Appendix A

Sample of Monte Carlo N-Particle Transport Code Input Listings

Appendix A

Sample of Monte Carlo N-Particle Transport Code Input Listings

This appendix contains examples of the Monte Carlo N-Particle Transport Code input listings for various computational models used in this criticality safety evaluation for the OU 7-10 Glovebox Excavator Method Project.

Case soil3b:

Transfer cart modeled with 30 g/L PuO_2 in fully saturated soil, full reflection around the transfer cart with fully saturated soil.

```
Case soil3b - Subsurface Disposal Area (SDA)  PuO2 and H2O in soil
c
c Water Saturated Soil as Reflector
c
c 30 g/L PuO2 dispersed homogenously throughout the volume of the
c   transfer cart.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 422.32
c
1    1   8.1249-02     -1 +2 -3 +4 -5 +6 u=1 $ PuO2, H2O, Soil
2    2   8.1049-02     +1:-2:+3:-4:+5:-6 u=1 $ Water reflector
3    0                -7 +8 -9 +10 -11 +12  fill=1    $ Boundary of Reflector
4    0                +7:-8:+9:-10:+11:-12            $ ziow

1    px    53.34    $ +x Transfer Cart
2    px   -53.34    $ -x Transfer Cart
3    py    38.10    $ +y Transfer Cart
4    py   -38.10    $ -y Transfer Cart
5    pz    17.78    $ +z Transfer Cart
6    pz     0.0     $ -z Transfer Cart
7    px   103.34    $ +x Refl Boundary
8    px  -103.34    $ -x Refl Boundary
9    py    88.10    $ +y Refl Boundary
10   py   -88.10    $ -y Refl Boundary
11   pz    67.78    $ +z Refl Boundary
12   pz   -50.0     $ -z Refl Boundary

mode n
imp:n 1 1 1 0
c
c
c  PuO2 in Saturated Soil in SDA (40% Void Volume Filled w H2O)
m1     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9468-02
      94239.55c 6.3321-05  94240.50c 3.3188-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  10
c
print
```

Case drum_741a15:

Single drum containing Series 741 sludge and 15 g/L of PuO_2 dispersed homogeneously throughout drum volume, fully reflected by fully saturated soil.

```
Case drum_741a15 - Subsurface Disposal Area (SDA)  PuO2 in 741 Sludge
c
c Soil as Reflector
c
c Sludge modelled with an average density of 1.0 g/cm3
c 15 g/L PuO2 dispersed homogenously throughout the volume of the
c   55 gal waste drum.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 1102
c
1    1   6.3313-02     -1 -2 +3    u=1         $ PuO2 in sludge
2    4   8.5863-02     (+1:+2:-3)  u=1         $ Carbon steel Drum
3    0                -4 -5 +6  fill=1  u=2   $ Carbon steel Drum
4    2   8.1049-02     (+4:+5:-6)        u=2
5    0                -7 +8 -9 +10 -11 +12  fill=2   $ Reflector
6    0                +7:-8:+9:-10:+11:-12  $ ziow

1    cz    28.57    $ Inside Radius of 55 gal drum
2    pz    42.545   $ +z Inside Height of 55 gal drum
3    pz   -42.545   $ -z Inside Height of 55 gal dru
4    cz    28.727   $ Carbon Steel 55 gal drum outer radius
5    pz    42.695   $ +z Outer Height of 55 gal drum
6    pz   -42.695   $ -z Outer Height of 55 gal drum
7    px   128.57    $ +x Refl Boundary
8    px  -128.57    $ -x Refl Boundary
9    py   128.57    $ +y Refl Boundary
10   py  -128.57    $ -y Refl Boundary
11   pz   142.695   $ +z Refl Boundary
12   pz  -142.695   $ -z Refl Boundary

mode n
imp:n 1 4r 0
c
c
c  PuO2 in 741 Sludge
m1     14000.50c 2.0630-03  13027.50c 2.0560-04  26000.55c 5.1875-04
      20000.50c 1.9993-03  19000.50c 9.4589-05  12000.50c 3.2968-04
      11023.50c 1.8768-03  17000.50c 1.0432-04  16032.50c 6.4163-06
       7014.50c 2.2069-03   1001.50c 3.4899-02   8016.50c 1.8801-02
       6012.50c 1.7461-04  94239.55c 3.1660-05  94240.50c 1.6594-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9366-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
c  Carbon Steel Drum
m4    6000.50c 1.9604-03  26000.55c 8.3903-02
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case sphere_sludge_25cm:

Sphere of Series 741 sludge and various concentrations of PuO_2 dispersed homogeneously sphere, volume of material in sphere equal to volume of fully loaded drum, fully reflected by fully saturated soil.

```
Case sphere_sludge_25cm - Subsurface Disposal Area (SDA)  PuO2 and H2O in soil
c
c Soil as Reflector
c
c 1,500 g Pu239 in PuO2 Form dispersed homogenously throughout the volume of sphere
c   25 cm radius - PuO2 and Sludge
c
c Volume of PuO2 is ignored in model
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 636.42
c
1    1   6.338601-02   -1              $ PuO2, H2O, Soil
2    3   8.1049-02     +1 -2           $ Saturated soil reflector
3    0               +2              $ ziow

1    so     25.0    $ Radius of PuO2 and Sludge
2    so    125.0    $ 100 cm saturated soil reflector

mode n
imp:n 1 1 0
c
c
c  PuO2 in 741 Sludge
m1     14000.50c 2.0630-03  13027.50c 2.0560-04  26000.55c 5.1875-04
      20000.50c 1.9993-03  19000.50c 9.4589-05  12000.50c 3.2968-04
      11023.50c 1.8768-03  17000.50c 1.0432-04  16032.50c 6.4163-06
       7014.50c 2.2069-03   1001.50c 3.4899-02   8016.50c 1.8850-02
       6012.50c 1.7461-04  94239.55c 5.4836-05  94240.50c 2.8861-06
c
c 741 Sludge
m2     14000.50c 2.0630-03  13027.50c 2.0560-04  26000.55c 5.1875-04
      20000.50c 1.9993-03  19000.50c 9.4589-05  12000.50c 3.2968-04
      11023.50c 1.8768-03  17000.50c 1.0432-04  16032.50c 6.4163-06
       7014.50c 2.2069-03   1001.50c 3.4899-02   8016.50c 1.8734-02
       6012.50c 1.7461-04
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m3     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m4      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case drum_743a20:

