Introduction

A shielding calculation was performed with both Monte Carlo (MCNP) and Attila. An N^{16} gamma source was distributed uniformly in a water medium surrounded by a steel tank. A 5 cm thick steel wall was located between the source and points where the dose was calculated. Attila and Monte Carlo calculations generously provided by Richard Haley of Nuclear Technologies, Plc. (www.nuclear.co.uk).

Problem Summary

Figure 1 illustrates the model geometry. The isotropic volumetric gamma source is applied in a 90 cm high x 20 cm diameter cylindrical water volume contained inside a 2 cm thick annular steel shell. The near side of a 5 cm thick steel wall is located 20 cm in the x-direction from the center of the cylindrical tank. Measurement points are located in air at distances of 30, 40, 50, and 60 cm in the x-direction from the cylindrical tank center, and at a height of z=50 cm, corresponding to the axial midpoint of the tank. Two sets of measurement points are applied. Points referred to as 'in line dose rate positions' are located at y=50, the same y-location as the tank center. Points referred to as 'off line dose rate positions' are located at y=90, and are offset 40 cm from the tank center. The surrounding medium is void.

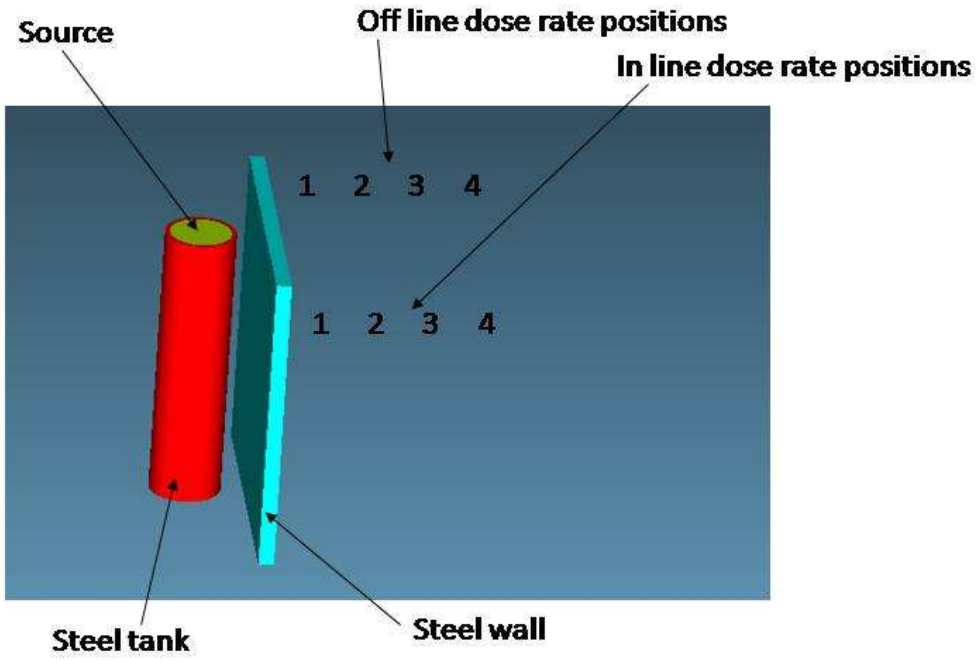

Figure 1: Model geometry.

The source is an isotropic volume source from N^{16} gamma emission, with chi values of 2.553 and 0.185 for energies of 6.129 MeV and 7.115 MeV, respectively.

Attila Calculation Summary

The Attila computational mesh contained approximately 10,000 elements. Since four spatial unknowns are solved in each tetrahedral element, this equates to approximately 40,000 spatial degrees of freedom. Two calculations were performed; one using the Radion15 cross section set (22 neutron, 25 gamma groups), and one using the Transpire46G cross section set (46 gamma groups). In both calculations, all fine gamma groups below 8 MV (the highest source energy) were used in the calculation, which corresponded to 19 groups for the Radion15

calculation, and 36 energy groups for the Transpire46G calculation. The Triangular Chebychev Legendre quadrature set was used with an S_{16} quadrature order. The scattering order for the calculation was P_3.

