1 October 2021

UK Health Security Agency

IMBA Information Sheet

The UKHSA is pleased to announce new versions of its internal dosimetry software package IMBA (based on the Integrated Modules for Bioassay Analysis), which give the user increased functionality at reduced cost through a simpler and more cost-effective distribution model. The new software is only available in three standard versions: **IMBA*Lite*, IMBA*Plus*** and **IMBA*Pro***, but these cover the entire range of user functionality, which for earlier versions of IMBA required the selection, purchase and management, of numerous add-on options.

All of these new standard versions of **IMBA** enable the user to:

- Assess an intake from bioassay measurement data - including log-normally distributed and/or partially censored (e.g. less than the limit of detection) data
- Predict bioassay quantities at different times from a specified intake
- Calculate equivalent organ doses and effective dose from a single intake

This core functionality is the same as in the "Base Unit" of previous versions of IMBA Professional Plus, but it is now applicable to an extended and very comprehensive list of radionuclides (formerly only available through the purchase of additional radionuclide packs). If this core functionality is all that a user requires, our entry new level version **IMBA*Lite*** will meet their needs. More advanced functionality, to meet the needs of internal dose specialists and researchers, which would previously have required the purchase of individual Add-Ons, is now provided through the **IMBA*Plus*** and **IMBA*Pro*** versions. **IMBA*Plus*** comes pre-packaged with a selection of the most commonly requested Add-Ons, while **IMBA*Pro*** includes all available add-on functionality to provide a powerful tool for the most demanding of users.
A summary of the functionalities and cost of these new standard versions are provided in the table below.

IMBA^{Lite}	**IMBA^{Plus}**	**IMBA^{Pro}**
Base unit	**IMBA^{Lite}** functionality +	**IMBA^{Plus}** functionality +
Additional Radionuclides (Pack 1)	Multiple Intake Regimes	Errors on Intake
Additional Radionuclides (Pack 2)	Multiple Bioassay Types	Bayes Implementation
Candu Models	Associated Radionuclides	Tritium Tool
	Uranium Mixtures	Compensation Type Calculations
	Uptake from Wounds	Ingrowth of Americium
		Statistics Package

How to Order

An order form is available on the IMBA web site:
https://www.ukhsa-protectionservices.org.uk/imba/resources

Further Information

For further information or specific enquiries, please contact us at:
https://www.ukhsa-protectionservices.org.uk/imba/contact

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IMBA^{Lite}, IMBA^{Plus} and IMBA^{Pro} Core Functionality

The core functionality of IMBA enables the user to perform basic internal dosimetry calculations (e.g., calculating doses from specified intakes, estimating intakes from bioassay measurements, and calculating bioassay quantities from given intakes). It implements biokinetic and dosimetric models which are recommended by the International Commission on Radiological Protection (ICRP) for the Reference Worker (ICRP 68 and US 10 CFR 835) and applies the methodology described in ICRP Publication 60. Output is both tabular and graphical and special tools enable data transfer between Windows™ applications. For standard calculations, all of the ICRP default values can be selected from built in databases at the touch of a button. For more detailed calculations, the user can enter individual parameter values. The product has been extensively quality assured and comes with complete documentation.

The core functionality is now applicable to an extended and very comprehensive list of radionuclides which includes 75 radionuclides shown in the Table below (previously implemented in the Base Unit) and further 665 radionuclides, previously implemented within Additional Radionuclide Packs 1 and 2 (see Appendix A).

Ac-227	Ac-228	Am-241	Am-243	Sb-124	Sb-125	Ba-140
Cs-134	Cs-137	Cf-252	C-14	Ce-141	Ce-144	Cr-51
Co-57	Co-58	Co-60	Cm-242	Cm-243	Cm-244	Eu-152
Eu-154	Eu-155	Eu-156	Hf-181	H-3	I-125	I-129
I-131	I-133	I-134	I-135	Fe-55	Fe-59	La-140
Mn-54	Np-237	Np-239	Ni-63	Nb-94	Nb-95	P-32
P-33	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242	Pm-147
Pa-231	Po-210	Ra-224	Ra-226	Ra-228	Ru-103	Ru-106
Ag-110m	Na-22	Na-24	Sr-85	Sr-89	Sr-90	S-35
Tb-160	Th-228	Th-230	Th-232	Sn-113	U-234	U-235
U-236	U-238	Y-90	Zr-95	Zn-65		

IMBA^{Lite}, IMBA^{Plus} and **IMBA^{Pro}** are the successors to the IMBA Professional Plus and the earlier IMBA Professional and IMBA Expert™, software series, they are considerably faster than their earlier predecessors, more versatile, and cost effective.

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IMBA*Plus* and IMBA*Pro* Additional Functionality

Add-On 1
Multiple Intake Regimes

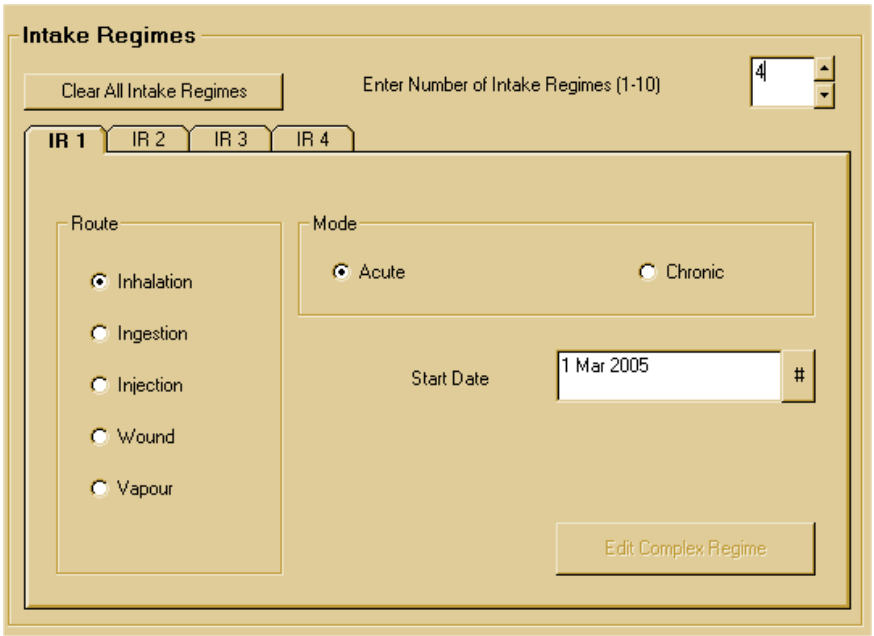
Description

An intake regime defines both the mode of intake (inhalation of aerosols or vapours, ingestion, injection, wound etc.) and the time of intake (e.g. an acute intake on a certain date, or a chronic intake between two dates). This Add-on enables the user to deal with up to 10 separate intake regimes simultaneously. Thus, when calculating doses or predicting bioassay quantities, the software automatically includes the contribution from each intake. It is also possible to assign different model parameter values separately to each intake regime if required. This option also works during intake estimation and so up to 10 intakes can be fitted to the measurement data simultaneously.