Single drum containing Series 743 sludge and 20 g/L of PuO_2 dispersed homogeneously throughout drum volume, fully reflected by fully saturated soil.

```
Case drum_743a20 - Subsurface Disposal Area (SDA)  PuO2 in 743 Sludge
c
c Soil as Reflector
c
c Sludge modelled with an average density of 1.2175 g/cm3
c 20 g/L PuO2 dispersed homogenously throughout the volume of the
c   55 gal waste drum.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 1254.6
c
1    1   9.3138-02     -1 -2 +3    u=1         $ PuO2 in 743 sludge
2    4   8.5863-02     (+1:+2:-3)  u=1         $ Carbon steel Drum
3    0                -4 -5 +6  fill=1  u=2   $ Carbon steel Drum
4    2   8.1049-02     (+4:+5:-6)        u=2
5    0                -7 +8 -9 +10 -11 +12  fill=2   $ Reflector
6    0                +7:-8:+9:-10:+11:-12  $ ziow

1    cz    28.57    $ Inside Radius of 55 gal drum
2    pz    42.545   $ +z Inside Height of 55 gal drum
3    pz   -42.545   $ -z Inside Height of 55 gal dru
4    cz    28.727   $ Carbon Steel 55 gal drum outer radius
5    pz    42.695   $ +z Outer Height of 55 gal drum
6    pz   -42.695   $ -z Outer Height of 55 gal drum
7    px   128.57    $ +x Refl Boundary
8    px  -128.57    $ -x Refl Boundary
9    py   128.57    $ +y Refl Boundary
10   py  -128.57    $ -y Refl Boundary
11   pz   142.695   $ +z Refl Boundary
12   pz  -142.695   $ -z Refl Boundary

mode n
imp:n 1 4r 0
c
c
c  PuO2 in 741 Sludge
m1     14000.50c 1.9394-03  13027.50c 1.2174-04  26000.55c 2.1650-05
      20000.50c 1.4150-03  19000.50c 3.8139-05  12000.50c 3.6688-04
      11023.50c 3.8139-03  17000.50c 4.3083-03   1001.50c 3.4899-02
       8016.50c 5.6725-03   6012.50c 2.6540-02
      94239.55c 4.2214-05  94240.50c 2.2125-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9366-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
c  Carbon Steel Drum
m4    6000.50c 1.9604-03  26000.55c 8.3903-02
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case sphere_743sludge_15cm:

Sphere of Series 743 sludge and various concentrations of PuO_2 dispersed homogeneously sphere, volume of material in sphere equal to volume of fully loaded drum, fully reflected by fully saturated soil.

```
Case sphere_743sludge_15cm - Subsurface Disposal Area (SDA)  PuO2 in 743 Sludge
c
c Saturated Soil as Reflector
c
c 1,500 g Pu239 in PuO2 Form dispersed homogenously throughout the volume of sphere
c   15 cm radius - PuO2 and 743 Sludge
c
c Volume of PuO2 is ignored in model
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 208.6
c
1    1   9.380663-02   -1              $ PuO2, and 743 Sludge
2    3   8.1049-02     +1 -2           $ Saturated soil reflector
3    0                 +2              $ ziow

1    so     15.0    $ Radius of PuO2 and Sludge
2    so    115.0    $ 100 cm saturated soil reflector

mode n
imp:n 1 1 0
c
c
c  PuO2 in 743 Sludge
m1     14000.50c 1.9394-03  13027.50c 1.2174-04  26000.55c 2.1650-05
      20000.50c 1.4150-03  19000.50c 3.8139-05  12000.50c 3.6688-04
      11023.50c 3.8139-03  17000.50c 4.3083-03   1001.50c 3.4899-02
       8016.50c 6.1181-03   6012.50c 2.6540-02
      94239.55c 2.5387-04  94240.50c 1.3362-05
c
c 743 Sludge
m2     14000.50c 1.9394-03  13027.50c 1.2174-04  26000.55c 2.1650-05
      20000.50c 1.4150-03  19000.50c 3.8139-05  12000.50c 3.6688-04
      11023.50c 3.8139-03  17000.50c 4.3083-03   1001.50c 3.4899-02
       8016.50c 5.5836-03   6012.50c 2.6540-02
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m3     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m4      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case drum_soil3a9:

Single drum containing Series 743 sludge and 13 g/L of PuO_2 dispersed homogeneously throughout drum volume, fully reflected by fully saturated soil.

```
Case drum_soil3a9 - Subsurface Disposal Area (SDA)  PuO2 and H2O in soil
c
c Soil as Reflector
c
c 13 g/L PuO2 dispersed homogenously throughout the volume of the
c   55 gal waste drum.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 974
c
1    1   8.1136-02     -1 -2 +3    u=1         $ PuO2, H2O, Soil
2    4   8.5863-02     (+1:+2:-3)  u=1         $ Carbon steel Drum
3    0                -4 -5 +6  fill=1  u=2   $ Carbon steel Drum
4    2   8.1049-02     (+4:+5:-6)        u=2
5    0                -7 +8 -9 +10 -11 +12  fill=2   $ Reflector
6    0                +7:-8:+9:-10:+11:-12  $ ziow

1    cz    28.57    $ Inside Radius of 55 gal drum
2    pz    42.545   $ +z Inside Height of 55 gal drum
3    pz   -42.545   $ -z Inside Height of 55 gal dru
4    cz    28.727   $ Carbon Steel 55 gal drum outer radius
5    pz    42.695   $ +z Outer Height of 55 gal drum
6    pz   -42.695   $ -z Outer Height of 55 gal drum
7    px   128.57    $ +x Refl Boundary
8    px  -128.57    $ -x Refl Boundary
9    py   128.57    $ +y Refl Boundary
10   py  -128.57    $ -y Refl Boundary
11   pz   142.695   $ +z Refl Boundary
12   pz  -142.695   $ -z Refl Boundary

mode n
imp:n 1 4r 0
c
c  PuO2 in Saturated Soil in SDA (40% Void Volume Filled w H2O)
m1     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9388-02
      94239.55c 2.7439-05  94240.50c 1.4381-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9366-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
c  Carbon Steel Drum
m4    6000.50c 1.9604-03  26000.55c 8.3903-02
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case sphere_soil_25cm:

Sphere of soil and various concentrations of PuO_2 dispersed homogeneously sphere, volume of material in sphere equal to volume of fully loaded drum, fully reflected by fully saturated soil.

```
Case sphere_soil_25cm - Subsurface Disposal Area (SDA)  PuO2 and H2O in soil
c
c Soil as Reflector
c
c 1500 g PuO2 dispersed homogenously throughout the volume of sphere
c   25 cm radius - PuO2 and Soil
c 40% void fraction in soil filled with H2O
c Volume of PuO2 is ignored in model
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 487.7
c
1    1   8.122253-02   -1              $ PuO2, H2O, Soil
2    2   8.1049-02     +1 -2           $ Saturated soil reflector
3    0               +2              $ ziow

1    so     25.0    $ Radius of PuO2 and Soil
2    so    125.0    $ 100 cm saturated soil reflector

mode n
imp:n 1 1 0
c
c
c  PuO2 in Saturated Soil in SDA (40% Void Volume Filled w H2O)
m1     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9450-02
      94239.55c 5.4836-05  94240.50c 2.8861-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Case soil3a_8in_15gperl_soilrefl:

Rectangular tray of plutonium oxide at 15 g/L in saturated soil fully reflected by saturated soil to envelope transfer cart and drum sizing tray.

```
Case soil3a_8in_15gperl_soilrefl - Subsurface Disposal Area (SDA)  PuO2 and H2O in soil
c
c Saturated Soil as Reflector
c
c 15 g/L PuO2 dispersed homogenously throughout the volume of the
c   transfer cart.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 844.65
c
1    1   8.1149-02     -1 +2 -3 +4 -5 +6 u=1 $ PuO2, H2O, Soil
2    2   8.1049-02     +1:-2:+3:-4:+5:-6 u=1 $ Saturated Soil reflector
3    0                -7 +8 -9 +10 -11 +12  fill=1    $ Boundary of Reflector
4    0                +7:-8:+9:-10:+11:-12            $ ziow

1    px    63.5     $ +x Transfer Cart
2    px   -63.5     $ -x Transfer Cart
3    py    78.74    $ +y Transfer Cart
4    py   -78.74    $ -y Transfer Cart
5    pz    20.32    $ +z Transfer Cart
6    pz     0.0     $ -z Transfer Cart
7    px   113.5     $ +x Refl Boundary
8    px  -113.5     $ -x Refl Boundary
9    py   128.74    $ +y Refl Boundary
10   py  -128.74    $ -y Refl Boundary
11   pz    70.32    $ +z Refl Boundary
12   pz   -50.0     $ -z Refl Boundary

mode n
imp:n 1 1 1 0
c
c
c  PuO2 in Saturated Soil in SDA (40% Void Volume Filled w H2O)
m1     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
       20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
       11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
        5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9402-02
       94239.55c 3.1660-05  94240.50c 1.6594-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
       20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
       11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
        5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  10
c
print
```

Case water_11g-l_tilt:

Drum-sizing tray of plutonium oxide at 11 g/L in water soil fully reflected by water at a tilted angle to envelope worst case tilt scenario

```
Case water_11g-l_tilt - Subsurface Disposal Area (SDA)  PuO2 in H2O
c
c Water as Reflector
c
c 11 g/L PuO2 dispersed homogenously throughout the volume of the
c   drum sizing tray.
c
c Pu modelled as 95% Pu239 5% Pu240
c  H/Pu Ratio 1589
c
1    1   1.0017-01     -8 -7 -3 +4 -5 +6 -20            $ PuO2, H2O
2    3   -0.9982       -8 -7 -3 +4 -5 +6 +20           $ PuO2, H2O
3    3   -0.9982       #1 #2 -9 +10 -11 +12 -13 +14      $ Water reflector
4    0                +9:-10:+11:-12:+13:-14           $ ziow

1    px    60.6425  $ +x Transfer Cart
2    px   -60.6425  $ -x Transfer Cart
3    py    76.2     $ +y Transfer Cart
4    py   -76.2     $ -y Transfer Cart
5    pz    43.18    $ +z Transfer Cart
6    pz     0.0     $ -z Transfer Cart
7    p   -33.02 -76.20 0  -33.02 76.20 0  -60.6425 -76.20 45.72    $ -x Slanted Surface
8    p    33.02 -76.20 0   33.02 76.20 0   60.6425 -76.20 45.72    $ +x Slanted Surface
9    px    91.1225  $ +x Refl Boundary
10   px   -91.1225  $ -x Refl Boundary
11   py   106.68    $ +y Refl Boundary
12   py  -106.68    $ -y Refl Boundary
13   pz    73.66    $ +z Refl Boundary
14   pz   -30.48    $ -z Refl Boundary
20   p    33.02 -76.20 20.32  -33.02 -76.20 20.32    60.6425  76.20   45.72    $ z Slanted Surface

mode n
imp:n 1 1 1 0
c
c
c  PuO2 in H2O
m1      1001.50c 6.6734-02   8016.50c 3.3416-02
      94239.55c 2.3218-05  94240.50c 1.2169-06
c
c  Saturated Soil in SDA (40% Void Volume Filled w H2O)
m2     14000.50c 1.0034-02  13027.50c 2.2387-03  26000.55c 5.1263-04
      20000.50c 6.3198-04  19000.50c 6.1135-04  12000.50c 4.1109-04
      11023.50c 4.2591-04  22000.50c 8.2025-05  25055.50c 1.1108-05
       5011.56c 1.3781-05   1001.50c 2.6742-02   8016.50c 3.9335-02
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  10
c
print
```

Validation Case - Bare_ps1258:

Bare sphere of plutonium nitrate

```
Case Bare-ps1258 - PuNO3 Bare Sphere PU-SOL_THERM-021
c
c 39.0 g Pu/l, 1.081 g/cc, 0.4N 65.26g NO3 4.57% Pu-240
c
c
1   1   1.0078556-01     -1  u=1   $ Pu Nitrate
2   2   8.62396-02       +1 -2 u=1 $ 304 SS Shell
3   0                   #1 #2 -7 +10 u=1
4   2   8.62396-02       #1 #2 +7 -6 +10 u=1
5   0                   #1 #2 -9 -10 u=1
6   2   8.62396-02       #1 #2 +9 -8 -10 u=1
7   0                   +2 #3 #4 #5 #6 u=1
8   0                   -5  fill=1
9   0                   +5                  $ ZIOW

1   so    19.3304     $ Sphere Inner Radius
2   so    19.4523     $ Sphere Outer Radius
3   px    19.3304     $ Liquid Level
4   px     0.0       $ Mid point
5   so    49.4523     $ Outer surface
6   c/z   0.0  3.811  2.8575    $ Top Support Tube OD
7   c/z   0.0  3.811  2.6924    $ Top Support Tube ID
8   cz     2.86       $ Bottom Tube OD
9   cz     2.555      $ Bottom Tube ID
10  pz     0.0        $ Mid point

mode n
imp:n 1 7r 0
c
c
c  PuO2 in H2O
m1      1001.50c 6.5515-02   8016.50c 3.4538-02
      94239.55c 9.3366-05  94240.50c 4.5680-06
      94238.50c 5.9197-09  94241.50c 2.7573-07
      94242.50c 8.7324-09   7014.50c 6.3382-04
c
c  304L SS
m2     24000.50c 1.7428-02  28000.50c 7.7203-03  26000.55c 5.9355-02
      25055.50c 7.7203-03
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
mt1  lwtr.01t          $ S(Alpha, Beta)
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Validation Case - Refl_ps2325:

Reflected sphere of Plutonium Nitrate

```
Case Refl-ps2325 - PuNO3 Refl Sphere PU-SOL_THERM-021
c
c 25.2 g Pu/l, 1.060 g/cc, 0.4N 65.26g NO3 4.57% Pu-240
c
c
1    1   1.0044471-01     -1 -3  u=1   $ Pu Nitrate
2    0                   -1 +3  u=1   $Void above solution
3    2   8.62396-02       +1 -2 u=1 $ 304 SS Shell
4    0                   #1 #2 #3 -7 +10 u=1
5    2   8.62396-02       #1 #2 #3 +7 -6 +10 u=1
6    0                   #1 #2 #3 -9 -10 u=1
7    2   8.62396-02       #1 #2 #3 +9 -8 -10 u=1
8    3  -0.9982           +2 #4 #5 #6 #7 u=1
9    0                   -5  fill=1
10   0                    +5                  $ ZIOW

