

## Dosimetry demonstration and practical

### Part A: The influence of size and occupancy on internal and external dosimetry

In this exercise you will create three different sized marine organisms using the information in Table 1. For the first practical assume an input for each radionuclide (H-3, Co-60, Pu-240 and Sr-90) of 1 Bq/l in the water and 1 Bq/kg in the organism. This allows you to look at the effect of dosimetry only and removes any influence of transfer parameters on the dose rates predicted. Note you will need to enter a CR value for each radionuclide/new organism geometry. Please enter the value of 1 in each CR box. This will not actually be used in the calculations you perform.

Assume initial occupancies are 100% in the water column.

Record the internal, external and total dose rates for each organism type and examine the results for each radionuclide and explain any differences in the dose rates that you observe.

Table 1 Organism geometries

Organism type	Mass (kg)	Length (cm)	Height (cm)	Width (cm)
Fish egg	4.2E-06	0.2	0.2	0.2
Fish	1.5	50	8.5	6.5
Seal	200	200	45	45

### External dose rate

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

### Internal dose rate

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

### Total dose rate

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

*Part B*

Now repeat the exercise in part A but in this case place the organisms at the water surface for 100% of their time. Record the external dose rate for each organism and describe any differences that you observe. Why might there be a difference if this is the case? The internal dose rate should be unaffected by this change to the occupancy factors but you should check this.

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

*Part C: The influence of radiation weighting factors on internal dosimetry*

Now amend the alpha radiation weighting factor to 100 and the low energy beta factor to 1 and complete the dose rate calculations for each organism. Record the internal and external dose rate results describing any differences you observe between the external dose rate calculated here and that in part B and for the internal dose rates with those calculated in Part A. Explain any observed differences.

**External dose rate**

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

**Internal dose rate**

Isotope	Fish egg	Fish	Seal
H-3			
Co-60			
Pu-240			
Sr-90			

*Part D: Effect of occupancy on external and total dose rate*

Use the terrestrial ecosystem and the mammal (rat) geometry to explore the effect of occupancy on the external and total dose rates. For these radionuclides (Am-241, Co-60, Cs-137, Pu-240, Sr-90) assume 1 Bq/kg in soil. Run the model first assuming 100% occupancy in soil and record your results for external and total dose rate. Then re-run assuming 100% occupancy on soil and record your results for external and total dose rate. Describe and explain any differences observed.

**External dose rate (Occupancy 100% in soil)**

Isotope	Rat
Am-241	
Co-60	
Cs-137	
Pu-240	
Sr-90	

**Total dose rate (Occupancy 100% in soil)**

Isotope	Rat
Am-241	
Co-60	
Cs-137	
Pu-240	
Sr-90	

**External dose rate (Occupancy 100% on soil)**

Isotope	Rat
Am-241	
Co-60	
Cs-137	
Pu-240	
Sr-90	

**Total dose rate (Occupancy 100% on soil)**

Isotope	Rat
Am-241	
Co-60	
Cs-137	
Pu-240	
Sr-90	

*Part E: Comparing the current ERICA default macroalgae geometry to the ICRP geometry*

The default ERICA geometry for macroalgae is supposed to be the same as that used by the ICRP for their Reference Brown Seaweed (ICRP Publication 108), but, it isn't. The ICRP changed the geometry between providing information to the ERICA developers for the Tool and publishing the ICRP report.

Create a new organism 'ICRPseaweed' with a mass of 0.652 kg and dimensions of 50x50x0.5 cm (height x width x length). Define the occupancy as 100% at the water-sediment interface.

At the assessment context screen select both the default and your newly created macroalgae geometries. Select Am-241, Co-60, Cs-137, Sr-90 and U-238. Give your new geometry the same CR values as the default Macroalgae.

Input 1 Bq/l of each radionuclide and record results below for both internal and external dose rates

<b>Internal Dose Rate [<math>\mu\text{Gy h}^{-1}</math>] ----- Isotope</b>	<b>Macroalgae</b>	<b>ICRPseaweed</b>
Cs-137		
Am-241		
U-238		
Co-60		
Sr-90		

<b>External Dose Rate [<math>\mu\text{Gy h}^{-1}</math>] ----- Isotope</b>	<b>Macroalgae</b>	<b>ICRPseaweed</b>
Cs-137		
Am-241		
U-238		
Co-60		
Sr-90		

You can find details of the default macroalgae geometry in Tables 9 and 19 of the ERICA Help file. Compare this to the ICRP geometry when looking at your results.