INFORMATION ONLY

DOE/SNF/REP-078
Rev. 0

# United States Department of Energy

## National Spent Nuclear Fuel Program

# Volume II

## Source Term Estimates for DOE Spent Nuclear Fuels

March 2003

U.S. Department of Energy
Assistant Secretary for Environmental Management
Office of Nuclear Material and Spent Fuel

Enclosure 1

This document was developed and is controlled in accordance with NSNFP procedures. It has been reviewed and determined adequate for Beyond Category 2 consequence, TSPA, shielding, and decay heat analysis. For other uses, the information must be evaluated for adequacy if relied on to support design or decisions important to safety or waste isolation.

# Appendix C

# Source Term Estimates for the Year 2010

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## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name AMERICIUM TARGETS
SNF ID # 776
Fuel Units & Descr 12 - SCRAP
Heavy Metal Mass BOL=0 078kg, EOL=0 074kg
ROD Storage Site· HANFORD

[1]Fuel decay start date 1970
Estimates as of: 2010
Template FFTF (FAST, SST, 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 35 years

Estimated Canister usage
HIC
3 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 1822E-12 | 3 59 | 7.19 | 0 00E+00 | 2.22E-11 | 4 44E-11 |
| Am-241 | 1.1066E-01 | 3 59 | 7.19 | 1 50E-01 | 5 48E-01 | 9 46E-01 |
| Am-242m | 1.9247E-03 | 3 59 | 7 19 | 0 00E+00 | 6 92E-03 | 1.38E-02 |
| Am-243 | 1 0740E-04 | 3 59 | 7 19 | 9 57E+00 | 9 57E+00 | 9 57E+00 |
| C-14 | 2 6042E-05 | 3.59 | 7 19 | 0 00E+00 | 9 36E-05 | 1 87E-04 |
| Cl-36 | 3 4243E-10 | 3.59 | 7 19 | 0 00E+00 | 1.23E-09 | 2 46E-09 |
| Cm-243 | 4 0629E-04 | 3 59 | 7 19 | 0 00E+00 | 1.46E-03 | 2 92E-03 |
| Cm-244 | 1 6024E-03 | 3 59 | 7 19 | 0 00E+00 | 5 76E-03 | 1 15E-02 |
| Co-60 | 3 4275E-03 | 3 59 | 7.19 | 0 00E+00 | 1.23E-02 | 2 46E-02 |
| Cs-134 | 1.5566E-03 | 3 59 | 7.19 | 0 00E+00 | 5 59E-03 | 1 12E-02 |
| Cs-135 | 4.7693E-05 | 3 59 | 7.19 | 0 00E+00 | 1 71E-04 | 3 43E-04 |
| Cs-137 | 1.4007E+00 | 3 59 | 7 19 | 0 00E+00 | 5 03E+00 | 1 01E+01 |
| Eu-154 | 1 6184E-02 | 3.59 | 7 19 | 0 00E+00 | 5 82E-02 | 1 16E-01 |
| Eu-155 | 1 3774E-02 | 3 59 | 7 19 | 0 00E+00 | 4 95E-02 | 9 90E-02 |
| Fe-55 | 3 8028E-04 | 3 59 | 7 19 | 0 00E+00 | 1.37E-03 | 2 73E-03 |
| H-3 | 3 8454E-03 | 3 59 | 7 19 | 0 00E+00 | 1.38E-02 | 2 76E-02 |
| I-129 | 1 2891E-06 | 3 59 | 7.19 | 0 00E+00 | 4 63E-06 | 9 26E-06 |
| Kr-85 | 2 7848E-02 | 3 59 | 7.19 | 0 00E+00 | 1 00E-01 | 2 00E-01 |
| Np-237 | 3 7516E-06 | 3 59 | 7.19 | 0 00E+00 | 1.35E-05 | 2 70E-05 |
| Pa-231 | 1.2488E-11 | 3 59 | 7.19 | 0 00E+00 | 4 49E-11 | 8 97E-11 |
| Pb-210 | 2 4206E-12 | 3.59 | 7 19 | 0 00E+00 | 8 70E-12 | 1 74E-11 |
| Pm-147 | 1.5671E-02 | 3 59 | 7 19 | 0 00E+00 | 5 63E-02 | 1 13E-01 |
| Pu-238 | 1 4877E-02 | 3 59 | 7 19 | 0 00E+00 | 5.35E-02 | 1 07E-01 |
| Pu-239 | -3 5520E-02 | 3 59 | 0 00 | 1.23E+00 | 1 11E+00 | 1.23E+00 |
| Pu-240 | 2 0690E-02 | 3 59 | 7 19 | 6.27E-01 | 7.02E-01 | 7 76E-01 |
| Pu-241 | -1.4799E+00 | 3 59 | 0 00 | 2.82E+01 | 2.28E+01 | 2 82E+01 |
| Pu-242 | 1 1252E-05 | 3 59 | 7.19 | 1 67E-04 | 2 08E-04 | 2 48E-04 |
| Ra-226 | 7.8524E-12 | 3 59 | 7 19 | 0 00E+00 | 2 82E-11 | 5 64E-11 |
| Ra-228 | 2 4086E-16 | 3 59 | 7 19 | 0 00E+00 | 8 65E-16 | 1.73E-15 |
| Ru-106 | 1 5066E-05 | 3.59 | 7 19 | 0 00E+00 | 5 41E-05 | 1.08E-04 |
| Se-79 | 1 0127E-05 | 3 59 | 7 19 | 0 00E+00 | 3 64E-05 | 7.28E-05 |
| Sn-126 | 4 3902E-05 | 3 59 | 7 19 | 0 00E+00 | 1.58E-04 | 3 16E-04 |
| Sr-90 | 5 0088E-01 | 3 59 | 7 19 | 0 00E+00 | 1 80E+00 | 3 60E+00 |
| Tc-99 | 3 9412E-04 | 3 59 | 7.19 | 0 00E+00 | 1.42E-03 | 2 83E-03 |
| Th-229 | 2 7219E-12 | 3 59 | 7.19 | 0 00E+00 | 9 78E-12 | 1 96E-11 |
| Th-230 | 1 0441E-09 | 3 59 | 7.19 | 0 00E+00 | 3 75E-09 | 7.50E-09 |
| Th-232 | 3.1689E-16 | 3 59 | 7.19 | 0 00E+00 | 1 14E-15 | 2.28E-15 |
| Tl-208 | 4 6636E-07 | 3 59 | 7 19 | 0 00E+00 | 1 68E-06 | 3.35E-06 |
| U-232 | 1.2638E-06 | 3.59 | 7 19 | 0 00E+00 | 4 54E-06 | 9 08E-06 |
| U-233 | 5 7451E-10 | 3 59 | 7 19 | 0 00E+00 | 2 06E-09 | 4 13E-09 |
| U-234 | 4 3044E-06 | 3 59 | 7 19 | 0 00E+00 | 1.55E-05 | 3 09E-05 |
| U-235 | -7.7765E-09 | 3 59 | 0 00 | 2.53E-07 | 2.26E-07 | 2 53E-07 |
| U-236 | 1 8050E-07 | 3 59 | 7.19 | 0 00E+00 | 6 49E-07 | 1 30E-06 |
| U-238 | -1.7914E-07 | 3 59 | 0 00 | 1 85E-05 | 1 78E-05 | 1 85E-05 |
| Y-90 | 5 0088E-01 | 3 59 | 7.19 | 0 00E+00 | 1 80E+00 | 3 60E+00 |
| Other Radionuclides | | | | | 5 09E+00 | 1 02E+01 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 3.215E+11 |
| 0.0250 | 4 681E+10 |
| 0 0375 | 7 733E+10 |
| 0 0575 | 5.515E+10 |
| 0 0850 | 2.325E+11 |
| 0 1250 | 2.066E+10 |
| 0 2250 | 2.100E+10 |
| 0 3750 | 9 100E+09 |
| 0 5750 | 3 686E+11 |
| 0 8500 | 3 852E+09 |
| 1.2500 | 4 610E+09 |
| 1 7500 | 1 043E+08 |
| 2.2500 | 2.140E+04 |
| 2 7500 | 1 194E+05 |
| 3 5000 | 8 076E+02 |
| 5 0000 | 2.874E+02 |
| 7 0000 | 3 187E+01 |
| 11 0000 | 3.584E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.22E-01 | 4.81E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator· | FAST | FAST |
| Fuel Cladding | ALUM | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences·**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown) and cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 3 59 |
| Bounding | | 7 19 |

**Basis for burnup used in estimate·**

Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 30 | |
| Bounding | 0 61 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: CALVERT CLIFFS 1
SNF ID #: 307
Fuel Units & Descr: 2 - 14 X 14 ROD ARRAY
Heavy Metal Mass: BOL=772kg; EOL=675 9kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1980
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage: 18"x15" 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 91,386.55 | 182,773.11 | 0 00E+00 | 6 07E-05 | 1.21E-04 |
| Am-241 | 1.3144E-01 | 91,386.55 | 182,773.11 | 0 00E+00 | 1 20E+04 | 2 40E+04 |
| Am-242m | 3.0039E-04 | 91,386 55 | 182,773.11 | 0 00E+00 | 2 75E+01 | 5 49E+01 |
| Am-243 | 6 2629E-04 | 91,386 55 | 182,773.11 | 0 00E+00 | 5 72E+01 | 1 14E+02 |
| C-14 | 4 7965E-05 | 91,386 55 | 182,773.11 | 0 00E+00 | 4.38E+00 | 8 77E+00 |
| Cl-36 | 8 0297E-07 | 91,386 55 | 182,773 11 | 0 00E+00 | 7 34E-02 | 1 47E-01 |
| Cm-243 | 3.1993E-04 | 91,386 55 | 182,773 11 | 0 00E+00 | 2 92E+01 | 5 85E+01 |
| Cm-244 | 7 1851E-02 | 91,386 55 | 182,773 11 | 0 00E+00 | 6 57E+03 | 1 31E+04 |
| Co-60 | 9 5220E-03 | 91,386 55 | 182,773 11 | 0 00E+00 | 8 70E+02 | 1 74E+03 |
| Cs-134 | 1 1662E-03 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 07E+02 | 2.13E+02 |
| Cs-135 | 1 4433E-05 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 32E+00 | 2 64E+00 |
| Cs-137 | 1 7603E+00 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 61E+05 | 3.22E+05 |
| Eu-154 | 4 5203E-02 | 91,386 55 | 182,773.11 | 0 00E+00 | 4 13E+03 | 8.26E+03 |
| Eu-155 | 7.1479E-03 | 91,386.55 | 182,773.11 | 0.00E+00 | 6 53E+02 | 1.31E+03 |
| Fe-55 | 6 1919E-04 | 91,386.55 | 182,773.11 | 0 00E+00 | 5 66E+01 | 1 13E+02 |
| H-3 | 3 6386E-02 | 91,386 55 | 182,773.11 | 0 00E+00 | 3 33E+03 | 6 65E+03 |
| I-129 | 9 8288E-07 | 91,386 55 | 182,773.11 | 0 00E+00 | 8 98E-02 | 1 80E-01 |
| Kr-85 | 5 3844E-02 | 91,386 55 | 182,773.11 | 0 00E+00 | 4.92E+03 | 9 84E+03 |
| Np-237 | 1 0546E-05 | 91,386 55 | 182,773.11 | 0 00E+00 | 9 64E-01 | 1 93E+00 |
| Pa-231 | 1 1370E-09 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 04E-04 | 2 08E-04 |
| Pb-210 | 3 3624E-11 | 91,386 55 | 182,773 11 | 0 00E+00 | 3 07E-06 | 6 15E-06 |
| Pm-147 | 5 1211E-03 | 91,386 55 | 182,773 11 | 0 00E+00 | 4 68E+02 | 9.36E+02 |
| Pu-238 | 8 0669E-02 | 91,386 55 | 182,773 11 | 0 00E+00 | 7 37E+03 | 1 47E+04 |
| Pu-239 | 1 1626E-02 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 06E+03 | 2.12E+03 |
| Pu-240 | 1 5097E-02 | 91,386 55 | 182,773.11 | 0 00E+00 | 1.38E+03 | 2 76E+03 |
| Pu-241 | 1 4567E+00 | 91,386 55 | 182,773 11 | 0 00E+00 | 1.33E+05 | 2 66E+05 |
| Pu-242 | 6 4260E-05 | 91,386.55 | 182,773.11 | 0 00E+00 | 5 87E+00 | 1 17E+01 |
| Ra-226 | 1.1392E-10 | 91,386.55 | 182,773.11 | 0 00E+00 | 1 04E-05 | 2 08E-05 |
| Ra-228 | 5.1841E-12 | 91,386 55 | 182,773.11 | 0 00E+00 | 4 74E-07 | 9 48E-07 |
| Ru-106 | 5 9012E-07 | 91,386 55 | 182,773 11 | 0 00E+00 | 5.39E-02 | 1 08E-01 |
| Se-79 | 1.2379E-05 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 13E+00 | 2 26E+00 |
| Sn-126 | 2 5210E-05 | 91,386 55 | 182,773 11 | 0 00E+00 | 2 30E+00 | 4 61E+00 |
| Sr-90 | 1 1630E+00 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 06E+05 | 2 13E+05 |
| Tc-99 | 3 9357E-04 | 91,386 55 | 182,773 11 | 0 00E+00 | 3 60E+01 | 7.19E+01 |
| Th-229 | 8 5691E-11 | 91,386 55 | 182,773.11 | 0.00E+00 | 7 83E-06 | 1.57E-05 |
| Th-230 | 1 4493E-08 | 91,386 55 | 182,773.11 | 0 00E+00 | 1 32E-03 | 2 65E-03 |
| Th-232 | 5 2923E-12 | 91,386.55 | 182,773.11 | 0 00E+00 | 4 84E-07 | 9 67E-07 |
| Tl-208 | 1 9202E-07 | 91,386.55 | 182,773.11 | 0 00E+00 | 1.75E-02 | 3.51E-02 |
| U-232 | 5.2083E-07 | 91,386.55 | 182,773.11 | 0 00E+00 | 4 76E-02 | 9.52E-02 |
| U-233 | 2 4386E-08 | 91,386 55 | 182,773 11 | 0 00E+00 | 2.23E-03 | 4 46E-03 |
| U-234 | 4 7012E-05 | 91,386 55 | 182,773.11 | 0 00E+00 | 4.30E+00 | 8 59E+00 |
| U-235 | -1 4492E-06 | 91,386 55 | 0.00 | 5 00E-02 | 0 00E+00 | 5 00E-02 |
| U-236 | 7.5759E-06 | 91,386 55 | 182,773 11 | 0 00E+00 | 6 92E-01 | 1 38E+00 |
| U-238 | -2 6129E-07 | 91,386 55 | 0 00 | 2 52E-01 | 2.28E-01 | 2 52E-01 |
| Y-90 | 1 1631E+00 | 91,386 55 | 182,773 11 | 0 00E+00 | 1 06E+05 | 2.13E+05 |
| Other Radionuclides | | | | | 1 54E+05 | 3 09E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1.243E+16 |
| 0.0250 | 2.517E+15 |
| 0 0375 | 2 436E+15 |
| 0 0575 | 2 658E+15 |
| 0 0850 | 1 408E+15 |
| 0 1250 | 1.029E+15 |
| 0 2250 | 1.209E+15 |
| 0 3750 | 5 187E+14 |
| 0 5750 | 1 192E+16 |
| 0 8500 | 2.353E+14 |
| 1.2500 | 3 178E+14 |
| 1 7500 | 6 963E+12 |
| 2.2500 | 1.286E+09 |
| 2 7500 | 1 446E+09 |
| 3.5000 | 1 894E+08 |
| 5.0000 | 8 095E+07 |
| 7 0000 | 9.333E+06 |
| 11 0000 | 1 072E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.51E+03 | 5 01E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents. | U | U |
| BOL Enrichment % | 3 | 0 to 5 |

Basis for Parameter Differences.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 32,848 60 | 91,386.55 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 33,041 60 | 182,773 11 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 3 38 | 2.78 |
| Bounding | 6 76 | 5 53 |

Estimated EOL HM/Given EOL HM: 1 06

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | COOPER NUCLEAR | [1]Fuel decay start date | 1982 |
| SNF ID # | 308 | Estimates as of | 2010 |
| Fuel Units & Descr | 2 - 7 X 7 ROD ARRAY | Template | PWR (Light Water Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=370kg EOL=368.2kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage
18"x15'
1 00

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 10,273 05 | 10,378 50 | 0 00E+00 | 6 82E-06 | 6 89E-06 |
| Am-241 | 1 3144E-01 | 10,273 05 | 10,378 50 | 0 00E+00 | 1.35E+03 | 1.36E+03 |
| Am-242m | 3 0039E-04 | 10,273 05 | 10,378 50 | 0 00E+00 | 3 09E+00 | 3 12E+00 |
| Am-243 | 6 2629E-04 | 10,273 05 | 10,378.50 | 0 00E+00 | 6 43E+00 | 6 50E+00 |
| C-14 | 4 7965E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 4 93E-01 | 4 98E-01 |
| Cl-36 | 8 0297E-07 | 10,273 05 | 10,378 50 | 0 00E+00 | 8.25E-03 | 8 33E-03 |
| Cm-243 | 3 1993E-04 | 10,273 05 | 10,378 50 | 0 00E+00 | 3.29E+00 | 3 32E+00 |
| Cm-244 | 7 1851E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 7.38E+02 | 7 46E+02 |
| Co-60 | 9 5220E-03 | 10,273 05 | 10,378 50 | 0 00E+00 | 9 78E+01 | 9 88E+01 |
| Cs-134 | 1 1662E-03 | 10,273 05 | 10 378 50 | 0 00E+00 | 1.20E+01 | 1 21E+01 |
| Cs-135 | 1 4433E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 48E-01 | 1 50E-01 |
| Cs-137 | 1 7603E+00 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 81E+04 | 1 83E+04 |
| Eu-154 | 4 5203E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 4 64E+02 | 4 69E+02 |
| Eu-155 | 7.1479E-03 | 10,273 05 | 10,378 50 | 0 00E+00 | 7.34E+01 | 7 42E+01 |
| Fe-55 | 6 1919E-04 | 10,273 05 | 10,378 50 | 0 00E+00 | 6 36E+00 | 6 43E+00 |
| H-3 | 3 6386E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 3 74E+02 | 3 78E+02 |
| I-129 | 9 8288E-07 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 01E-02 | 1 02E-02 |
| Kr-85 | 5 3844E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 5 53E+02 | 5 59E+02 |
| Np-237 | 1 0546E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 08E-01 | 1.09E-01 |
| Pa-231 | 1 1370E-09 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 17E-05 | 1.18E-05 |
| Pb-210 | 3 3624E-11 | 10,273 05 | 10,378 50 | 0 00E+00 | 3 45E-07 | 3 49E-07 |
| Pm-147 | 5 1211E-03 | 10,273 05 | 10,378 50 | 0 00E+00 | 5 26E+01 | 5 31E+01 |
| Pu-238 | 8 0669E-02 | 10,273 05 | 10,378 50 | 0.00E+00 | 8 29E+02 | 8 37E+02 |
| Pu-239 | 1 1626E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 19E+02 | 1.21E+02 |
| Pu-240 | 1 5097E-02 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 55E+02 | 1.57E+02 |
| Pu-241 | 1 4567E+00 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 50E+04 | 1.51E+04 |
| Pu-242 | 6 4260E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 6 60E-01 | 6 67E-01 |
| Ra-226 | 1 1392E-10 | 10,273 05 | 10,378 50 | 0 00E+00 | 1.17E-06 | 1 18E-06 |
| Ra-228 | 5 1841E-12 | 10,273 05 | 10,378 50 | 0 00E+00 | 5 33E-08 | 5.38E-08 |
| Ru-106 | 5 9012E-07 | 10,273 05 | 10,378 50 | 0 00E+00 | 6 06E-03 | 6 12E-03 |
| Se-79 | 1 2379E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 1.27E-01 | 1.28E-01 |
| Sn-126 | 2 5210E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 2 59E-01 | 2 62E-01 |
| Sr-90 | 1 1630E+00 | 10,273 05 | 10,378 50 | 0 00E+00 | 1.19E+04 | 1.21E+04 |
| Tc-99 | 3 9357E-04 | 10,273 05 | 10,378.50 | 0 00E+00 | 4 04E+00 | 4 08E+00 |
| Th-229 | 8 5691E-11 | 10,273 05 | 10,378.50 | 0 00E+00 | 8 80E-07 | 8 89E-07 |
| Th-230 | 1 4493E-08 | 10,273 05 | 10,378 50 | 0 00E+00 | 1.49E-04 | 1 50E-04 |
| Th-232 | 5 2923E-12 | 10,273 05 | 10,378 50 | 0 00E+00 | 5 44E-08 | 5 49E-08 |
| Tl-208 | 1 9202E-07 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 97E-03 | 1 99E-03 |
| U-232 | 5 2083E-07 | 10,273 05 | 10,378 50 | 0 00E+00 | 5 35E-03 | 5 41E-03 |
| U-233 | 2 4386E-08 | 10,273 05 | 10,378 50 | 0 00E+00 | 2.51E-04 | 2 53E-04 |
| U-234 | 4 7012E-05 | 10,273 05 | 10,378 50 | 0 00E+00 | 4 83E-01 | 4 88E-01 |
| U-235 | -1 4492E-06 | 10,273 05 | 0 00 | 1.28E-02 | 0 00E+00 | 1.28E-02 |
| U-236 | 7 5759E-06 | 10,273 05 | 10,378 50 | 0 00E+00 | 7.78E-02 | 7 86E-02 |
| U-238 | -2 6129E-07 | 10,273 05 | 0 00 | 1.22E-01 | 1.20E-01 | 1.22E-01 |
| Y-90 | 1 1631E+00 | 10,273 05 | 10,378 50 | 0 00E+00 | 1 19E+04 | 1 21E+04 |
| Other Radionuclides | | | | | 1 74E+04 | 1 75E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 058E+14 |
| 0 0250 | 1 429E+14 |
| 0 0375 | 1.383E+14 |
| 0 0575 | 1.509E+14 |
| 0 0850 | 7.997E+13 |
| 0 1250 | 5.842E+13 |
| 0 2250 | 6 865E+13 |
| 0 3750 | 2.946E+13 |
| 0 5750 | 6 769E+14 |
| 0 8500 | 1.336E+13 |
| 1.2500 | 1.805E+13 |
| 1 7500 | 3.954E+11 |
| 2.2500 | 7.303E+07 |
| 2.7500 | 8.208E+07 |
| 3 5000 | 1 076E+07 |
| 5 0000 | 4.597E+06 |
| 7 0000 | 5.300E+05 |
| 11 0000 | 6 088E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.82E+02 | 2.85E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 1 6 | 0 to 5 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 10,273 05 | 1,711 71 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 10,378 50 | 3 423 43 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 79 | 0 17 |
| Bounding | 0 80 | 0 33 |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FFTF-DFA/TDFA
SNF ID #: 71
Fuel Units & Descr: 261 - HEX ARRAY 217 ROD
Heavy Metal Mass: BOL=9083 087kg; EOL=8443 742kg
ROD Storage Site HANFORD

[1]Fuel decay start date: 1992
Estimates as of 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd): 5011.2
Template BOL Heavy Metal Mass (MT): 0 0329181
Template Decay Time: 15 years