1    so    19.3304     $ Sphere Inner Radius
2    so    19.4523     $ Sphere Outer Radius
3    pz    18.7540     $ Liquid Level
4    px     0.0       $ Mid point
5    so    49.4523     $ Outer surface
6    c/z   0.0  3.811  2.8575    $ Top Support Tube OD
7    c/z   0.0  3.811  2.6924    $ Top Support Tube ID
8    cz     2.86       $ Bottom Tube OD
9    cz     2.555      $ Bottom Tube ID
10   pz     0.0        $ Mid point

mode n
imp:n 1 8r 0
c
c
c  PuO2 in H2O
m1      1001.50c 6.5486-02   8016.50c 3.4317-02
      94239.55c 6.0329-05  94240.50c 2.9516-06
      94238.50c 3.8250-09  94241.50c 1.7816-07
      94242.50c 5.6425-09   7014.50c 5.7905-04
c
c  304L SS
m2     24000.50c 1.7428-02  28000.50c 7.7203-03  26000.55c 5.9355-02
      25055.50c 7.7203-03
c
c  Water (0.9982 g/cm3)
m3      1001.50c  2     8016.50c 1
c
mt1  lwtr.01t          $ S(Alpha, Beta)
c
kcode 4000 1.0 50 200
c
c Source for Array
ksrc 0  0  0
c
print
```

Appendix B

Excel Spreadsheets—Calculated Inputs for Computational Models

Appendix B

Excel Spreadsheets—Calculated Inputs for Computational Model

The spreadsheets in this appendix contain the mathematical calculations to produce the input parameters that were used in the computational models for the OU 7-10 Glovebox Excavator Method Project criticality safety evaluation.

Table B-1. Excel spreadsheet calculations used in transfer cart computational models.

Calculations For GEM Transfer Carts

^{239}Pu Gram per liter values

		Constituent	wt% in PuO_2
MA Pu239(95%) Pu240 (5%)	239.1021	Pu^{239}	0.8379
MA Pu239	239.0521	Pu^{240}	0.0441
MA Pu240	240.0538	O	0.1180
MA Pu239(95%) Pu240 (5%)O2	271.1009	Total	1
Density of PuO2 (g/cm3)	11.46		
Volume of transfer cart(l)	144.53		

g/L PuO_2	g/cm^3 PuO_2	N^{Pu239}	N^{Pu240}	N^{O}	N^{Total}	N^{OTot}	$N^{Total\ Overall}$	Total Mass PuO_2 (g)
5	0.005	1.0553E-05	5.5313E-07	2.22131E-05	3.3320E-05	3.9357E-02	8.1083E-02	722.65
6	0.006	1.2664E-05	6.6375E-07	2.66558E-05	3.9984E-05	3.9362E-02	8.1089E-02	867.18
7	0.007	1.4775E-05	7.7438E-07	3.10984E-05	4.6648E-05	3.9366E-02	8.1096E-02	1011.71
8	0.008	1.6886E-05	8.8500E-07	3.5541E-05	5.3312E-05	3.9370E-02	8.1103E-02	1156.24
9	0.009	1.8996E-05	9.9563E-07	3.99836E-05	5.9975E-05	3.9375E-02	8.1109E-02	1300.77
10	0.01	2.1107E-05	1.1063E-06	4.44263E-05	6.6639E-05	3.9379E-02	8.1116E-02	1445.3
11	0.011	2.3218E-05	1.2169E-06	4.88689E-05	7.3303E-05	3.9384E-02	8.1123E-02	1589.83
12	0.012	2.5328E-05	1.3275E-06	5.33115E-05	7.9967E-05	3.9388E-02	8.1129E-02	1734.36
13	0.013	2.7439E-05	1.4381E-06	5.77541E-05	8.6631E-05	3.9393E-02	8.1136E-02	1878.89
14	0.014	2.9550E-05	1.5488E-06	6.21968E-05	9.3295E-05	3.9397E-02	8.1143E-02	2023.42
15	0.015	3.1660E-05	1.6594E-06	6.66394E-05	9.9959E-05	3.9402E-02	8.1149E-02	2167.95
16	0.016	3.3771E-05	1.7700E-06	7.1082E-05	1.0662E-04	3.9406E-02	8.1156E-02	2312.48
17	0.017	3.5882E-05	1.8806E-06	7.55246E-05	1.1329E-04	3.9410E-02	8.1163E-02	2457.01
18	0.018	3.7992E-05	1.9913E-06	7.99673E-05	1.1995E-04	3.9415E-02	8.1169E-02	2601.54
19	0.019	4.0103E-05	2.1019E-06	8.44099E-05	1.2661E-04	3.9419E-02	8.1176E-02	2746.07
20	0.02	4.2214E-05	2.2125E-06	8.88525E-05	1.3328E-04	3.9424E-02	8.1183E-02	2890.6
30	0.03	6.3321E-05	3.3188E-06	1.33279E-04	1.9992E-04	3.9468E-02	8.1249E-02	4335.9
40	0.04	8.4428E-05	4.4250E-06	1.77705E-04	2.6656E-04	3.9513E-02	8.1316E-02	5781.2
50	0.05	1.0553E-04	5.5313E-06	2.22131E-04	3.3320E-04	3.9557E-02	8.1383E-02	7226.5
60	0.06	1.2664E-04	6.6375E-06	2.66558E-04	3.9984E-04	3.9601E-02	8.1449E-02	8671.8
70	0.07	1.4775E-04	7.7438E-06	3.10984E-04	4.6648E-04	3.9646E-02	8.1516E-02	10117.1
80	0.08	1.6886E-04	8.8500E-06	3.55410E-04	5.3312E-04	3.9690E-02	8.1582E-02	11562.4
90	0.09	1.8996E-04	9.9563E-06	3.99836E-04	5.9975E-04	3.9735E-02	8.1649E-02	13007.7
100	0.1	2.1107E-04	1.1063E-05	4.44263E-04	6.6639E-04	3.9779E-02	8.1716E-02	14453
110	0.11	2.3218E-04	1.2169E-05	4.88689E-04	7.3303E-04	3.9824E-02	8.1782E-02	15898.3

g/L PuO_2	H/Pu Ratio	Grams of ^{239}Pu
5	2533.95	605.49
6	2111.62	726.58
7	1809.96	847.68
8	1583.72	968.78
9	1407.75	1089.87
10	1266.97	1210.97
11	1151.79	1332.07
12	1055.81	1453.17
13	974.59	1574.26
14	904.98	1695.36
15	844.65	1816.46
16	791.86	1937.55
17	745.28	2058.65
18	703.87	2179.75
19	666.83	2300.85
20	633.49	2421.94
30	422.32	3632.92
40	316.74	4843.89
50	253.39	6054.86
60	211.16	7265.83
70	181.00	8476.80
80	158.37	9687.77
90	140.77	10898.75
100	126.70	12109.72
110	115.18	13320.69

WVF	0	0.1	0.2	0.3	0.4
Element					
Si	1.0034E-02	1.0034E-02	1.0034E-02	1.0034E-02	1.0034E-02
Al	2.2387E-03	2.2387E-03	2.2387E-03	2.2387E-03	2.2387E-03