How is it implemented?

This Add-On is integrated seamlessly on the main screen. The user selects the number of intake regimes, and each intake regime (IR) can be set up independently by selecting the appropriate tab.

In the Bioassay screen, the single intake on the left-hand side of the screen is replaced by the chosen number of intakes. For dose calculations, the dose to each organ is calculated separately for each intake regime. The total dose (from all intake regimes) is also given.



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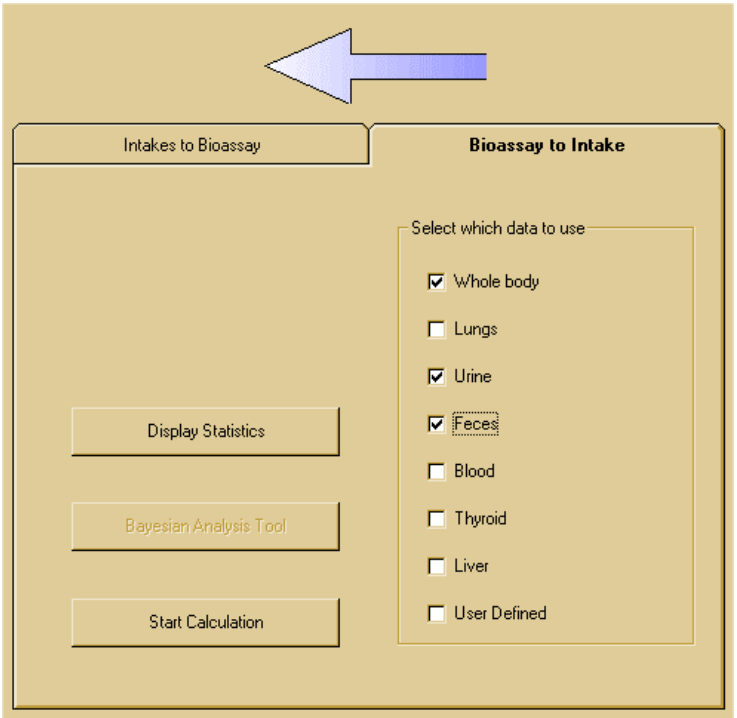
Add-On 2
Multiple Bioassay Types

Description

The base unit will deal with 8 different bioassay quantities (whole body, lung, urinary and faecal excretion, blood, thyroid, liver and user defined). However, only one type of data set can be used at any one time. This Add-on enables the user to fit the intake to different bioassay types simultaneously. This Add-on also works with Add-On 1 (Multiple Intake Regimes) to enable multiple intakes to be fitted to multiple bioassay data types simultaneously.

How is it implemented?

This Add-On integrates seamlessly into the base module. When assessing intakes from bioassay measurements, the user simply selects which data to use by checking the appropriate boxes.



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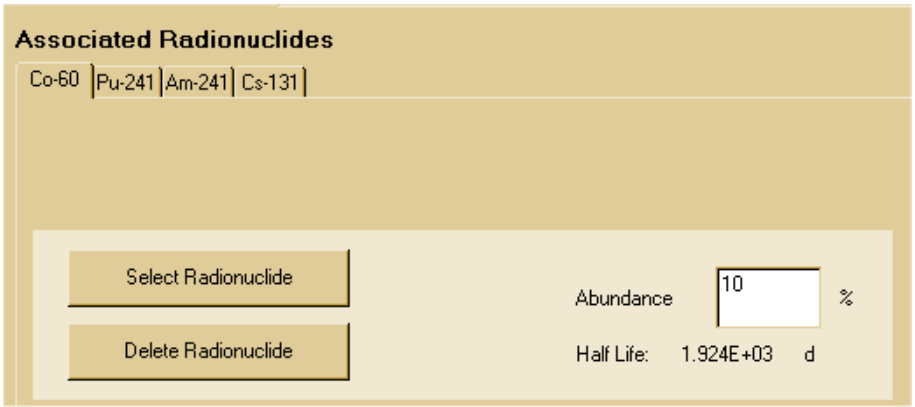
Add-On 3
Associated Radionuclides

Description

The base unit performs dose calculations on the selected radionuclide (known in IMBA Professional Plus as the indicator nuclide). In some situations, many different radionuclides are bound together in a particle matrix (e.g., fission products). This Add-on enables the user to specify up to 30 additional associated radionuclides, defining the amount of each with respect to the indicator radionuclide. Subsequent dose calculations will include the components from all of the associated radionuclides. In the dose calculations, it is assumed that the absorption rates (and f_1 values) of each associated radionuclide are identical to that of the indicator radionuclide.

How is it implemented?

If this Add-On is installed, then the user can specify up to 30 additional radionuclides from the main screen. The abundance of each radionuclide (the percentage of activity of the Indicator Nuclide) is entered by selecting the appropriate tab.