The dose was obtained at the 8 points listed in Tables 1 and 2 using the ICRU-57 (ICRP74) flux-to-dose conversion factor for both Attila and MCNP. Table 1 provides the Radion15 calculation results, and Table 2 provides the Transpire46G results. Attila results were calculated at points with the use of the last-collided method, which semi-analytically transports the last scattered flux to the associated edit points.

Results

Section plots of the gamma flux are provided in Figure 2.

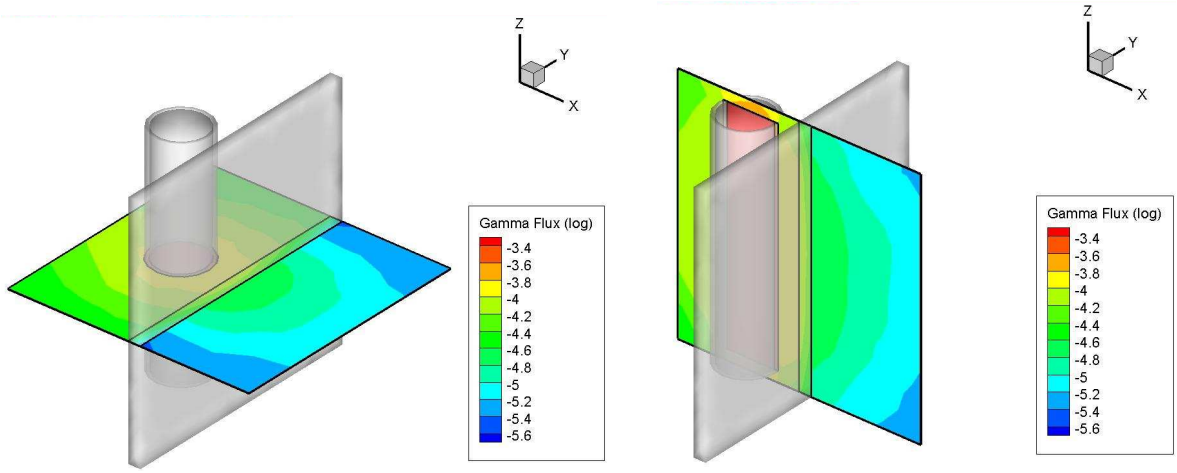

Figure 2: Total gamma flux (log).

Point Number	In-line points			Off-line points		
	MCNP	Attila	MC/Attila	MCNP	Attila	MC/Attila
Point 1	8.20e-7	7.98e-7	1.03	2.06e-7	1.98e-7	1.04
Point 2	5.70e-7	5.56e-7	1.03	2.22e-7	2.15e-7	1.03
Point 3	4.17e-7	4.07e-7	1.03	2.12e-7	2.05e-7	1.03
Point 4	3.17e-7	3.07e-7	1.03	1.89e-7	1.84e-7	1.03

Table 1: Point dose results, including comparison between Attila (Radion15) and MCNP. Dose is in units of microSv/hr for a total source strength of 1 particle/second.

Point Number	In-line points			Off-line points		
	MCNP	Attila	MC/Attila	MCNP	Attila	MC/Attila
Point 1	8.20e-7	7.94e-7	1.03	2.06e-7	1.97e-7	1.05
Point 2	5.70e-7	5.54e-7	1.03	2.22e-7	2.14e-7	1.04
Point 3	4.17e-7	4.05e-7	1.03	2.12e-7	2.04e-7	1.04
Point 4	3.17e-7	3.06e-7	1.04	1.89e-7	1.83e-7	1.03

Table 2: Point dose results, including comparison between Attila (Transpire46G) and MCNP. Dose is in units of microSv/hr for a total source strength of 1 particle/second.