Fe	5.1263E-04	5.1263E-04	5.1263E-04	5.1263E-04	5.1263E-04
Ca	6.3198E-04	6.3198E-04	6.3198E-04	6.3198E-04	6.3198E-04
K	6.1135E-04	6.1135E-04	6.1135E-04	6.1135E-04	6.1135E-04
Mg	4.1109E-04	4.1109E-04	4.1109E-04	4.1109E-04	4.1109E-04
Na	4.2591E-04	4.2591E-04	4.2591E-04	4.2591E-04	4.2591E-04
Ti	8.2025E-05	8.2025E-05	8.2025E-05	8.2025E-05	8.2025E-05
Mn	1.1108E-05	1.1108E-05	1.1108E-05	1.1108E-05	1.1108E-05
B11	1.3781E-05	1.3781E-05	1.3781E-05	1.3781E-05	1.3781E-05
H	0.0000E+00	6.6855E-03	1.3371E-02	2.0056E-02	2.6742E-02
O	2.5964E-02	2.9307E-02	3.2649E-02	3.5992E-02	3.9335E-02
	4.093657E-02	5.096477E-02	6.099297E-02	7.102117E-02	8.104937E-02

Table B-2. Excel spreadsheet calculations used for Series 741 sludge spherical computational models.

PuO2 in 741 Sludge Calculations

$^{239}Pu(95\%)$ $^{240}Pu(5\%)$ O_2-741 Sludge Mixture

Density of Graphite (g/cm^3)	2.25					
M_A $Pu^{239}(95\%)$ Pu^{240} (5%)	239.1021					
M_A $Pu^{239}(95\%)$ Pu^{240} (5%)O_2	271.1009					
Density of PuO_2 (g/cm^3)	11.46					
Grams of Pu (g)	1500	200	400	600	800	1000
Grams of PuO_2 (g)	1700.74	226.77	453.53	680.30	907.06	1133.83
Volume of PuO_2 (cm^3)	148.41	19.79	39.58	59.36	79.15	98.94

Inside Radius of 55 Gal Drum (cm)	28.57
Inside Hieght of 55 Gal Drum (cm)	85.09
Vol of 55 Gal Drum (cm3)	218197.0512
Radius of Sludge Sphere (cm)	37.3467

Radius of PuO_2 in 741 Sludge(cm)	5.0	10.0	15.0	20.0	25.0	30.0	35.0	37.3467
Vol of PuO_2 at Radius (cm^3)	523.5988	4188.7902	14137.1669	33510.3216	65449.8469	113097.3355	179594.3800	218194.6815
Vol of 741 Sludge (Vol tot - Vol PuO2)	375.1918	4040.3833	13988.7600	33361.9147	65301.4400	112948.9286	179445.9731	218046.2745
N^{239}	6.8545E-03	8.5681E-04	2.5387E-04	1.0710E-04	5.4836E-05	3.1734E-05	1.9984E-05	1.6449E-05
N^{240}	3.6076E-04	4.5095E-05	1.3362E-05	5.6369E-06	2.8861E-06	1.6702E-06	1.0518E-06	8.6571E-07
N^{O}	1.4430E-02	1.8038E-03	5.3446E-04	2.2548E-04	1.1544E-04	6.6808E-05	4.2071E-05	3.4629E-05
$N^{O\ Tot}$	3.3165E-02	2.0538E-02	1.9269E-02	1.8960E-02	1.8850E-02	1.8801E-02	1.8776E-02	1.8769E-02
N^{Tot}	8.485853E-02	6.591855E-02	6.401454E-02	6.355106E-02	6.338601E-02	6.331306E-02	6.327595E-02	6.326479E-02
Density of PuO_2 in 741 Sludge (g/cm^3)	3.24818	0.40602	0.12030	0.05075	0.02599	0.01504	0.00947	0.00779
H/Pu Ratio	5.09	40.73	137.47	325.85	636.42	1099.73	1746.34	2121.68

741 Sludge

Constiuent	Avg. Wt. %'s	Norm. wt. %'s	Atomic Mass	Atomic Mass Pres	Atom Density
Al	0.9	0.921	26.9815	0.2486	2.0560E-04
Ca	13	13.306	40.078	5.3328	1.9993E-03
Fe	4.7	4.811	55.845	2.6865	5.1875E-04
K	0.6	0.614	39.0983	0.2401	9.4589E-05
Mg	1.3	1.331	24.305	0.3234	3.2968E-04
Na	7	7.165	22.989	1.6471	1.8768E-03
Si	9.4	9.621	28.0855	2.7022	2.0630E-03
Ga	0	0.000	69.723	0.0000	0.0000E+00
NO3 Compound	7.4	7.574	62.0049	4.6964	
N		5.133	14.0067		2.2069E-03
O		1.954	15.9994		7.3562E-04
CO3 Compound	1.7	1.740	60.0089	1.0442	
C		0.348	12.0107		1.7461E-04
O		1.392	15.9994		5.2384E-04
Cl	0.6	0.614	35.4527	0.2177	1.0432E-04
F	0	0.000	18.9984	0.0000	0.0000E+00
PO4 Compound	0	0.000	94.9713	0.0000	
P		0.000	30.9737		0.0000E+00
O		0.000	15.9994		0.0000E+00
SO4 Compound	0.1	0.102	96.0636	0.0983	
S		0.034	32.066		6.4163E-06
O		0.068	15.9994		2.5665E-05
H2O Compound	51	52.201	18.0152	9.4040	
H		5.841	1.00794		3.4899E-02
O		46.360	15.9994		1.7449E-02
O Total					1.8734E-02
	97.7	108.930		28.6413	6.3213E-02

Table B-3. Excel Spreadsheet calculations used for Series 743 sludge spherical computational models.

PuO2 in 743 Sludge Spherical Calculations

$^{239}Pu(95\%)$ $^{240}Pu(5\%)$ O_2-743 Sludge Mixture

Density of Graphite (g/cm^3)	2.25					
M_A $Pu^{239}(95\%)$ Pu^{240} (5%)	239.1021					
M_A $Pu^{239}(95\%)$ Pu^{240} (5%)O_2	271.1009					
Density of PuO_2 (g/cm^3)	11.46					
Grams of Pu (g)	1500	200	400	600	800	1000
Grams of PuO_2 (g)	1700.74	226.77	453.53	680.30	907.06	1133.83
Volume of PuO_2 (cm^3)	148.41	19.79	39.58	59.36	79.15	98.94

Inside Radius of 55 Gal Drum (cm)	28.57
Inside Hieght of 55 Gal Drum (cm)	85.09
Vol of 55 Gal Drum (cm3)	218197.0512
Radius of Sludge Sphere (cm)	37.3467

Radius of PuO_2 in 743 Sludge(cm)	5.0	10.0	15.0	20.0	25.0	30.0	35.0	37.3467
Vol of PuO_2 at Radius (cm^3)	523.5988	4188.7902	14137.1669	33510.3216	65449.8469	113097.3355	179594.3800	218194.6815
Vol of 743 Sludge (Vol tot - Vol PuO2)	375.1918	4040.3833	13988.7600	33361.9147	65301.4400	112948.9286	179445.9731	218046.2745
N^{239}	6.8545E-03	8.5681E-04	2.5387E-04	1.0710E-04	5.4836E-05	3.1734E-05	1.9984E-05	1.6449E-05
N^{240}	3.6076E-04	4.5095E-05	1.3362E-05	5.6369E-06	2.8861E-06	1.6702E-06	1.0518E-06	8.6571E-07