Estimated Canister usage: 18"x15" 52 20

**II. Estimates**

| Radionuclide | m: CI/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (CI) | $y_n$: Nominal Fuel Inventories(CI) | $y_b$: Bounding Fuel Inventories(CI) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3735E-12 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 8 77E-07 | 1 75E-06 |
| Am-241 | 7 9527E-02 | 638,157 18 | 1,276,314 37 | 1 75E+04 | 6 83E+04 | 1 19E+05 |
| Am-242m | 2 1053E-03 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 34E+03 | 2 69E+03 |
| Am-243 | 1 0760E-04 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 6 87E+01 | 1 37E+02 |
| C-14 | 2 6141E-05 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 67E+01 | 3 34E+01 |
| Cl-36 | 3 4243E-10 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 2 19E-04 | 4 37E-04 |
| Cm-243 | 6 6092E-04 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 4.22E+02 | 8 44E+02 |
| Cm-244 | 2 9933E-03 | 638,157 18 | 1,276,314 37 | 0.00E+00 | 1 91E+03 | 3 82E+03 |
| Co-60 | 1 5934E-02 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 02E+04 | 2 03E+04 |
| Cs-134 | 4 6356E-02 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 2 96E+04 | 5 92E+04 |
| Cs-135 | 4 7693E-05 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 3 04E+01 | 6 09E+01 |
| Cs-137 | 2 1113E+00 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 35E+06 | 2 69E+06 |
| Eu-154 | 4 8092E-02 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 3 07E+04 | 6 14E+04 |
| Eu-155 | 6 8447E-02 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 4 37E+04 | 8 74E+04 |
| Fe-55 | 5 8479E-03 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 3 73E+03 | 7 46E+03 |
| H-3 | 8 9300E-03 | 638,157.18 | 1,276,314 37 | 0 00E+00 | 5 70E+03 | 1 14E+04 |
| I-129 | 1.2891E-06 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 8 23E-01 | 1 65E+00 |
| Kr-85 | 7 0941E-02 | 638,157 18 | 1,276,314 37 | 0.00E+00 | 4 53E+04 | 9 05E+04 |
| Np-237 | 2 6541E-06 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 1 69E+00 | 3 39E+00 |
| Pa-231 | 4 8970E-12 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 3 13E-06 | 6.25E-06 |
| Pb-210 | 2.2170E-13 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 41E-07 | 2 83E-07 |
| Pm-147 | 2 3617E-01 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 1 51E+05 | 3 01E+05 |
| Pu-238 | 2 8636E-02 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 83E+04 | 3 65E+04 |
| Pu-239 | -3 5520E-02 | 638,157 18 | 0 00 | 1 44E+05 | 1.21E+05 | 1 44E+05 |
| Pu-240 | 2 0790E-02 | 638,157 18 | 1,276,314 37 | 7.31E+04 | 8 63E+04 | 9 96E+04 |
| Pu-241 | -4 8316E-01 | 638,157 18 | 0 00 | 3.28E+06 | 2 97E+06 | 3 28E+06 |
| Pu-242 | 1 1052E-05 | 638,157 18 | 1,276,314 37 | 1 95E+01 | 2 65E+01 | 3 36E+01 |
| Ra-226 | 5 7471E-13 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 3 67E-07 | 7 34E-07 |
| Ra-228 | 5 4957E-17 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 3 51E-11 | 7 01E-11 |
| Ru-106 | 1 4582E-02 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 9 31E+03 | 1 86E+04 |
| Se-79 | 1 0137E-05 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 6 47E+00 | 1 29E+01 |
| Sn-126 | 4.3922E-05 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 2 80E+01 | 5 61E+01 |
| Sr-90 | 7 6329E-01 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 4 87E+05 | 9 74E+05 |
| Tc-99 | 3 9412E-04 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 2 52E+02 | 5 03E+02 |
| Th-229 | 1 6457E-12 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 05E-06 | 2 10E-06 |
| Th-230 | 1 8822E-10 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 20E-04 | 2.40E-04 |
| Th-232 | 9 7601E-17 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 6 23E-11 | 1.25E-10 |
| Tl-208 | 5 2722E-07 | 638,157.18 | 1,276,314 37 | 0 00E+00 | 3 36E-01 | 6.73E-01 |
| U-232 | 1 4925E-06 | 638,157 18 | 1,276,314.37 | 0 00E+00 | 9 52E-01 | 1 90E+00 |
| U-233 | 2 1113E-10 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 35E-04 | 2 69E-04 |
| U-234 | 1 9528E-06 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 1 25E+00 | 2 49E+00 |
| U-235 | -9 7920E-09 | 638,157 18 | 0 00 | 2.95E-02 | 2 33E-02 | 2.95E-02 |
| U-236 | 1 1570E-07 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 7 38E-02 | 1 48E-01 |
| U-238 | -1 7914E-07 | 638,157 18 | 0 00 | 2 15E+00 | 2 03E+00 | 2 15E+00 |
| Y-90 | 7 6329E-01 | 638,157 18 | 1,276,314 37 | 0 00E+00 | 4 87E+05 | 9 74E+05 |
| Other Radionuclides | | | | | 1 38E+06 | 2 77E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 417E+16 |
| 0 0250 | 1.384E+16 |
| 0.0375 | 1.583E+16 |
| 0 0575 | 1.347E+16 |
| 0.0850 | 7.885E+15 |
| 0 1250 | 5 889E+15 |
| 0.2250 | 5 971E+15 |
| 0.3750 | 3 070E+15 |
| 0.5750 | 1 026E+17 |
| 0.8500 | 3 433E+15 |
| 1.2500 | 2.989E+15 |
| 1 7500 | 4 910E+13 |
| 2.2500 | 1 653E+12 |
| 2 7500 | 1 724E+11 |
| 3.5000 | 1 946E+10 |
| 5.0000 | 4 815E+07 |
| 7 0000 | 5 509E+06 |
| 11 0000 | 6 309E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.03E+04 | 3 47E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | 0 71 | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 635,816 10 | 638 157 18 |
| Bounding | 1,362,463.07 | 1 276 314 37 |

**Basis for burnup used in estimate:**
Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 46 | 1 00 |
| Bounding | 0 92 | 0 94 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | FFTF-DFA/TDFA PINS | [1]Fuel decay start date | 1992 |
| SNF ID #: | 323 | Estimates as of | 2010 |
| Fuel Units & Descr: | 2768 - ROD | Template | FFTF (FAST, SST, 10 to 30%, Pu & U) |
| Heavy Metal Mass | BOL= , EOL=443 987kg | [2]Template Burnup(MWd) | 5011.2 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 0329181 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x15' 41 94

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 31,146 44 | 69,045 35 | 0 00E+00 | 4 28E-08 | 9 48E-08 |
| Am-241 | 7 9527E-02 | 31,146 44 | 69,045 35 | 9 16E+02 | 3 39E+03 | 6 41E+03 |
| Am-242m | 2 1053E-03 | 31,146 44 | 69,045 35 | 0 00E+00 | 6 56E+01 | 1 45E+02 |
| Am-243 | 1 0760E-04 | 31,146 44 | 69,045 35 | 0 00E+00 | 3 35E+00 | 7 43E+00 |
| C-14 | 2 6141E-05 | 31,146 44 | 69,045 35 | 0 00E+00 | 8 14E-01 | 1 80E+00 |
| Cl-36 | 3 4243E-10 | 31,146 44 | 69 045 35 | 0 00E+00 | 1 07E-05 | 2 36E-05 |
| Cm-243 | 6 6092E-04 | 31,146 44 | 69,045 35 | 0 00E+00 | 2 06E+01 | 4 56E+01 |
| Cm-244 | 2 9933E-03 | 31,146 44 | 69,045 35 | 0 00E+00 | 9 32E+01 | 2 07E+02 |
| Co-60 | 1.5934E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 4 96E+02 | 1 10E+03 |
| Cs-134 | 4 6356E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 44E+03 | 3 20E+03 |
| Cs-135 | 4 7693E-05 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 49E+00 | 3 29E+00 |
| Cs-137 | 2 1113E+00 | 31,146 44 | 69,045 35 | 0 00E+00 | 6.58E+04 | 1 46E+05 |
| Eu-154 | 4 8092E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 1.50E+03 | 3 32E+03 |
| Eu-155 | 6 8447E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 2.13E+03 | 4 73E+03 |
| Fe-55 | 5 8479E-03 | 31,146 44 | 69,045 35 | 0 00E+00 | 1.82E+02 | 4 04E+02 |
| H-3 | 8 9300E-03 | 31,146 44 | 69,045 35 | 0 00E+00 | 2 78E+02 | 6 17E+02 |
| I-129 | 1.2891E-06 | 31,146 44 | 69,045 35 | 0 00E+00 | 4 02E-02 | 8 90E-02 |
| Kr-85 | 7 0941E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 2.21E+03 | 4 90E+03 |
| Np-237 | 2 6541E-06 | 31,146 44 | 69,045 35 | 0 00E+00 | 8.27E-02 | 1 83E-01 |
| Pa-231 | 4 8970E-12 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 53E-07 | 3 38E-07 |
| Pb-210 | 2.2170E-13 | 31,146 44 | 69,045 35 | 0 00E+00 | 6 91E-09 | 1.53E-08 |
| Pm-147 | 2 3617E-01 | 31,146 44 | 69,045.35 | 0 00E+00 | 7.36E+03 | 1 63E+04 |
| Pu-238 | 2 8636E-02 | 31,146 44 | 69,045.35 | 0 00E+00 | 8 92E+02 | 1 98E+03 |
| Pu-239 | -3 5520E-02 | 31,146 44 | 0 00 | 7 52E+03 | 6 41E+03 | 7 52E+03 |
| Pu-240 | 2 0790E-02 | 31,146 44 | 69,045 35 | 3 82E+03 | 4 47E+03 | 5.26E+03 |
| Pu-241 | -4 8316E-01 | 31,146 44 | 0 00 | 1 72E+05 | 1 57E+05 | 1 72E+05 |
| Pu-242 | 1 1052E-05 | 31,146 44 | 69,045 35 | 1 02E+00 | 1 36E+00 | 1.78E+00 |
| Ra-226 | 5 7471E-13 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 79E-08 | 3 97E-08 |
| Ra-228 | 5 4957E-17 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 71E-12 | 3 79E-12 |
| Ru-106 | 1 4582E-02 | 31,146 44 | 69,045 35 | 0 00E+00 | 4 54E+02 | 1.01E+03 |
| Se-79 | 1 0137E-05 | 31,146 44 | 69,045 35 | 0 00E+00 | 3 16E-01 | 7 00E-01 |
| Sn-126 | 4 3922E-05 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 37E+00 | 3 03E+00 |
| Sr-90 | 7 6329E-01 | 31,146 44 | 69,045 35 | 0 00E+00 | 2 38E+04 | 5.27E+04 |
| Tc-99 | 3 9412E-04 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 23E+01 | 2 72E+01 |
| Th-229 | 1 6457E-12 | 31,146.44 | 69,045 35 | 0 00E+00 | 5 13E-08 | 1 14E-07 |
| Th-230 | 1 8822E-10 | 31,146 44 | 69,045 35 | 0 00E+00 | 5 86E-06 | 1.30E-05 |
| Th-232 | 9 7601E-17 | 31,146 44 | 69,045 35 | 0 00E+00 | 3 04E-12 | 6 74E-12 |
| Tl-208 | 5.2722E-07 | 31,146 44 | 69,045 35 | 0 00E+00 | 1 64E-02 | 3 64E-02 |
| U-232 | 1 4925E-06 | 31,146 44 | 69,045 35 | 0 00E+00 | 4 65E-02 | 1 03E-01 |
| U-233 | 2.1113E-10 | 31,146 44 | 69,045 35 | 0 00E+00 | 6 58E-06 | 1 46E-05 |
| U-234 | 1.9528E-06 | 31,146 44 | 69,045 35 | 0 00E+00 | 6 08E-02 | 1 35E-01 |
| U-235 | -9 7920E-09 | 31,146 44 | 0 00 | 1.54E-03 | 1.24E-03 | 1 54E-03 |
| U-236 | 1.1570E-07 | 31,146 44 | 69,045 35 | 0 00E+00 | 3 60E-03 | 7 99E-03 |
| U-238 | -1 7914E-07 | 31,146 44 | 0 00 | 1.12E-01 | 1 07E-01 | 1 12E-01 |
| Y-90 | 7.6329E-01 | 31,146 44 | 69,045 35 | 0 00E+00 | 2 38E+04 | 5 27E+04 |
| Other Radionuclides | | | | | 6 75E+04 | 1 50E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 470E+15 |
| 0 0250 | 7 487E+14 |
| 0 0375 | 8 562E+14 |
| 0 0575 | 7.280E+14 |
| 0 0850 | 4.266E+14 |
| 0 1250 | 3 186E+14 |
| 0.2250 | 3.230E+14 |
| 0.3750 | 1 661E+14 |
| 0 5750 | 5 549E+15 |
| 0.8500 | 1 857E+14 |
| 1.2500 | 1 617E+14 |
| 1 7500 | 2 656E+12 |
| 2.2500 | 8 941E+10 |
| 2 7500 | 9 326E+09 |
| 3 5000 | 1 053E+09 |
| 5 0000 | 2 574E+06 |
| 7 0000 | 2.945E+05 |
| 11 0000 | 3 373E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 02E+03 | 1.86E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 31 146 44 |
| Bounding | | 69 045.35 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=475 192kg

Bounding burnup taken from SFD and converted to MWd using BOL=475 192kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 43 | |
| Bounding | 0 95 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: FFTF-TFA PINS | [1]Fuel decay start date: | 1992 | Estimated Canister usage 18"x15' |
| SNF ID #: 320 | Estimates as of | 2010 | 24 92 |
| Fuel Units & Descr. 1645 - ROD | Template | FFTF (FAST, SST, 10 to 30%, Pu & U) | |
| Heavy Metal Mass BOL= , EOL=389 701kg | [2]Template Burnup(MWd): | 5011.2 | |
| ROD Storage Site. HANFORD | Template BOL Heavy Metal Mass (MT): | 0 0329181 | |
| | Template Decay Time | 15 years | |

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 27,338.13 | 60,603 11 | 0 00E+00 | 3 75E-08 | 8 32E-08 |
| Am-241 | 7 9527E-02 | 27,338 13 | 60,603 11 | 8 04E+02 | 2.98E+03 | 5 62E+03 |
| Am-242m | 2 1053E-03 | 27,338.13 | 60,603 11 | 0 00E+00 | 5 76E+01 | 1 28E+02 |
| Am-243 | 1 0760E-04 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 94E+00 | 6 52E+00 |
| C-14 | 2 6141E-05 | 27,338.13 | 60,603 11 | 0 00E+00 | 7 15E-01 | 1 58E+00 |
| Cl-36 | 3 4243E-10 | 27,338.13 | 60,603 11 | 0 00E+00 | 9 36E-06 | 2 08E-05 |
| Cm-243 | 6 6092E-04 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 81E+01 | 4 01E+01 |
| Cm-244 | 2 9933E-03 | 27,338 13 | 60,603 11 | 0 00E+00 | 8 18E+01 | 1 81E+02 |
| Co-60 | 1 5934E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 4 36E+02 | 9 66E+02 |
| Cs-134 | 4 6356E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 27E+03 | 2 81E+03 |
| Cs-135 | 4 7693E-05 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 30E+00 | 2 89E+00 |
| Cs-137 | 2 1113E+00 | 27,338 13 | 60,603 11 | 0 00E+00 | 5 77E+04 | 1 28E+05 |
| Eu-154 | 4 8092E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 31E+03 | 2 91E+03 |
| Eu-155 | 6 8447E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 87E+03 | 4 15E+03 |
| Fe-55 | 5 8479E-03 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 60E+02 | 3 54E+02 |
| H-3 | 8 9300E-03 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 44E+02 | 5 41E+02 |
| I-129 | 1 2891E-06 | 27,338 13 | 60,603 11 | 0 00E+00 | 3 52E-02 | 7 81E-02 |
| Kr-85 | 7 0941E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 94E+03 | 4 30E+03 |
| Np-237 | 2 6541E-06 | 27,338 13 | 60,603 11 | 0 00E+00 | 7 26E-02 | 1 61E-01 |
| Pa-231 | 4 8970E-12 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 34E-07 | 2.97E-07 |
| Pb-210 | 2 2170E-13 | 27,338 13 | 60,603 11 | 0 00E+00 | 6 06E-09 | 1.34E-08 |
| Pm-147 | 2 3617E-01 | 27,338 13 | 60,603 11 | 0 00E+00 | 6 46E+03 | 1 43E+04 |
| Pu-238 | 2 8636E-02 | 27,338 13 | 60,603 11 | 0 00E+00 | 7 83E+02 | 1 74E+03 |
| Pu-239 | -3 5520E-02 | 27,338 13 | 0.00 | 6 60E+03 | 5 63E+03 | 6 60E+03 |
| Pu-240 | 2 0790E-02 | 27,338 13 | 60,603 11 | 3 36E+03 | 3 92E+03 | 4 62E+03 |
| Pu-241 | -4 8316E-01 | 27,338 13 | 0 00 | 1 51E+05 | 1 37E+05 | 1 51E+05 |
| Pu-242 | 1 1052E-05 | 27,338 13 | 60,603 11 | 8 95E-01 | 1 20E+00 | 1 56E+00 |
| Ra-226 | 5 7471E-13 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 57E-08 | 3.48E-08 |
| Ra-228 | 5 4957E-17 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 50E-12 | 3.33E-12 |
| Ru-106 | 1 4582E-02 | 27,338.13 | 60,603 11 | 0 00E+00 | 3 99E+02 | 8 84E+02 |
| Se-79 | 1 0137E-05 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 77E-01 | 6.14E-01 |
| Sn-126 | 4 3922E-05 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 20E+00 | 2 66E+00 |
| Sr-90 | 7 6329E-01 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 09E+04 | 4 63E+04 |
| Tc-99 | 3 9412E-04 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 08E+01 | 2 39E+01 |
| Th-229 | 1 6457E-12 | 27,338 13 | 60,603 11 | 0 00E+00 | 4 50E-08 | 9 97E-08 |
| Th-230 | 1 8822E-10 | 27,338 13 | 60,603 11 | 0 00E+00 | 5 15E-06 | 1.14E-05 |
| Th-232 | 9 7601E-17 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 67E-12 | 5 91E-12 |
| Tl-208 | 5.2722E-07 | 27,338 13 | 60,603 11 | 0 00E+00 | 1 44E-02 | 3.20E-02 |
| U-232 | 1 4925E-06 | 27,338 13 | 60,603 11 | 0 00E+00 | 4 08E-02 | 9 04E-02 |
| U-233 | 2.1113E-10 | 27,338 13 | 60,603 11 | 0 00E+00 | 5 77E-06 | 1.28E-05 |
| U-234 | 1 9528E-06 | 27,338 13 | 60,603 11 | 0 00E+00 | 5 34E-02 | 1.18E-01 |
| U-235 | -9 7920E-09 | 27,338 13 | 0.00 | 1 36E-03 | 1 09E-03 | 1 36E-03 |
| U-236 | 1 1570E-07 | 27,338 13 | 60,603 11 | 0 00E+00 | 3.16E-03 | 7 01E-03 |
| U-238 | -1 7914E-07 | 27,338 13 | 0 00 | 9 87E-02 | 9 38E-02 | 9 87E-02 |
| Y-90 | 7 6329E-01 | 27,338 13 | 60,603 11 | 0 00E+00 | 2 09E+04 | 4.63E+04 |
| Other Radionuclides | | | | | 5 93E+04 | 1.31E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 046E+15 |
| 0 0250 | 6 572E+14 |
| 0 0375 | 7 515E+14 |
| 0 0575 | 6 390E+14 |
| 0 0850 | 3 744E+14 |
| 0 1250 | 2.796E+14 |
| 0.2250 | 2.835E+14 |
| 0 3750 | 1 458E+14 |
| 0 5750 | 4 870E+15 |
| 0 8500 | 1 630E+14 |
| 1.2500 | 1 419E+14 |
| 1 7500 | 2.331E+12 |
| 2.2500 | 7 848E+10 |
| 2.7500 | 8 186E+09 |
| 3 5000 | 9.241E+08 |
| 5 0000 | 2.259E+06 |
| 7 0000 | 2.585E+05 |
| 11 0000 | 2.960E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8 93E+02 | 1 63E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons:

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 27,338 13 |
| Bounding | | 60 603 11 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=417 09kg

Bounding burnup taken from SFD and converted to MWd using BOL=417 09kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 43 | |
| Bounding | 0 95 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FFTF-TFA PINS (AC-3) | [1]Fuel decay start date | 1992 |
| SNF ID # | 1046 | Estimates as of | 2010 |
| Fuel Units & Descr | 72 - ROD | Template | FFTF (FAST, SST 10 to 30% Pu & U) |
| Heavy Metal Mass | BOL= , EOL=8 878kg | [2]Template Burnup(MWd) | 5011 2 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 0329181 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x15' 1 09

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 1 3735E-12 | 634 54 | 787 70 | 0 00E+00 | 8 72E-10 | 1 08E-09 |
| Am-241 | 7 9527E-02 | 634 54 | 787 70 | 1 83E+01 | 6 88E+01 | 8 10E+01 |
| Am-242m | 2 1053E-03 | 634 54 | 787.70 | 0 00E+00 | 1 34E+00 | 1.66E+00 |
| Am-243 | 1 0760E-04 | 634 54 | 787.70 | 0 00E+00 | 6 83E-02 | 8 48E-02 |
| C-14 | 2 6141E-05 | 634 54 | 787.70 | 0 00E+00 | 1 66E-02 | 2 06E-02 |
| Cl-36 | 3 4243E-10 | 634 54 | 787 70 | 0 00E+00 | 2 17E-07 | 2 70E-07 |
| Cm-243 | 6 6092E-04 | 634 54 | 787 70 | 0 00E+00 | 4 19E-01 | 5 21E-01 |
| Cm-244 | 2 9933E-03 | 634 54 | 787 70 | 0 00E+00 | 1 90E+00 | 2 36E+00 |
| Co-60 | 1.5934E-02 | 634 54 | 787 70 | 0 00E+00 | 1 01E+01 | 1 26E+01 |
| Cs-134 | 4 6356E-02 | 634 54 | 787 70 | 0 00E+00 | 2 94E+01 | 3 65E+01 |
| Cs-135 | 4 7693E-05 | 634 54 | 787 70 | 0 00E+00 | 3 03E-02 | 3 76E-02 |
| Cs-137 | 2 1113E+00 | 634 54 | 787 70 | 0 00E+00 | 1 34E+03 | 1 66E+03 |
| Eu-154 | 4 8092E-02 | 634 54 | 787 70 | 0 00E+00 | 3 05E+01 | 3 79E+01 |
| Eu-155 | 6 8447E-02 | 634.54 | 787 70 | 0 00E+00 | 4 34E+01 | 5 39E+01 |
| Fe-55 | 5 8479E-03 | 634 54 | 787 70 | 0 00E+00 | 3 71E+00 | 4 61E+00 |
| H-3 | 8 9300E-03 | 634 54 | 787.70 | 0 00E+00 | 5 67E+00 | 7.03E+00 |
| I-129 | 1 2891E-06 | 634 54 | 787.70 | 0 00E+00 | 8 18E-04 | 1 02E-03 |
| Kr-85 | 7 0941E-02 | 634 54 | 787.70 | 0 00E+00 | 4 50E+01 | 5 59E+01 |
| Np-237 | 2 6541E-06 | 634 54 | 787 70 | 0 00E+00 | 1 68E-03 | 2 09E-03 |
| Pa-231 | 4 8970E-12 | 634 54 | 787 70 | 0 00E+00 | 3 11E-09 | 3 86E-09 |
| Pb-210 | 2.2170E-13 | 634 54 | 787 70 | 0 00E+00 | 1 41E-10 | 1 75E-10 |
| Pm-147 | 2.3617E-01 | 634 54 | 787 70 | 0 00E+00 | 1 50E+02 | 1 86E+02 |
| Pu-238 | 2 8636E-02 | 634 54 | 787 70 | 0 00E+00 | 1 82E+01 | 2 26E+01 |
| Pu-239 | -3 5520E-02 | 634 54 | 0 00 | 1 51E+02 | 1 28E+02 | 1 51E+02 |
| Pu-240 | 2 0790E-02 | 634 54 | 787 70 | 7 65E+01 | 8 97E+01 | 9 29E+01 |
| Pu-241 | -4 8316E-01 | 634 54 | 0 00 | 3 44E+03 | 3 13E+03 | 3 44E+03 |
| Pu-242 | 1 1052E-05 | 634.54 | 787 70 | 2 04E-02 | 2 74E-02 | 2.91E-02 |
| Ra-226 | 5 7471E-13 | 634 54 | 787.70 | 0 00E+00 | 3 65E-10 | 4.53E-10 |
| Ra-228 | 5 4957E-17 | 634 54 | 787.70 | 0 00E+00 | 3 49E-14 | 4.33E-14 |
| Ru-106 | 1 4582E-02 | 634 54 | 787.70 | 0 00E+00 | 9 25E+00 | 1.15E+01 |
| Se-79 | 1 0137E-05 | 634 54 | 787 70 | 0 00E+00 | 6 43E-03 | 7 99E-03 |
| Sn-126 | 4 3922E-05 | 634 54 | 787 70 | 0 00E+00 | 2 79E-02 | 3 46E-02 |
| Sr-90 | 7 6329E-01 | 634 54 | 787 70 | 0 00E+00 | 4 84E+02 | 6 01E+02 |
| Tc-99 | 3 9412E-04 | 634 54 | 787 70 | 0 00E+00 | 2 50E-01 | 3 10E-01 |
| Th-229 | 1 6457E-12 | 634 54 | 787 70 | 0 00E+00 | 1 04E-09 | 1 30E-09 |
| Th-230 | 1 8822E-10 | 634 54 | 787 70 | 0 00E+00 | 1 19E-07 | 1 48E-07 |
| Th-232 | 9 7601E-17 | 634 54 | 787 70 | 0 00E+00 | 6 19E-14 | 7 69E-14 |
| Tl-208 | 5 2722E-07 | 634 54 | 787 70 | 0 00E+00 | 3 35E-04 | 4 15E-04 |
| U-232 | 1 4925E-06 | 634.54 | 787 70 | 0 00E+00 | 9 47E-04 | 1.18E-03 |
| U-233 | 2 1113E-10 | 634 54 | 787.70 | 0 00E+00 | 1.34E-07 | 1.66E-07 |
| U-234 | 1 9528E-06 | 634 54 | 787.70 | 0 00E+00 | 1.24E-03 | 1.54E-03 |
| U-235 | -9 7920E-09 | 634 54 | 0 00 | 3 09E-05 | 2.47E-05 | 3 09E-05 |
| U-236 | 1 1570E-07 | 634 54 | 787.70 | 0 00E+00 | 7.34E-05 | 9 11E-05 |
| U-238 | -1 7914E-07 | 634 54 | 0 00 | 2.25E-03 | 2 14E-03 | 2.25E-03 |
| Y-90 | 7.6329E-01 | 634 54 | 787 70 | 0 00E+00 | 4.84E+02 | 6 01E+02 |
| Other Radionuclides | | | | | 1.38E+03 | 1 71E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 001E+13 |
| 0 0250 | 8 549E+12 |
| 0 0375 | 9 768E+12 |
| 0 0575 | 8 415E+12 |
| 0 0850 | 4 867E+12 |
| 0 1250 | 3 635E+12 |
| 0.2250 | 3 685E+12 |
| 0.3750 | 1 895E+12 |
| 0.5750 | 6.330E+13 |
| 0.8500 | 2 119E+12 |
| 1.2500 | 1.845E+12 |
| 1 7500 | 3 030E+10 |
| 2.2500 | 1 020E+09 |
| 2 7500 | 1 064E+08 |
| 3 5000 | 1.203E+07 |
| 5 0000 | 3 718E+04 |
| 7 0000 | 4.250E+03 |
| 11 0000 | 4.865E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.06E+01 | 2.46E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 634 54 |
| Bounding | | 787 70 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=9.513kg

