.
- **Measurement Error** - value of the error for each measurement.
- **Error Distribution** - either Normal or Lognormal.

Example of Single Intake
This completes **Step #7** in the **single intake** example - entering data *via* the **Windows® clipboard**:

- Proceed to the next step - plot a graph of your data.
- Return to the case description and list of steps.
- Check out how import an external data file.

Example of Multiple Intakes
This completes **Step #9** in the **multiple intake** example - entering data *via* the **Windows® clipboard**:

- Proceed to the next step - plot a graph of your data.
- Return to the case description and list of steps.
- Check out how import an external data file.

Importing a Data File

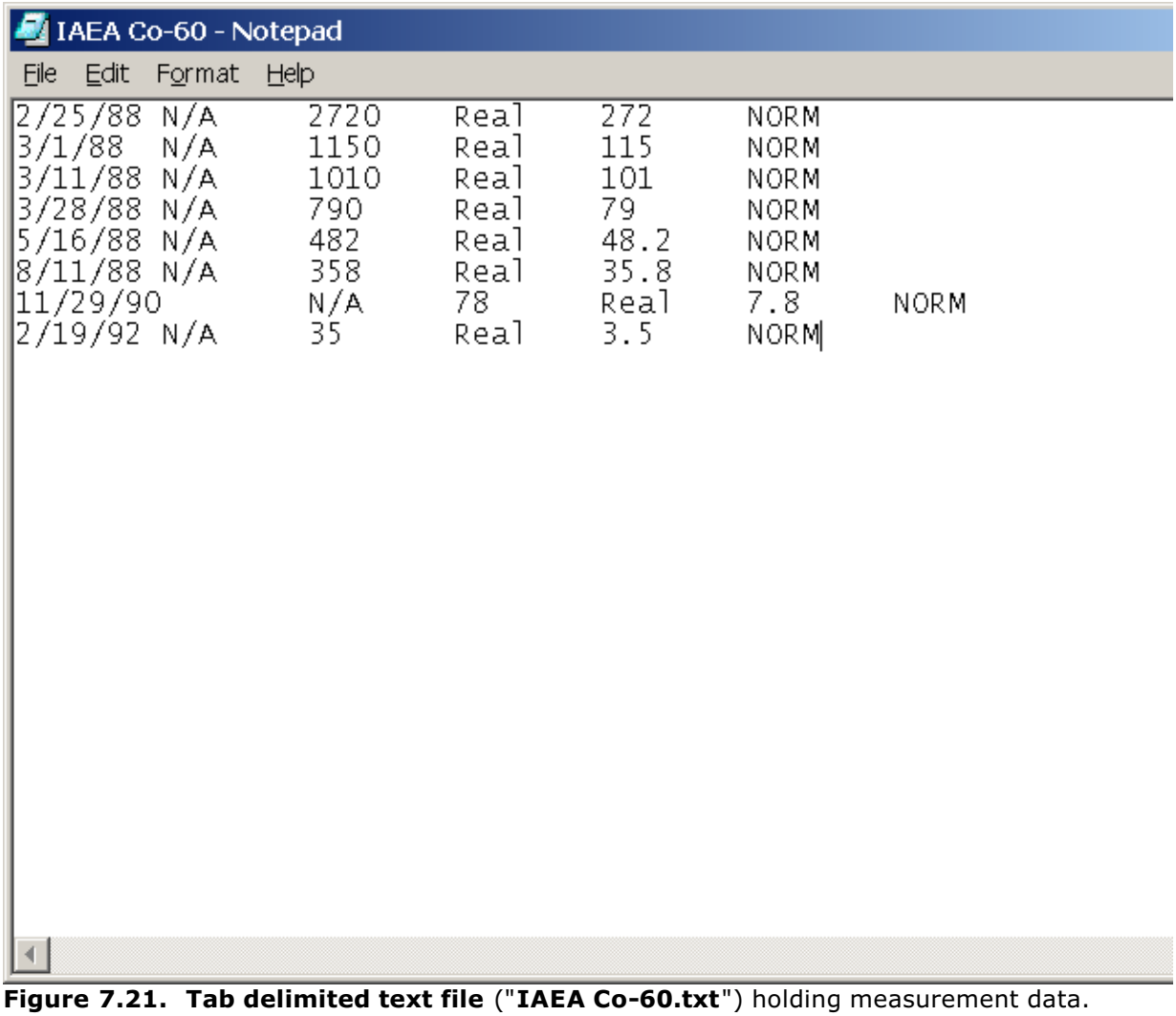


Figure 7.21. Tab delimited text file ("**IAEA Co-60.txt**") holding measurement data.