N^{O}	1.4430E-02	1.8038E-03	5.3446E-04	2.2548E-04	1.1544E-04	6.6808E-05	4.2071E-05	3.4629E-05
$N^{O\ Tot}$	2.0014E-02	7.3874E-03	6.1181E-03	5.8091E-03	5.6991E-03	5.6504E-03	5.6257E-03	5.6182E-03
N^{Tot}	1.146506E-01	9.571064E-02	9.380663E-02	9.334315E-02	9.317810E-02	9.310515E-02	9.306804E-02	9.305688E-02
Density of PuO_2 in 741 Sludge (g/cm^3)	3.24818	0.40602	0.12030	0.05075	0.02599	0.01504	0.00947	0.00779
H/Pu Ratio	7.73	61.81	208.62	494.51	965.84	1668.97	2650.26	3219.89

Mixture Density (g/cm^3) 1.2175

Constiuent		Atomic Mass	Comp. Norm wt. %	Overall Wt%	Atom Density		
Micro-cel E							
SiO_2		60.0843	55.95	28.407			
	Si	28.0855	26.1530	7.4293	1.9394E-03		
	O	15.9994	29.7970	8.4644	3.8787E-03		
Al_2O_3		101.9602	2.98				
	Al	26.981	1.5772	0.4480	1.2174E-04		
	O	15.9994	1.4028	0.3985	1.8261E-04		
Fe_2O_3		159.688	0.830				
	Fe	55.845	0.5805	0.1649	2.1650E-05		
	O	15.9994	0.2495	0.0709	3.2475E-05		
CaO		56.077	38.100				
	Ca	40.078	27.2297	7.7351	1.4150E-03		
	O	15.9994	10.8703	3.0879	1.4150E-03		
MgO		40.304	0.710				
	Mg	24.305	0.4282	0.1216	3.6688E-05		
	O	15.9994	0.2818	0.0801	3.6688E-05		
$Na_2O + K_2O$		156.175	1.430				
	Na	22.9897	0.4210	0.1196	3.8139E-05		
	O	15.9994	0.1465	0.0416	1.9070E-05		
	K	39.0983	0.7160	0.2034	3.8139E-05		
	O	15.9994	0.1465	0.0416	1.9070E-05		
Teaxco Regal Oil				48.995			
$C_{25}H_{52}$ (C_nH_{2n+2})		352.6783					
	C	12.0107		41.7140	2.5463E-02		
	H	1.0079		7.2810	5.2963E-02		
Carbon Tetrachloride				22.598			
CCl_4		153.8215					
	C	12.0107		1.7645	1.0771E-03		
	Cl	35.4527		20.8335	4.3083E-03		
					9.3005E-02	$N^{OTot\ Sludge}$	5.5836E-03
						$N^{C\ Tot\ Sludge}$	2.6540E-02
						$N^{Tot\ Sludge}$	9.3005E-02

Table B-4. Excel spreadsheet calculations used for Series 743 sludge in drum computational models.

Calculations For Plutonium Oxide in 743 Sludge Drums - OU 7-10 Projects

^{239}Pu Gram per liter values

MA Pu239(95%) Pu240 (5%)	239.1021	Pu^{239}	0.8379
MA Pu239	239.0521	Pu^{240}	0.0441
MA Pu240	240.0538	O	0.1180
MA Pu239(95%) Pu240 (5%)O2	271.1009	Total	1
Density of PuO2 (g/cm3)	11.46		
Inside Radius 55 Gal Drum (cm)	28.57		
Inside Ht 55 Gal Drum (cm)	85.09		
Vol of 55 Gal Drum (cm3)	218197.0512		

g/L PuO_2	g/cm^3 PuO_2	N^{Pu239}	N^{Pu240}	N^{O}	$N^{PuO2\ Total}$	$N^{O\ Total\ Overall}$	$N^{Total\ Overall}$
5	0.005	1.0553E-05	5.5313E-07	2.22131E-05	3.3320E-05	5.6058E-03	9.3038E-02
6	0.006	1.2664E-05	6.6375E-07	2.66558E-05	3.9984E-05	5.6103E-03	9.3045E-02
7	0.007	1.4775E-05	7.7438E-07	3.10984E-05	4.6648E-05	5.6147E-03	9.3052E-02
8	0.008	1.6886E-05	8.8500E-07	3.5541E-05	5.3312E-05	5.6192E-03	9.3058E-02
9	0.009	1.8996E-05	9.9563E-07	3.99836E-05	5.9975E-05	5.6236E-03	9.3065E-02
10	0.01	2.1107E-05	1.1063E-06	4.44263E-05	6.6639E-05	5.6280E-03	9.3072E-02
11	0.011	2.3218E-05	1.2169E-06	4.88689E-05	7.3303E-05	5.6325E-03	9.3078E-02
12	0.012	2.5328E-05	1.3275E-06	5.33115E-05	7.9967E-05	5.6369E-03	9.3085E-02
13	0.013	2.7439E-05	1.4381E-06	5.77541E-05	8.6631E-05	5.6414E-03	9.3092E-02
14	0.014	2.9550E-05	1.5488E-06	6.21968E-05	9.3295E-05	5.6458E-03	9.3098E-02
15	0.015	3.1660E-05	1.6594E-06	6.66394E-05	9.9959E-05	5.6502E-03	9.3105E-02
16	0.016	3.3771E-05	1.7700E-06	7.1082E-05	1.0662E-04	5.6547E-03	9.3112E-02
17	0.017	3.5882E-05	1.8806E-06	7.55246E-05	1.1329E-04	5.6591E-03	9.3118E-02
18	0.018	3.7992E-05	1.9913E-06	7.99673E-05	1.1995E-04	5.6636E-03	9.3125E-02
19	0.019	4.0103E-05	2.1019E-06	8.44099E-05	1.2661E-04	5.6680E-03	9.3132E-02
20	0.02	4.2214E-05	2.2125E-06	8.88525E-05	1.3328E-04	5.6725E-03	9.3138E-02
30	0.03	6.3321E-05	3.3188E-06	1.33279E-04	1.9992E-04	5.7169E-03	9.3205E-02
40	0.04	8.4428E-05	4.4250E-06	1.77705E-04	2.6656E-04	5.7613E-03	9.3271E-02
50	0.05	1.0553E-04	5.5313E-06	2.22131E-04	3.3320E-04	5.8057E-03	9.3338E-02
60	0.06	1.2664E-04	6.6375E-06	2.66558E-04	3.9984E-04	5.8502E-03	9.3405E-02
70	0.07	1.4775E-04	7.7438E-06	3.10984E-04	4.6648E-04	5.8946E-03	9.3471E-02
80	0.08	1.6886E-04	8.8500E-06	3.55410E-04	5.3312E-04	5.9390E-03	9.3538E-02
90	0.09	1.8996E-04	9.9563E-06	3.99836E-04	5.9975E-04	5.9834E-03	9.3605E-02
100	0.1	2.1107E-04	1.1063E-05	4.44263E-04	6.6639E-04	6.0279E-03	9.3671E-02
Mixture Density (g/cm^3)	1.2175						

g/L PuO_2	Total Mass PuO_2 (g)	Total Mass ^{239}Pu (g)	H/Pu Ratio
5	1090.99	914.10	5018.50
6	1309.18	1096.92	4182.09
7	1527.38	1279.74	3584.65
8	1745.58	1462.56	3136.57
9	1963.77	1645.38	2788.06
10	2181.97	1828.21	2509.25
11	2400.17	2011.03	2281.14
12	2618.36	2193.85	2091.04
13	2836.56	2376.67	1930.19
14	3054.76	2559.49	1792.32
15	3272.96	2742.31	1672.83