Bounding burnup taken from SFD and converted to MWd using BOL=9.513kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 44 | |
| Bounding | 0 54 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FFTF-TFA-AB-1
SNF ID #. 317
Fuel Units & Descr. 1 - HEX ARRAY 217 ROD
Heavy Metal Mass. BOL= , EOL=34 655kg
ROD Storage Site. HANFORD

[1]Fuel decay start date: 1992
Estimates as of: 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd): 5011.2
Template BOL Heavy Metal Mass (MT): 0.0329181
Template Decay Time: 15 years

Estimated Canister usage: 18"x15'
0 20

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 251 33 | 502 65 | 0 00E+00 | 3 45E-10 | 6 90E-10 |
| Am-241 | 7 9527E-02 | 251 33 | 502 65 | 6 73E+01 | 8 73E+01 | 1 07E+02 |
| Am-242m | 2 1053E-03 | 251 33 | 502 65 | 0 00E+00 | 5 29E-01 | 1 06E+00 |
| Am-243 | 1 0760E-04 | 251 33 | 502 65 | 0 00E+00 | 2 70E-02 | 5 41E-02 |
| C-14 | 2 6141E-05 | 251 33 | 502 65 | 0 00E+00 | 6 57E-03 | 1 31E-02 |
| Cl-36 | 3 4243E-10 | 251 33 | 502 65 | 0 00E+00 | 8 61E-08 | 1 72E-07 |
| Cm-243 | 6 6092E-04 | 251 33 | 502 65 | 0 00E+00 | 1 66E-01 | 3 32E-01 |
| Cm-244 | 2 9933E-03 | 251 33 | 502 65 | 0 00E+00 | 7 52E-01 | 1.50E+00 |
| Co-60 | 1 5934E-02 | 251 33 | 502 65 | 0 00E+00 | 4 00E+00 | 8 01E+00 |
| Cs-134 | 4 6356E-02 | 251 33 | 502 65 | 0 00E+00 | 1 17E+01 | 2 33E+01 |
| Cs-135 | 4 7693E-05 | 251.33 | 502 65 | 0 00E+00 | 1 20E-02 | 2.40E-02 |
| Cs-137 | 2 1113E+00 | 251 33 | 502 65 | 0 00E+00 | 5 31E+02 | 1 06E+03 |
| Eu-154 | 4 8092E-02 | 251 33 | 502 65 | 0 00E+00 | 1.21E+01 | 2 42E+01 |
| Eu-155 | 6 8447E-02 | 251 33 | 502 65 | 0 00E+00 | 1 72E+01 | 3 44E+01 |
| Fe-55 | 5 8479E-03 | 251 33 | 502 65 | 0 00E+00 | 1 47E+00 | 2 94E+00 |
| H-3 | 8 9300E-03 | 251 33 | 502 65 | 0 00E+00 | 2.24E+00 | 4 49E+00 |
| I-129 | 1 2891E-06 | 251 33 | 502 65 | 0 00E+00 | 3.24E-04 | 6.48E-04 |
| Kr-85 | 7 0941E-02 | 251 33 | 502 65 | 0 00E+00 | 1.78E+01 | 3 57E+01 |
| Np-237 | 2 6541E-06 | 251 33 | 502 65 | 0 00E+00 | 6 67E-04 | 1 33E-03 |
| Pa-231 | 4 8970E-12 | 251 33 | 502 65 | 0 00E+00 | 1.23E-09 | 2 46E-09 |
| Pb-210 | 2 2170E-13 | 251.33 | 502 65 | 0 00E+00 | 5 57E-11 | 1 11E-10 |
| Pm-147 | 2 3617E-01 | 251.33 | 502 65 | 0 00E+00 | 5 94E+01 | 1 19E+02 |
| Pu-238 | 2 8636E-02 | 251.33 | 502.65 | 0 00E+00 | 7.20E+00 | 1 44E+01 |
| Pu-239 | -3 5520E-02 | 251.33 | 0 00 | 5 52E+02 | 5 44E+02 | 5 52E+02 |
| Pu-240 | 2 0790E-02 | 251.33 | 502.65 | 2 81E+02 | 2 86E+02 | 2 91E+02 |
| Pu-241 | -4 8316E-01 | 251 33 | 0 00 | 1 26E+04 | 1 25E+04 | 1 26E+04 |
| Pu-242 | 1 1052E-05 | 251.33 | 502 65 | 7 49E-02 | 7.77E-02 | 8 04E-02 |
| Ra-226 | 5 7471E-13 | 251 33 | 502 65 | 0 00E+00 | 1 44E-10 | 2 89E-10 |
| Ra-228 | 5 4957E-17 | 251 33 | 502 65 | 0 00E+00 | 1.38E-14 | 2 76E-14 |
| Ru-106 | 1 4582E-02 | 251 33 | 502 65 | 0 00E+00 | 3 66E+00 | 7.33E+00 |
| Se-79 | 1 0137E-05 | 251 33 | 502 65 | 0 00E+00 | 2 55E-03 | 5 10E-03 |
| Sn-126 | 4.3922E-05 | 251 33 | 502 65 | 0 00E+00 | 1 10E-02 | 2 21E-02 |
| Sr-90 | 7 6329E-01 | 251 33 | 502 65 | 0 00E+00 | 1 92E+02 | 3 84E+02 |
| Tc-99 | 3.9412E-04 | 251 33 | 502 65 | 0 00E+00 | 9 91E-02 | 1 98E-01 |
| Th-229 | 1 6457E-12 | 251 33 | 502 65 | 0 00E+00 | 4 14E-10 | 8 27E-10 |
| Th-230 | 1 8822E-10 | 251 33 | 502 65 | 0 00E+00 | 4 73E-08 | 9 46E-08 |
| Th-232 | 9 7601E-17 | 251 33 | 502 65 | 0 00E+00 | 2 45E-14 | 4 91E-14 |
| Tl-208 | 5.2722E-07 | 251 33 | 502 65 | 0 00E+00 | 1 33E-04 | 2 65E-04 |
| U-232 | 1 4925E-06 | 251 33 | 502 65 | 0 00E+00 | 3 75E-04 | 7 50E-04 |
| U-233 | 2.1113E-10 | 251 33 | 502 65 | 0 00E+00 | 5 31E-08 | 1 06E-07 |
| U-234 | 1 9528E-06 | 251 33 | 502 65 | 0 00E+00 | 4 91E-04 | 9 82E-04 |
| U-235 | -9 7920E-09 | 251.33 | 0 00 | 1 13E-04 | 1 11E-04 | 1.13E-04 |
| U-236 | 1 1570E-07 | 251.33 | 502 65 | 0 00E+00 | 2 91E-05 | 5 82E-05 |
| U-238 | -1.7914E-07 | 251 33 | 0 00 | 8.26E-03 | 8 21E-03 | 8.26E-03 |
| Y-90 | 7 6329E-01 | 251.33 | 502 65 | 0.00E+00 | 1 92E+02 | 3 84E+02 |
| Other Radionuclides | | | | | 5 45E+02 | 1 09E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 2 853E+13 |
| 0 0250 | 5 507E+12 |
| 0 0375 | 6.239E+12 |
| 0 0575 | 6 142E+12 |
| 0 0850 | 3 106E+12 |
| 0 1250 | 2 322E+12 |
| 0.2250 | 2.352E+12 |
| 0.3750 | 1.210E+12 |
| 0.5750 | 4 039E+13 |
| 0.8500 | 1 352E+12 |
| 1.2500 | 1 177E+12 |
| 1 7500 | 1 934E+10 |
| 2.2500 | 6 512E+08 |
| 2.7500 | 6 806E+07 |
| 3 5000 | 7.806E+06 |
| 5.0000 | 7.882E+04 |
| 7 0000 | 8 982E+03 |
| 11 0000 | 1 027E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.35E+01 | 3 91E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 251 33 |
| Bounding | | 502 65 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=34.907kg
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 05 | |
| Bounding | 0 09 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name FFTF-TFA-ABA-1 THRU 6
SNF ID # 318
Fuel Units & Descr 6 - HEX ARRAY 91 ROD
Heavy Metal Mass BOL= , EOL=257 428kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of 2010
Template FERMI (Fast Zirc 10 to 40% U)
[2]Template Burnup(MWd) 58 6725048
Template BOL Heavy Metal Mass (MT) 0 018774
Template Decay Time 15 years

Estimated Canister usage
18"x15'
1 20

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 1509E-08 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 28E-04 | 1.82E-04 |
| Am-241 | 4 6529E-07 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 76E-03 | 3 95E-03 |
| Am-242m | 0 0000E+00 | 5,934 58 | 8,479 48 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3923E-15 | 5,934 58 | 8,479 48 | 0 00E+00 | 4 98E-11 | 7 12E-11 |
| C-14 | 2 1765E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 1.29E-01 | 1 85E-01 |
| Cl-36 | 5 5188E-08 | 5,934 58 | 8 479 48 | 0 00E+00 | 3 28E-04 | 4 68E-04 |
| Cm-243 | 2 5208E-14 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 50E-10 | 2 14E-10 |
| Cm-244 | 1 1259E-15 | 5,934 58 | 8,479 48 | 0 00E+00 | 6 68E-12 | 9 55E-12 |
| Co-60 | 2 9094E-02 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 73E+02 | 2 47E+02 |
| Cs-134 | 5 1932E-04 | 5,934 58 | 8,479 48 | 0 00E+00 | 3 08E+00 | 4 40E+00 |
| Cs-135 | 4 4996E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 67E-01 | 3 82E-01 |
| Cs-137 | 2 1867E+00 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 30E+04 | 1 85E+04 |
| Eu-154 | 9 2837E-04 | 5,934 58 | 8,479 48 | 0 00E+00 | 5 51E+00 | 7 87E+00 |
| Eu-155 | 2 3180E-02 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 38E+02 | 1.97E+02 |
| Fe-55 | 2 9332E-03 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 74E+01 | 2 49E+01 |
| H-3 | 1 0871E-02 | 5,934 58 | 8,479 48 | 0 00E+00 | 6 45E+01 | 9 22E+01 |
| I-129 | 1 1426E-06 | 5,934 58 | 8,479 48 | 0 00E+00 | 6 78E-03 | 9 69E-03 |
| Kr-85 | 1 4068E-01 | 5,934 58 | 8,479 48 | 0 00E+00 | 8 35E+02 | 1 19E+03 |
| Np-237 | 3 3099E-06 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 96E-02 | 2 81E-02 |
| Pa-231 | 7 8640E-08 | 5,934 58 | 8,479 48 | 0 00E+00 | 4 67E-04 | 6 67E-04 |
| Pb-210 | 7 4277E-13 | 5,934 58 | 8,479 48 | 0 00E+00 | 4 41E-09 | 6 30E-09 |
| Pm-147 | 2.2856E-01 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 36E+03 | 1 94E+03 |
| Pu-238 | 2 0095E-04 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 19E+00 | 1 70E+00 |
| Pu-239 | 1.9481E-02 | 5 934 58 | 8,479 48 | 0 00E+00 | 1 16E+02 | 1 65E+02 |
| Pu-240 | 6 8056E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 4 04E-01 | 5 77E-01 |
| Pu-241 | 1 0939E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 6 49E-02 | 9 28E-02 |
| Pu-242 | 4 3751E-13 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 60E-09 | 3 71E-09 |
| Ra-226 | 4 0428E-12 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 40E-08 | 3 43E-08 |
| Ra-228 | 2 1032E-11 | 5,934 58 | 8,479 48 | 0 00E+00 | 1.25E-07 | 1 78E-07 |
| Ru-106 | 2 9077E-04 | 5,934 58 | 8,479 48 | 0 00E+00 | 1.73E+00 | 2 47E+00 |
| Se-79 | 1 6492E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 9 79E-02 | 1 40E-01 |
| Sn-126 | 3 7564E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 2.23E-01 | 3 19E-01 |
| Sr-90 | 1 9396E+00 | 5,934.58 | 8,479 48 | 0 00E+00 | 1.15E+04 | 1 64E+04 |
| Tc-99 | 4 4842E-04 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 66E+00 | 3 80E+00 |
| Th-229 | 1 8544E-11 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 10E-07 | 1.57E-07 |
| Th-230 | 9 0605E-10 | 5,934 58 | 8,479 48 | 0 00E+00 | 5 38E-06 | 7.68E-06 |
| Th-232 | 2 3674E-11 | 5,934.58 | 8,479 48 | 0 00E+00 | 1 40E-07 | 2 01E-07 |
| Tl-208 | 7.0323E-09 | 5,934 58 | 8,479 48 | 0 00E+00 | 4 17E-05 | 5 96E-05 |
| U-232 | 1.9106E-08 | 5,934.58 | 8,479 48 | 0 00E+00 | 1 13E-04 | 1 62E-04 |
| U-233 | 9 6774E-09 | 5,934 58 | 8,479 48 | 0 00E+00 | 5 74E-05 | 8 21E-05 |
| U-234 | 4 8796E-06 | 5,934 58 | 8,479 48 | 0 00E+00 | 2 90E-02 | 4 14E-02 |
| U-235 | -2 3191E-06 | 5,934 58 | 0 00 | 1 46E-01 | 1.32E-01 | 1 46E-01 |
| U-236 | 1 2633E-05 | 5,934 58 | 8,479 48 | 0 00E+00 | 7 50E-02 | 1 07E-01 |
| U-238 | -9 5407E-08 | 5,934 58 | 0 00 | 6 61E-02 | 6 55E-02 | 6 61E-02 |
| Y-90 | 1 9396E+00 | 5,934 58 | 8,479 48 | 0 00E+00 | 1 15E+04 | 1 64E+04 |
| Other Radionuclides | | | | | 1.29E+04 | 1 84E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 091E+14 |
| 0 0250 | 1.927E+14 |
| 0 0375 | 1 675E+14 |
| 0 0575 | 1 759E+14 |
| 0 0850 | 1.081E+14 |
| 0 1250 | 6 990E+13 |
| 0.2250 | 9 128E+13 |
| 0 3750 | 4 178E+13 |
| 0 5750 | 6 926E+14 |
| 0 8500 | 6 689E+12 |
| 1.2500 | 2 054E+13 |
| 1 7500 | 1 700E+11 |
| 2.2500 | 4 864E+08 |
| 2 7500 | 2.222E+07 |
| 3 5000 | 2.565E+06 |
| 5 0000 | 6.262E+02 |
| 7 0000 | 5.570E+01 |
| 11 0000 | 5 315E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.48E+02 | 2.12E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 10 to 40 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This template is a good approximation since it is a FAST Uranium fuel

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 5 934 58 |
| Bounding | | 8 479 48 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=264 158kg
Bounding burnup taken from SFD and converted to MWd using BOL=264 158kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 7 19 | |
| Bounding | 10.27 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name FFTF-TFA-ACN-1 (MOX) PINS
SNF ID #: 321
Fuel Units & Descr: 90 - ROD
Heavy Metal Mass: BOL= , EOL=14 346kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of: 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd). 5011.2
Template BOL Heavy Metal Mass (MT): 0.0329181
Template Decay Time: 15 years