You can import data directly into the **Table Tool** from an **ASCII text file** with the following types of delimiter:

- **comma** separated values;
- **tab** delimited values;

- **space** delimited values;
- **your own definition** of the delimiter.

To import your data:

- *right-click* on the **destination cell** for your imported text file data (Figure 7.22) - the "**File Import**" menu will appear;
- *click* "**File Import**".

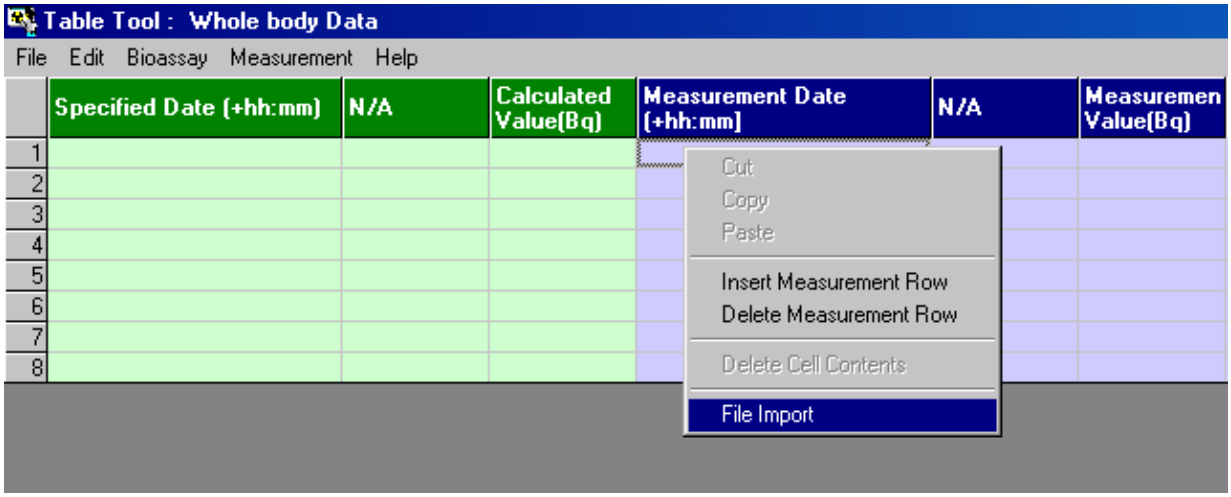


Figure 7.22. "**File Import**" menu.

The message shown in Figure 7.23 will appear - to remind you to check that you are importing the file into the correct location in the Table.

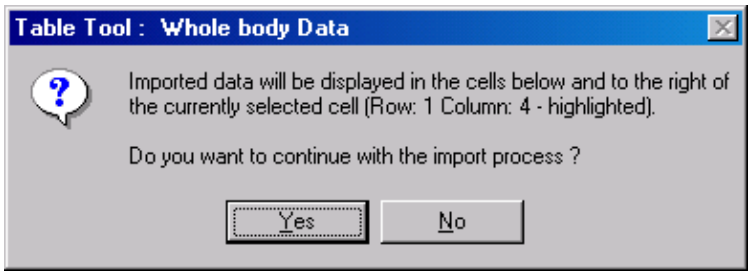


Figure 7.23. Notice to confirm the target location in the data table.

Click "**Yes**" to *open* the "**ASCII file import wizard**" (Figure 7.24). Use the wizard to:

- *browse* to the ASCII text file containing your measurement data;
- *view* the data file - Figure 7.25;
- *select* the appropriate type of data delimitation - "**Tab delimited**" in this example.

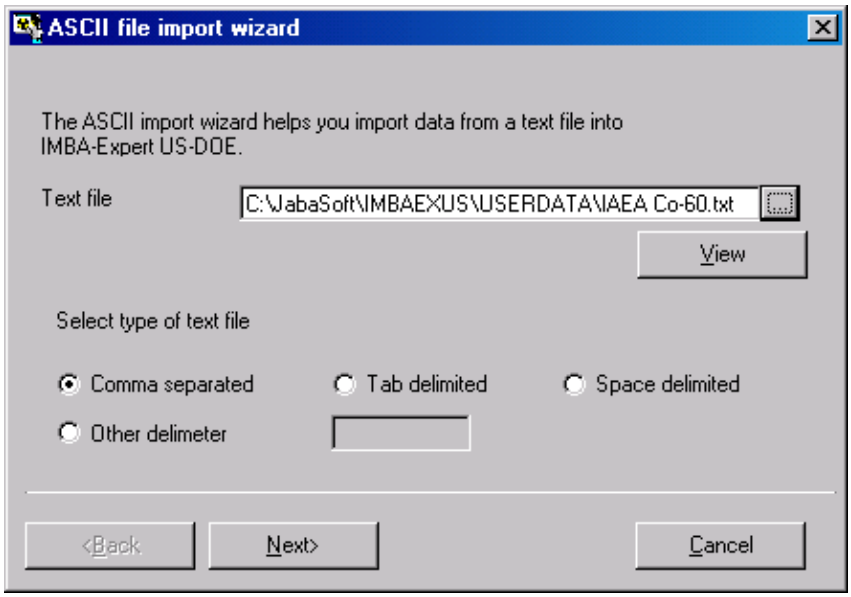


Figure 7.24. ASCII file import wizard for browsing to the **data text file** containing measurement data.