16	3491.15	2925.13	1568.28
17	3709.35	3107.95	1476.03
18	3927.55	3290.77	1394.03
19	4145.74	3473.59	1320.66
20	4363.94	3656.41	1254.63
30	6545.91	5484.62	836.42
40	8727.88	7312.82	627.31
50	10909.85	9141.03	501.85
60	13091.82	10969.23	418.21
70	15273.79	12797.44	358.46
80	17455.76	14625.64	313.66
90	19637.73	16453.85	278.81
100	21819.71	18282.05	250.93

Constiuent		Atomic Mass	Comp. Norm wt. %	Overall Wt%	Atom Density		
Micro-cel E							
SiO_2		60.0843	55.95	28.407			
	Si	28.0855	26.1530	7.4293	1.9394E-03		
	O	15.9994	29.7970	8.4644	3.8787E-03		
Al_2O_3		101.9602	2.98				
	Al	26.981	1.5772	0.4480	1.2174E-04		
	O	15.9994	1.4028	0.3985	1.8261E-04		
Fe_2O_3		159.688	0.830				
	Fe	55.845	0.5805	0.1649	2.1650E-05		
	O	15.9994	0.2495	0.0709	3.2475E-05		
CaO		56.077	38.100				
	Ca	40.078	27.2297	7.7351	1.4150E-03		
	O	15.9994	10.8703	3.0879	1.4150E-03		
MgO		40.304	0.710				
	Mg	24.305	0.4282	0.1216	3.6688E-05		
	O	15.9994	0.2818	0.0801	3.6688E-05		
$Na_2O + K_2O$		156.175	1.430				
	Na	22.9897	0.4210	0.1196	3.8139E-05		
	O	15.9994	0.1465	0.0416	1.9070E-05		
	K	39.0983	0.7160	0.2034	3.8139E-05		
	O	15.9994	0.1465	0.0416	1.9070E-05		
Teaxco Regal Oil				48.995			
$C_{25}H_{52}$ (C_nH_{2n+2})		352.6783					
	C	12.0107		41.7140	2.5463E-02		
	H	1.0079		7.2810	5.2963E-02		
Carbon Tetrachloride				22.598			
CCl_4		153.8215					
	C	12.0107		1.7645	1.0771E-03		
	Cl	35.4527		20.8335	4.3083E-03		
					9.3005E-02	$N^{OTot\ Sludge}$	5.5836E-03
						$N^{C\ Tot\ Sludge}$	2.6540E-02
						$N^{Tot\ Sludge}$	9.3005E-02

Table B-5. Excel spreadsheet calculations used for Series 741 sludge in drum computational models.

Calculations For Plutonium Oxide in 741 Sludge Drums - OU 7-10 Projects

^{239}Pu Gram per liter values

MA Pu239(95%) Pu240 (5%)	239.1021	Pu^{239}	0.8379
MA Pu239	239.0521	Pu^{240}	0.0441
MA Pu240	240.0538	O	0.1180
MA Pu239(95%) Pu240 (5%)O2	271.1009	Total	1
Density of PuO2 (g/cm3)	11.46		
Inside Radius 55 Gal Drum (cm)	28.57		
Inside Ht 55 Gal Drum (cm)	85.09		
Vol of 55 Gal Drum (cm3)	218197.0512		

g/L PuO_2	g/cm^3 PuO_2	N^{Pu239}	N^{Pu240}	N^{O}	$N^{PuO2\ Total}$	$N^{O\ Total\ Overall}$	$N^{Total\ Overall}$
5	0.005	1.0553E-05	5.5313E-07	2.22131E-05	3.3320E-05	1.8757E-02	6.3246E-02
6	0.006	1.2664E-05	6.6375E-07	2.66558E-05	3.9984E-05	1.8761E-02	6.3253E-02
7	0.007	1.4775E-05	7.7438E-07	3.10984E-05	4.6648E-05	1.8765E-02	6.3259E-02
8	0.008	1.6886E-05	8.8500E-07	3.5541E-05	5.3312E-05	1.8770E-02	6.3266E-02
9	0.009	1.8996E-05	9.9563E-07	3.99836E-05	5.9975E-05	1.8774E-02	6.3273E-02
10	0.01	2.1107E-05	1.1063E-06	4.44263E-05	6.6639E-05	1.8779E-02	6.3279E-02
11	0.011	2.3218E-05	1.2169E-06	4.88689E-05	7.3303E-05	1.8783E-02	6.3286E-02
12	0.012	2.5328E-05	1.3275E-06	5.33115E-05	7.9967E-05	1.8788E-02	6.3293E-02
13	0.013	2.7439E-05	1.4381E-06	5.77541E-05	8.6631E-05	1.8792E-02	6.3299E-02
14	0.014	2.9550E-05	1.5488E-06	6.21968E-05	9.3295E-05	1.8797E-02	6.3306E-02
15	0.015	3.1660E-05	1.6594E-06	6.66394E-05	9.9959E-05	1.8801E-02	6.3313E-02
16	0.016	3.3771E-05	1.7700E-06	7.1082E-05	1.0662E-04	1.8805E-02	6.3319E-02
17	0.017	3.5882E-05	1.8806E-06	7.55246E-05	1.1329E-04	1.8810E-02	6.3326E-02
18	0.018	3.7992E-05	1.9913E-06	7.99673E-05	1.1995E-04	1.8814E-02	6.3333E-02
19	0.019	4.0103E-05	2.1019E-06	8.44099E-05	1.2661E-04	1.8819E-02	6.3339E-02
20	0.02	4.2214E-05	2.2125E-06	8.88525E-05	1.3328E-04	1.8823E-02	6.3346E-02
30	0.03	6.3321E-05	3.3188E-06	1.33279E-04	1.9992E-04	1.8868E-02	6.3413E-02
40	0.04	8.4428E-05	4.4250E-06	1.77705E-04	2.6656E-04	1.8912E-02	6.3479E-02
50	0.05	1.0553E-04	5.5313E-06	2.22131E-04	3.3320E-04	1.8957E-02	6.3546E-02
60	0.06	1.2664E-04	6.6375E-06	2.66558E-04	3.9984E-04	1.9001E-02	6.3613E-02
70	0.07	1.4775E-04	7.7438E-06	3.10984E-04	4.6648E-04	1.9045E-02	6.3679E-02
80	0.08	1.6886E-04	8.8500E-06	3.55410E-04	5.3312E-04	1.9090E-02	6.3746E-02
90	0.09	1.8996E-04	9.9563E-06	3.99836E-04	5.9975E-04	1.9134E-02	6.3813E-02
100	0.1	2.1107E-04	1.1063E-05	4.44263E-04	6.6639E-04	1.9179E-02	6.3879E-02

g/L PuO_2	Total Mass PuO_2 (g)	Total Mass ^{239}Pu (g)	H/Pu Ratio
5	1090.99	914.10	3306.84
6	1309.18	1096.92	2755.70
7	1527.38	1279.74	2362.03
8	1745.58	1462.56	2066.77
9	1963.77	1645.38	1837.13
10	2181.97	1828.21	1653.42
11	2400.17	2011.03	1503.11
12	2618.36	2193.85	1377.85
13	2836.56	2376.67	1271.86
14	3054.76	2559.49	1181.01
15	3272.96	2742.31	1102.28
16	3491.15	2925.13	1033.39
17	3709.35	3107.95	972.60
18	3927.55	3290.77	918.57
19	4145.74	3473.59	870.22
20	4363.94	3656.41	826.71
30	6545.91	5484.62	551.14
40	8727.88	7312.82	413.35
50	10909.85	9141.03	330.68
60	13091.82	10969.23	275.57
