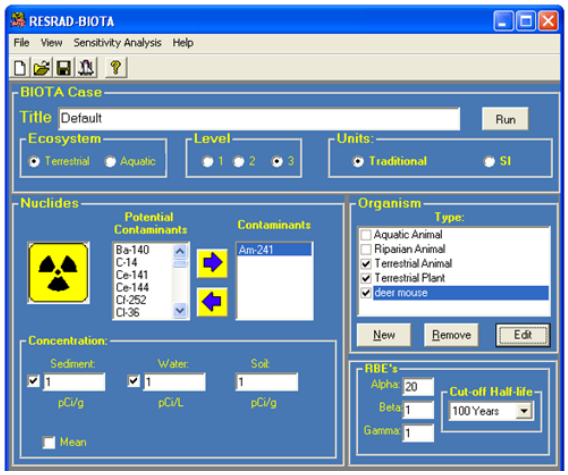
Verification/Benchmarking of RESRAD-BIOTA

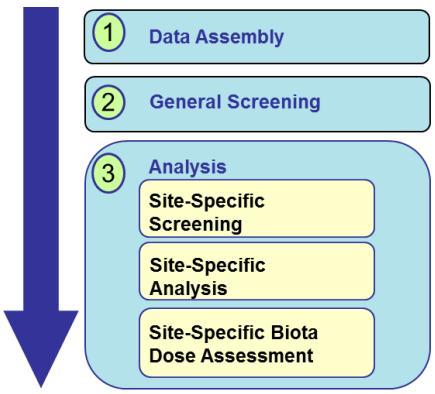
A computer program for evaluating radiation doses to nonhuman biota

What is RESRAD-BIOTA?

RESRAD-BIOTA is a computer code that implements the U.S. Department of Energy's (DOE's) graded approach methodology described in DOE Technical Standard DOE-STD-1153-2002, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. The Graded Approach methodology was developed through the Department's Biota Dose Assessment Committee (BDAC).



How were the results verified?



- **Level 1 –** Results were compared with and matched the Biota Concentration Guides (BCGs) recommended in DOE Standards STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*.
- **Level 1 and Level 2 –** Results were compared and in good agreement with the results of a spreadsheet calculator called RAD-BCG, under the same input conditions.
- **Level 3 –** Results were verified with spreadsheet calculations that implemented the same mathematical equations as RESRAD-BIOTA. These included results generated with default and size-specific dose conversion factors (DCFs), with bioaccumulation factor and allometric input options, and with specified food chain information, for default and created organisms.

The development of code was sponsored by DOE's Office of Environment, Health, Safety and Security, and the Office of Environmental Management, with support from the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission. The code was developed by Environmental Science Division of Argonne National Laboratory. Code and version control are currently maintained by DOE through Argonne as part of the RESRAD family of codes.

Benchmarking of RESRAD-BIOTA

RESRAD-BIOTA was used in the International Atomic Energy Agency (IAEA) Environmental Modeling for Radiation Safety (**EMRAS and EMRAS II**) Programs and the IAEA's Modelling and Data for Radiololgical Impact Assessments (**MODARIA**) Program, Biota Working Group's model comparison exercises.

- **DCFs comparison** – Compared external and internal DCFs for 5 reference organisms, associated with 7 radionuclides in the source media (J. Vives i Batlle et al., 2007, *Radiation and Environmental Biophysics*, 46:349-373).

- **Tissue concentrations comparison** – Compared estimated tissue concentrations in 7 terrestrial and 12 aquatic organisms, associated with 18 different radionuclides, each with a unit concentration in soil and water (N.A. Beresford et al., 2008, *Radiation and Environmental Biophysics*, 47:491-514).

- **Perch Lake Canada scenario** – Comparison of predicted tissue concentrations in freshwater organisms based on radionuclide concentrations in water (T.L. Yankovich et al., 2010, *Journal of Radiological Protection*, 30:299-340).

- **Chernobyl terrestrial scenario** – Comparison of predicted tissue concentrations in terrestrial organisms, based on radionuclide concentrations in soil and water (N.A. Beresford et al., 2010, *Journal of Radiological Protection*, 30:341-373).

- **Little Forest Burial Ground Australia scenario** – Comparison of estimated dose rates and tissue concentrations for a range of organisms exposed to soil contamination at a shallow radioactive waste burial site (M.P. Johansen et al., 2012, *Science of the Total Environment*, 427-428:238-246).

- **Fukushima scenario** – Comparison of predicted dynamic tissue concentrations in marine organisms based on hydrodynamic forecasts of water and sediment radionuclide concentrations (J. Vives i Batlle et al., 2016, *Journal of Environmental Radioactivity*, 153:31-50).