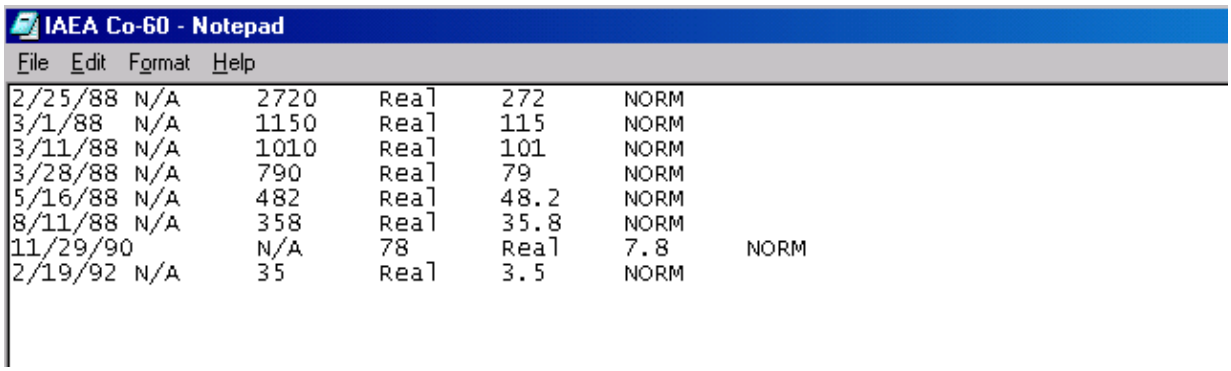


Figure 7.25. Text data file viewed in the **ASCII file import wizard**.

Clicking "N**ext**" in the **ASCII file import wizard** enables you to *select* (by *highlighting*) the data that you wish to **import** into the **Table Tool** (Figure 7.26). *Click* the "**Select All**" *button* to select all of the **whole ASCII text file**. Once you have selected the data that you want to import into the **Table Tool**, *click* "N**ext**" (Figure 7.26).

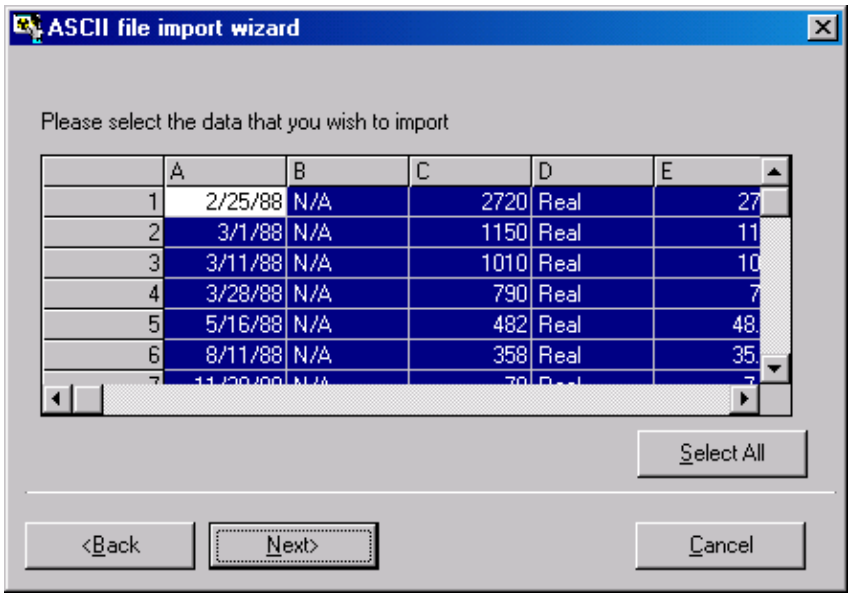


Figure 7.26. Selecting the data in the ASCII text file to **import** into the **Table Tool**.

Click "N**ext**". You will be given an opportunity to change your mind about pasting the selected data - which will overwrite any existing data in the target cells of the **Table Tool** (Figure 7.27).