70	15273.79	12797.44	236.20
80	17455.76	14625.64	206.68
90	19637.73	16453.85	183.71
100	21819.71	18282.05	165.34

Constiuent	Avg. Wt. %'s	Normalized wt. %'s	Atomic Mass	Atomic Mass Present	Atom Density
Al	0.9	0.921	26.9815	0.2486	2.0560E-04
Ca	13	13.306	40.078	5.3328	1.9993E-03
Fe	4.7	4.811	55.845	2.6865	5.1875E-04
K	0.6	0.614	39.0983	0.2401	9.4589E-05
Mg	1.3	1.331	24.305	0.3234	3.2968E-04
Na	7	7.165	22.989	1.6471	1.8768E-03
Si	9.4	9.621	28.0855	2.7022	2.0630E-03
Ga	0	0.000	69.723	0.0000	0.0000E+00
NO_3 Compound	7.4	7.574	62.0049	4.6964	
N		5.133	14.0067		2.2069E-03
O		1.954	15.9994		7.3562E-04
CO_3 Compound	1.7	1.740	60.0089	1.0442	
C		0.348	12.0107		1.7461E-04
O		1.392	15.9994		5.2384E-04
Cl	0.6	0.614	35.4527	0.2177	1.0432E-04
F	0	0.000	18.9984	0.0000	0.0000E+00
PO_4 Compound	0	0.000	94.9713	0.0000	
P		0.000	30.9737		0.0000E+00
O		0.000	15.9994		0.0000E+00
SO_4 Compound	0.1	0.102	96.0636	0.0983	
S		0.034	32.066		6.4163E-06
O		0.068	15.9994		2.5665E-05
H_2O Compound	51	52.201	18.0152	9.4040	
H		5.841	1.00794		3.4899E-02
O		46.360	15.9994		1.7449E-02
O Total					1.8734E-02
	97.7	108.930		28.6413	6.3213E-02

Appendix C

Subsurface Disposal Area Soil Information

Appendix C

Subsurface Disposal Area Soil Information

The tables in this appendix show the soil composition and input parameters used in the computational models for the OU 7-10 Glovebox Excavator Method Project criticality safety evaluation.

Table C-1. Analysis of soil sample from the spreading areas [a] at the Idaho National Engineering and Environmental Laboratory.

Oxide	Composition (wt%)
SiO_2	62.60
Al_2O_3	11.85
Fe_2O_3	4.25
CaO	3.68
K_2O	2.99
MgO	1.72
Na_2O	1.37
TiO_2	0.68
MnO_2	0.10
BaO	0.09
ZrO_2	0.05
B_2O_3	0.05
NiO	0.04
SrO	0.02
Cr_2O_3	0.02
Total oxide	**89.51**
Moisture	**7.5**

a. Data taken from Callow et al. (1991).

Table C-2. Analysis of normalized soil sample from the spreading areas at the Idaho National Engineering and Environmental Laboratory.

Oxide	Composition (wt%)
SiO_2	69.936
Al_2O_3	13.239
Fe_2O_3	4.748
CaO	4.111
K_2O	3.340
MgO	1.922
Na_2O	1.531
TiO_2	0.760
MnO_2	0.112
BaO	0.101
ZrO_2	0.056
B_2O_3	0.056
NiO	0.044
SrO	0.022
Cr_2O_3	0.022
Total oxide	**100.0**

Table C-3. Compositions of soil from the Subsurface Disposal Area at the Idaho National Engineering and Environmental Laboratory.

Description	Element	Atoms/barn-cm
Wet soil	Si	1.0034E-02
	Al	2.2387E-03
	Fe	5.1263E-04
	Ca	6.3198E-04
	K	6.1135E-04
	Mg	4.1109E-04
	Na	4.2591E-04
	Ti	8.2025E-05
	Mn	1.1108E-05
	B-11	1.3781E-05
	H	2.6742E-02
	O	3.9335E-02
Dry soil	Si	1.0034E-02
	Al	2.2387E-03
	Fe	5.1263E-04
	Ca	6.3198E-04
	K	6.1135E-04
	Mg	4.1109E-04
	Na	4.2591E-04
	Ti	8.2025E-05
	Mn	1.1108E-05
	B-11	1.3781E-05
	O	2.5964E-02

Table C-4. Number densities used for cellulose ($C_6H_{10}O_5$ ρ_{dens} = 1.45 g/cm^3) material in the MCNP (RSIC 1997) code models.

Element	Nuclide Identification	Number Density (atoms/bn-cm)
Carbon	6012.50c	3.2310-02
Hydrogen	1001.50c	5.3851-02
Oxygen	8016.50c	2.6925-02

Table C-5. Average composition of Series 741 and 742 sludge matrices.

Constituent	Series 741 Composition (wt%)	Series 742 Composition (wt%)
Al	0.9	1.0
Ca	13.0	12.2
Fe	4.7	4.9
K	0.6	-
Mg	1.3	1.8
Na	7.0	10.0
Si	9.4	-
NO_3	7.4	8.1
CO_3	1.7	0.6
Cl	0.6	1.5
SO_4	0.1	0.14
H_2O	51.0	60.0
Total composition	97.7	100.0

Table C-6. Composition of Micro-Cel E used in Series 743 sludge matrices.

Celite Corporation
P.O. Box 519
Lompoc, California 93438-0518
Telephone: (805) 735-7791

Technical Data

MICRO-CEL® E

TYPICAL PHYSICAL PROPERTIES

Color	Grey to buff
Appearance	Fine Powder
Description	Synthetic Calcium Silicate
Crystalline Silica as Quartz %	<0.1
Screen Analysis	
+325 Mesh, %	6.0
Water Absorption, % by weight	550.0
Oil Absorption	420.0
Specific Gravity	2.6
Loose Weight, lb. ft^3	5.4
pH 10% Slurry	8.4
Moisture, % H_2O as shipped	5.5
Refractive Index	1.55
BET Surface Area, m^2/g	120.0
Brightness Photovolt, Blue Light	60.0
d50, Cilas Granulometer, Microns	18.0

TYPICAL CHEMICAL ANALYSIS, WEIGHT %

SiO_2	47.0
Al_2O_3	2.5
Fe_2O_3	0.7
CaO	32.0
MgO	0.6
$Na_2O + K_2O$	1.2
Total LOI	16.0

The physical or chemical properties of Celite® products represent typical, average values obtained in accordance with generally accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice.
Technical data shown above are considered accurate and reliable, however, no guarantee is given nor intended. For Important Health & Safety Information, pl ase refer to MSDS. A World Minerals Company.

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