Estimated Canister usage: 18"x15" 0 02

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 1 3735E-12 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 43E-09 | 2 85E-09 |
| Am-241 | 7 9527E-02 | 1,038 59 | 2,077 18 | 2 97E+01 | 1 12E+02 | 1 95E+02 |
| Am-242m | 2 1053E-03 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 19E+00 | 4 37E+00 |
| Am-243 | 1 0760E-04 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 12E-01 | 2 24E-01 |
| C-14 | 2 6141E-05 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 72E-02 | 5 43E-02 |
| Cl-36 | 3 4243E-10 | 1,038 59 | 2,077 18 | 0 00E+00 | 3 56E-07 | 7 11E-07 |
| Cm-243 | 6 6092E-04 | 1,038 59 | 2,077 18 | 0 00E+00 | 6 86E-01 | 1 37E+00 |
| Cm-244 | 2 9933E-03 | 1,038 59 | 2,077 18 | 0 00E+00 | 3 11E+00 | 6 22E+00 |
| Co-60 | 1 5934E-02 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 65E+01 | 3 31E+01 |
| Cs-134 | 4 6356E-02 | 1,038 59 | 2,077 18 | 0 00E+00 | 4 81E+01 | 9 63E+01 |
| Cs-135 | 4 7693E-05 | 1,038 59 | 2,077 18 | 0 00E+00 | 4 95E-02 | 9 91E-02 |
| Cs-137 | 2 1113E+00 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 19E+03 | 4 39E+03 |
| Eu-154 | 4 8092E-02 | 1,038 59 | 2,077 18 | 0 00E+00 | 4 99E+01 | 9 99E+01 |
| Eu-155 | 6 8447E-02 | 1,038 59 | 2,077 18 | 0 00E+00 | 7 11E+01 | 1 42E+02 |
| Fe-55 | 5 8479E-03 | 1,038 59 | 2,077 18 | 0 00E+00 | 6 07E+00 | 1.21E+01 |
| H-3 | 8 9300E-03 | 1,038 59 | 2,077 18 | 0 00E+00 | 9 27E+00 | 1 85E+01 |
| I-129 | 1 2891E-06 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 34E-03 | 2 68E-03 |
| Kr-85 | 7 0941E-02 | 1,038 59 | 2,077.18 | 0 00E+00 | 7 37E+01 | 1 47E+02 |
| Np-237 | 2 6541E-06 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 76E-03 | 5 51E-03 |
| Pa-231 | 4 8970E-12 | 1,038 59 | 2,077 18 | 0 00E+00 | 5 09E-09 | 1 02E-08 |
| Pb-210 | 2 2170E-13 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 30E-10 | 4 61E-10 |
| Pm-147 | 2 3617E-01 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 45E+02 | 4 91E+02 |
| Pu-238 | 2 8636E-02 | 1,038 59 | 2,077 18 | 0 00E+00 | 2 97E+01 | 5 95E+01 |
| Pu-239 | -3 5520E-02 | 1,038 59 | 0 00 | 2 44E+02 | 2 07E+02 | 2 44E+02 |
| Pu-240 | 2 0790E-02 | 1,038 59 | 2,077 18 | 1.24E+02 | 1 45E+02 | 1 67E+02 |
| Pu-241 | -4 8316E-01 | 1,038 59 | 0 00 | 5 56E+03 | 5 05E+03 | 5 56E+03 |
| Pu-242 | 1 1052E-05 | 1,038 59 | 2,077 18 | 3.30E-02 | 4 45E-02 | 5 60E-02 |
| Ra-226 | 5 7471E-13 | 1,038 59 | 2,077 18 | 0 00E+00 | 5 97E-10 | 1 19E-09 |
| Ra-228 | 5 4957E-17 | 1,038 59 | 2,077 18 | 0 00E+00 | 5 71E-14 | 1 14E-13 |
| Ru-106 | 1 4582E-02 | 1,038.59 | 2,077 18 | 0 00E+00 | 1.51E+01 | 3 03E+01 |
| Se-79 | 1 0137E-05 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 05E-02 | 2.11E-02 |
| Sn-126 | 4 3922E-05 | 1,038 59 | 2,077 18 | 0 00E+00 | 4 56E-02 | 9 12E-02 |
| Sr-90 | 7 6329E-01 | 1,038 59 | 2,077 18 | 0 00E+00 | 7.93E+02 | 1.59E+03 |
| Tc-99 | 3 9412E-04 | 1,038 59 | 2,077 18 | 0 00E+00 | 4 09E-01 | 8 19E-01 |
| Th-229 | 1 6457E-12 | 1,038 59 | 2,077.18 | 0 00E+00 | 1 71E-09 | 3 42E-09 |
| Th-230 | 1 8822E-10 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 95E-07 | 3 91E-07 |
| Th-232 | 9 7601E-17 | 1,038 59 | 2,077 18 | 0 00E+00 | 1 01E-13 | 2 03E-13 |
| Tl-208 | 5 2722E-07 | 1,038 59 | 2,077 18 | 0 00E+00 | 5 48E-04 | 1.10E-03 |
| U-232 | 1 4925E-06 | 1,038.59 | 2,077.18 | 0 00E+00 | 1 55E-03 | 3.10E-03 |
| U-233 | 2 1113E-10 | 1,038 59 | 2,077 18 | 0 00E+00 | 2.19E-07 | 4.39E-07 |
| U-234 | 1 9528E-06 | 1,038.59 | 2,077.18 | 0 00E+00 | 2 03E-03 | 4 06E-03 |
| U-235 | -9 7920E-09 | 1,038 59 | 0 00 | 5 00E-05 | 3 98E-05 | 5 00E-05 |
| U-236 | 1 1570E-07 | 1,038 59 | 2,077.18 | 0 00E+00 | 1.20E-04 | 2 40E-04 |
| U-238 | -1 7914E-07 | 1,038.59 | 0 00 | 3 64E-03 | 3 45E-03 | 3 64E-03 |
| Y-90 | 7 6329E-01 | 1,038 59 | 2,077.18 | 0 00E+00 | 7 93E+02 | 1.59E+03 |
| Other Radionuclides | | | | | 2.25E+03 | 4.50E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 045E+14 |
| 0 0250 | 2.253E+13 |
| 0 0375 | 2 576E+13 |
| 0 0575 | 2.193E+13 |
| 0 0850 | 1 283E+13 |
| 0 1250 | 9 584E+12 |
| 0.2250 | 9 718E+12 |
| 0.3750 | 4 996E+12 |
| 0.5750 | 1 669E+14 |
| 0.8500 | 5 587E+12 |
| 1.2500 | 4 864E+12 |
| 1 7500 | 7 991E+10 |
| 2.2500 | 2 690E+09 |
| 2 7500 | 2.806E+08 |
| 3 5000 | 3 168E+07 |
| 5 0000 | 7 952E+04 |
| 7 0000 | 9 097E+03 |
| 11 0000 | 1 042E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.36E+01 | 5 69E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1,038 59 |
| Bounding | | 2,077 18 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=15.387kg
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 44 | |
| Bounding | 0.89 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FFTF-TFA-ACN-1 (PU/UC) PINS | [1]Fuel decay start date | 1992 |
| SNF ID # | 865 | Estimates as of | 2010 |
| Fuel Units & Descr | 16 - ROD | Template | FFTF (FAST SST 10 to 30% Pu & U) |
| Heavy Metal Mass | BOL= , EOL=2.558kg | [2]Template Burnup(MWd) | 5011.2 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 0329181 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x15' 1.00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 185 22 | 370 43 | 0 00E+00 | 2 54E-10 | 5 09E-10 |
| Am-241 | 7 9527E-02 | 185 22 | 370 43 | 5 29E+00 | 2 00E+01 | 3 48E+01 |
| Am-242m | 2 1053E-03 | 185 22 | 370 43 | 0 00E+00 | 3 90E-01 | 7 80E-01 |
| Am-243 | 1 0760E-04 | 185 22 | 370 43 | 0 00E+00 | 1 99E-02 | 3 99E-02 |
| C-14 | 2 6141E-05 | 185 22 | 370 43 | 0 00E+00 | 4 84E-03 | 9 68E-03 |
| Cl-36 | 3 4243E-10 | 185 22 | 370 43 | 0 00E+00 | 6 34E-08 | 1 27E-07 |
| Cm-243 | 6 6092E-04 | 185 22 | 370 43 | 0 00E+00 | 1.22E-01 | 2 45E-01 |
| Cm-244 | 2 9933E-03 | 185.22 | 370 43 | 0 00E+00 | 5 54E-01 | 1 11E+00 |
| Co-60 | 1 5934E-02 | 185.22 | 370 43 | 0 00E+00 | 2 95E+00 | 5 90E+00 |
| Cs-134 | 4 6356E-02 | 185.22 | 370 43 | 0 00E+00 | 8 59E+00 | 1 72E+01 |
| Cs-135 | 4 7693E-05 | 185.22 | 370 43 | 0 00E+00 | 8 83E-03 | 1 77E-02 |
| Cs-137 | 2 1113E+00 | 185.22 | 370 43 | 0 00E+00 | 3 91E+02 | 7 82E+02 |
| Eu-154 | 4 8092E-02 | 185 22 | 370 43 | 0 00E+00 | 8 91E+00 | 1 78E+01 |
| Eu-155 | 6 8447E-02 | 185.22 | 370 43 | 0 00E+00 | 1 27E+01 | 2 54E+01 |
| Fe-55 | 5 8479E-03 | 185.22 | 370 43 | 0 00E+00 | 1 08E+00 | 2 17E+00 |
| H-3 | 8 9300E-03 | 185.22 | 370 43 | 0 00E+00 | 1 65E+00 | 3 31E+00 |
| I-129 | 1 2891E-06 | 185.22 | 370 43 | 0 00E+00 | 2 39E-04 | 4 78E-04 |
| Kr-85 | 7 0941E-02 | 185 22 | 370 43 | 0 00E+00 | 1 31E+01 | 2 63E+01 |
| Np-237 | 2 6541E-06 | 185 22 | 370 43 | 0 00E+00 | 4 92E-04 | 9 83E-04 |
| Pa-231 | 4 8970E-12 | 185 22 | 370 43 | 0 00E+00 | 9 07E-10 | 1 81E-09 |
| Pb-210 | 2.2170E-13 | 185 22 | 370 43 | 0 00E+00 | 4 11E-11 | 8 21E-11 |
| Pm-147 | 2 3617E-01 | 185 22 | 370 43 | 0 00E+00 | 4 37E+01 | 8 75E+01 |
| Pu-238 | 2 8636E-02 | 185 22 | 370 43 | 0 00E+00 | 5 30E+00 | 1 06E+01 |
| Pu-239 | -3 5520E-02 | 185 22 | 0 00 | 4.34E+01 | 3 68E+01 | 4 34E+01 |
| Pu-240 | 2 0790E-02 | 185 22 | 370 43 | 2.21E+01 | 2 59E+01 | 2 98E+01 |
| Pu-241 | -4 8316E-01 | 185 22 | 0 00 | 9 91E+02 | 9 01E+02 | 9 91E+02 |
| Pu-242 | 1 1052E-05 | 185 22 | 370 43 | 5 89E-03 | 7.93E-03 | 9 98E-03 |
| Ra-226 | 5 7471E-13 | 185 22 | 370 43 | 0 00E+00 | 1.06E-10 | 2.13E-10 |
| Ra-228 | 5 4957E-17 | 185 22 | 370 43 | 0 00E+00 | 1.02E-14 | 2 04E-14 |
| Ru-106 | 1 4582E-02 | 185.22 | 370 43 | 0 00E+00 | 2 70E+00 | 5 40E+00 |
| Se-79 | 1 0137E-05 | 185.22 | 370 43 | 0 00E+00 | 1 88E-03 | 3 76E-03 |
| Sn-126 | 4 3922E-05 | 185 22 | 370 43 | 0 00E+00 | 8 14E-03 | 1 63E-02 |
| Sr-90 | 7 6329E-01 | 185 22 | 370 43 | 0 00E+00 | 1.41E+02 | 2 83E+02 |
| Tc-99 | 3 9412E-04 | 185.22 | 370 43 | 0 00E+00 | 7 30E-02 | 1 46E-01 |
| Th-229 | 1 6457E-12 | 185.22 | 370 43 | 0 00E+00 | 3 05E-10 | 6 10E-10 |
| Th-230 | 1 8822E-10 | 185.22 | 370 43 | 0 00E+00 | 3 49E-08 | 6 97E-08 |
| Th-232 | 9 7601E-17 | 185.22 | 370 43 | 0 00E+00 | 1 81E-14 | 3 62E-14 |
| Tl-208 | 5 2722E-07 | 185.22 | 370 43 | 0 00E+00 | 9 77E-05 | 1 95E-04 |
| U-232 | 1 4925E-06 | 185.22 | 370 43 | 0 00E+00 | 2 76E-04 | 5 53E-04 |
| U-233 | 2 1113E-10 | 185.22 | 370 43 | 0 00E+00 | 3 91E-08 | 7 82E-08 |
| U-234 | 1 9528E-06 | 185 22 | 370 43 | 0 00E+00 | 3 62E-04 | 7 23E-04 |
| U-235 | -9 7920E-09 | 185 22 | 0 00 | 8 92E-06 | 7 10E-06 | 8 92E-06 |
| U-236 | 1.1570E-07 | 185 22 | 370 43 | 0 00E+00 | 2 14E-05 | 4 29E-05 |
| U-238 | -1 7914E-07 | 185 22 | 0 00 | 6 49E-04 | 6 16E-04 | 6 49E-04 |
| Y-90 | 7 6329E-01 | 185 22 | 370 43 | 0 00E+00 | 1 41E+02 | 2 83E+02 |
| Other Radionuclides | | | | | 4 01E+02 | 8 03E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 864E+13 |
| 0 0250 | 4 017E+12 |
| 0 0375 | 4 593E+12 |
| 0 0575 | 3 911E+12 |
| 0 0850 | 2.289E+12 |
| 0 1250 | 1 709E+12 |
| 0.2250 | 1 733E+12 |
| 0 3750 | 8 910E+11 |
| 0 5750 | 2 977E+13 |
| 0 8500 | 9 963E+11 |
| 1.2500 | 8 675E+11 |
| 1 7500 | 1 425E+10 |
| 2.2500 | 4 797E+08 |
| 2 7500 | 5 004E+07 |
| 3 5000 | 5 650E+06 |
| 5 0000 | 1 418E+04 |
| 7 0000 | 1 622E+03 |
| 11 0000 | 1.858E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 99E+00 | 1 02E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 185.22 |
| Bounding | | 370 43 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=2.744kg

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 44 | |
| Bounding | 0 89 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FFTF-TFA-ACO-2 4 THRU 16
SNF ID #: 329
Fuel Units & Descr: 14 - HEX ARRAY 169 ROD
Heavy Metal Mass: BOL= , EOL=605 982kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1992
Estimates as of: 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd): 5011.2
Template BOL Heavy Metal Mass (MT): 0 0329181
Template Decay Time 15 years

Estimated Canister usage 18"x15' 2 80

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 32E-07 | 1 92E-07 |
| Am-241 | 7 9527E-02 | 96,319 97 | 140,074 70 | 1 35E+03 | 9 01E+03 | 1 25E+04 |
| Am-242m | 2 1053E-03 | 96,319 97 | 140,074 70 | 0 00E+00 | 2 03E+02 | 2 95E+02 |
| Am-243 | 1 0760E-04 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 04E+01 | 1 51E+01 |
| C-14 | 2 6141E-05 | 96,319 97 | 140,074 70 | 0 00E+00 | 2 52E+00 | 3 66E+00 |
| Cl-36 | 3 4243E-10 | 96,319 97 | 140,074 70 | 0 00E+00 | 3 30E-05 | 4 80E-05 |
| Cm-243 | 6 6092E-04 | 96,319 97 | 140,074 70 | 0 00E+00 | 6 37E+01 | 9 26E+01 |
| Cm-244 | 2 9933E-03 | 96,319 97 | 140,074 70 | 0 00E+00 | 2 88E+02 | 4 19E+02 |
| Co-60 | 1 5934E-02 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 53E+03 | 2 23E+03 |
| Cs-134 | 4 6356E-02 | 96,319 97 | 140,074 70 | 0 00E+00 | 4 47E+03 | 6 49E+03 |
| Cs-135 | 4 7693E-05 | 96,319 97 | 140,074 70 | 0 00E+00 | 4 59E+00 | 6 68E+00 |
| Cs-137 | 2 1113E+00 | 96,319 97 | 140,074 70 | 0 00E+00 | 2.03E+05 | 2 96E+05 |
| Eu-154 | 4 8092E-02 | 96,319 97 | 140,074 70 | 0 00E+00 | 4 63E+03 | 6 74E+03 |
| Eu-155 | 6 8447E-02 | 96,319 97 | 140,074 70 | 0 00E+00 | 6 59E+03 | 9 59E+03 |
| Fe-55 | 5 8479E-03 | 96,319 97 | 140,074 70 | 0 00E+00 | 5 63E+02 | 8 19E+02 |
| H-3 | 8 9300E-03 | 96,319 97 | 140,074 70 | 0 00E+00 | 8 60E+02 | 1.25E+03 |
| I-129 | 1 2891E-06 | 96,319 97 | 140,074 70 | 0 00E+00 | 1.24E-01 | 1 81E-01 |
| Kr-85 | 7 0941E-02 | 96,319 97 | 140,074 70 | 0 00E+00 | 6 83E+03 | 9 94E+03 |
| Np-237 | 2 6541E-06 | 96,319 97 | 140,074.70 | 0.00E+00 | 2 56E-01 | 3 72E-01 |
| Pa-231 | 4 8970E-12 | 96,319.97 | 140,074.70 | 0 00E+00 | 4 72E-07 | 6 86E-07 |
| Pb-210 | 2 2170E-13 | 96,319 97 | 140,074.70 | 0 00E+00 | 2.14E-08 | 3 11E-08 |
| Pm-147 | 2 3617E-01 | 96 319 97 | 140,074.70 | 0 00E+00 | 2.27E+04 | 3 31E+04 |
| Pu-238 | 2 8636E-02 | 96,319 97 | 140,074.70 | 0 00E+00 | 2 76E+03 | 4 01E+03 |
| Pu-239 | -3 5520E-02 | 96,319 97 | 0 00 | 1 11E+04 | 7 70E+03 | 1 11E+04 |
| Pu-240 | 2 0790E-02 | 96,319 97 | 140,074.70 | 5 65E+03 | 7 65E+03 | 8 56E+03 |
| Pu-241 | -4 8316E-01 | 96,319 97 | 0 00 | 2 54E+05 | 2 07E+05 | 2 54E+05 |
| Pu-242 | 1 1052E-05 | 96,319 97 | 140,074.70 | 1 51E+00 | 2 57E+00 | 3 06E+00 |
| Ra-226 | 5 7471E-13 | 96,319 97 | 140,074.70 | 0 00E+00 | 5 54E-08 | 8 05E-08 |
| Ra-228 | 5 4957E-17 | 96,319 97 | 140,074 70 | 0 00E+00 | 5 29E-12 | 7 70E-12 |
| Ru-106 | 1 4582E-02 | 96,319 97 | 140,074.70 | 0 00E+00 | 1 40E+03 | 2.04E+03 |
| Se-79 | 1 0137E-05 | 96,319 97 | 140,074 70 | 0 00E+00 | 9.76E-01 | 1 42E+00 |
| Sn-126 | 4 3922E-05 | 96,319 97 | 140,074 70 | 0 00E+00 | 4 23E+00 | 6 15E+00 |
| Sr-90 | 7 6329E-01 | 96,319 97 | 140,074 70 | 0 00E+00 | 7 35E+04 | 1.07E+05 |
| Tc-99 | 3 9412E-04 | 96,319 97 | 140,074 70 | 0 00E+00 | 3 80E+01 | 5 52E+01 |
| Th-229 | 1 6457E-12 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 59E-07 | 2.31E-07 |
| Th-230 | 1 8822E-10 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 81E-05 | 2 64E-05 |
| Th-232 | 9 7601E-17 | 96,319 97 | 140,074 70 | 0 00E+00 | 9 40E-12 | 1.37E-11 |
| Tl-208 | 5 2722E-07 | 96,319 97 | 140,074 70 | 0 00E+00 | 5 08E-02 | 7.39E-02 |
| U-232 | 1 4925E-06 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 44E-01 | 2 09E-01 |
| U-233 | 2.1113E-10 | 96,319 97 | 140,074 70 | 0 00E+00 | 2 03E-05 | 2 96E-05 |
| U-234 | 1 9528E-06 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 88E-01 | 2 74E-01 |
| U-235 | -9 7920E-09 | 96,319 97 | 0 00 | 2 28E-03 | 1 34E-03 | 2.28E-03 |
| U-236 | 1 1570E-07 | 96,319 97 | 140,074 70 | 0 00E+00 | 1 11E-02 | 1 62E-02 |
| U-238 | -1 7914E-07 | 96,319 97 | 0 00 | 1 66E-01 | 1 49E-01 | 1 66E-01 |
| Y-90 | 7 6329E-01 | 96,319 97 | 140,074 70 | 0 00E+00 | 7 35E+04 | 1 07E+05 |
| Other Radionuclides | | | | | 2 09E+05 | 3 04E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 013E+15 |
| 0 0250 | 1 518E+15 |
| 0 0375 | 1 737E+15 |
| 0 0575 | 1 470E+15 |
| 0 0850 | 8 654E+14 |
| 0 1250 | 6 463E+14 |
| 0.2250 | 6.553E+14 |
| 0 3750 | 3.369E+14 |
| 0 5750 | 1 126E+16 |
| 0 8500 | 3 768E+14 |
| 1.2500 | 3.280E+14 |
| 1 7500 | 5.389E+12 |
| 2.2500 | 1 814E+11 |
| 2 7500 | 1 892E+10 |
| 3 5000 | 2.135E+09 |
| 5 0000 | 4 722E+06 |
| 7 0000 | 5 406E+05 |
| 11 0000 | 6 192E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.52E+03 | 3.57E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 96,319 97 |
| Bounding | | 140 074 70 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=702.481kg
Bounding burnup taken from SFD and converted to MWd using BOL=702.481kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 90 | |
| Bounding | 1 31 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name FFTF-TFA-CRBR-3 & CRBR-5
SNF ID # 322
Fuel Units & Descr 2 - HEX ARRAY 217 ROD
Heavy Metal Mass BOL= , EOL=69 402kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of 2010
Template FFTF (FAST SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage
18"x15'
0 40

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3735E-12 | 5,116 34 | 5,738 65 | 0 00E+00 | 7 03E-09 | 7 88E-09 |
| Am-241 | 7 9527E-02 | 5,116 34 | 5,738 65 | 1 44E+02 | 5 51E+02 | 6 00E+02 |
| Am-242m | 2 1053E-03 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 08E+01 | 1 21E+01 |
| Am-243 | 1 0760E-04 | 5,116 34 | 5,738 65 | 0 00E+00 | 5 51E-01 | 6 17E-01 |
| C-14 | 2 6141E-05 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 34E-01 | 1 50E-01 |
| Cl-36 | 3 4243E-10 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 75E-06 | 1 97E-06 |
| Cm-243 | 6 6092E-04 | 5,116 34 | 5,738 65 | 0 00E+00 | 3 38E+00 | 3 79E+00 |
| Cm-244 | 2 9933E-03 | 5,116.34 | 5,738 65 | 0 00E+00 | 1 53E+01 | 1 72E+01 |
| Co-60 | 1.5934E-02 | 5,116.34 | 5,738 65 | 0 00E+00 | 8 15E+01 | 9 14E+01 |
| Cs-134 | 4 6356E-02 | 5,116 34 | 5,738 65 | 0 00E+00 | 2.37E+02 | 2 66E+02 |
| Cs-135 | 4 7693E-05 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 44E-01 | 2 74E-01 |
| Cs-137 | 2 1113E+00 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 08E+04 | 1.21E+04 |
| Eu-154 | 4 8092E-02 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 46E+02 | 2 76E+02 |
| Eu-155 | 6 8447E-02 | 5,116 34 | 5,738 65 | 0 00E+00 | 3 50E+02 | 3 93E+02 |
| Fe-55 | 5 8479E-03 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 99E+01 | 3 36E+01 |
| H-3 | 8 9300E-03 | 5,116 34 | 5,738 65 | 0 00E+00 | 4 57E+01 | 5 12E+01 |
| I-129 | 1.2891E-06 | 5,116 34 | 5,738 65 | 0 00E+00 | 6 60E-03 | 7 40E-03 |
| Kr-85 | 7.0941E-02 | 5,116.34 | 5,738 65 | 0 00E+00 | 3 63E+02 | 4 07E+02 |
| Np-237 | 2 6541E-06 | 5,116 34 | 5,738 65 | 0 00E+00 | 1.36E-02 | 1 52E-02 |
| Pa-231 | 4 8970E-12 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 51E-08 | 2 81E-08 |
| Pb-210 | 2.2170E-13 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 13E-09 | 1.27E-09 |
| Pm-147 | 2 3617E-01 | 5,116 34 | 5,738 65 | 0 00E+00 | 1.21E+03 | 1.36E+03 |
| Pu-238 | 2 8636E-02 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 47E+02 | 1 64E+02 |
| Pu-239 | -3 5520E-02 | 5,116 34 | 0 00 | 1 18E+03 | 9 98E+02 | 1 18E+03 |
| Pu-240 | 2 0790E-02 | 5,116 34 | 5,738 65 | 6 00E+02 | 7 06E+02 | 7 19E+02 |
| Pu-241 | -4 8316E-01 | 5,116 34 | 0 00 | 2 69E+04 | 2 44E+04 | 2 69E+04 |
| Pu-242 | 1.1052E-05 | 5,116 34 | 5,738 65 | 1 60E-01 | 2.16E-01 | 2 23E-01 |
| Ra-226 | 5 7471E-13 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 94E-09 | 3 30E-09 |
| Ra-228 | 5 4957E-17 | 5 116 34 | 5,738 65 | 0 00E+00 | 2 81E-13 | 3 15E-13 |
| Ru-106 | 1 4582E-02 | 5,116 34 | 5,738 65 | 0 00E+00 | 7.46E+01 | 8 37E+01 |
| Se-79 | 1 0137E-05 | 5,116 34 | 5,738 65 | 0 00E+00 | 5 19E-02 | 5 82E-02 |
| Sn-126 | 4 3922E-05 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 25E-01 | 2.52E-01 |
| Sr-90 | 7 6329E-01 | 5,116 34 | 5,738 65 | 0 00E+00 | 3 91E+03 | 4 38E+03 |
| Tc-99 | 3 9412E-04 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 02E+00 | 2.26E+00 |
| Th-229 | 1 6457E-12 | 5,116 34 | 5,738 65 | 0 00E+00 | 8 42E-09 | 9 44E-09 |
| Th-230 | 1 8822E-10 | 5,116 34 | 5,738 65 | 0 00E+00 | 9 63E-07 | 1 08E-06 |
| Th-232 | 9 7601E-17 | 5,116.34 | 5,738 65 | 0 00E+00 | 4 99E-13 | 5 60E-13 |
| Tl-208 | 5.2722E-07 | 5,116 34 | 5,738 65 | 0 00E+00 | 2 70E-03 | 3 03E-03 |
| U-232 | 1 4925E-06 | 5,116 34 | 5,738 65 | 0 00E+00 | 7.64E-03 | 8 56E-03 |
| U-233 | 2 1113E-10 | 5,116 34 | 5,738 65 | 0 00E+00 | 1 08E-06 | 1.21E-06 |
| U-234 | 1 9528E-06 | 5,116 34 | 5,738 65 | 0 00E+00 | 9 99E-03 | 1.12E-02 |
| U-235 | -9 7920E-09 | 5,116 34 | 0 00 | 2 42E-04 | 1 92E-04 | 2.42E-04 |
| U-236 | 1 1570E-07 | 5,116 34 | 5,738 65 | 0 00E+00 | 5 92E-04 | 6 64E-04 |
| U-238 | -1.7914E-07 | 5,116 34 | 0 00 | 1 76E-02 | 1 67E-02 | 1 76E-02 |
| Y-90 | 7 6329E-01 | 5,116 34 | 5,738 65 | 0 00E+00 | 3 91E+03 | 4.38E+03 |
| Other Radionuclides | | | | | 1 11E+04 | 1 24E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 921E+14 |
| 0 0250 | 6.229E+13 |
| 0 0375 | 7 117E+13 |
| 0 0575 | 6 144E+13 |
| 0 0850 | 3.545E+13 |
| 0 1250 | 2 648E+13 |
| 0 2250 | 2 685E+13 |
| 0 3750 | 1.380E+13 |
| 0 5750 | 4 612E+14 |
| 0 8500 | 1 544E+13 |
| 1.2500 | 1 344E+13 |
| 1 7500 | 2 208E+11 |
| 2.2500 | 7 431E+09 |
| 2 7500 | 7 753E+08 |
| 3 5000 | 8 767E+07 |
| 5 0000 | 2.809E+05 |
| 7 0000 | 3.210E+04 |
| 11 0000 | 3 674E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 64E+02 | 1.83E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 5 116 34 |
| Bounding | | 5 738 65 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=74.528kg
Bounding burnup taken from SFD and converted to MWd using BOL=74 528kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 45 | |
| Bounding | 0 51 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | FFTF-TFA-DEA-2 | [1]Fuel decay start date | 1992 |
| SNF ID # | 324 | Estimates as of. | 2010 |
| Fuel Units & Descr | 1 - HEX ARRAY 217 ROD | Template | FFTF (FAST, SST, 10 to 30% Pu & U) |
| Heavy Metal Mass | BOL= , EOL=34 606kg | [2]Template Burnup(MWd): | 5011 2 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT). | 0 0329181 |
| | | Template Decay Time: | 15 years |