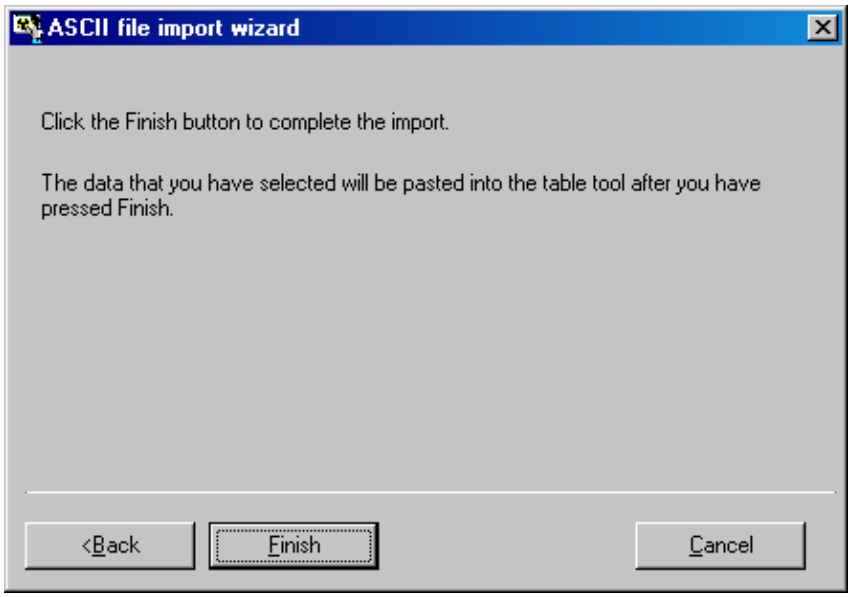


Figure 7.27. Reminder that you are about to paste data into the Table Tool.

Click "F**inish**" to proceed with your data import (Figure 7.28) - or "C**ancel**" this.

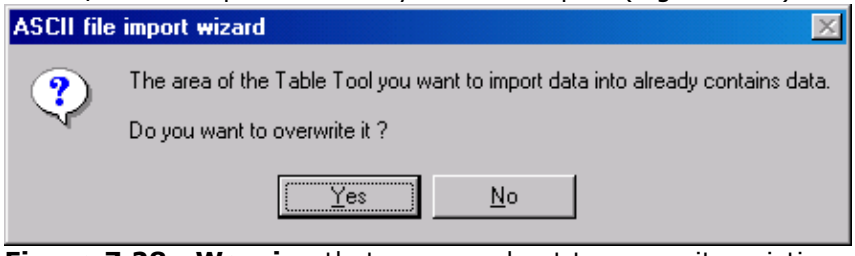


Figure 7.28. Warning that you are about to overwrite existing data in the target cells.

To *complete* the importation of your selected data, *click* "Y**es**". This will automatically write your **imported data** to the target cells of the **Table Tool**, starting in the first row of the first measurement data column (blue background), as shown in Figure 7.29.

Table Tool : Whole body Data

File Edit Bioassay Measurement Help

	Specified Date (+hh:mm)	N/A	Calculated Value(Bq)	Measurement Date (+hh:mm)	N/A	Measuremen Value(Bq)
1				2/25/88	N/A	2720
2				3/1/88	N/A	1150
3				3/11/88	N/A	1010
4				3/28/88	N/A	790
5				5/16/88	N/A	482
6				8/11/88	N/A	358
7				11/29/90	N/A	78
8				2/19/92	N/A	35

Figure 7.29. Data successfully imported into the **Table Tool**.

If there are **not enough rows open** in the **Table Tool** to hold your data, you will be **warned** (Figure 7.30).

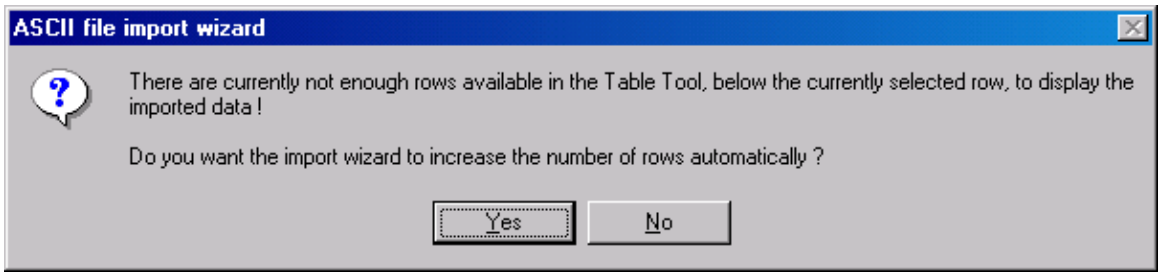


Figure 7.30. Warning message if there are **too few rows** opened in the **Table Tool** to receive imported data.