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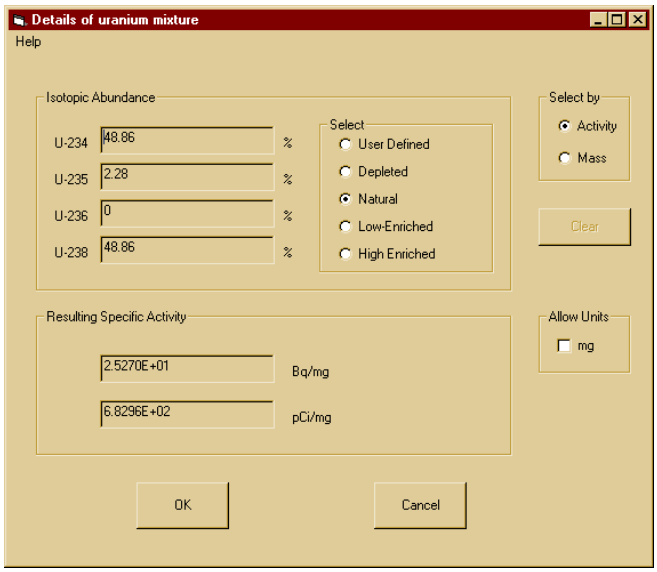
Add-On 4
Uranium Mixtures

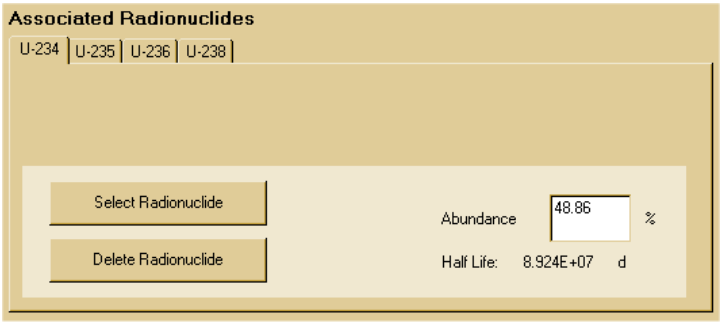
Description

This option enables the user to specify a mixture of uranium isotopes (U-234, U-235, U-236 and U-238) for dose and bioassay calculations. The user can choose default values for enriched, depleted, or natural uranium, or specify the mixtures directly. The specific activity of the resulting mixture is automatically calculated. This option also allows the user to specify the intakes in terms of mass (mg).

How is it implemented?

This Add-On will enable the user to select 'Uranium-mixture' from the drop-down list of uranium isotopes in the periodic table. If this is selected, then a button labelled 'Specify U mixture' appears on the main screen. This brings up a new form enabling the user to specify the isotopic composition.





After exiting this screen, the uranium isotopes are automatically included as associated radionuclides with the selected abundances. In this case, the 'indicator' radionuclide is the complete uranium isotope mixture.

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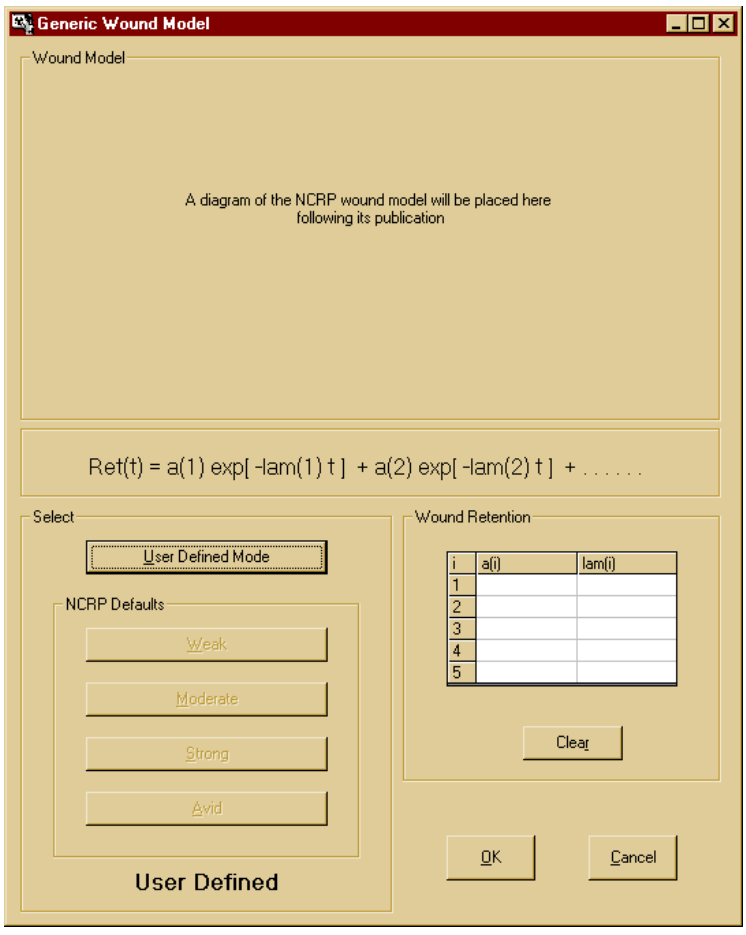
Add-On 5
Uptake from wounds

Description

The base module allows intakes via inhalation (aerosols and vapours), ingestion or direct injection. This Add-on enables the user to deal with intakes from a wound site. A generic wound model is specified by the user. This functionality is integrated automatically with all of the calculations (dosimetry, bioassay and intake fitting). It is planned to include default values from the NCRP wound model when published.

How is it implemented?

If this Add-On is installed, the user can select 'Wound' as a route of intake from the main screen. The Wound button in Model Parameters is enabled, and the retention function for the wound can be entered as a sum of exponential terms.



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IMBA*Pro* Additional Functionality

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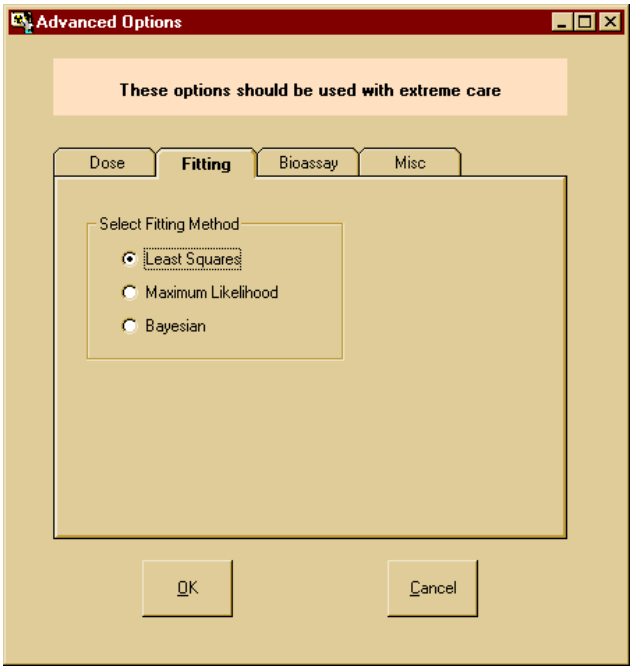
Add-On 6
Errors on intake