Estimated Canister usage 18"x15' 0 20

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 3 46 | 6 92 | 0 00E+00 | 4 75E-12 | 9 51E-12 |
| Am-241 | 7 9527E-02 | 3 46 | 6 92 | 6 67E+01 | 6 70E+01 | 6 73E+01 |
| Am-242m | 2 1053E-03 | 3 46 | 6 92 | 0 00E+00 | 7 29E-03 | 1 46E-02 |
| Am-243 | 1 0760E-04 | 3 46 | 6 92 | 0 00E+00 | 3 72E-04 | 7 45E-04 |
| C-14 | 2 6141E-05 | 3 46 | 6 92 | 0 00E+00 | 9 05E-05 | 1 81E-04 |
| Cl-36 | 3 4243E-10 | 3 46 | 6 92 | 0 00E+00 | 1 19E-09 | 2 37E-09 |
| Cm-243 | 6 6092E-04 | 3 46 | 6 92 | 0 00E+00 | 2 29E-03 | 4 57E-03 |
| Cm-244 | 2 9933E-03 | 3 46 | 6 92 | 0 00E+00 | 1 04E-02 | 2 07E-02 |
| Co-60 | 1 5934E-02 | 3 46 | 6 92 | 0 00E+00 | 5 51E-02 | 1 10E-01 |
| Cs-134 | 4 6356E-02 | 3 46 | 6 92 | 0 00E+00 | 1 60E-01 | 3.21E-01 |
| Cs-135 | 4 7693E-05 | 3 46 | 6 92 | 0 00E+00 | 1 65E-04 | 3 30E-04 |
| Cs-137 | 2 1113E+00 | 3 46 | 6 92 | 0 00E+00 | 7.31E+00 | 1 46E+01 |
| Eu-154 | 4 8092E-02 | 3 46 | 6 92 | 0 00E+00 | 1 66E-01 | 3 33E-01 |
| Eu-155 | 6 8447E-02 | 3 46 | 6 92 | 0 00E+00 | 2 37E-01 | 4 74E-01 |
| Fe-55 | 5 8479E-03 | 3 46 | 6 92 | 0 00E+00 | 2.02E-02 | 4 05E-02 |
| H-3 | 8 9300E-03 | 3 46 | 6 92 | 0 00E+00 | 3 09E-02 | 6 18E-02 |
| I-129 | 1 2891E-06 | 3 46 | 6 92 | 0 00E+00 | 4 46E-06 | 8 92E-06 |
| Kr-85 | 7 0941E-02 | 3 46 | 6 92 | 0 00E+00 | 2 46E-01 | 4 91E-01 |
| Np-237 | 2 6541E-06 | 3 46 | 6 92 | 0 00E+00 | 9 19E-06 | 1 84E-05 |
| Pa-231 | 4 8970E-12 | 3 46 | 6 92 | 0 00E+00 | 1 69E-11 | 3 39E-11 |
| Pb-210 | 2 2170E-13 | 3 46 | 6 92 | 0 00E+00 | 7 67E-13 | 1 53E-12 |
| Pm-147 | 2 3617E-01 | 3 46 | 6.92 | 0 00E+00 | 8 17E-01 | 1 63E+00 |
| Pu-238 | 2 8636E-02 | 3 46 | 6 92 | 0 00E+00 | 9 91E-02 | 1 98E-01 |
| Pu-239 | -3 5520E-02 | 3 46 | 0 00 | 5 48E+02 | 5 48E+02 | 5 48E+02 |
| Pu-240 | 2 0790E-02 | 3 46 | 6 92 | 2.78E+02 | 2 78E+02 | 2.79E+02 |
| Pu-241 | -4 8316E-01 | 3 46 | 0 00 | 1.25E+04 | 1 25E+04 | 1.25E+04 |
| Pu-242 | 1 1052E-05 | 3 46 | 6 92 | 7 42E-02 | 7 43E-02 | 7 43E-02 |
| Ra-226 | 5 7471E-13 | 3.46 | 6 92 | 0 00E+00 | 1 99E-12 | 3 98E-12 |
| Ra-228 | 5 4957E-17 | 3 46 | 6 92 | 0 00E+00 | 1 90E-16 | 3 80E-16 |
| Ru-106 | 1 4582E-02 | 3.46 | 6 92 | 0 00E+00 | 5 05E-02 | 1 01E-01 |
| Se-79 | 1 0137E-05 | 3 46 | 6 92 | 0 00E+00 | 3 51E-05 | 7 02E-05 |
| Sn-126 | 4.3922E-05 | 3 46 | 6 92 | 0 00E+00 | 1 52E-04 | 3 04E-04 |
| Sr-90 | 7 6329E-01 | 3 46 | 6 92 | 0 00E+00 | 2 64E+00 | 5 28E+00 |
| Tc-99 | 3 9412E-04 | 3 46 | 6 92 | 0 00E+00 | 1 36E-03 | 2.73E-03 |
| Th-229 | 1 6457E-12 | 3 46 | 6 92 | 0 00E+00 | 5 70E-12 | 1 14E-11 |
| Th-230 | 1 8822E-10 | 3 46 | 6 92 | 0 00E+00 | 6 51E-10 | 1 30E-09 |
| Th-232 | 9 7601E-17 | 3 46 | 6 92 | 0 00E+00 | 3 38E-16 | 6.76E-16 |
| Tl-208 | 5 2722E-07 | 3 46 | 6 92 | 0 00E+00 | 1 82E-06 | 3 65E-06 |
| U-232 | 1 4925E-06 | 3 46 | 6 92 | 0 00E+00 | 5 17E-06 | 1 03E-05 |
| U-233 | 2 1113E-10 | 3 46 | 6 92 | 0 00E+00 | 7 31E-10 | 1 46E-09 |
| U-234 | 1 9528E-06 | 3 46 | 6 92 | 0 00E+00 | 6 76E-06 | 1 35E-05 |
| U-235 | -9 7920E-09 | 3 46 | 0 00 | 1 12E-04 | 1 12E-04 | 1 12E-04 |
| U-236 | 1 1570E-07 | 3 46 | 6 92 | 0 00E+00 | 4 00E-07 | 8 01E-07 |
| U-238 | -1 7914E-07 | 3 46 | 0 00 | 8 19E-03 | 8 19E-03 | 8 19E-03 |
| Y-90 | 7 6329E-01 | 3 46 | 6.92 | 0 00E+00 | 2 64E+00 | 5 28E+00 |
| Other Radionuclides | | | | | 7 50E+00 | 1 50E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 943E+12 |
| 0 0250 | 1 374E+11 |
| 0 0375 | 9 220E+10 |
| 0 0575 | 9 982E+11 |
| 0 0850 | 4 379E+10 |
| 0 1250 | 3 482E+10 |
| 0.2250 | 3.270E+10 |
| 0.3750 | 1 797E+10 |
| 0.5750 | 5 563E+11 |
| 0.8500 | 1.863E+10 |
| 1.2500 | 1 621E+10 |
| 1 7500 | 2 668E+08 |
| 2.2500 | 9.267E+06 |
| 2.7500 | 1 110E+06 |
| 3.5000 | 2.610E+05 |
| 5 0000 | 6.629E+04 |
| 7 0000 | 7.545E+03 |
| 11 0000 | 8 623E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 82E+01 | 2.83E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 3 46 |
| Bounding | | 6 92 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=34.61kg

Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | |
| Bounding | 0 00 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name FFTF-TFA-FC-1
SNF ID # 325
Fuel Units & Descr 1 - HEX ARRAY 91 ROD
Heavy Metal Mass BOL= , EOL=42.584kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of 2010
Template FFTF (FAST SST 10 to 30%, Pu & U)
[2]Template Burnup(MWd) 5011 2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage 18"x15' 0 20

### II. Estimates

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3735E-12 | 2,694 34 | 5,388 68 | 0 00E+00 | 3 70E-09 | 7 40E-09 |
| Am-241 | 7 9527E-02 | 2,694 34 | 5,388 68 | 8 73E+01 | 3 02E+02 | 5 16E+02 |
| Am-242m | 2 1053E-03 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 67E+00 | 1 13E+01 |
| Am-243 | 1 0760E-04 | 2,694 34 | 5,388 68 | 0 00E+00 | 2 90E-01 | 5 80E-01 |
| C-14 | 2 6141E-05 | 2,694 34 | 5,388 68 | 0 00E+00 | 7.04E-02 | 1.41E-01 |
| Cl-36 | 3 4243E-10 | 2,694.34 | 5,388 68 | 0 00E+00 | 9.23E-07 | 1 85E-06 |
| Cm-243 | 6 6092E-04 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 78E+00 | 3 56E+00 |
| Cm-244 | 2 9933E-03 | 2,694 34 | 5,388 68 | 0 00E+00 | 8 06E+00 | 1.61E+01 |
| Co-60 | 1 5934E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 4.29E+01 | 8 59E+01 |
| Cs-134 | 4 6356E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 1.25E+02 | 2 50E+02 |
| Cs-135 | 4.7693E-05 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 29E-01 | 2 57E-01 |
| Cs-137 | 2 1113E+00 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 69E+03 | 1 14E+04 |
| Eu-154 | 4 8092E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 30E+02 | 2 59E+02 |
| Eu-155 | 6 8447E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 84E+02 | 3 69E+02 |
| Fe-55 | 5 8479E-03 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 58E+01 | 3 15E+01 |
| H-3 | 8 9300E-03 | 2,694.34 | 5,388 68 | 0 00E+00 | 2 41E+01 | 4 81E+01 |
| I-129 | 1.2891E-06 | 2,694 34 | 5,388 68 | 0 00E+00 | 3 47E-03 | 6 95E-03 |
| Kr-85 | 7 0941E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 91E+02 | 3 82E+02 |
| Np-237 | 2 6541E-06 | 2,694 34 | 5,388 68 | 0 00E+00 | 7.15E-03 | 1 43E-02 |
| Pa-231 | 4 8970E-12 | 2,694 34 | 5,388 68 | 0 00E+00 | 1.32E-08 | 2 64E-08 |
| Pb-210 | 2 2170E-13 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 97E-10 | 1 19E-09 |
| Pm-147 | 2 3617E-01 | 2,694 34 | 5,388 68 | 0 00E+00 | 6 36E+02 | 1.27E+03 |
| Pu-238 | 2 8636E-02 | 2,694 34 | 5,388 68 | 0 00E+00 | 7.72E+01 | 1.54E+02 |
| Pu-239 | -3 5520E-02 | 2,694 34 | 0 00 | 7 17E+02 | 6 21E+02 | 7 17E+02 |
| Pu-240 | 2 0790E-02 | 2,694 34 | 5,388 68 | 3 64E+02 | 4 20E+02 | 4 76E+02 |
| Pu-241 | -4 8316E-01 | 2,694 34 | 0 00 | 1 64E+04 | 1 50E+04 | 1 64E+04 |
| Pu-242 | 1 1052E-05 | 2,694 34 | 5,388 68 | 9 71E-02 | 1 27E-01 | 1 57E-01 |
| Ra-226 | 5 7471E-13 | 2,694 34 | 5 388 68 | 0 00E+00 | 1 55E-09 | 3 10E-09 |
| Ra-228 | 5 4957E-17 | 2,694.34 | 5,388 68 | 0 00E+00 | 1 48E-13 | 2 96E-13 |
| Ru-106 | 1 4582E-02 | 2,694.34 | 5,388 68 | 0 00E+00 | 3 93E+01 | 7 86E+01 |
| Se-79 | 1 0137E-05 | 2,694.34 | 5,388 68 | 0 00E+00 | 2 73E-02 | 5 46E-02 |
| Sn-126 | 4 3922E-05 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 18E-01 | 2 37E-01 |
| Sr-90 | 7 6329E-01 | 2,694 34 | 5,388 68 | 0 00E+00 | 2 06E+03 | 4 11E+03 |
| Tc-99 | 3 9412E-04 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 06E+00 | 2 12E+00 |
| Th-229 | 1 6457E-12 | 2,694 34 | 5,388 68 | 0 00E+00 | 4 43E-09 | 8 87E-09 |
| Th-230 | 1 8822E-10 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 07E-07 | 1.01E-06 |
| Th-232 | 9 7601E-17 | 2,694 34 | 5,388 68 | 0 00E+00 | 2 63E-13 | 5.26E-13 |
| Tl-208 | 5.2722E-07 | 2,694 34 | 5,388 68 | 0 00E+00 | 1 42E-03 | 2 84E-03 |
| U-232 | 1.4925E-06 | 2,694 34 | 5,388 68 | 0 00E+00 | 4 02E-03 | 8 04E-03 |
| U-233 | 2 1113E-10 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 69E-07 | 1 14E-06 |
| U-234 | 1 9528E-06 | 2,694 34 | 5,388 68 | 0 00E+00 | 5 26E-03 | 1 05E-02 |
| U-235 | -9 7920E-09 | 2,694.34 | 0 00 | 1 47E-04 | 1 21E-04 | 1 47E-04 |
| U-236 | 1 1570E-07 | 2,694 34 | 5,388 68 | 0 00E+00 | 3 12E-04 | 6 23E-04 |
| U-238 | -1 7914E-07 | 2,694 34 | 0 00 | 1.07E-02 | 1 02E-02 | 1 07E-02 |
| Y-90 | 7 6329E-01 | 2,694 34 | 5,388 68 | 0 00E+00 | 2 06E+03 | 4 11E+03 |
| Other Radionuclides | | | | | 5 84E+03 | 1 17E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 717E+14 |
| 0 0250 | 5 845E+13 |
| 0 0375 | 6 682E+13 |
| 0 0575 | 5 704E+13 |
| 0 0850 | 3.329E+13 |
| 0 1250 | 2 486E+13 |
| 0 2250 | 2.521E+13 |
| 0 3750 | 1.296E+13 |
| 0 5750 | 4.330E+14 |
| 0 8500 | 1 449E+13 |
| 1.2500 | 1.262E+13 |
| 1 7500 | 2 073E+11 |
| 2.2500 | 6 978E+09 |
| 2 7500 | 7.279E+08 |
| 3.5000 | 8 221E+07 |
| 5 0000 | 2 165E+05 |
| 7 0000 | 2 477E+04 |
| 11 0000 | 2.836E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 14E+01 | 1.52E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment %* | | 10 to 30 |

**Basis for Parameter Differences***

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 2,694 34 |
| Bounding | | 5,388 68 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=45.283kg
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 39 | |
| Bounding | 0 78 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. FFTF-TFA-MFF-1 & 1A (CDE)
SNF ID #· 330
Fuel Units & Descr· 2 - HEX ARRAY 169 ROD
Heavy Metal Mass BOL= , EOL=88.107kg
ROD Storage Site HANFORD

[1]Fuel decay start date: 1992
Estimates as of 2010
Template· FFTF (FAST, SST, 10 to 30% Pu & U)
[2]Template Burnup(MWd): 5011 2
Template BOL Heavy Metal Mass (MT). 0 0329181
Template Decay Time 15 years

Estimated Canister usage 18"x15' 0 40

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 10,382 82 | 20,765 65 | 0 00E+00 | 1 43E-08 | 2 85E-08 |
| Am-241 | 7 9527E-02 | 10,382 82 | 20,765 65 | 1 90E+02 | 1 02E+03 | 1 84E+03 |
| Am-242m | 2 1053E-03 | 10,382.82 | 20,765 65 | 0 00E+00 | 2.19E+01 | 4 37E+01 |
| Am-243 | 1 0760E-04 | 10,382.82 | 20,765 65 | 0 00E+00 | 1.12E+00 | 2 23E+00 |
| C-14 | 2 6141E-05 | 10,382.82 | 20,765 65 | 0 00E+00 | 2 71E-01 | 5 43E-01 |
| Cl-36 | 3 4243E-10 | 10,382 82 | 20,765 65 | 0 00E+00 | 3 56E-06 | 7.11E-06 |
| Cm-243 | 6 6092E-04 | 10,382.82 | 20,765 65 | 0 00E+00 | 6 86E+00 | 1 37E+01 |
| Cm-244 | 2 9933E-03 | 10,382.82 | 20,765 65 | 0 00E+00 | 3 11E+01 | 6.22E+01 |
| Co-60 | 1 5934E-02 | 10,382.82 | 20,765 65 | 0 00E+00 | 1 65E+02 | 3 31E+02 |
| Cs-134 | 4 6356E-02 | 10,382.82 | 20,765 65 | 0 00E+00 | 4 81E+02 | 9 63E+02 |
| Cs-135 | 4 7693E-05 | 10 382.82 | 20,765 65 | 0 00E+00 | 4 95E-01 | 9 90E-01 |
| Cs-137 | 2 1113E+00 | 10,382 82 | 20,765 65 | 0 00E+00 | 2.19E+04 | 4 38E+04 |
| Eu-154 | 4 8092E-02 | 10,382 82 | 20,765 65 | 0 00E+00 | 4 99E+02 | 9 99E+02 |
| Eu-155 | 6 8447E-02 | 10,382 82 | 20,765 65 | 0 00E+00 | 7.11E+02 | 1 42E+03 |
| Fe-55 | 5 8479E-03 | 10,382 82 | 20,765 65 | 0 00E+00 | 6 07E+01 | 1.21E+02 |
| H-3 | 8 9300E-03 | 10,382 82 | 20,765 65 | 0 00E+00 | 9.27E+01 | 1 85E+02 |
| I-129 | 1 2891E-06 | 10,382.82 | 20,765 65 | 0 00E+00 | 1 34E-02 | 2 68E-02 |
| Kr-85 | 7 0941E-02 | 10,382.82 | 20,765 65 | 0 00E+00 | 7.37E+02 | 1 47E+03 |
| Np-237 | 2 6541E-06 | 10,382.82 | 20,765 65 | 0 00E+00 | 2 76E-02 | 5.51E-02 |
| Pa-231 | 4 8970E-12 | 10,382.82 | 20,765 65 | 0 00E+00 | 5 08E-08 | 1.02E-07 |
| Pb-210 | 2 2170E-13 | 10,382.82 | 20,765 65 | 0 00E+00 | 2 30E-09 | 4 60E-09 |
| Pm-147 | 2 3617E-01 | 10,382.82 | 20,765 65 | 0 00E+00 | 2.45E+03 | 4 90E+03 |
| Pu-238 | 2 8636E-02 | 10,382.82 | 20,765 65 | 0 00E+00 | 2.97E+02 | 5 95E+02 |
| Pu-239 | -3 5520E-02 | 10,382 82 | 0 00 | 1 56E+03 | 1.19E+03 | 1 56E+03 |
| Pu-240 | 2 0790E-02 | 10,382.82 | 20,765 65 | 7 92E+02 | 1.01E+03 | 1 22E+03 |
| Pu-241 | -4 8316E-01 | 10,382.82 | 0 00 | 3 56E+04 | 3 06E+04 | 3 56E+04 |
| Pu-242 | 1 1052E-05 | 10,382.82 | 20,765 65 | 2 11E-01 | 3.26E-01 | 4 41E-01 |
| Ra-226 | 5 7471E-13 | 10,382.82 | 20,765 65 | 0 00E+00 | 5 97E-09 | 1.19E-08 |
| Ra-228 | 5 4957E-17 | 10,382 82 | 20,765 65 | 0 00E+00 | 5.71E-13 | 1 14E-12 |
| Ru-106 | 1 4582E-02 | 10,382.82 | 20,765 65 | 0 00E+00 | 1 51E+02 | 3 03E+02 |
| Se-79 | 1 0137E-05 | 10,382 82 | 20,765 65 | 0 00E+00 | 1.05E-01 | 2 11E-01 |
| Sn-126 | 4 3922E-05 | 10,382.82 | 20,765 65 | 0 00E+00 | 4.56E-01 | 9 12E-01 |
| Sr-90 | 7 6329E-01 | 10,382.82 | 20,765 65 | 0 00E+00 | 7 93E+03 | 1 59E+04 |
| Tc-99 | 3 9412E-04 | 10,382.82 | 20,765 65 | 0 00E+00 | 4 09E+00 | 8 18E+00 |
| Th-229 | 1 6457E-12 | 10,382.82 | 20,765 65 | 0 00E+00 | 1.71E-08 | 3 42E-08 |
| Th-230 | 1 8822E-10 | 10,382 82 | 20,765 65 | 0 00E+00 | 1 95E-06 | 3 91E-06 |
| Th-232 | 9 7601E-17 | 10,382.82 | 20,765 65 | 0 00E+00 | 1.01E-12 | 2.03E-12 |
| Tl-208 | 5 2722E-07 | 10,382.82 | 20,765 65 | 0 00E+00 | 5.47E-03 | 1 09E-02 |
| U-232 | 1 4925E-06 | 10,382.82 | 20,765.65 | 0 00E+00 | 1.55E-02 | 3 10E-02 |
| U-233 | 2 1113E-10 | 10,382 82 | 20,765.65 | 0 00E+00 | 2.19E-06 | 4 38E-06 |
| U-234 | 1 9528E-06 | 10,382 82 | 20,765 65 | 0 00E+00 | 2.03E-02 | 4 06E-02 |
| U-235 | -9 7920E-09 | 10,382 82 | 0 00 | 3.20E-04 | 2.18E-04 | 3.20E-04 |
| U-236 | 1 1570E-07 | 10,382 82 | 20,765 65 | 0 00E+00 | 1.20E-03 | 2 40E-03 |
| U-238 | -1.7914E-07 | 10,382 82 | 0 00 | 2.33E-02 | 2 14E-02 | 2 33E-02 |
| Y-90 | 7 6329E-01 | 10,382 82 | 20,765 65 | 0 00E+00 | 7 93E+03 | 1 59E+04 |
| Other Radionuclides | | | | | 2.25E+04 | 4 50E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 039E+15 |
| 0 0250 | 2.251E+14 |
| 0 0375 | 2 575E+14 |
| 0 0575 | 2 178E+14 |
| 0 0850 | 1.283E+14 |
| 0 1250 | 9 581E+13 |
| 0.2250 | 9 715E+13 |
| 0 3750 | 4 995E+13 |
| 0 5750 | 1 669E+15 |
| 0 8500 | 5.585E+13 |
| 1.2500 | 4 863E+13 |
| 1 7500 | 7 989E+11 |
| 2.2500 | 2 689E+10 |
| 2 7500 | 2.805E+09 |
| 3 5000 | 3 165E+08 |
| 5 0000 | 6 893E+05 |
| 7 0000 | 7 892E+04 |
| 11 0000 | 9 040E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.91E+02 | 5.24E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Drfferences:**

This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 10,382.82 |
| Bounding | | 20 765 65 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=98.509kg
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 69 | |
| Bounding | 1 38 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name FFTF-TFA-P0-2 4 & 5
SNF ID #: 333
Fuel Units & Descr: 3 - HEX ARRAY 169 ROD
Heavy Metal Mass BOL= EOL=131.25kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of 2010
Template FFTF (FAST, SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage
18"x15'
0 60