In this case, *click* "Y**es**" to automatically *add* the required number of new rows to the table - and *import* the *highlighted* data from the **external file**.

BIOASSAY QUANTITY

Graph Table Hide Whole body (oot)

Measurement Date (+hh:mm)	N/A	Measuremen Value(Bq)	Data Type	Measuremen Error
25/02/1988	N/A	2.720E+03	Real	2.720E+02
03/01/1988	N/A	1.150E+03	Real	1.150E+02
03/11/1988	N/A	1.010E+03	Real	1.010E+02
28/03/1988	N/A	7.900E+02	Real	7.900E+01
16/05/1988	N/A	4.820E+02	Real	4.820E+01
08/11/1988	N/A	3.580E+02	Real	3.580E+01
29/11/1990	N/A	7.800E+01	Real	7.800E+00
19/02/1992	N/A	3.500E+01	Real	3.500E+00

Figure 7.31. Imported data as it appears in the **Bioassay Quantity** window.

Important: IMBA Professional automatically **converts all dates** in the imported file to **your international setting**. In the example above, the dates in the imported text file were in the "U.S." convention. These were automatically converted to the "European" convention when the data was written to the Bioassay Quantity window (Figure 7.31).

Example of Single Intake
This completes **Step #7** in the **single intake** example - **importing** data from an **external ASCII text file**:

- Proceed to the next step - plot a graph of your data.
- Return to the case description and list of steps.

Example of Multiple Intakes
This completes **Step #9** in the **multiple intake** example - **importing** data from an **external ASCII text file**:

- Proceed to the next step - plot a graph of your data.
- Return to the case description and list of steps.

Graph Tool for Viewing the Data and Fit

Note: This topic is part of BOTH the **single intake** and **multiple intakes** examples. For brevity, only the **multiple intakes** data are illustrated.

