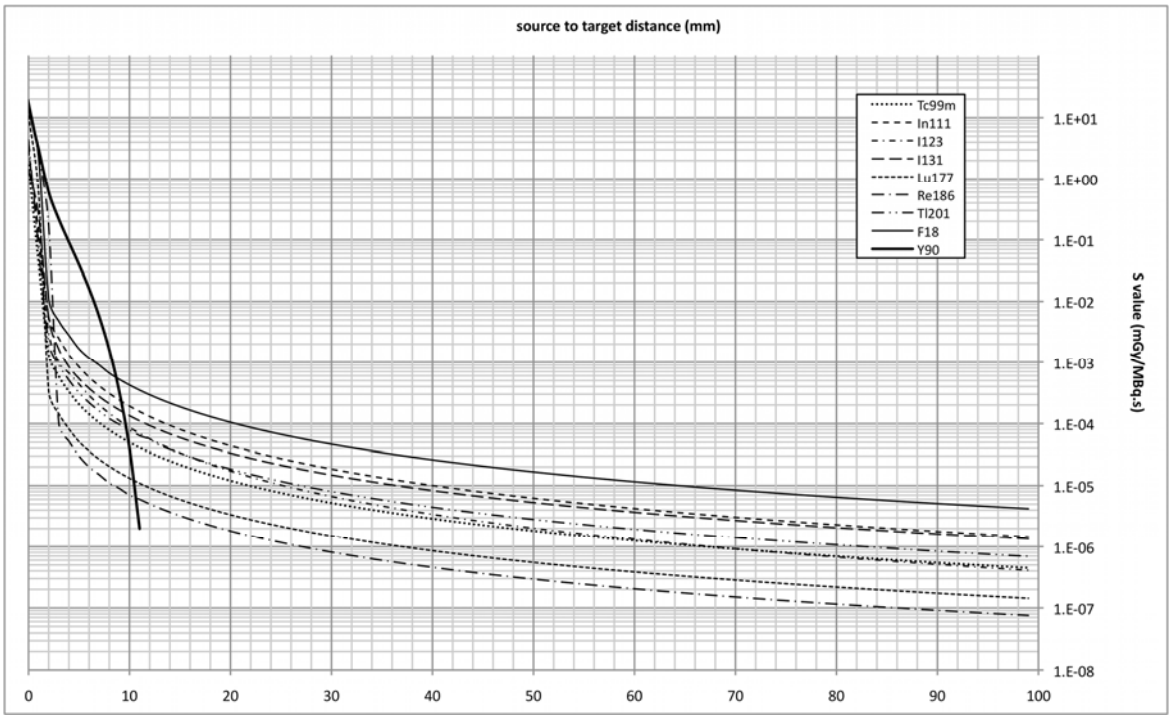
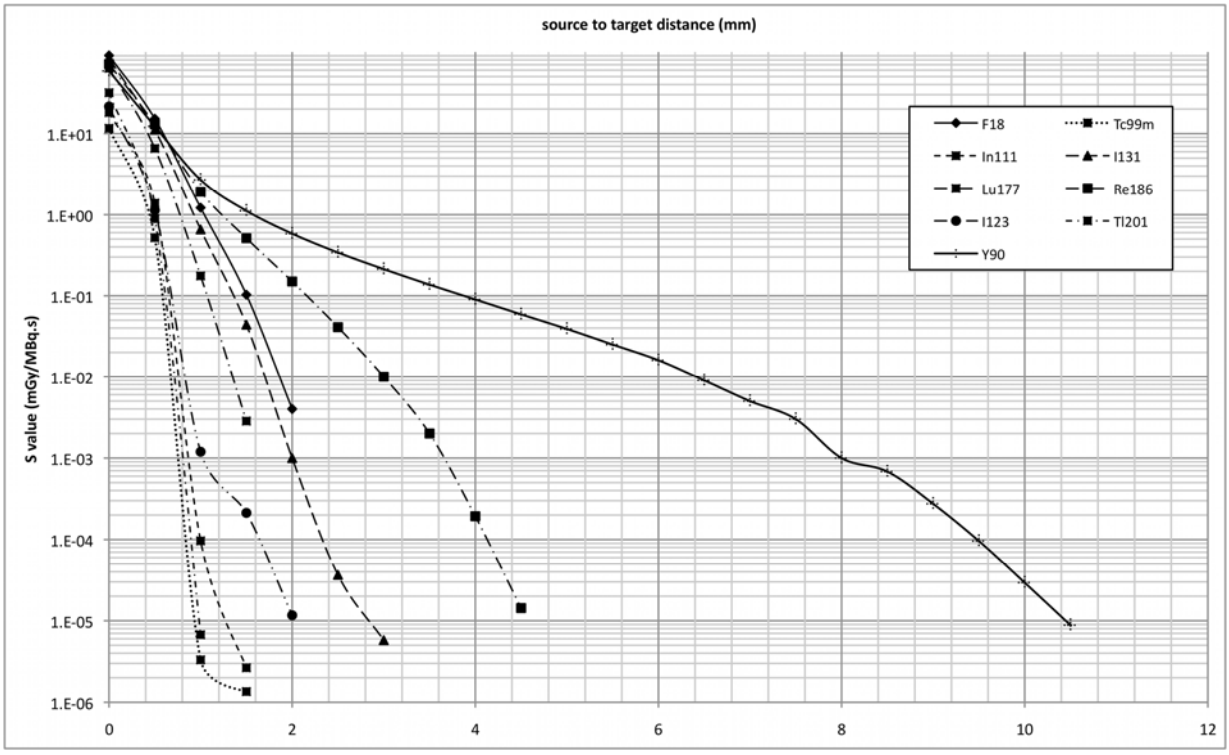