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 47E-08 | 1 56E-08 |
| Am-241 | 7.9527E-02 | 10,725 31 | 11,359 60 | 2 74E+02 | 1 13E+03 | 1 18E+03 |
| Am-242m | 2 1053E-03 | 10,725.31 | 11,359 60 | 0 00E+00 | 2 26E+01 | 2 39E+01 |
| Am-243 | 1 0760E-04 | 10,725.31 | 11,359 60 | 0 00E+00 | 1 15E+00 | 1 22E+00 |
| C-14 | 2 6141E-05 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 80E-01 | 2 97E-01 |
| Cl-36 | 3 4243E-10 | 10,725 31 | 11,359 60 | 0 00E+00 | 3 67E-06 | 3 89E-06 |
| Cm-243 | 6 6092E-04 | 10,725 31 | 11,359 60 | 0 00E+00 | 7 09E+00 | 7 51E+00 |
| Cm-244 | 2 9933E-03 | 10,725 31 | 11,359 60 | 0 00E+00 | 3 21E+01 | 3 40E+01 |
| Co-60 | 1 5934E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 71E+02 | 1 81E+02 |
| Cs-134 | 4 6356E-02 | 10 725 31 | 11,359 60 | 0 00E+00 | 4 97E+02 | 5.27E+02 |
| Cs-135 | 4 7693E-05 | 10,725 31 | 11,359 60 | 0 00E+00 | 5.12E-01 | 5 42E-01 |
| Cs-137 | 2 1113E+00 | 10,725 31 | 11,359 60 | 0 00E+00 | 2.26E+04 | 2 40E+04 |
| Eu-154 | 4 8092E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 5 16E+02 | 5 46E+02 |
| Eu-155 | 6 8447E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 7.34E+02 | 7 78E+02 |
| Fe-55 | 5 8479E-03 | 10,725.31 | 11,359 60 | 0 00E+00 | 6 27E+01 | 6 64E+01 |
| H-3 | 8 9300E-03 | 10,725.31 | 11,359 60 | 0 00E+00 | 9 58E+01 | 1 01E+02 |
| I-129 | 1.2891E-06 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 38E-02 | 1 46E-02 |
| Kr-85 | 7 0941E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 7 61E+02 | 8 06E+02 |
| Np-237 | 2 6541E-06 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 85E-02 | 3 01E-02 |
| Pa-231 | 4 8970E-12 | 10,725 31 | 11,359 60 | 0 00E+00 | 5 25E-08 | 5 56E-08 |
| Pb-210 | 2 2170E-13 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 38E-09 | 2 52E-09 |
| Pm-147 | 2 3617E-01 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 53E+03 | 2 68E+03 |
| Pu-238 | 2 8636E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 3 07E+02 | 3 25E+02 |
| Pu-239 | -3 5520E-02 | 10,725 31 | 0 00 | 2 25E+03 | 1 87E+03 | 2 25E+03 |
| Pu-240 | 2.0790E-02 | 10,725 31 | 11,359 60 | 1.14E+03 | 1 37E+03 | 1.38E+03 |
| Pu-241 | -4 8316E-01 | 10,725.31 | 0 00 | 5.13E+04 | 4 61E+04 | 5 13E+04 |
| Pu-242 | 1 1052E-05 | 10,725.31 | 11,359 60 | 3 05E-01 | 4.23E-01 | 4 30E-01 |
| Ra-226 | 5 7471E-13 | 10,725 31 | 11,359 60 | 0 00E+00 | 6 16E-09 | 6 53E-09 |
| Ra-228 | 5 4957E-17 | 10,725 31 | 11,359 60 | 0 00E+00 | 5 89E-13 | 6 24E-13 |
| Ru-106 | 1 4582E-02 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 56E+02 | 1 66E+02 |
| Se-79 | 1 0137E-05 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 09E-01 | 1 15E-01 |
| Sn-126 | 4 3922E-05 | 10,725 31 | 11,359 60 | 0 00E+00 | 4 71E-01 | 4 99E-01 |
| Sr-90 | 7 6329E-01 | 10,725 31 | 11,359 60 | 0 00E+00 | 8 19E+03 | 8 67E+03 |
| Tc-99 | 3 9412E-04 | 10,725 31 | 11,359 60 | 0 00E+00 | 4 23E+00 | 4 48E+00 |
| Th-229 | 1 6457E-12 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 77E-08 | 1.87E-08 |
| Th-230 | 1 8822E-10 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 02E-06 | 2 14E-06 |
| Th-232 | 9 7601E-17 | 10,725 31 | 11,359 60 | 0 00E+00 | 1.05E-12 | 1 11E-12 |
| Tl-208 | 5.2722E-07 | 10,725.31 | 11,359 60 | 0 00E+00 | 5 65E-03 | 5 99E-03 |
| U-232 | 1 4925E-06 | 10,725.31 | 11,359 60 | 0 00E+00 | 1 60E-02 | 1 70E-02 |
| U-233 | 2 1113E-10 | 10,725 31 | 11,359 60 | 0 00E+00 | 2.26E-06 | 2 40E-06 |
| U-234 | 1 9528E-06 | 10,725 31 | 11,359 60 | 0 00E+00 | 2 09E-02 | 2 22E-02 |
| U-235 | -9 7920E-09 | 10,725 31 | 0 00 | 4 61E-04 | 3 56E-04 | 4 61E-04 |
| U-236 | 1 1570E-07 | 10,725 31 | 11,359 60 | 0 00E+00 | 1 24E-03 | 1 31E-03 |
| U-238 | -1 7914E-07 | 10,725 31 | 0 00 | 3 36E-02 | 3 17E-02 | 3 36E-02 |
| Y-90 | 7 6329E-01 | 10,725 31 | 11,359 60 | 0 00E+00 | 8 19E+03 | 8 67E+03 |
| Other Radionuclides | | | | | 2 32E+04 | 2 46E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 775E+14 |
| 0 0250 | 1 233E+14 |
| 0 0375 | 1 409E+14 |
| 0 0575 | 1.215E+14 |
| 0 0850 | 7 018E+13 |
| 0 1250 | 5.242E+13 |
| 0.2250 | 5 315E+13 |
| 0 3750 | 2.733E+13 |
| 0 5750 | 9 129E+14 |
| 0 8500 | 3.055E+13 |
| 1.2500 | 2 660E+13 |
| 1 7500 | 4.370E+11 |
| 2.2500 | 1 471E+10 |
| 2 7500 | 1.535E+09 |
| 3 5000 | 1 735E+08 |
| 5 0000 | 5 454E+05 |
| 7 0000 | 6.233E+04 |
| 11 0000 | 7 135E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.33E+02 | 3.58E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 10 725 31 |
| Bounding | | 11 359 60 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=141 995kg
Bounding burnup taken from SFD and converted to MWd using BOL=141 995kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 50 | |
| Bounding | 0 53 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FFTF-TFA-SRF-3&4
SNF ID #: 334
Fuel Units & Descr: 2 - HEX ARRAY 91 ROD
Heavy Metal Mass: BOL= , EOL=85 81kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1992
Estimates as of: 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd): 5011 2
Template BOL Heavy Metal Mass (MT): 0 0329181
Template Decay Time: 15 years

Estimated Canister usage
18"x15'
0 40

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 3,631 59 | 3,953 60 | 0 00E+00 | 4 99E-09 | 5 43E-09 |
| Am-241 | 7 9527E-02 | 3,631 59 | 3,953 60 | 1 72E+02 | 4 61E+02 | 4 87E+02 |
| Am-242m | 2 1053E-03 | 3,631.59 | 3,953 60 | 0 00E+00 | 7 65E+00 | 8 32E+00 |
| Am-243 | 1 0760E-04 | 3,631.59 | 3,953 60 | 0 00E+00 | 3 91E-01 | 4 25E-01 |
| C-14 | 2 6141E-05 | 3,631.59 | 3,953 60 | 0 00E+00 | 9 49E-02 | 1.03E-01 |
| Cl-36 | 3 4243E-10 | 3,631.59 | 3,953 60 | 0 00E+00 | 1.24E-06 | 1.35E-06 |
| Cm-243 | 6 6092E-04 | 3,631.59 | 3,953 60 | 0 00E+00 | 2 40E+00 | 2 61E+00 |
| Cm-244 | 2 9933E-03 | 3,631.59 | 3,953 60 | 0 00E+00 | 1 09E+01 | 1 18E+01 |
| Co-60 | 1 5934E-02 | 3,631.59 | 3,953 60 | 0 00E+00 | 5 79E+01 | 6 30E+01 |
| Cs-134 | 4 6356E-02 | 3,631.59 | 3,953 60 | 0 00E+00 | 1 68E+02 | 1 83E+02 |
| Cs-135 | 4 7693E-05 | 3,631.59 | 3,953 60 | 0 00E+00 | 1.73E-01 | 1 89E-01 |
| Cs-137 | 2 1113E+00 | 3,631 59 | 3,953 60 | 0 00E+00 | 7 67E+03 | 8 35E+03 |
| Eu-154 | 4 8092E-02 | 3,631.59 | 3,953 60 | 0 00E+00 | 1 75E+02 | 1 90E+02 |
| Eu-155 | 6 8447E-02 | 3,631 59 | 3,953 60 | 0 00E+00 | 2 49E+02 | 2 71E+02 |
| Fe-55 | 5 8479E-03 | 3,631 59 | 3,953 60 | 0 00E+00 | 2.12E+01 | 2 31E+01 |
| H-3 | 8 9300E-03 | 3,631 59 | 3,953 60 | 0 00E+00 | 3 24E+01 | 3 53E+01 |
| I-129 | 1.2891E-06 | 3,631 59 | 3,953 60 | 0 00E+00 | 4 68E-03 | 5 10E-03 |
| Kr-85 | 7 0941E-02 | 3,631 59 | 3,953 60 | 0 00E+00 | 2 58E+02 | 2 80E+02 |
| Np-237 | 2 6541E-06 | 3,631 59 | 3,953 60 | 0 00E+00 | 9 64E-03 | 1 05E-02 |
| Pa-231 | 4 8970E-12 | 3,631 59 | 3,953 60 | 0 00E+00 | 1 78E-08 | 1 94E-08 |
| Pb-210 | 2.2170E-13 | 3,631 59 | 3,953 60 | 0 00E+00 | 8 05E-10 | 8 77E-10 |
| Pm-147 | 2 3617E-01 | 3,631 59 | 3,953 60 | 0 00E+00 | 8 58E+02 | 9 34E+02 |
| Pu-238 | 2 8636E-02 | 3,631 59 | 3,953 60 | 0 00E+00 | 1 04E+02 | 1 13E+02 |
| Pu-239 | -3 5520E-02 | 3,631 59 | 0 00 | 1 42E+03 | 1 29E+03 | 1 42E+03 |
| Pu-240 | 2 0790E-02 | 3,631 59 | 3,953 60 | 7 20E+02 | 7 95E+02 | 8 02E+02 |
| Pu-241 | -4 8316E-01 | 3,631 59 | 0 00 | 3.23E+04 | 3 05E+04 | 3 23E+04 |
| Pu-242 | 1 1052E-05 | 3,631 59 | 3,953 60 | 1 92E-01 | 2 32E-01 | 2 36E-01 |
| Ra-226 | 5 7471E-13 | 3,631 59 | 3,953 60 | 0 00E+00 | 2 09E-09 | 2 27E-09 |
| Ra-228 | 5 4957E-17 | 3,631 59 | 3,953 60 | 0 00E+00 | 2 00E-13 | 2 17E-13 |
| Ru-106 | 1 4582E-02 | 3,631 59 | 3,953 60 | 0 00E+00 | 5 30E+01 | 5 77E+01 |
| Se-79 | 1 0137E-05 | 3,631.59 | 3,953 60 | 0 00E+00 | 3 68E-02 | 4 01E-02 |
| Sn-126 | 4 3922E-05 | 3,631.59 | 3,953 60 | 0 00E+00 | 1 60E-01 | 1 74E-01 |
| Sr-90 | 7 6329E-01 | 3 631 59 | 3,953 60 | 0 00E+00 | 2.77E+03 | 3 02E+03 |
| Tc-99 | 3 9412E-04 | 3,631.59 | 3,953 60 | 0 00E+00 | 1 43E+00 | 1.56E+00 |
| Th-229 | 1 6457E-12 | 3,631.59 | 3,953 60 | 0 00E+00 | 5 98E-09 | 6 51E-09 |
| Th-230 | 1 8822E-10 | 3,631 59 | 3,953 60 | 0 00E+00 | 6 84E-07 | 7.44E-07 |
| Th-232 | 9 7601E-17 | 3,631 59 | 3,953 60 | 0 00E+00 | 3 54E-13 | 3 86E-13 |
| Tl-208 | 5 2722E-07 | 3,631.59 | 3,953 60 | 0 00E+00 | 1.91E-03 | 2 08E-03 |
| U-232 | 1 4925E-06 | 3,631 59 | 3,953 60 | 0 00E+00 | 5.42E-03 | 5 90E-03 |
| U-233 | 2 1113E-10 | 3,631 59 | 3,953 60 | 0 00E+00 | 7.67E-07 | 8.35E-07 |
| U-234 | 1 9528E-06 | 3,631 59 | 3,953 60 | 0 00E+00 | 7 09E-03 | 7.72E-03 |
| U-235 | -9 7920E-09 | 3,631 59 | 0 00 | 2 91E-04 | 2 55E-04 | 2.91E-04 |
| U-236 | 1 1570E-07 | 3,631 59 | 3,953 60 | 0 00E+00 | 4.20E-04 | 4.57E-04 |
| U-238 | -1 7914E-07 | 3,631 59 | 0 00 | 2 12E-02 | 2 05E-02 | 2 12E-02 |
| Y-90 | 7 6329E-01 | 3,631 59 | 3,953 60 | 0 00E+00 | 2 77E+03 | 3 02E+03 |
| Other Radionuclides | | | | | 7 87E+03 | 8 57E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 052E+14 |
| 0 0250 | 4.298E+13 |
| 0 0375 | 4 904E+13 |
| 0 0575 | 4 335E+13 |
| 0 0850 | 2 443E+13 |
| 0 1250 | 1 825E+13 |
| 0 2250 | 1.850E+13 |
| 0 3750 | 9 512E+12 |
| 0 5750 | 3 177E+14 |
| 0 8500 | 1 063E+13 |
| 1 2500 | 9.259E+12 |
| 1 7500 | 1.521E+11 |
| 2 2500 | 5 120E+09 |
| 2.7500 | 5.344E+08 |
| 3 5000 | 6.057E+07 |
| 5 0000 | 2.663E+05 |
| 7 0000 | 3 040E+04 |
| 11 0000 | 3 478E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.46E+02 | 1.57E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 3 631 59 |
| Bounding | | 3 953 60 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=89 448kg
Bounding burnup taken from SFD and converted to MWd using BOL=89 448kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.27 | |
| Bounding | 0 29 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name FFTF-TFA-UO-1
SNF ID # 335
Fuel Units & Descr 1 - HEX ARRAY 217 ROD
Heavy Metal Mass BOL= EOL=35 012kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of: 2010
Template FFTF (FAST SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage
18"x15'
0 20

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 835 27 | 1,229 60 | 0 00E+00 | 1 15E-09 | 1 69E-09 |
| Am-241 | 7 9527E-02 | 835 27 | 1,229 60 | 6 91E+01 | 1 36E+02 | 1 67E+02 |
| Am-242m | 2 1053E-03 | 835 27 | 1,229 60 | 0 00E+00 | 1 76E+00 | 2 59E+00 |
| Am-243 | 1 0760E-04 | 835 27 | 1,229 60 | 0 00E+00 | 8 99E-02 | 1 32E-01 |
| C-14 | 2 6141E-05 | 835 27 | 1,229 60 | 0 00E+00 | 2 18E-02 | 3 21E-02 |
| Cl-36 | 3 4243E-10 | 835.27 | 1,229 60 | 0 00E+00 | 2 86E-07 | 4 21E-07 |
| Cm-243 | 6 6092E-04 | 835.27 | 1,229 60 | 0 00E+00 | 5 52E-01 | 8 13E-01 |
| Cm-244 | 2 9933E-03 | 835.27 | 1,229 60 | 0 00E+00 | 2 50E+00 | 3 68E+00 |
| Co-60 | 1 5934E-02 | 835.27 | 1,229 60 | 0 00E+00 | 1 33E+01 | 1 96E+01 |
| Cs-134 | 4 6356E-02 | 835 27 | 1,229 60 | 0 00E+00 | 3 87E+01 | 5 70E+01 |
| Cs-135 | 4 7693E-05 | 835 27 | 1,229 60 | 0 00E+00 | 3 98E-02 | 5 86E-02 |
| Cs-137 | 2 1113E+00 | 835 27 | 1,229 60 | 0 00E+00 | 1 76E+03 | 2 60E+03 |
| Eu-154 | 4 8092E-02 | 835 27 | 1,229 60 | 0 00E+00 | 4 02E+01 | 5 91E+01 |
| Eu-155 | 6 8447E-02 | 835 27 | 1,229 60 | 0 00E+00 | 5 72E+01 | 8 42E+01 |
| Fe-55 | 5 8479E-03 | 835 27 | 1,229 60 | 0 00E+00 | 4 88E+00 | 7 19E+00 |
| H-3 | 8 9300E-03 | 835 27 | 1,229 60 | 0 00E+00 | 7.46E+00 | 1 10E+01 |
| I-129 | 1.2891E-06 | 835 27 | 1,229 60 | 0 00E+00 | 1 08E-03 | 1 59E-03 |
| Kr-85 | 7 0941E-02 | 835.27 | 1,229 60 | 0 00E+00 | 5 93E+01 | 8 72E+01 |
| Np-237 | 2 6541E-06 | 835.27 | 1,229 60 | 0 00E+00 | 2 22E-03 | 3 26E-03 |
| Pa-231 | 4 8970E-12 | 835.27 | 1,229 60 | 0 00E+00 | 4 09E-09 | 6 02E-09 |
| Pb-210 | 2 2170E-13 | 835.27 | 1,229 60 | 0 00E+00 | 1 85E-10 | 2 73E-10 |
| Pm-147 | 2 3617E-01 | 835.27 | 1,229 60 | 0 00E+00 | 1 97E+02 | 2 90E+02 |
| Pu-238 | 2 8636E-02 | 835 27 | 1,229 60 | 0 00E+00 | 2 39E+01 | 3 52E+01 |
| Pu-239 | -3 5520E-02 | 835 27 | 0 00 | 5 67E+02 | 5 38E+02 | 5 67E+02 |
| Pu-240 | 2 0790E-02 | 835 27 | 1,229 60 | 2 88E+02 | 3 06E+02 | 3 14E+02 |
| Pu-241 | -4 8316E-01 | 835 27 | 0 00 | 1.29E+04 | 1 25E+04 | 1.29E+04 |
| Pu-242 | 1 1052E-05 | 835 27 | 1,229 60 | 7 69E-02 | 8 61E-02 | 9 05E-02 |
| Ra-226 | 5 7471E-13 | 835 27 | 1,229 60 | 0 00E+00 | 4 80E-10 | 7 07E-10 |
| Ra-228 | 5 4957E-17 | 835 27 | 1,229 60 | 0 00E+00 | 4 59E-14 | 6 76E-14 |
| Ru-106 | 1 4582E-02 | 835.27 | 1,229 60 | 0 00E+00 | 1.22E+01 | 1 79E+01 |
| Se-79 | 1 0137E-05 | 835.27 | 1,229 60 | 0 00E+00 | 8 47E-03 | 1 25E-02 |
| Sn-126 | 4 3922E-05 | 835.27 | 1,229 60 | 0 00E+00 | 3 67E-02 | 5 40E-02 |
| Sr-90 | 7 6329E-01 | 835.27 | 1,229 60 | 0 00E+00 | 6.38E+02 | 9 39E+02 |
| Tc-99 | 3 9412E-04 | 835.27 | 1,229 60 | 0 00E+00 | 3 29E-01 | 4 85E-01 |
| Th-229 | 1 6457E-12 | 835 27 | 1,229 60 | 0 00E+00 | 1 37E-09 | 2 02E-09 |
| Th-230 | 1 8822E-10 | 835 27 | 1,229 60 | 0 00E+00 | 1 57E-07 | 2 31E-07 |
| Th-232 | 9 7601E-17 | 835 27 | 1,229 60 | 0 00E+00 | 8 15E-14 | 1.20E-13 |
| Tl-208 | 5.2722E-07 | 835 27 | 1,229 60 | 0 00E+00 | 4 40E-04 | 6 48E-04 |
| U-232 | 1 4925E-06 | 835 27 | 1,229 60 | 0 00E+00 | 1.25E-03 | 1 84E-03 |
| U-233 | 2 1113E-10 | 835 27 | 1,229 60 | 0 00E+00 | 1 76E-07 | 2 60E-07 |
| U-234 | 1.9528E-06 | 835.27 | 1,229 60 | 0 00E+00 | 1 63E-03 | 2 40E-03 |
| U-235 | -9 7920E-09 | 835.27 | 0 00 | 1 16E-04 | 1.08E-04 | 1 16E-04 |
| U-236 | 1 1570E-07 | 835.27 | 1,229 60 | 0 00E+00 | 9 66E-05 | 1 42E-04 |
| U-238 | -1 7914E-07 | 835.27 | 0 00 | 8 48E-03 | 8 33E-03 | 8 48E-03 |
| Y-90 | 7 6329E-01 | 835.27 | 1,229 60 | 0 00E+00 | 6 38E+02 | 9 39E+02 |
| Other Radionuclides | | | | | 1 81E+03 | 2 67E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 464E+13 |
| 0 0250 | 1.338E+13 |
| 0 0375 | 1 525E+13 |
| 0 0575 | 1.370E+13 |
| 0 0850 | 7.597E+12 |
| 0 1250 | 5 676E+12 |
| 0.2250 | 5 753E+12 |
| 0 3750 | 2 959E+12 |
| 0 5750 | 9 881E+13 |
| 0 8500 | 3 307E+12 |
| 1.2500 | 2.879E+12 |
| 1 7500 | 4 730E+10 |
| 2 2500 | 1 592E+09 |
| 2 7500 | 1 662E+08 |
| 3 5000 | 1 887E+07 |
| 5 0000 | 9 816E+04 |
| 7 0000 | 1 120E+04 |
| 11 0000 | 1.281E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 61E+01 | 5 54E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 835.27 |
| Bounding | | 1,229 60 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=35.848kg
Bounding burnup taken from SFD and converted to MWd using BOL=35.848kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 15 | |
| Bounding | 0.23 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FFTF-TFA-WBO18 & WBO42
SNF ID #: 336
Fuel Units & Descr: 2 - HEX ARRAY 61 ROD
Heavy Metal Mass: BOL= ; EOL=94 984kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1992
Estimates as of 2010
Template FERMI (Fast, Zirc. 10 to 40%, U)
[2]Template Burnup(MWd): 58 6725048
Template BOL Heavy Metal Mass (MT). 0 018774
Template Decay Time 15 years