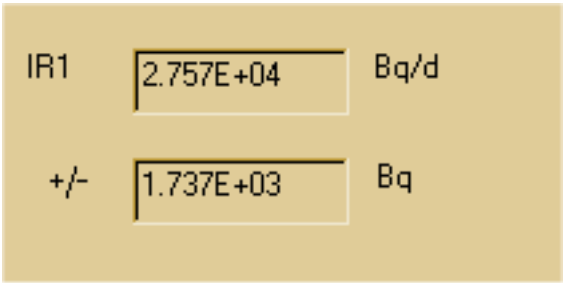
Description

In cases where an intake is being estimated from bioassay data, and all of the data are assumed to be normally distributed with a specified standard deviation, then this Add-On will propagate the errors to calculate their contribution to the error in the estimate of intake. The method of error fitting employed in this case is based on the Least Squares method.

How is it implemented?

The user must first select Advanced Fitting Options either from the main screen (Advanced /Advanced Options/ Fitting Tab) or from the bioassay screen (Advanced / Advanced Fitting Options) and select Least Squares as the method of fitting.





After calculating the intake, the error will be displayed automatically next to the intake on the left-hand side of the Bioassay screen.

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Add-On 7
Bayes Implementation

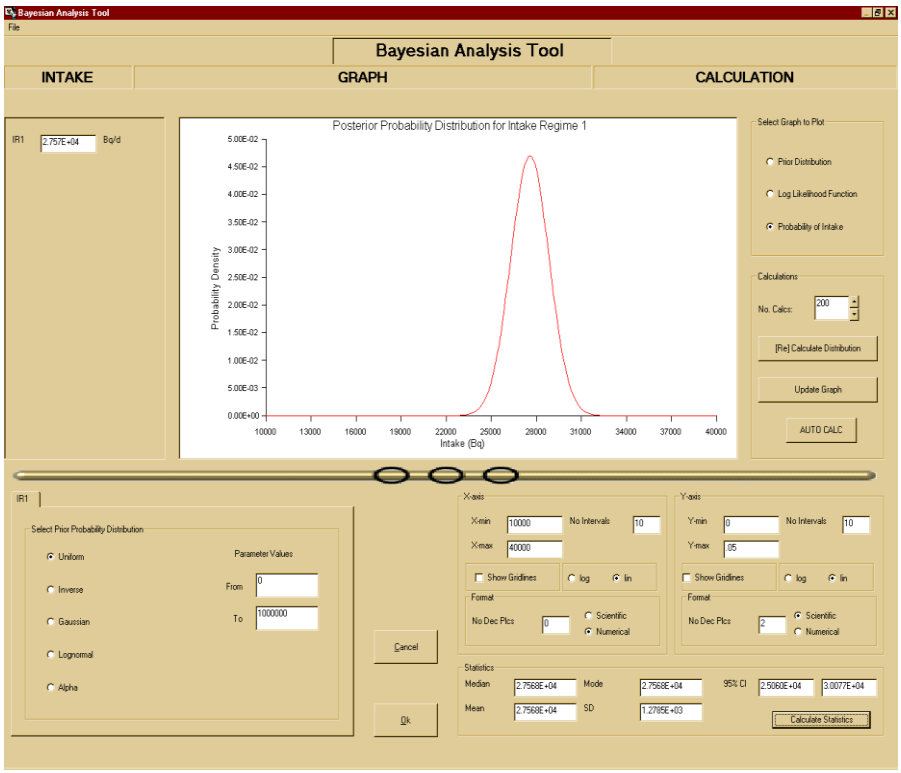
Description

The base module uses a fitting method based on the Maximum Likelihood Method to estimate intakes from measurement data. This Add-On enables the user to use a Bayesian approach to estimate an intake. Thus, prior knowledge about the intake (either from other measurements such as air sampling, or from hypothetical judgements) can be used in conjunction with the measurement data to obtain the probability distribution of intake. The user can choose from a variety of 'prior' intake distributions and both graphical and statistical displays are given. This module works in conjunction with the Multiple Intake Regimes Add-On to enable the probability distributions of different intakes (each with their own prior) to be estimated simultaneously.

How is it implemented?

From the Bioassay screen menu, select 'Advanced/Fitting Options' and click the Bayesian option. A new button called Bayesian Analysis Tool will appear in the Bioassay screen. Pressing this button will call up the Bayesian Analysis Tool enabling the user to calculate probability distributions of intake under different prior assumptions.

The prior distributions selected in this screen will also be used in any further fitting processes.



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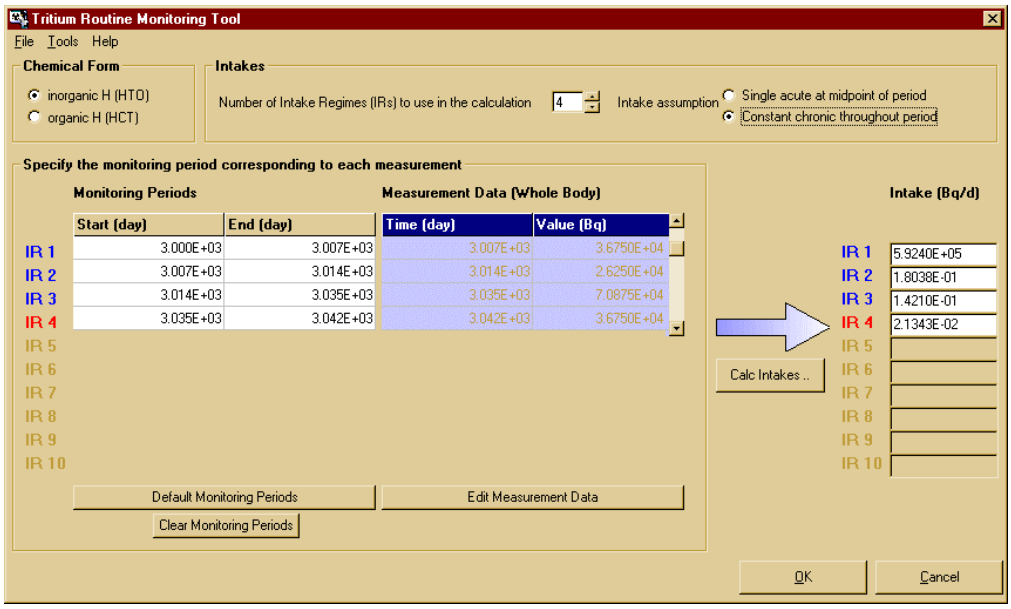
Add-On 8
Tritium Tool