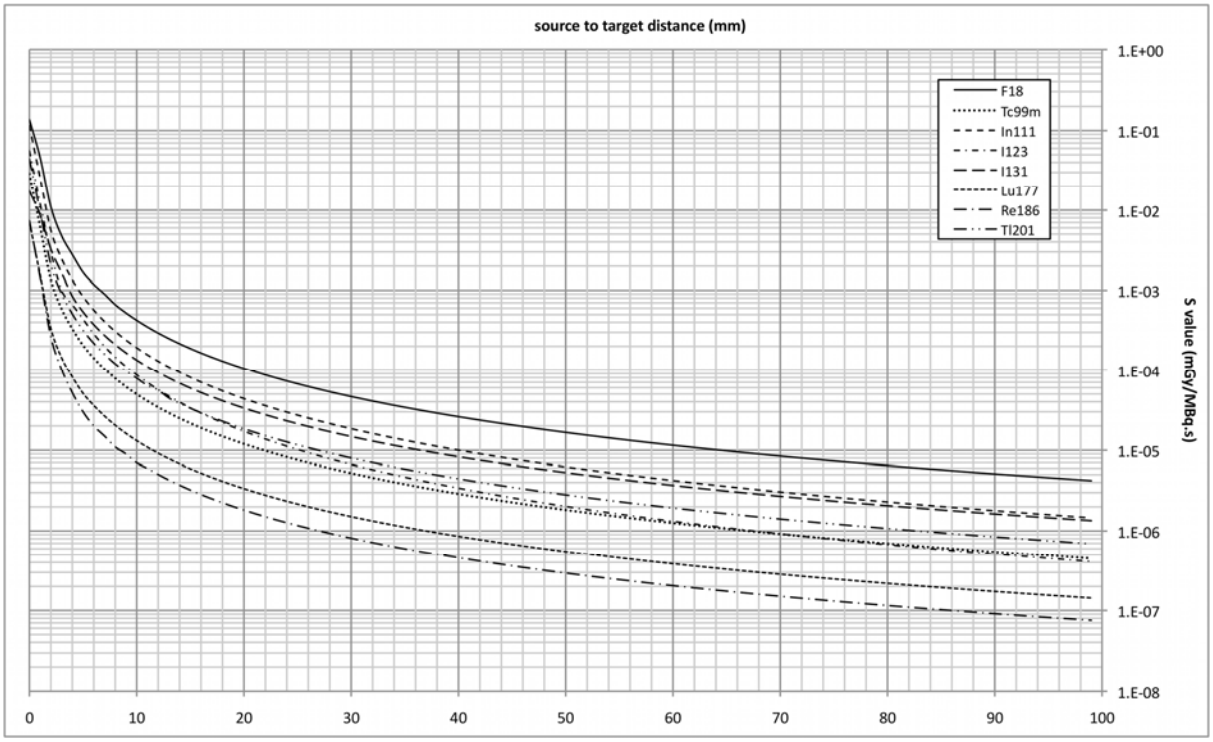