Estimated Canister usage: 18"x15' 0 40

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 1509E-08 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 59E-05 | 2 90E-05 |
| Am-241 | 4 6529E-07 | 1,204 37 | 1,348 90 | 0 00E+00 | 5 60E-04 | 6 28E-04 |
| Am-242m | 0 0000E+00 | 1,204 37 | 1,348 90 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3923E-15 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 01E-11 | 1 13E-11 |
| C-14 | 2.1765E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 62E-02 | 2 94E-02 |
| Cl-36 | 5 5188E-08 | 1,204 37 | 1,348 90 | 0 00E+00 | 6 65E-05 | 7 44E-05 |
| Cm-243 | 2 5208E-14 | 1,204 37 | 1,348 90 | 0 00E+00 | 3 04E-11 | 3 40E-11 |
| Cm-244 | 1.1259E-15 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 36E-12 | 1 52E-12 |
| Co-60 | 2 9094E-02 | 1,204 37 | 1,348 90 | 0 00E+00 | 3 50E+01 | 3 92E+01 |
| Cs-134 | 5 1932E-04 | 1,204 37 | 1,348 90 | 0 00E+00 | 6 25E-01 | 7 01E-01 |
| Cs-135 | 4 4996E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 5 42E-02 | 6 07E-02 |
| Cs-137 | 2 1867E+00 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 63E+03 | 2 95E+03 |
| Eu-154 | 9 2837E-04 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 12E+00 | 1.25E+00 |
| Eu-155 | 2 3180E-02 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 79E+01 | 3 13E+01 |
| Fe-55 | 2.9332E-03 | 1,204 37 | 1,348 90 | 0 00E+00 | 3 53E+00 | 3 96E+00 |
| H-3 | 1 0871E-02 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 31E+01 | 1 47E+01 |
| I-129 | 1 1426E-06 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 38E-03 | 1 54E-03 |
| Kr-85 | 1 4068E-01 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 69E+02 | 1 90E+02 |
| Np-237 | 3 3099E-06 | 1,204 37 | 1,348 90 | 0 00E+00 | 3 99E-03 | 4 46E-03 |
| Pa-231 | 7 8640E-08 | 1,204 37 | 1,348 90 | 0 00E+00 | 9 47E-05 | 1 06E-04 |
| Pb-210 | 7 4277E-13 | 1,204 37 | 1,348 90 | 0 00E+00 | 8 95E-10 | 1 00E-09 |
| Pm-147 | 2 2856E-01 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 75E+02 | 3 08E+02 |
| Pu-238 | 2 0095E-04 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 42E-01 | 2 71E-01 |
| Pu-239 | 1 9481E-02 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 35E+01 | 2 63E+01 |
| Pu-240 | 6 8056E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 8 20E-02 | 9 18E-02 |
| Pu-241 | 1 0939E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 32E-02 | 1 48E-02 |
| Pu-242 | 4 3751E-13 | 1,204 37 | 1,348 90 | 0 00E+00 | 5 27E-10 | 5 90E-10 |
| Ra-226 | 4 0428E-12 | 1,204 37 | 1,348 90 | 0 00E+00 | 4 87E-09 | 5 45E-09 |
| Ra-228 | 2 1032E-11 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 53E-08 | 2 84E-08 |
| Ru-106 | 2 9077E-04 | 1,204 37 | 1,348 90 | 0 00E+00 | 3 50E-01 | 3 92E-01 |
| Se-79 | 1 6492E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 99E-02 | 2 22E-02 |
| Sn-126 | 3 7564E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 4 52E-02 | 5 07E-02 |
| Sr-90 | 1 9396E+00 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 34E+03 | 2 62E+03 |
| Tc-99 | 4 4842E-04 | 1,204 37 | 1,348 90 | 0 00E+00 | 5 40E-01 | 6 05E-01 |
| Th-229 | 1 8544E-11 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 23E-08 | 2 50E-08 |
| Th-230 | 9 0605E-10 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 09E-06 | 1 22E-06 |
| Th-232 | 2 3674E-11 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 85E-08 | 3 19E-08 |
| Tl-208 | 7 0323E-09 | 1,204 37 | 1,348 90 | 0 00E+00 | 8 47E-06 | 9 49E-06 |
| U-232 | 1 9106E-08 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 30E-05 | 2 58E-05 |
| U-233 | 9 6774E-09 | 1,204 37 | 1,348 90 | 0 00E+00 | 1 17E-05 | 1 31E-05 |
| U-234 | 4 8796E-06 | 1,204 37 | 1,348 90 | 0 00E+00 | 5 88E-03 | 6 58E-03 |
| U-235 | -2 3191E-06 | 1,204 37 | 0 00 | 5 33E-02 | 5 05E-02 | 5 33E-02 |
| U-236 | 1 2633E-05 | 1,204 37 | 1,348 90 | 0 00E+00 | 1.52E-02 | 1 70E-02 |
| U-238 | -9 5407E-08 | 1,204 37 | 0 00 | 2 41E-02 | 2 40E-02 | 2 41E-02 |
| Y-90 | 1 9396E+00 | 1,204 37 | 1,348 90 | 0 00E+00 | 2 34E+03 | 2 62E+03 |
| Other Radionuclides | | | | | 2 62E+03 | 2 93E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 446E+14 |
| 0 0250 | 3 066E+13 |
| 0 0375 | 2 665E+13 |
| 0 0575 | 2 799E+13 |
| 0 0850 | 1 720E+13 |
| 0 1250 | 1 112E+13 |
| 0.2250 | 1 452E+13 |
| 0 3750 | 6 647E+12 |
| 0 5750 | 1 102E+14 |
| 0 8500 | 1 064E+12 |
| 1.2500 | 3.267E+12 |
| 1 7500 | 2 705E+10 |
| 2.2500 | 7 737E+07 |
| 2 7500 | 3.535E+06 |
| 3 5000 | 4 081E+05 |
| 5 0000 | 1.311E+02 |
| 7 0000 | 1.249E+01 |
| 11 0000 | 1.262E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 01E+01 | 3.37E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 10 to 40 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This template is a good approximation since it is a FAST, Uranium fuel

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1,204 37 |
| Bounding | | 1,348 90 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=96.35kg
Bounding burnup taken from SFD and converted to MWd using BOL=96.35kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 4 00 | |
| Bounding | 4 48 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name GE TEST
SNF ID # 96
Fuel Units & Descr 22 - CANISTER OF SCRAP
Heavy Metal Mass: BOL= EOL=45 203kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1972
Estimates as of 2010
Template FFTF (FAST SST 10 to 30% Pu & U)
[2]Template Burnup(MWd): 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 35 years

Estimated Canister usage
HIC
2 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 1822E-12 | 45,119 38 | 45,119 38 | 0 00E+00 | 2 79E-07 | 2.79E-07 |
| Am-241 | 1 1066E-01 | 45,119 38 | 45,119 38 | 1 74E+02 | 5 17E+03 | 5 17E+03 |
| Am-242m | 1 9247E-03 | 45,119 38 | 45,119 38 | 0 00E+00 | 8 68E+01 | 8 68E+01 |
| Am-243 | 1 0740E-04 | 45,119 38 | 45,119 38 | 0 00E+00 | 4 85E+00 | 4 85E+00 |
| C-14 | 2 6042E-05 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 17E+00 | 1 17E+00 |
| Cl-36 | 3 4243E-10 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.55E-05 | 1 55E-05 |
| Cm-243 | 4 0629E-04 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.83E+01 | 1 83E+01 |
| Cm-244 | 1 6024E-03 | 45,119 38 | 45,119 38 | 0 00E+00 | 7.23E+01 | 7 23E+01 |
| Co-60 | 3 4275E-03 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 55E+02 | 1 55E+02 |
| Cs-134 | 1 5566E-03 | 45,119 38 | 45,119 38 | 0 00E+00 | 7 02E+01 | 7 02E+01 |
| Cs-135 | 4 7693E-05 | 45,119 38 | 45,119.38 | 0 00E+00 | 2 15E+00 | 2.15E+00 |
| Cs-137 | 1.4007E+00 | 45,119 38 | 45,119 38 | 0 00E+00 | 6 32E+04 | 6 32E+04 |
| Eu-154 | 1 6184E-02 | 45,119 38 | 45,119 38 | 0 00E+00 | 7 30E+02 | 7 30E+02 |
| Eu-155 | 1 3774E-02 | 45,119 38 | 45,119 38 | 0 00E+00 | 6 21E+02 | 6 21E+02 |
| Fe-55 | 3 8028E-04 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.72E+01 | 1 72E+01 |
| H-3 | 3 8454E-03 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 74E+02 | 1 74E+02 |
| I-129 | 1 2891E-06 | 45,119 38 | 45,119 38 | 0 00E+00 | 5 82E-02 | 5 82E-02 |
| Kr-85 | 2 7848E-02 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 26E+03 | 1.26E+03 |
| Np-237 | 3 7516E-06 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 69E-01 | 1 69E-01 |
| Pa-231 | 1 2488E-11 | 45,119 38 | 45,119 38 | 0 00E+00 | 5 63E-07 | 5 63E-07 |
| Pb-210 | 2 4206E-12 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.09E-07 | 1 09E-07 |
| Pm-147 | 1 5671E-02 | 45,119 38 | 45,119 38 | 0 00E+00 | 7.07E+02 | 7 07E+02 |
| Pu-238 | 1 4877E-02 | 45,119 38 | 45,119 38 | 0 00E+00 | 6 71E+02 | 6 71E+02 |
| Pu-239 | -3 5520E-02 | 45,119.38 | 0 00 | 1 43E+03 | 0 00E+00 | 1 43E+03 |
| Pu-240 | 2 0690E-02 | 45,119 38 | 45,119 38 | 7.27E+02 | 1 66E+03 | 1 66E+03 |
| Pu-241 | -1 4799E+00 | 45,119 38 | 0 00 | 3.26E+04 | 0 00E+00 | 3.26E+04 |
| Pu-242 | 1 1252E-05 | 45,119 38 | 45,119 38 | 1.94E-01 | 7 02E-01 | 7 02E-01 |
| Ra-226 | 7 8524E-12 | 45,119 38 | 45,119 38 | 0 00E+00 | 3 54E-07 | 3 54E-07 |
| Ra-228 | 2 4086E-16 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.09E-11 | 1 09E-11 |
| Ru-106 | 1 5066E-05 | 45,119 38 | 45,119 38 | 0 00E+00 | 6 80E-01 | 6 80E-01 |
| Se-79 | 1 0127E-05 | 45,119 38 | 45,119 38 | 0 00E+00 | 4 57E-01 | 4 57E-01 |
| Sn-126 | 4.3902E-05 | 45 119.38 | 45,119 38 | 0 00E+00 | 1 98E+00 | 1 98E+00 |
| Sr-90 | 5 0088E-01 | 45,119 38 | 45,119 38 | 0 00E+00 | 2 26E+04 | 2.26E+04 |
| Tc-99 | 3 9412E-04 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 78E+01 | 1.78E+01 |
| Th-229 | 2 7219E-12 | 45,119 38 | 45,119 38 | 0 00E+00 | 1.23E-07 | 1.23E-07 |
| Th-230 | 1 0441E-09 | 45,119 38 | 45,119 38 | 0 00E+00 | 4.71E-05 | 4 71E-05 |
| Th-232 | 3 1689E-16 | 45,119 38 | 45,119 38 | 0 00E+00 | 1 43E-11 | 1 43E-11 |
| Tl-208 | 4 6636E-07 | 45,119 38 | 45,119 38 | 0 00E+00 | 2 10E-02 | 2 10E-02 |
| U-232 | 1.2638E-06 | 45,119 38 | 45,119 38 | 0 00E+00 | 5 70E-02 | 5 70E-02 |
| U-233 | 5 7451E-10 | 45,119 38 | 45,119 38 | 0 00E+00 | 2 59E-05 | 2 59E-05 |
| U-234 | 4 3044E-06 | 45,119 38 | 45,119.38 | 0 00E+00 | 1 94E-01 | 1 94E-01 |
| U-235 | -7 7765E-09 | 45,119 38 | 0 00 | 2.94E-04 | 0 00E+00 | 2 94E-04 |
| U-236 | 1 8050E-07 | 45,119 38 | 45,119 38 | 0 00E+00 | 8 14E-03 | 8 14E-03 |
| U-238 | -1.7914E-07 | 45,119 38 | 0 00 | 2 14E-02 | 1.33E-02 | 2 14E-02 |
| Y-90 | 5 0088E-01 | 45,119 38 | 45,119 38 | 0 00E+00 | 2 26E+04 | 2 26E+04 |
| Other Radionuclides | | | | | 6.39E+04 | 6 39E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 459E+15 |
| 0 0250 | 2.932E+14 |
| 0 0375 | 3 409E+14 |
| 0 0575 | 3.353E+14 |
| 0 0850 | 1 633E+14 |
| 0 1250 | 1 149E+14 |
| 0 2250 | 1 318E+14 |
| 0 3750 | 5 712E+13 |
| 0 5750 | 2.314E+15 |
| 0 8500 | 2 418E+13 |
| 1.2500 | 2.894E+13 |
| 1 7500 | 6.547E+11 |
| 2.2500 | 1.296E+08 |
| 2 7500 | 7 467E+08 |
| 3 5000 | 2 769E+06 |
| 5 0000 | 8 765E+05 |
| 7 0000 | 1 001E+05 |
| 11 0000 | 1 145E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7 19E+02 | 7.64E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | ZIRC | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences.**

This Template was used for the following reasons:
This fuel matches on all parameters except enrichment (unknown) and cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 45 119 38 |
| Bounding | | 45 119 38 |

**Basis for burnup used in estimate**

Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 3.28 | |
| Bounding | 3.28 | |

Estimated EOL HM/Given EOL HM: 1 05

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: LWR COMMERCIAL FUEL
SNF ID #: 130
Fuel Units & Descr: 6 - CANISTER OF SCRAP
Heavy Metal Mass: BOL= , EOL=63 893kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1982
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage HIC: 3 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 03E-05 | 4 03E-05 |
| Am-241 | 1 3144E-01 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 99E+03 | 7.99E+03 |
| Am-242m | 3 0039E-04 | 60,759 03 | 60,759 03 | 0 00E+00 | 1 83E+01 | 1 83E+01 |
| Am-243 | 6 2629E-04 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 81E+01 | 3 81E+01 |
| C-14 | 4 7965E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 2 91E+00 | 2 91E+00 |
| Cl-36 | 8 0297E-07 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 88E-02 | 4 88E-02 |
| Cm-243 | 3 1993E-04 | 60,759 03 | 60,759 03 | 0 00E+00 | 1 94E+01 | 1 94E+01 |
| Cm-244 | 7 1851E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 37E+03 | 4 37E+03 |
| Co-60 | 9 5220E-03 | 60,759 03 | 60,759 03 | 0 00E+00 | 5 79E+02 | 5 79E+02 |
| Cs-134 | 1 1662E-03 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 09E+01 | 7 09E+01 |
| Cs-135 | 1 4433E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 8 77E-01 | 8 77E-01 |
| Cs-137 | 1 7603E+00 | 60,759 03 | 60,759 03 | 0 00E+00 | 1 07E+05 | 1 07E+05 |
| Eu-154 | 4 5203E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 2 75E+03 | 2 75E+03 |
| Eu-155 | 7 1479E-03 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 34E+02 | 4 34E+02 |
| Fe-55 | 6 1919E-04 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 76E+01 | 3 76E+01 |
| H-3 | 3 6386E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 2.21E+03 | 2 21E+03 |
| I-129 | 9 8288E-07 | 60,759 03 | 60,759 03 | 0 00E+00 | 5 97E-02 | 5 97E-02 |
| Kr-85 | 5 3844E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 3.27E+03 | 3 27E+03 |
| Np-237 | 1 0546E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 6 41E-01 | 6 41E-01 |
| Pa-231 | 1.1370E-09 | 60,759 03 | 60,759 03 | 0 00E+00 | 6 91E-05 | 6 91E-05 |
| Pb-210 | 3.3624E-11 | 60,759 03 | 60,759 03 | 0 00E+00 | 2 04E-06 | 2 04E-06 |
| Pm-147 | 5.1211E-03 | 60,759 03 | 60,759 03 | 0 00E+00 | 3.11E+02 | 3 11E+02 |
| Pu-238 | 8 0669E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 90E+03 | 4 90E+03 |
| Pu-239 | 1.1626E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 06E+02 | 7 06E+02 |
| Pu-240 | 1 5097E-02 | 60,759 03 | 60,759 03 | 0 00E+00 | 9 17E+02 | 9 17E+02 |
| Pu-241 | 1 4567E+00 | 60,759 03 | 60,759 03 | 0 00E+00 | 8 85E+04 | 8 85E+04 |
| Pu-242 | 6 4260E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 90E+00 | 3 90E+00 |
| Ra-226 | 1 1392E-10 | 60,759 03 | 60,759 03 | 0 00E+00 | 6 92E-06 | 6 92E-06 |
| Ra-228 | 5 1841E-12 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 15E-07 | 3.15E-07 |
| Ru-106 | 5 9012E-07 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 59E-02 | 3 59E-02 |
| Se-79 | 1 2379E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 52E-01 | 7 52E-01 |
| Sn-126 | 2 5210E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 1 53E+00 | 1 53E+00 |
| Sr-90 | 1 1630E+00 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 07E+04 | 7 07E+04 |
| Tc-99 | 3 9357E-04 | 60,759 03 | 60,759 03 | 0 00E+00 | 2 39E+01 | 2 39E+01 |
| Th-229 | 8 5691E-11 | 60,759 03 | 60,759 03 | 0 00E+00 | 5 21E-06 | 5.21E-06 |
| Th-230 | 1 4493E-08 | 60,759 03 | 60,759 03 | 0 00E+00 | 8 81E-04 | 8 81E-04 |
| Th-232 | 5 2923E-12 | 60,759 03 | 60,759 03 | 0 00E+00 | 3.22E-07 | 3 22E-07 |
| Tl-208 | 1 9202E-07 | 60,759 03 | 60,759 03 | 0 00E+00 | 1.17E-02 | 1 17E-02 |
| U-232 | 5 2083E-07 | 60,759 03 | 60,759 03 | 0 00E+00 | 3 16E-02 | 3 16E-02 |
| U-233 | 2 4386E-08 | 60,759 03 | 60,759 03 | 0 00E+00 | 1 48E-03 | 1 48E-03 |
| U-234 | 4 7012E-05 | 60,759 03 | 60,759 03 | 0 00E+00 | 2 86E+00 | 2 86E+00 |
| U-235 | -1 4492E-06 | 60,759 03 | 0 00 | 8 84E-03 | 0 00E+00 | 8 84E-03 |
| U-236 | 7.5759E-06 | 60,759 03 | 60,759 03 | 0 00E+00 | 4 60E-01 | 4 60E-01 |
| U-238 | -2 6129E-07 | 60,759 03 | 0 00 | 4 16E-02 | 2.57E-02 | 4 16E-02 |
| Y-90 | 1 1631E+00 | 60,759 03 | 60,759 03 | 0 00E+00 | 7 07E+04 | 7 07E+04 |
| Other Radionuclides | | | | | 1 03E+05 | 1 03E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 132E+15 |
| 0 0250 | 8 368E+14 |
| 0 0375 | 8 099E+14 |
| 0 0575 | 8 835E+14 |
| 0 0850 | 4 682E+14 |
| 0 1250 | 3 420E+14 |
| 0.2250 | 4 019E+14 |
| 0.3750 | 1 724E+14 |
| 0.5750 | 3 963E+15 |
| 0.8500 | 7 821E+13 |
| 1.2500 | 1 056E+14 |
| 1 7500 | 2.315E+12 |
| 2.2500 | 4.275E+08 |
| 2 7500 | 4 805E+08 |
| 3 5000 | 6.297E+07 |
| 5 0000 | 2 691E+07 |
| 7 0000 | 3 102E+06 |
| 11 0000 | 3.564E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 67E+03 | 1 67E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | This Template was used for the following reasons. |
| Fuel Cladding | ZIRC | ZIRC | This fuel matches on all parameters except enrichment (unknown) |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 60,759 03 | Nominal burnup set equal to bounding burnup. |
| Bounding | | 60 759 03 | Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 13 58 | |
| Bounding | 13 58 | |

Estimated EOL HM/Given EOL HM: 1 59

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | LWR SCRAP | [1]Fuel decay start date | 1963 |
| SNF ID # | 309 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - SCRAP | Template | PWR (Light Water Zirc 0 to 5% U) |
| Heavy Metal Mass | BOL=76 554kg EOL=75 31kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage

| HIC |
|---|
| 1 00 |

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 8 7758E-10 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 88E-06 | 2 15E-06 |
| Am-241 | 4352E-01 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 08E+02 | 3 52E+02 |
| Am-242m | 2 8698E-04 | 2,143 51 | 2,449 72 | 0 00E+00 | 6 15E-01 | 7.03E-01 |
| Am-243 | 6 2565E-04 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 34E+00 | 1 53E+00 |
| C-14 | 4 7901E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 03E-01 | 1 17E-01 |
| Cl-36 | 8 0297E-07 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 72E-03 | 1 97E-03 |
| Cm-243 | 2 5081E-04 | 2,143 51 | 2,449 72 | 0.00E+00 | 5 38E-01 | 6 14E-01 |
| Cm-244 | 4 9015E-02 | 2 143 51 | 2,449 72 | 0 00E+00 | 1 05E+02 | 1.20E+02 |
| Co-60 | 2 5581E-03 | 2,143 51 | 2,449 72 | 0 00E+00 | 5 48E+00 | 6 27E+00 |
| Cs-134 | 4 0536E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 8 69E-02 | 9 93E-02 |
| Cs-135 | 1 4433E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 09E-02 | 3 54E-02 |
| Cs-137 | 1 3979E+00 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 00E+03 | 3 42E+03 |
| Eu-154 | 2 0203E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 4.33E+01 | 4 95E+01 |
| Eu-155 | 1 7684E-03 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 79E+00 | 4 33E+00 |
| Fe-55 | 4 3136E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 9 25E-02 | 1 06E-01 |
| H-3 | 2 0769E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 4 45E+01 | 5 09E+01 |
| I-129 | 9 8288E-07 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 11E-03 | 2 41E-03 |
| Kr-85 | 2 8214E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 6 05E+01 | 6 91E+01 |
| Np-237 | 1.1218E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 40E-02 | 2 75E-02 |
| Pa-231 | 1.3036E-09 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 79E-06 | 3 19E-06 |
| Pb-210 | 8 5078E-11 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 82E-07 | 2.08E-07 |
| Pm-147 | 3 6531E-04 | 2,143 51 | 2,449 72 | 0 00E+00 | 7 83E-01 | 8 95E-01 |
| Pu-238 | 7 4564E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 60E+02 | 1 83E+02 |
| Pu-239 | 1 1623E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 49E+01 | 2.85E+01 |
| Pu-240 | 1 5132E-02 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 24E+01 | 3 71E+01 |
| Pu-241 | 9 0036E-01 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 93E+03 | 2.21E+03 |
| Pu-242 | 6 4260E-05 | 2 143 51 | 2,449 72 | 0 00E+00 | 1 38E-01 | 1 57E-01 |
| Ra-226 | 2 2804E-10 | 2,143 51 | 2,449 72 | 0 00E+00 | 4 89E-07 | 5 59E-07 |
| Ra-228 | 5 2713E-12 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 13E-08 | 1 29E-08 |
| Ru-106 | 6 1160E-10 | 2,143 51 | 2,449 72 | 0 00E+00 | 1.31E-06 | 1 50E-06 |
| Se-79 | 1 2377E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 65E-02 | 3 03E-02 |
| Sn-126 | 2 5210E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 5 40E-02 | 6 18E-02 |
| Sr-90 | 9 1667E-01 | 2,143.51 | 2,449 72 | 0 00E+00 | 1 96E+03 | 2 25E+03 |
| Tc-99 | 3 9357E-04 | 2,143 51 | 2,449 72 | 0 00E+00 | 8 44E-01 | 9 64E-01 |
| Th-229 | 1.2057E-10 | 2,143 51 | 2,449 72 | 0 00E+00 | 2 58E-07 | 2 95E-07 |
| Th-230 | 2.1043E-08 | 2,143 51 | 2,449 72 | 0 00E+00 | 4 51E-05 | 5 16E-05 |
| Th-232 | 5.2972E-12 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 14E-08 | 1 30E-08 |
| Tl-208 | 1 7474E-07 | 2,143 51 | 2,449 72 | 0 00E+00 | 3 75E-04 | 4.28E-04 |
| U-232 | 4 7368E-07 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 02E-03 | 1.16E-03 |
| U-233 | 2 5097E-08 | 2,143 51 | 2,449 72 | 0 00E+00 | 5 38E-05 | 6 15E-05 |
| U-234 | 5 0000E-05 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 07E-01 | 1.22E-01 |
| U-235 | -1 4489E-06 | 2,143 51 | 0 00 | 4.58E-03 | 1 47E-03 | 4 58E-03 |
| U-236 | 7 5824E-06 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 63E-02 | 1 86E-02 |
| U-238 | -2 6129E-07 | 2,143 51 | 0 00 | 2.50E-02 | 2 45E-02 | 2 50E-02 |
| Y-90 | 9 1699E-01 | 2,143 51 | 2,449 72 | 0 00E+00 | 1 97E+03 | 2 25E+03 |
| Other Radionuclides | | | | | 2 88E+03 | 3 29E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.318E+14 |
| 0 0250 | 2 658E+13 |
| 0 0375 | 2 535E+13 |
| 0 0575 | 2 929E+13 |
| 0 0850 | 1 475E+13 |
| 0 1250 | 1 023E+13 |
| 0 2250 | 1.265E+13 |
| 0 3750 | 5 438E+12 |
| 0 5750 | 1.265E+14 |
| 0 8500 | 1 750E+12 |
| 1.2500 | 1 719E+12 |
| 1 7500 | 5 147E+10 |
| 2.2500 | 8 288E+06 |
| 2 7500 | 1 698E+07 |
| 3 5000 | 1 749E+06 |
| 5 0000 | 7 476E+05 |
| 7 0000 | 8 617E+04 |
| 11 0000 | 9 896E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.93E+01 | 5 63E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2 767 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 2 143 51 | 1,182 79 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 2 449 72 | 2 365 59 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 80 | 0 55 |
| Bounding | 0 91 | 0.97 |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | N REACTOR | [1]Fuel decay start date: | 1971 |
| SNF ID #: | 991 | Estimates as of: | 2010 |
| Fuel Units & Descr: | 103673 - 2 CONCENTRIC TUBES | Template: | N-Reactor (Graphite, Zirc 0 to 5%, U) |
| Heavy Metal Mass | BOL=2102208 523kg EOL=2099824 044kg | [2]Template Burnup(MWd): | 69600 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 11 6 |
| | | Template Decay Time: | 35 years |