Description

Typical procedures for estimating tritium intakes which have occurred at some unknown time in a monitoring interval involve making assumptions about (a) the time of intake, and (b) the contribution to the current measurement from intakes in previous monitoring intervals. Because the new ICRP tritium model is no longer a single exponential, it is no longer possible to use just the previous measurement to correct the current measurement. This Add-On enables the user to select up to 10 previous tritium measurements, and to fit simultaneously the best 10 intakes. In a sense, the previous 9 intakes are used to correct for the current estimate of intake.

How is it implemented?

The user can enter the complete history of an individual's monitoring results (up to 200 measurements) in the Table Tool. The Tritium Tool is then launched from a button which will appear in the Bioassay screen. The tool enables the user to select and analyse data directly from the Table Tool.



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Add-On 9
Compensation Type Calculations

Description

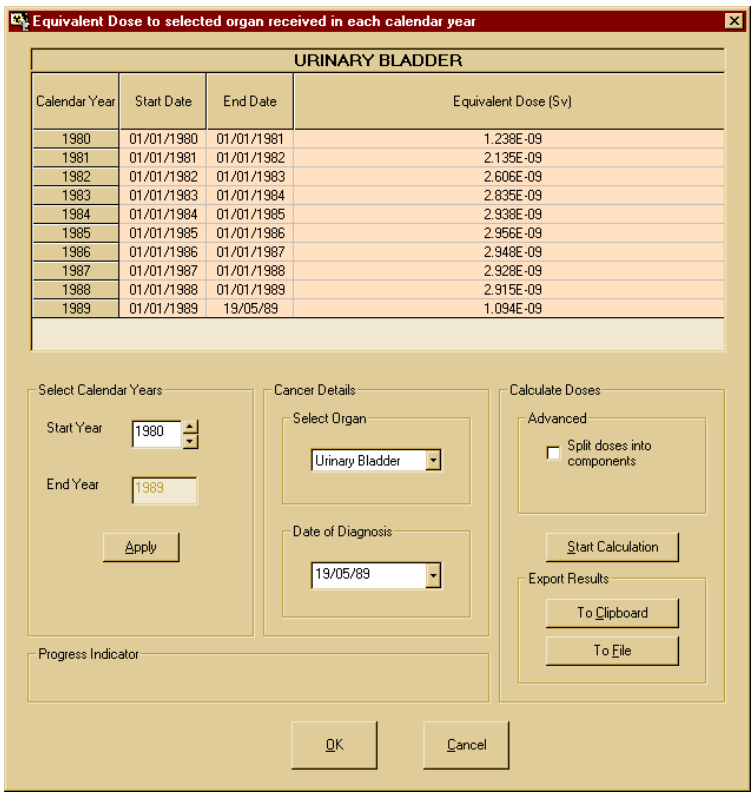
This Add-On enables the user to select an organ, and a date on which cancer was diagnosed in the organ. The program then calculates the equivalent dose to the organ in each (of up to 99) calendar years previous to the cancer diagnosis. A simple wizard for exporting this data to other files or databases is also included. This type of information is required as part of the process of estimating causation probabilities for compensation type calculations.

How is it implemented?

A button appears in the Dose Calculations screen which calls up a new form. On this form, the user can specify a tissue or organ from a drop-down list, the time of the incidence of the cancer, and the number of calendar doses to calculate.

This screen is fully integrated with the base module so that all of the parameters used in the intake calculation will also be used for these dose calculations.

Data can be imported or exported to other files or the Windows™ clipboard. Calculations (together with all of the assumptions made) can be added to the report file.



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Add-On 10
Ingrowth of Americium

Description

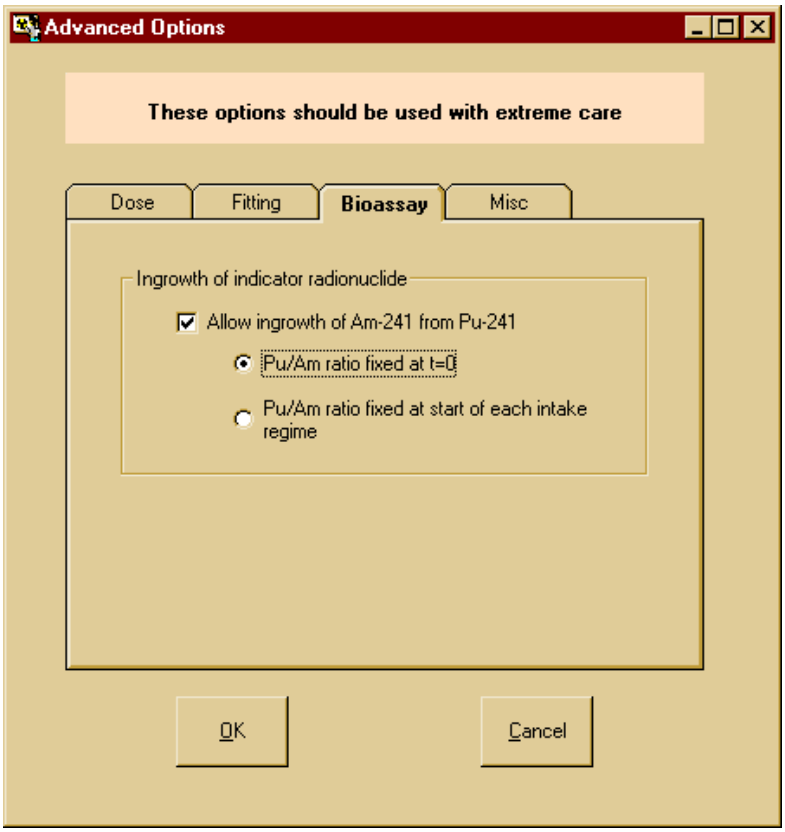
The interpretation of measurements of Am-241 in an individual can be complicated if the individual has also had an intake of Pu-241 because of the continuous ingrowth of Am-241 from Pu-241. This Add-On allows the user to take ingrowth into account automatically when performing calculations.