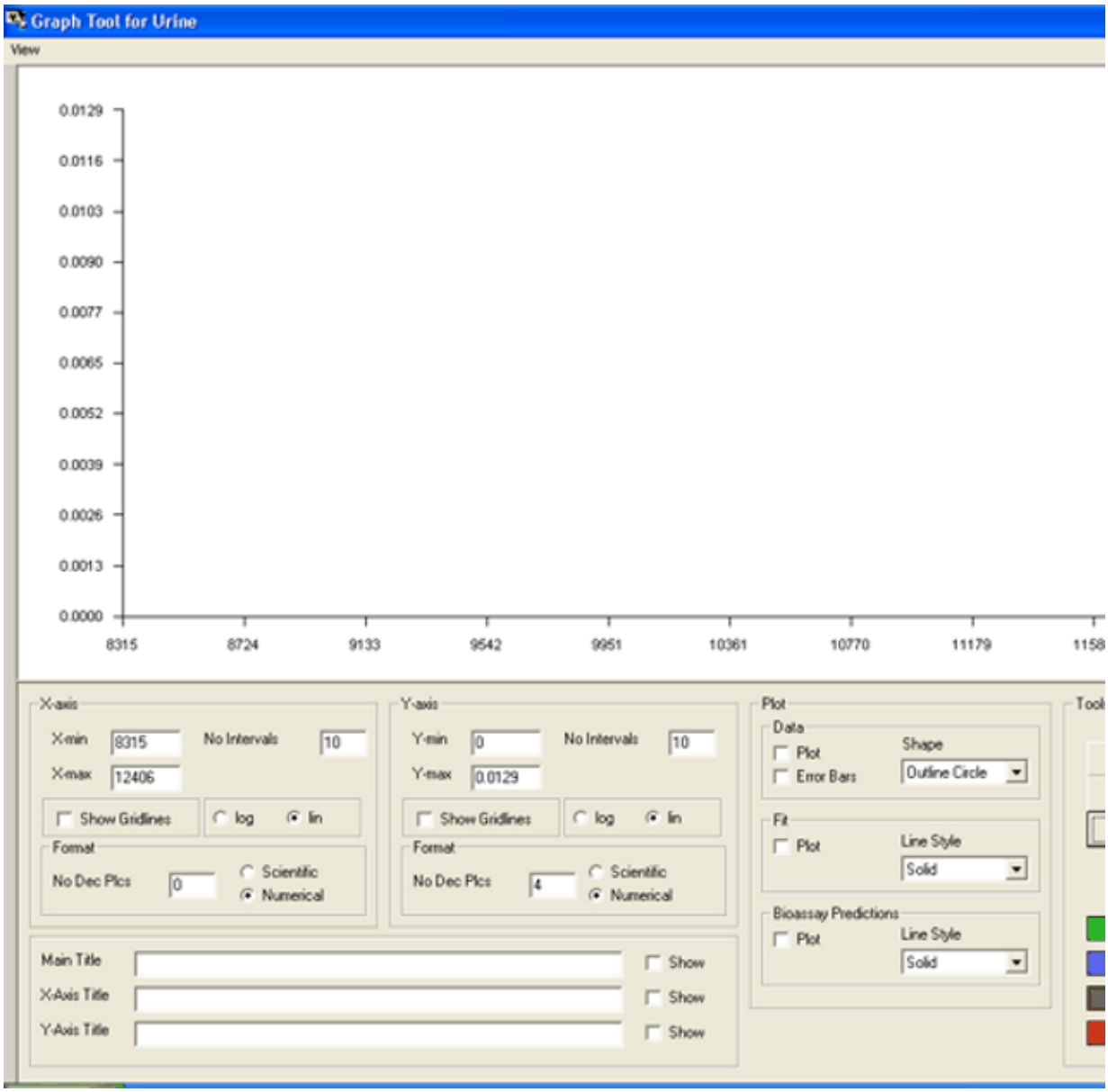


Figure 8.1. Selecting Axes Automatically in the **Graph Tool**.

In the "**Tools**" sub-panel, ***click*** **Select Axes Automatically** (Figure 8.1). This will set up the range of the X- and Y-axes to include **all of the data points**.

To ***plot*** the data points with their error bars (as in Figure 8.2):

- ***select*** "**Outline Circle**" for the **Shape** of the **data symbol** ("**Plot**" sub-panel);
- ***check*** the "**Plot**" ***box***;
- ***check*** the "**Error Bars**" ***box.***

As you ***check*** each ***box***, the respective symbol is plotted automatically (Figure 8.2).

In the example shown (Figure 8.2), the following "**User**" selections have been made for the Y-axis:

- **Scientific** scale;
- "**1**" decimal place;

- "**3**" intervals.

You can also **select** the **scale** of the **X-axis**, the appearance of **plotted symbols**, and the "**Line Style**" of the plotted "**Fit**" and "**Bioassay Predictions**."