Supplemental Figure 1. Total Voxel S-Values (electron and photon components) for ^{18}F, ^{90}Y, ^{99m}Tc, ^{111}In, ^{123}I, ^{131}I, ^{177}Lu, ^{186}Re and ^{201}Tl, in a soft tissues medium (1.04 g cm^{-3}), for cubical voxels of 1 mm.



Supplemental Figure 2. Voxel S-Values for the electron emissions from ^{18}F, ^{90}Y, ^{99m}Tc, ^{111}In, ^{123}I, ^{131}I, ^{177}Lu, ^{186}Re and ^{201}Tl, in a soft tissues medium (1.04 g cm^{-3}), for cubical voxels of 0.5 mm.



Supplemental Figure 3. Voxel S-Values of the photon emissions from ^{18}F, ^{99m}Tc, ^{111}In, ^{123}I, ^{131}I, ^{177}Lu, ^{186}Re and ^{201}Tl, in a soft tissues medium (1.04 g cm^{-3}), for cubical voxels of 1 mm.

APPENDIX

This appendix gives an example MCNPX input deck to generate fine-resolution voxel S values for radionuclides not considered in this study. Further explanation on the use of MCNPX can be found in the *MCNPX USER'S MANUAL at http://mcnpx.lanl.gov/.*

MCNPX specific language is surrounded by "stars" in the following lines.

Radionuclide: ^{90}Y
Particles emitted: electrons with continuous spectrum (beta particles)
Medium: soft tissue
Voxel dimensions: 0.5 x 0.5 x 0.5 cm^3

1. CELL CARD

Cell 1 corresponds to the source voxel (surface 1) and is composed of soft tissue (material 1) at a mass density of 1.04 $g.cm^3$.
Cell 2 corresponds to the regions surrounding the source voxel (surface 2) and is composed of soft tissue (material 1) with a density of 1.04 $g.cm^3$.
Cell 3 corresponds to the remainder of the transport universe (regions outside the voxel matrix) and is composed of vacuum (material 0).

```
**********************************************************************************************
Cell card
1   1  -1.04   -1          IMP:e,p=1
2   1  -1.04    1  -2      IMP:e,p=1
3   0           2          IMP:e,p=0
**********************************************************************************************
```

2. SURFACE CARD

Surface 1 is a voxel 0.05 cm on a side with the coordinates of the origin set at (0,0,0).
Surface 2 is a sphere, simulating an infinite medium, with a radius of 10 cm containing the voxel, and the coordinates of its center is (0,0,0).

```
**********************************************************************************************
Surface card
1  BOX  0 0 0  0.05 0 0  0 0.05 0  0 0 0.05
2  SO    10
**********************************************************************************************
```

3. MODE

In this simulation, photons and secondary electrons are both tracked.

```
**********************************************************************************************
Mode e p
```

```
*********************************************************************************************
```

4. DATA CARD

Material 1 is defined as ICRU 46 soft tissue.

```
*********************************************************************************************
m1   1000   -10.454
       6000   -22.663
       7000   -2.490
…   Components with atomic number between 7 and 37 are not listed.
       37000   -0.001
       40000   -0.001
*********************************************************************************************
```

5. CUT

Electrons paths are simulated until the kinetic energy falls below 10 keV.

```
*********************************************************************************************
cut:e j 0.01  $stop any electrons below 0.01MeV
*********************************************************************************************
```

6. SOURCE DEFINITION

The emission point of electrons is sampled within the source voxel with a uniform probability. Coordinate (x,y,z) is sampled by (d1,d2,d3).
The kinetic energy at the emission point is sampled by the continuous energy spectrum. Energy is sampled using the variable d4.

```
*********************************************************************************************
sdef cel=1 x=d1 y=d2 z=d3 par=3 erg=d4
c
sc1 x
si1 0 0.05
sp1 d 0 1
c
sc2 Y
si2 0 0.05
sp2 d 0 1
c
sc3 z
si3 0 0.05
sp3 d 0 1
c
#    si4        sp4
     a       0.336899996
     0       0.336899996
     0.0001  0.336899996
 … Energies between 0.0001 MeV and 2 MeV are not listed.
     2       0.01528
     2.2     0
     2.2839
*********************************************************************************************
```

7. DEBUG INFORMATION CARD

The ITS mode (Integrated TIGER Series) is used, which provides better energy binning than the MCNP default mode. The input parameter x_{17} is set to "1".

```
**********************************************************************************
dbcn 17j 1 3j
**********************************************************************************
```

8. TALLY SPECIFICATION

Energy deposition is tracked in the source voxel itself and in the surrounding voxels up to the CSDA range of the maximum energy of the electron spectrum, i.e. 1.1 cm in soft tissue with a density of 1.04 $g.cm^{-3}$. A rectangular mesh is defined with *rmesh* : a cube of 1.1 1.1 1.1 cm^3, containing 22 22 22 voxels of 0.5 0.5 0.5 cm^3.

```
**********************************************************************************
tmesh
  rmesh3 total
  cora3 0 21i 1.1
  corb3 0 21i 1.1
  corc3 0 21i 1.1
endmd
**********************************************************************************
```

9. HISTORY CUTOFF

One billion particles were generated to achieve a reasonable statistical error in each voxel.

```
**********************************************************************************
nps 1e9
**********************************************************************************
```