How is it implemented?

First, Am-241 is selected as the indicator nuclide, and Pu-241 (and its abundance) as an associated radionuclide. The user can now select Advanced Bioassay Options (main menu: Advanced/Advanced Options and hit Bioassay tab). Here, a check box can be ticked to allow automatic ingrowth of the Americium from the plutonium to take place.

This Add-On is fully integrated with the base module and other Add-Ons. If specified, ingrowth will be included automatically for all bioassay calculations, and for estimating intakes from bioassay measurements.

If more than one intake regime is specified (Add-On 1) then the user can choose to keep the defined ratio of Pu/Am to apply to (a) t=0: i.e., it will automatically change with time, or (b) to apply the defined Pu/Am ratio to each intake regime. At the moment only acute intakes are allowed with this option.



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Add-On 11
Statistics Package

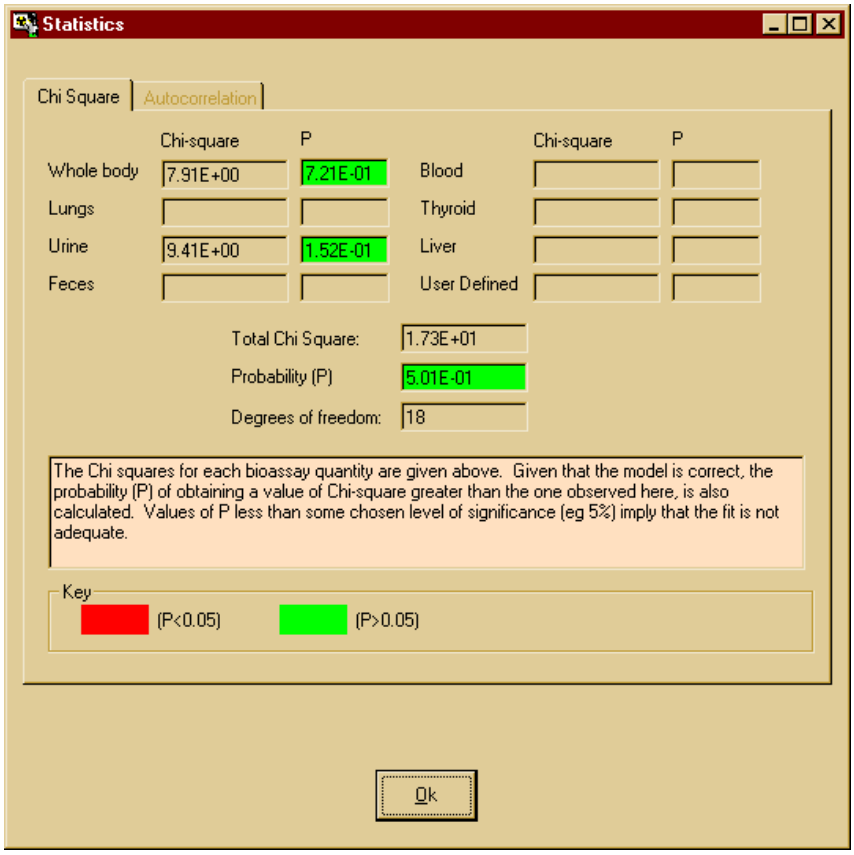
Description

This allows the user to bring up useful statistical information immediately after fitting intakes to measurement data. It calculates the chi-square value for each bioassay type, the total chi-square and the associated P value (probability of obtaining a chi square greater than or equal to the calculated value by random chance).

How is it implemented?

If this Add-On is installed, then a new button 'Display Statistics' appears on the Bioassay screen during the calculation of intakes. This button displays the chi-square value for each type of bioassay quantity used in the fit. Quantities of P greater than 0.05 (indicating a good fit) are automatically coloured green giving a quick indication that the fit is adequate.

This information is extremely useful when trying to decide whether the assumed set of parameters accurately model the measurement data.