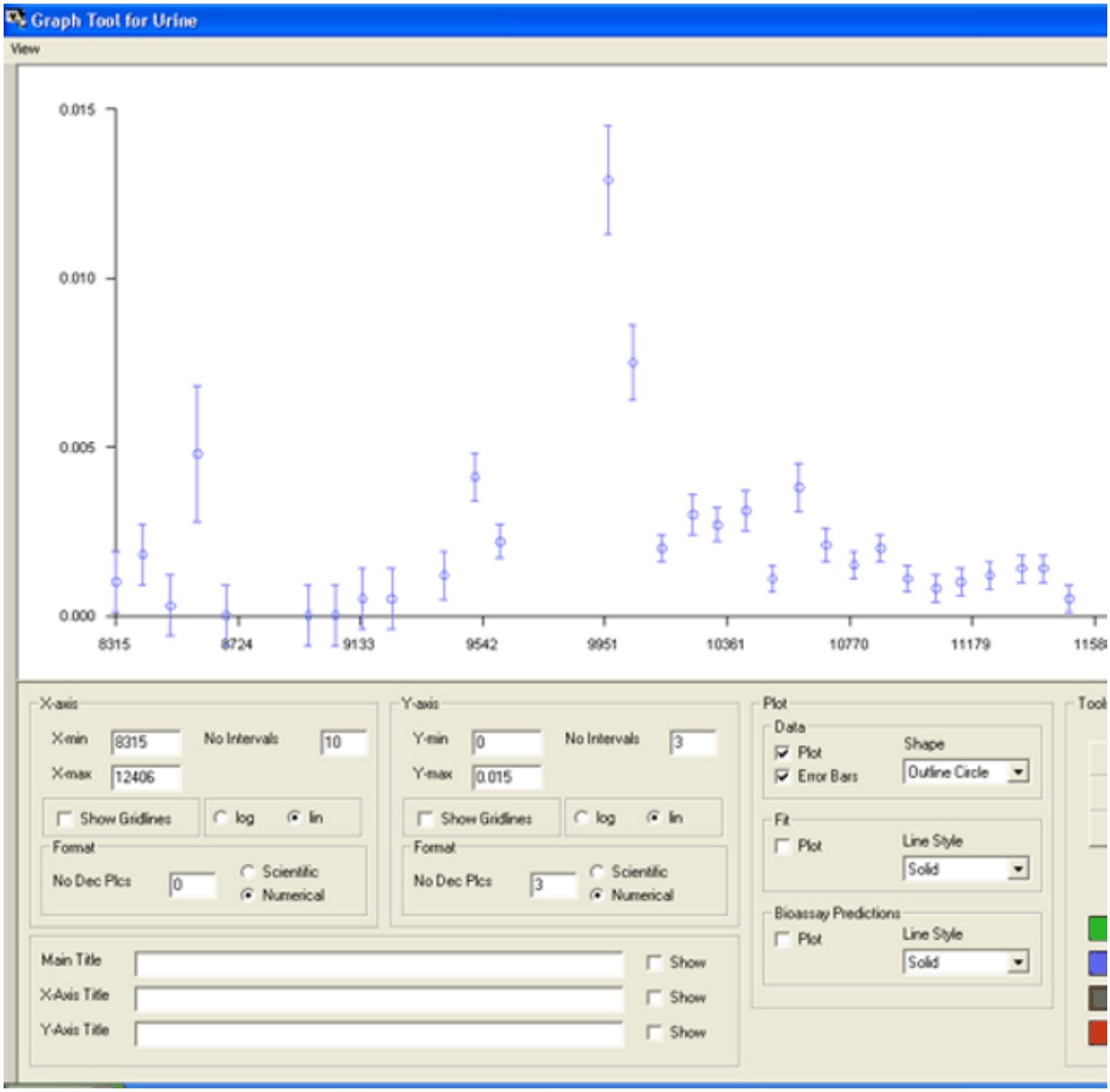


Figure 8.2. Plotting the **data points** and **error bars**.

Tip: Before you leave the **Graph Tool**, ***check*** the "**Plot**" **box** under the heading "**Fit**." This will automatically plot the **fit to the data** (in both the **Graph Tool** and the linked **Bioassay Quantity** window) - when you ***calculate*** the **maximum likelihood estimate** of the **Intake** amount(s).

Click the "*O***K**" ***button*** (right-side panel) to close the **Graph Tool** - and return to the **Bioassay Quantity** windows. The **graph** of the **data and error bars** will then be displayed in the opened **graph window** (Figure 8.3).

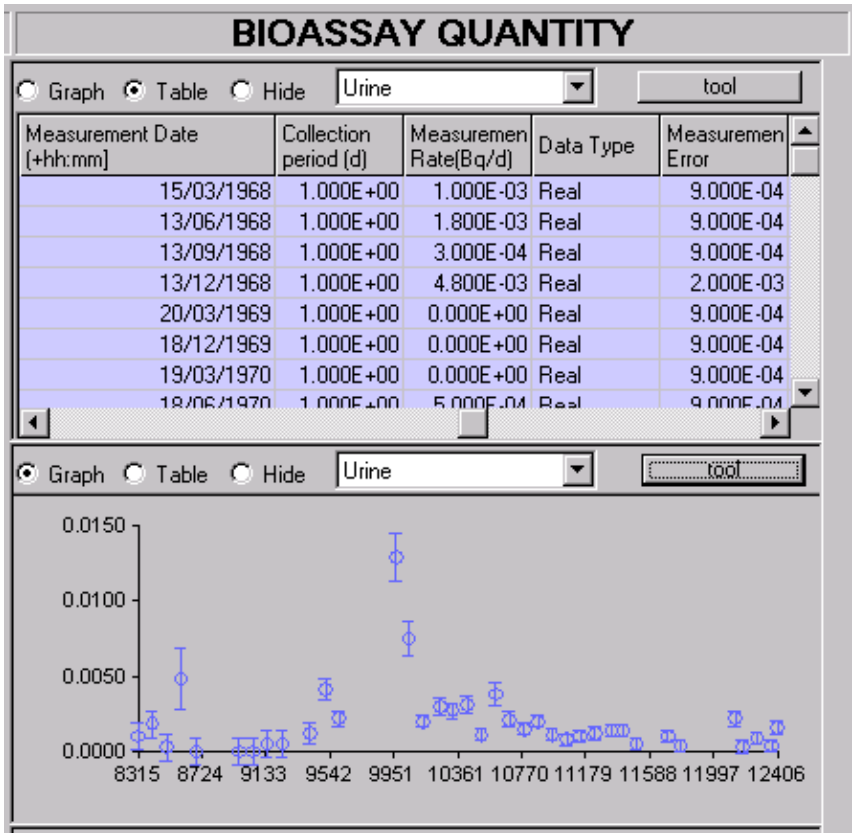


Figure 8.3. Graph of Whole body **data and error bars** displayed in **Bioassay Quantity** window.

This completes **Step #8** in the **single intake** example:

- Proceed to the **Intake Calculation** (**Step #9**);
- Return to the **case description** and list of steps for the **single intake** example.

This completes **Step #10** in the **multiple intakes** example:

- Proceed to the **Multiple Intakes Calculation** (**Step #11**);
- Return to the **case description** and list of steps for the **multiple intakes** example.

For a **Visual Tour** of the **Graph Tool**, see Visual Tour of Bioassay Screen: Graph Tool.