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Add-On 15
CANDU models

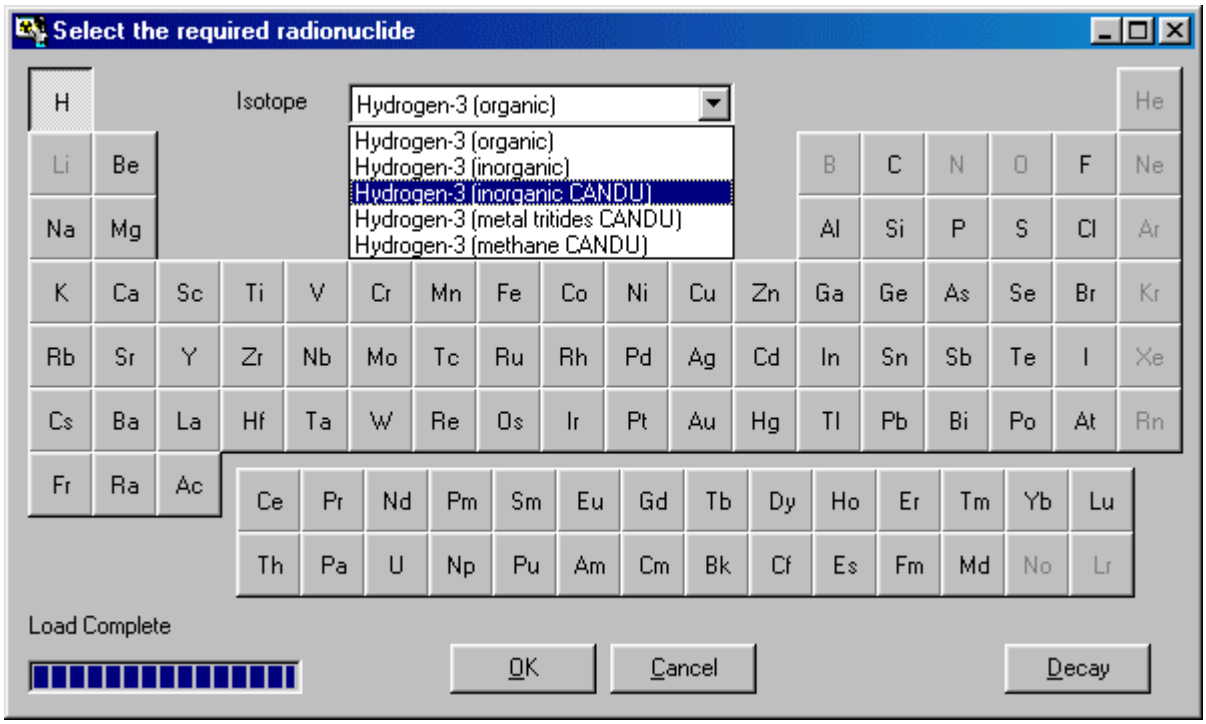
Description

The Base Unit allows the user to assess intakes from bioassay measurement data, calculate bioassay quantities at different times from a specified intake and calculate equivalent organ doses and effective dose for various chemical forms of hydrogen and carbon. This Add-On implements chemical forms of hydrogen and carbon that occur in CANDU type reactors using models that are currently recommended by COG (CANDU Owners Group) in Canada. These models are based on ICRP models but differ slightly from them. The chemical forms of hydrogen and carbon supplied in this Add-On are:

- Inorganic hydrogen CANDU model
- Metal tritides CANDU model
- Tritiated methane CANDU model
- Carbon dioxide CANDU model

How is it implemented?

If this Add-On is installed, then the chemical forms of hydrogen and carbon listed above will be available from the drop-down isotope in Periodic Table tool for whichever isotopes of hydrogen and carbon are installed.



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IMBA Information Sheet

Appendix A

Additional Radionuclides (Pack 1)

Description

The Base Unit allows the user to assess intakes from bioassay measurement data, calculate bioassay quantities at different times from a specified intake and calculate equivalent organ doses and effective dose for 75 radionuclides. This additional Radionuclide pack implements the 62 frequently requested additional radionuclides listed below.

As-74	Ba-133	Bk-249	Br-82	Br-83	Br-84	C-11	Ca-45	Ce-139
Ce-143	Cf-249	Cl-36	Cs-138	F-18	Ga-67	Hg-203	Ho-166	I-123
I-124	I-126	I-132	In-111	Ir-192	La-141	La-142	Lu-174	Mo-99
Pa-233	Pa-234	Pb-210	Pb-212	Po-208	Po-209	Pr-143	Pr-144	Ra-223
Rb-89	Ru-105	Sb-129	Sc-46	Sm-151	Sr-91	Ta-182	Tc-99	Tc-99m
Te-131	Te-131m	Th-234	Tl-201	Tl-202	Tl-204	Tm-170	U-232	U-233
U-239	W-188	Y-88	Y-91	Y-92	Y-93	Yb-169	Zr-97	

How is it implemented?

The additional radionuclides listed above are available from the Periodic Table tool for selection as indicator radionuclides. If Add-On 3 (Associated radionuclides) is also installed, then the additional radionuclides listed above will also be available from the Periodic Table tool for selection as associated radionuclides.

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Additional Radionuclides (Pack 2)

Description

The Base Unit allows the user to assess intakes from bioassay measurement data, calculate bioassay quantities at different times from a specified intake and calculate equivalent organ doses and effective dose for 75 radionuclides. This additional radionuclide pack implements a further 603 radionuclides as listed below.

Ac-224	Ac-225	Ac-226	Ag-102	Ag-103	Ag-104	Ag-104m	Ag-105	Ag-106
Ag-106m	Ag-108m	Ag-111	Ag-112	Ag-115	Al-26	Am-237	Am-238	Am-239
Am-240	Am-242	Am-242m	Am-244	Am-244m	Am-245	Am-246	Am-246m	As-69
As-70	As-71	As-72	As-73	As-76	As-77	As-78	At-207	At-211
Au-193	Au-194	Au-195	Au-198	Au-198m	Au-199	Au-200	Au-200m	Au-201
Ba-126	Ba-128	Ba-131	Ba-131m	Ba-133m	Ba-135m	Ba-139	Ba-141	Ba-142
Be-10	Be-7	Bi-200	Bi-201	Bi-202	Bi-203	Bi-205	Bi-206	Bi-207
Bi-210	Bi-210m	Bi-212	Bi-213	Bi-214	Bk-245	Bk-246	Bk-247	Bk-250
Br-74	Br-74m	Br-75	Br-76	Br-77	Br-80	Br-80m	Ca-41	Ca-47
Cd-104	Cd-107	Cd-109	Cd-113	Cd-113m	Cd-115	Cd-115m	Cd-117	Cd-117m
Ce-134	Ce-135	Ce-137	Ce-137m	Cf-244	Cf-246	Cf-248	Cf-250	Cf-251
Cf-253	Cf-254	Cl-38	Cl-39	Cm-238	Cm-240	Cm-241	Cm-245	Cm-246
Cm-247	Cm-248	Cm-249	Cm-250	Co-55	Co-56	Co-58m	Co-60m	Co-61
Co-62m	Cr-48	Cr-49	Cs-125	Cs-127	Cs-129	Cs-130	Cs-131	Cs-132
Cs-134m	Cs-135	Cs-135m	Cs-136	Cu-60	Cu-61	Cu-64	Cu-67	Dy-155
Dy-157	Dy-159	Dy-165	Dy-166	Er-161	Er-165	Er-169	Er-171	Er-172
Es-250	Es-251	Es-253	Es-254	Es-254m	Eu-145	Eu-146	Eu-147	Eu-148
Eu-149	Eu-150l	Eu-150s	Eu-152m	Eu-157	Eu-158	Fe-52	Fe-60	Fm-252
Fm-253	Fm-254	Fm-255	Fm-257	Fr-222	Fr-223	Ga-65	Ga-66	Ga-68
Ga-70	Ga-72	Ga-73	Gd-145	Gd-146	Gd-147	Gd-148	Gd-149	Gd-151
Gd-152	Gd-153	Gd-159	Ge-66	Ge-67	Ge-68	Ge-69	Ge-71	Ge-75
Ge-77	Ge-78	Hf-170	Hf-172	Hf-173	Hf-175	Hf-177m	Hf-178m	Hf-179m
Hf-180m	Hf-182	Hf-182m	Hf-183	Hf-184	Hg-193	Hg-193m	Hg-194	Hg-195
Hg-195m	Hg-197	Hg-197m	Hg-199m	Ho-155	Ho-157	Ho-159	Ho-161	Ho-162
Ho-162m	Ho-164	Ho-164m	Ho-166m	Ho-167	I-120	I-120m	I-121	I-128
I-130	I-132m	In-109	In-110l	In-110s	In-112	In-113m	In-114m	In-115
In-115m	In-116m	In-117	In-117m	In-119m	Ir-182	Ir-184	Ir-185	Ir-186l
Ir-186s	Ir-187	Ir-188	Ir-189	Ir-190	Ir-190ml	Ir-190ms	Ir-192m	Ir-194
Ir-194m	Ir-195	Ir-195m	K-40	K-42	K-43	K-44	K-45	La-131
La-132	La-135	La-137	La-138	La-143	Lu-169	Lu-170	Lu-171	Lu-172
Lu-173	Lu-174m	Lu-176	Lu-176m	Lu-177	Lu-177m	Lu-178	Lu-178m	Lu-179
Md-257	Md-258	Mg-28	Mn-51	Mn-52	Mn-52m	Mn-53	Mn-56	Mo-101
Mo-90	Mo-93	Mo-93m	Nb-88	Nb-89l	Nb-89s	Nb-90	Nb-93m	Nb-95m
Nb-96	Nb-97	Nb-98	Nd-136	Nd-138	Nd-139	Nd-139m	Nd-141	Nd-147
Nd-149	Nd-151	Ni-56	Ni-57	Ni-59	Ni-65	Ni-66	Np-232	Np-233
Np-234	Np-235	Np-236l	Np-236s	Np-238	Np-240	Os-180	Os-181	Os-182
Os-185	Os-189m	Os-191	Os-191m	Os-193	Os-194	Pa-227	Pa-228	Pa-230
Pa-232	Pb-195m	Pb-198	Pb-199	Pb-200	Pb-201	Pb-202	Pb-202m	Pb-203
Pb-205	Pb-209	Pb-211	Pb-214	Pd-100	Pd-101	Pd-103	Pd-107	Pd-109
Pm-141	Pm-143	Pm-144	Pm-145	Pm-146	Pm-148	Pm-148m	Pm-149	Pm-150
Pm-151	Po-203	Po-205	Po-207	Po-218	Pr-136	Pr-137	Pr-138m	Pr-139
Pr-142	Pr-142m	Pr-145	Pr-147	Pt-186	Pt-188	Pt-189	Pt-191	Pt-193
Pt-193m	Pt-195m	Pt-197	Pt-197m	Pt-199	Pt-200	Pu-234	Pu-235	Pu-236
Pu-237	Pu-243	Pu-244	Pu-245	Pu-246	Ra-225	Ra-227	Rb-79	Rb-81
Rb-81m	Rb-82m	Rb-83	Rb-84	Rb-86	Rb-87	Rb-88	Re-177	Re-178
Re-181	Re-182l	Re-182s	Re-184	Re-184m	Re-186	Re-186m	Re-187	Re-188
Re-188m	Re-189	Rh-100	Rh-101	Rh-101m	Rh-102	Rh-102m	Rh-103m	Rh-105
Rh-106m	Rh-107	Rh-99	Rh-99m	Ru-94	Ru-97	Sb-115	Sb-116	Sb-116m
Sb-117	Sb-118m	Sb-119	Sb-120l	Sb-120s	Sb-122	Sb-124ml	Sb-126	Sb-126m

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Sb-127	Sb-128l	Sb-128s	Sb-130	Sb-131	Sc-43	Sc-44	Sc-44m	Sc-47
Sc-48	Sc-49	Se-70	Se-73	Se-73m	Se-75	Se-79	Se-81	Se-81m
Se-83	Si-31	Si-32	Sm-141	Sm-141m	Sm-142	Sm-145	Sm-146	Sm-147
Sm-153	Sm-155	Sm-156	Sn-110	Sn-111	Sn-117m	Sn-119m	Sn-121	Sn-121m
Sn-123	Sn-123m	Sn-125	Sn-126	Sn-127	Sn-128	Sr-80	Sr-81	Sr-82
Sr-83	Sr-85m	Sr-87m	Sr-92	Ta-172	Ta-173	Ta-174	Ta-175	Ta-176
Ta-177	Ta-178l	Ta-179	Ta-180	Ta-180m	Ta-182m	Ta-183	Ta-184	Ta-185
Ta-186	Tb-147	Tb-149	Tb-150	Tb-151	Tb-153	Tb-154	Tb-155	Tb-156
Tb-156m	Tb-156n*	Tb-157	Tb-158	Tb-161	Tc-101	Tc-104	Tc-93	Tc-93m
Tc-94	Tc-94m	Tc-95	Tc-95m	Tc-96	Tc-96m	Tc-97	Tc-97m	Tc-98
Te-116	Te-121	Te-121m	Te-123	Te-123m	Te-125m	Te-127	Te-127m	Te-129
Te-129m	Te-132	Te-133	Te-133m	Te-134	Th-226	Th-227	Th-229	Th-231
Ti-44	Ti-45	Tl-194	Tl-194m	Tl-195	Tl-197	Tl-198	Tl-198m	Tl-199
Tl-200	Tm-162	Tm-166	Tm-167	Tm-171	Tm-172	Tm-173	Tm-175	U-230
U-231	U-237	U-240	V-47	V-48	V-49	W-176	W-177	W-178
W-179	W-181	W-185	W-187	Y-86	Y-86m	Y-87	Y-90m	Y-91m
Y-94	Y-95	Yb-162	Yb-166	Yb-167	Yb-175	Yb-177	Yb-178	Zn-62
Zn-63	Zn-69	Zn-69m	Zn-71m	Zn-72	Zr-86	Zr-88	Zr-89	Zr-93

*The suffix ‘n’ indicates that this metastable state is of higher energy than the first metastable state.

How is it implemented?

The additional radionuclides listed above are available from the Periodic Table tool for selection as indicator radionuclides. If Add-On 3 (Associated radionuclides) is also installed, then the additional radionuclides listed above will also be available from the Periodic Table tool for selection as associated radionuclides.