Maximizing and Exporting the Graph

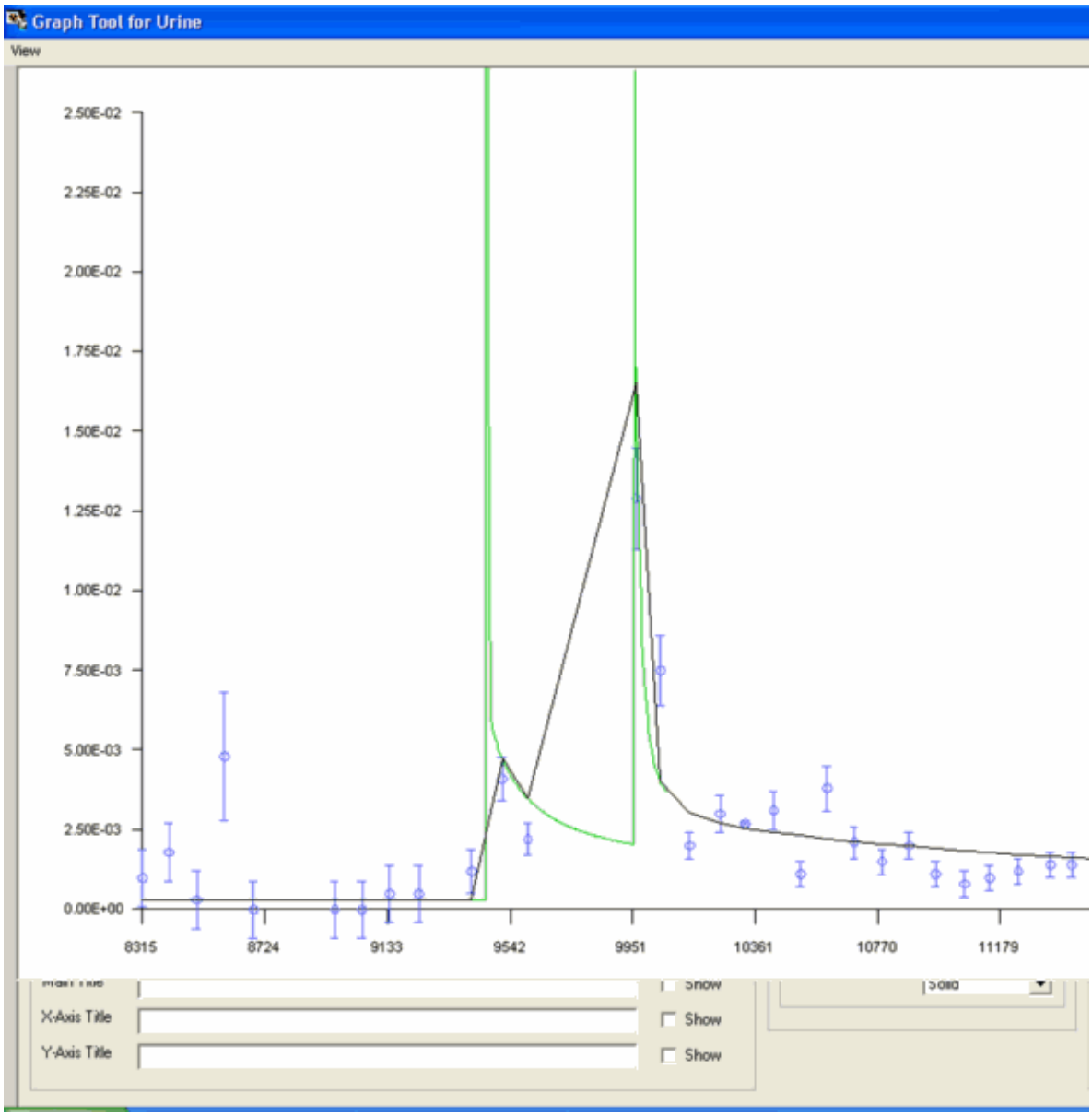


Figure 8.4. Maximised view of the Graph.

Clicking View | Maximise (from the View menu, top-left corner of the Graph Tool window) maximises the graph plot so that you can view this in finer detail, as shown in Figure 8.4.

Tip #1: Use the **Ctrl/Alt/Print Scrn** keys (together) to send the "maximized" image of the graph to the Windows® clipboard. You can then **paste** this image directly into another Windows® application file, ***e.g.***, a **report** being prepared in a word processor.

Tip #2: If you wish to "crop" the graph image to show only the plot itself (and not the background parts of the key etc.), you must currently use a separate "graphics" application to do this. The "Copy Graph" feature will be included in a future version – to enable you to export just the graph plot.