Estimated Canister usage

| MCO |
|---|
| 383 97 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 2184E-10 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 2 13E-03 | 2 41E-03 |
| Am-241 | 9 6379E-02 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 4 88E+05 | 5 51E+05 |
| Am-242m | 5 8463E-05 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 2 96E+02 | 3.34E+02 |
| Am-243 | 4 6279E-05 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 2 34E+02 | 2 65E+02 |
| C-14 | 9 2026E-05 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 4 66E+02 | 5.26E+02 |
| Cl-36 | 0 0000E+00 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 0 0000E+00 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 4 5445E-04 | 5,060,015.91 | 5,718,007 18 | 0 00E+00 | 2 30E+03 | 2 60E+03 |
| Co-60 | 6 3707E-05 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 3 22E+02 | 3 64E+02 |
| Cs-134 | 1 4042E-05 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 7 11E+01 | 8.03E+01 |
| Cs-135 | 1 0066E-05 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 5 09E+01 | 5 76E+01 |
| Cs-137 | 1 1945E+00 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 6 04E+06 | 6 83E+06 |
| Eu-154 | 6 6451E-03 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 3 36E+04 | 3 80E+04 |
| Eu-155 | 2 9052E-04 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 47E+03 | 1 66E+03 |
| Fe-55 | 2 8807E-06 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 46E+01 | 1 65E+01 |
| H-3 | 2 1063E-03 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 07E+04 | 1.20E+04 |
| I-129 | 8 6006E-07 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 4 35E+00 | 4 92E+00 |
| Kr-85 | 2 6739E-02 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 35E+05 | 1 53E+05 |
| Np-237 | 8 5589E-06 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 4 33E+01 | 4 89E+01 |
| Pa-231 | 1 2500E-09 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 6 33E-03 | 7.15E-03 |
| Pb-210 | 2 3017E-11 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 16E-04 | 1 32E-04 |
| Pm-147 | 5 9856E-04 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 3 03E+03 | 3 42E+03 |
| Pu-238 | 2 0029E-02 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 01E+05 | 1 15E+05 |
| Pu-239 | 2 8836E-02 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1 46E+05 | 1 65E+05 |
| Pu-240 | 2 2802E-02 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 1.15E+05 | 1 30E+05 |
| Pu-241 | 6 1020E-01 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 3 09E+06 | 3 49E+06 |
| Pu-242 | 1 4526E-05 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 7.35E+01 | 8 31E+01 |
| Ra-226 | 9 7701E-11 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 4 94E-04 | 5.59E-04 |
| Ra-228 | 1 1068E-14 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 5 60E-08 | 6.33E-08 |
| Ru-106 | 5 9224E-10 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 3 00E-03 | 3.39E-03 |
| Se-79 | 1 0899E-05 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 5 52E+01 | 6.23E+01 |
| Sn-126 | 0 0000E+00 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 8 4899E-01 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 4 30E+06 | 4 85E+06 |
| Tc-99 | 3 6494E-04 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 1 85E+03 | 2 09E+03 |
| Th-229 | 1.2928E-12 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 6 54E-06 | 7.39E-06 |
| Th-230 | 1 6293E-08 | 5,060,015 91 | 5,718,007.18 | 0.00E+00 | 8.24E-02 | 9 32E-02 |
| Th-232 | 1 6451E-14 | 5,060,015 91 | 5,718,007.18 | 0.00E+00 | 8.32E-08 | 9 41E-08 |
| Tl-208 | 3 4382E-15 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 1.74E-08 | 1 97E-08 |
| U-232 | 0 0000E+00 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 9 9425E-10 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 5 03E-03 | 5 69E-03 |
| U-234 | 6 5575E-05 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 3 32E+02 | 3 75E+02 |
| U-235 | -1 2944E-06 | 5 060,015 91 | 0 00 | 5.22E+01 | 4 57E+01 | 5.22E+01 |
| U-236 | 1.1951E-05 | 5,060,015 91 | 5,718,007.18 | 0 00E+00 | 6 05E+01 | 6 83E+01 |
| U-238 | -3 0619E-07 | 5,060,015 91 | 0 00 | 6 98E+02 | 6 97E+02 | 6 98E+02 |
| Y-90 | 8 4928E-01 | 5,060,015 91 | 5,718,007 18 | 0 00E+00 | 4 30E+06 | 4 86E+06 |
| Other Radionuclides | | | | | 5 80E+06 | 6 55E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 2 778E+17 |
| 0 0250 | 5 678E+16 |
| 0 0375 | 5.253E+16 |
| 0 0575 | 5.995E+16 |
| 0 0850 | 3 153E+16 |
| 0 1250 | 2 094E+16 |
| 0 2250 | 2 705E+16 |
| 0 3750 | 1 171E+16 |
| 0 5750 | 2.525E+17 |
| 0 8500 | 2.565E+15 |
| 1 2500 | 1.399E+15 |
| 1 7500 | 7.096E+13 |
| 2.2500 | 5 737E+09 |
| 2 7500 | 1.379E+08 |
| 3 5000 | 1.220E+08 |
| 5 0000 | 5 152E+07 |
| 7 0000 | 5.841E+06 |
| 11 0000 | 6.655E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8 63E+04 | 9 75E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences. |
|---|---|---|---|
| Reactor Moderator: | GRAPHITE | GRAPHITE | |
| Fuel Cladding: | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment %: | 1 15 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 5 060,015 91 | 2 515,522.81 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 5 718,007 18 | 5 031 045 62 | Bounding burnup taken directly from SFD (converted to MWd). |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 40 | 0.50 | 1 00 |
| Bounding | 0 45 | 0 88 | |

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name POINT BEACH
SNF ID # 311
Fuel Units & Descr 3 - 14 X 14 ROD ARRAY
Heavy Metal Mass BOL=1167kg EOL=1161.5kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1981
Estimates as of 2010
Template PWR (Light Water Zirc 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 25 years

Estimated Canister usage
18"x15'
1 50

### II. Estimates

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 53E-05 | 2 53E-05 |
| Am-241 | 1 3144E-01 | 38,160 90 | 38,160.90 | 0 00E+00 | 5 02E+03 | 5 02E+03 |
| Am-242m | 3 0039E-04 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 15E+01 | 1 15E+01 |
| Am-243 | 6 2629E-04 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 39E+01 | 2 39E+01 |
| C-14 | 4 7965E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 83E+00 | 1 83E+00 |
| Cl-36 | 8 0297E-07 | 38,160 90 | 38,160 90 | 0 00E+00 | 3 06E-02 | 3 06E-02 |
| Cm-243 | 3 1993E-04 | 38,160 90 | 38,160 90 | 0 00E+00 | 1.22E+01 | 1.22E+01 |
| Cm-244 | 7 1851E-02 | 38,160 90 | 38,160 90 | 0.00E+00 | 2 74E+03 | 2 74E+03 |
| Co-60 | 9 5220E-03 | 38 160 90 | 38,160 90 | 0 00E+00 | 3 63E+02 | 3 63E+02 |
| Cs-134 | 1 1662E-03 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 45E+01 | 4 45E+01 |
| Cs-135 | 1.4433E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 5 51E-01 | 5 51E-01 |
| Cs-137 | 1 7603E+00 | 38,160 90 | 38,160 90 | 0 00E+00 | 6 72E+04 | 6 72E+04 |
| Eu-154 | 4 5203E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 1.73E+03 | 1.73E+03 |
| Eu-155 | 7 1479E-03 | 38,160 90 | 38,160.90 | 0 00E+00 | 2 73E+02 | 2 73E+02 |
| Fe-55 | 6 1919E-04 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 36E+01 | 2 36E+01 |
| H-3 | 3 6386E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 39E+03 | 1 39E+03 |
| I-129 | 9 8288E-07 | 38,160 90 | 38,160 90 | 0 00E+00 | 3 75E-02 | 3 75E-02 |
| Kr-85 | 5 3844E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 05E+03 | 2 05E+03 |
| Np-237 | 1 0546E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 4.02E-01 | 4 02E-01 |
| Pa-231 | 1 1370E-09 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 34E-05 | 4 34E-05 |
| Pb-210 | 3 3624E-11 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 28E-06 | 1 28E-06 |
| Pm-147 | 5 1211E-03 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 95E+02 | 1 95E+02 |
| Pu-238 | 8 0669E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 3 08E+03 | 3 08E+03 |
| Pu-239 | 1.1626E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 44E+02 | 4 44E+02 |
| Pu-240 | 1 5097E-02 | 38,160 90 | 38,160 90 | 0 00E+00 | 5 76E+02 | 5 76E+02 |
| Pu-241 | 1 4567E+00 | 38,160 90 | 38,160 90 | 0 00E+00 | 5 56E+04 | 5 56E+04 |
| Pu-242 | 6 4260E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 45E+00 | 2 45E+00 |
| Ra-226 | 1 1392E-10 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 35E-06 | 4 35E-06 |
| Ra-228 | 5 1841E-12 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 98E-07 | 1 98E-07 |
| Ru-106 | 5 9012E-07 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 25E-02 | 2 25E-02 |
| Se-79 | 1.2379E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 72E-01 | 4 72E-01 |
| Sn-126 | 2 5210E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 9 62E-01 | 9 62E-01 |
| Sr-90 | 1 1630E+00 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 44E+04 | 4 44E+04 |
| Tc-99 | 3 9357E-04 | 38,160 90 | 38,160 90 | 0 00E+00 | 1.50E+01 | 1 50E+01 |
| Th-229 | 8 5691E-11 | 38,160 90 | 38,160 90 | 0 00E+00 | 3 27E-06 | 3 27E-06 |
| Th-230 | 1 4493E-08 | 38,160 90 | 38,160 90 | 0 00E+00 | 5 53E-04 | 5 53E-04 |
| Th-232 | 5.2923E-12 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 02E-07 | 2 02E-07 |
| Tl-208 | 1.9202E-07 | 38,160 90 | 38,160 90 | 0 00E+00 | 7.33E-03 | 7.33E-03 |
| U-232 | 5.2083E-07 | 38,160 90 | 38,160 90 | 0 00E+00 | 1.99E-02 | 1 99E-02 |
| U-233 | 2 4386E-08 | 38,160 90 | 38,160 90 | 0 00E+00 | 9 31E-04 | 9 31E-04 |
| U-234 | 4 7012E-05 | 38,160 90 | 38,160 90 | 0 00E+00 | 1 79E+00 | 1 79E+00 |
| U-235 | -1 4492E-06 | 38,160 90 | 0 00 | 6 30E-02 | 7 74E-03 | 6 30E-02 |
| U-236 | 7 5759E-06 | 38,160 90 | 38,160 90 | 0 00E+00 | 2 89E-01 | 2 89E-01 |
| U-238 | -2 6129E-07 | 38,160 90 | 0 00 | 3 82E-01 | 3 72E-01 | 3 82E-01 |
| Y-90 | 1.1631E+00 | 38,160 90 | 38,160 90 | 0 00E+00 | 4 44E+04 | 4 44E+04 |
| Other Radionuclides | | | | | 6 45E+04 | 6 45E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.595E+15 |
| 0 0250 | 5.256E+14 |
| 0 0375 | 5 087E+14 |
| 0 0575 | 5 549E+14 |
| 0 0850 | 2 940E+14 |
| 0 1250 | 2 148E+14 |
| 0.2250 | 2.524E+14 |
| 0 3750 | 1.083E+14 |
| 0 5750 | 2 489E+15 |
| 0 8500 | 4 912E+13 |
| 1.2500 | 6 636E+13 |
| 1 7500 | 1 454E+12 |
| 2.2500 | 2 685E+08 |
| 2 7500 | 3 018E+08 |
| 3 5000 | 3.955E+07 |
| 5 0000 | 1.690E+07 |
| 7 0000 | 1 949E+06 |
| 11 0000 | 2.238E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 05E+03 | 1 05E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences. |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2 5 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 38 160 90 | 5,230 14 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 38 160 90 | 10,460 29 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 93 | 0 14 |
| Bounding | 0 93 | 0 27 |

Estimated EOL HM/Given EOL HM: 0 97

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: SHIPPINGPORT PWR C2 BLKT
SNF ID #: 193
Fuel Units & Descr: 72 - 19 FLAT PLATES
Heavy Metal Mass: BOL=16236kg EOL=15780 002kg
ROD Storage Site: HANFORD

[1]Fuel decay start date: 1969
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage

| MCO |
|---|
| 18 00 |

### II. Estimates

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 8 7758E-10 | 433,632.15 | 867,264 30 | 0 00E+00 | 3 81E-04 | 7 61E-04 |
| Am-241 | 1 4352E-01 | 433,632 15 | 867,264.30 | 0 00E+00 | 6.22E+04 | 1 24E+05 |
| Am-242m | 2 8698E-04 | 433,632 15 | 867,264 30 | 0 00E+00 | 1.24E+02 | 2 49E+02 |
| Am-243 | 6 2565E-04 | 433,632 15 | 867,264.30 | 0 00E+00 | 2 71E+02 | 5 43E+02 |
| C-14 | 4 7901E-05 | 433,632 15 | 867,264 30 | 0 00E+00 | 2 08E+01 | 4 15E+01 |
| Cl-36 | 8 0297E-07 | 433,632 15 | 867,264 30 | 0 00E+00 | 3 48E-01 | 6 96E-01 |
| Cm-243 | 2 5081E-04 | 433,632 15 | 867,264 30 | 0 00E+00 | 1 09E+02 | 2 18E+02 |
| Cm-244 | 4 9015E-02 | 433,632 15 | 867,264 30 | 0 00E+00 | 2 13E+04 | 4 25E+04 |
| Co-60 | 2 5581E-03 | 433,632 15 | 867,264 30 | 0 00E+00 | 1 11E+03 | 2.22E+03 |
| Cs-134 | 4 0536E-05 | 433,632 15 | 867,264 30 | 0 00E+00 | 1 76E+01 | 3 52E+01 |
| Cs-135 | 1 4433E-05 | 433,632 15 | 867,264 30 | 0 00E+00 | 6 26E+00 | 1.25E+01 |
| Cs-137 | 1 3979E+00 | 433,632 15 | 867,264 30 | 0 00E+00 | 6 06E+05 | 1.21E+06 |
| Eu-154 | 2 0203E-02 | 433,632.15 | 867,264 30 | 0 00E+00 | 8 76E+03 | 1.75E+04 |
| Eu-155 | 1 7684E-03 | 433 632.15 | 867,264.30 | 0 00E+00 | 7 67E+02 | 1.53E+03 |
| Fe-55 | 4 3136E-05 | 433,632.15 | 867,264.30 | 0 00E+00 | 1 87E+01 | 3 74E+01 |
| H-3 | 2 0769E-02 | 433,632.15 | 867,264 30 | 0 00E+00 | 9 01E+03 | 1 80E+04 |
| I-129 | 9 8288E-07 | 433,632.15 | 867,264 30 | 0 00E+00 | 4.26E-01 | 8 52E-01 |
| Kr-85 | 2 8214E-02 | 433,632 15 | 867,264 30 | 0 00E+00 | 1.22E+04 | 2 45E+04 |
| Np-237 | 1 1218E-05 | 433,632 15 | 867,264 30 | 0 00E+00 | 4 86E+00 | 9 73E+00 |
| Pa-231 | 1 3036E-09 | 433,632 15 | 867,264 30 | 0 00E+00 | 5 65E-04 | 1 13E-03 |
| Pb-210 | 8 5078E-11 | 433,632 15 | 867,264 30 | 0 00E+00 | 3 69E-05 | 7 38E-05 |
| Pm-147 | 3 6531E-04 | 433,632 15 | 867,264 30 | 0 00E+00 | 1 58E+02 | 3 17E+02 |
| Pu-238 | 7 4564E-02 | 433,632 15 | 867,264 30 | 0 00E+00 | 3 23E+04 | 6 47E+04 |
| Pu-239 | 1.1623E-02 | 433,632 15 | 867,264 30 | 0 00E+00 | 5 04E+03 | 1 01E+04 |
| Pu-240 | 1 5132E-02 | 433,632 15 | 867,264 30 | 0 00E+00 | 6 56E+03 | 1 31E+04 |
| Pu-241 | 9 0036E-01 | 433,632.15 | 867,264 30 | 0 00E+00 | 3 90E+05 | 7.81E+05 |
| Pu-242 | 6 4260E-05 | 433,632.15 | 867,264.30 | 0 00E+00 | 2 79E+01 | 5 57E+01 |
| Ra-226 | 2 2804E-10 | 433,632.15 | 867,264.30 | 0 00E+00 | 9 89E-05 | 1 98E-04 |
| Ra-228 | 5 2713E-12 | 433,632.15 | 867,264.30 | 0 00E+00 | 2.29E-06 | 4.57E-06 |
| Ru-106 | 6 1160E-10 | 433,632.15 | 867,264 30 | 0 00E+00 | 2 65E-04 | 5 30E-04 |
| Se-79 | 1 2377E-05 | 433,632 15 | 867,264 30 | 0 00E+00 | 5.37E+00 | 1 07E+01 |
| Sn-126 | 2 5210E-05 | 433,632.15 | 867,264 30 | 0 00E+00 | 1 09E+01 | 2 19E+01 |
| Sr-90 | 9 1667E-01 | 433,632 15 | 867,264 30 | 0 00E+00 | 3 97E+05 | 7 95E+05 |
| Tc-99 | 3 9357E-04 | 433,632 15 | 867,264 30 | 0 00E+00 | 1 71E+02 | 3 41E+02 |
| Th-229 | 1.2057E-10 | 433,632 15 | 867,264 30 | 0 00E+00 | 5.23E-05 | 1 05E-04 |
| Th-230 | 2.1043E-08 | 433,632 15 | 867,264 30 | 0 00E+00 | 9 13E-03 | 1 83E-02 |
| Th-232 | 5.2972E-12 | 433,632 15 | 867,264 30 | 0 00E+00 | 2 30E-06 | 4 59E-06 |
| Tl-208 | 1 7474E-07 | 433,632 15 | 867,264 30 | 0 00E+00 | 7 58E-02 | 1 52E-01 |
| U-232 | 4 7368E-07 | 433,632.15 | 867,264.30 | 0 00E+00 | 2 05E-01 | 4 11E-01 |
| U-233 | 2 5097E-08 | 433,632 15 | 867,264.30 | 0 00E+00 | 1 09E-02 | 2.18E-02 |
| U-234 | 5 0000E-05 | 433,632.15 | 867,264.30 | 0 00E+00 | 2.17E+01 | 4.34E+01 |
| U-235 | -1 4489E-06 | 433,632.15 | 0 00 | 2 49E-01 | 0 00E+00 | 2 49E-01 |
| U-236 | 7 5824E-06 | 433,632.15 | 867,264.30 | 0 00E+00 | 3.29E+00 | 6 58E+00 |
| U-238 | -2 6129E-07 | 433,632 15 | 0 00 | 5 42E+00 | 5 30E+00 | 5 42E+00 |
| Y-90 | 9 1699E-01 | 433,632 15 | 867,264 30 | 0 00E+00 | 3 98E+05 | 7 95E+05 |
| Other Radionuclides | | | | | 5 82E+05 | 1 16E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 666E+16 |
| 0 0250 | 9 410E+15 |
| 0 0375 | 8 975E+15 |
| 0 0575 | 1 037E+16 |
| 0 0850 | 5.221E+15 |
| 0 1250 | 3 623E+15 |
| 0 2250 | 4 477E+15 |
| 0 3750 | 1 925E+15 |
| 0 5750 | 4 478E+16 |
| 0 8500 | 6 195E+14 |
| 1.2500 | 6 085E+14 |
| 1 7500 | 1 822E+13 |
| 2.2500 | 2 934E+09 |
| 2.7500 | 6 012E+09 |
| 3.5000 | 6 190E+08 |
| 5 0000 | 2 647E+08 |
| 7 0000 | 3 050E+07 |
| 11 0000 | 3.503E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 97E+03 | 1 99E+04 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 0 71 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 263,023.20 | 433 632 15 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 399,405 60 | 867,264 30 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 76 | 1 65 |
| Bounding | 1 53 | 2 17 |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name SINGLE PASS REACTOR FUEL
SNF ID # 198
Fuel Units & Descr. 835 - TUBE
Heavy Metal Mass: BOL=2891 605kg EOL=2885 844kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1971
Estimates as of 2010
Template N Reactor (Graphite Zirc 0 to 5% U)
[2]Template Burnup(MWd) 69600
Template BOL Heavy Metal Mass (MT) 11 6
Template Decay Time 35 years

Estimated Canister usage
MCO
0 86

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 2184E-10 | 6,078 13 | 12,156 27 | 0 00E+00 | 2.56E-06 | 5 13E-06 |
| Am-241 | 9 6379E-02 | 6,078 13 | 12,156 27 | 0 00E+00 | 5 86E+02 | 1 17E+03 |
| Am-242m | 5 8463E-05 | 6,078 13 | 12,156.27 | 0 00E+00 | 3 55E-01 | 7 11E-01 |
| Am-243 | 4 6279E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 2 81E-01 | 5 63E-01 |
| C-14 | 9.2026E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 5 59E-01 | 1 12E+00 |
| Cl-36 | 0 0000E+00 | 6 078 13 | 12,156 27 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 0 0000E+00 | 6,078 13 | 12,156 27 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 4 5445E-04 | 6,078 13 | 12,156 27 | 0 00E+00 | 2 76E+00 | 5.52E+00 |
| Co-60 | 6 3707E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 3 87E-01 | 7 74E-01 |
| Cs-134 | 1 4042E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 8.53E-02 | 1 71E-01 |
| Cs-135 | 1 0066E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 6 12E-02 | 1 22E-01 |
| Cs-137 | 1.1945E+00 | 6,078 13 | 12,156 27 | 0 00E+00 | 7.26E+03 | 1 45E+04 |
| Eu-154 | 6 6451E-03 | 6,078 13 | 12,156 27 | 0 00E+00 | 4 04E+01 | 8 08E+01 |
| Eu-155 | 2 9052E-04 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 77E+00 | 3 53E+00 |
| Fe-55 | 2 8807E-06 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 75E-02 | 3 50E-02 |
| H-3 | 2 1063E-03 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 28E+01 | 2.56E+01 |
| I-129 | 8 6006E-07 | 6,078 13 | 12,156 27 | 0 00E+00 | 5 23E-03 | 1 05E-02 |
| Kr-85 | 2 6739E-02 | 6,078 13 | 12,156.27 | 0 00E+00 | 1 63E+02 | 3 25E+02 |
| Np-237 | 8 5589E-06 | 6,078 13 | 12,156 27 | 0 00E+00 | 5.20E-02 | 1 04E-01 |
| Pa-231 | 1.2500E-09 | 6,078 13 | 12,156 27 | 0 00E+00 | 7 60E-06 | 1 52E-05 |
| Pb-210 | 2 3017E-11 | 6 078 13 | 12,156 27 | 0 00E+00 | 1 40E-07 | 2 80E-07 |
| Pm-147 | 5 9856E-04 | 6 078 13 | 12,156 27 | 0 00E+00 | 3 64E+00 | 7 28E+00 |
| Pu-238 | 2 0029E-02 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 22E+02 | 2 43E+02 |
| Pu-239 | 2 8836E-02 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 75E+02 | 3 51E+02 |
| Pu-240 | 2 2802E-02 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 39E+02 | 2.77E+02 |
| Pu-241 | 6 1020E-01 | 6,078 13 | 12,156.27 | 0 00E+00 | 3 71E+03 | 7 42E+03 |
| Pu-242 | 1 4526E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 8 83E-02 | 1 77E-01 |
| Ra-226 | 9 7701E-11 | 6,078 13 | 12,156.27 | 0 00E+00 | 5 94E-07 | 1 19E-06 |
| Ra-228 | 1.1068E-14 | 6,078 13 | 12,156 27 | 0 00E+00 | 6 73E-11 | 1 35E-10 |
| Ru-106 | 5 9224E-10 | 6,078 13 | 12,156 27 | 0 00E+00 | 3 60E-06 | 7.20E-06 |
| Se-79 | 1 0899E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 6 62E-02 | 1 32E-01 |
| Sn-126 | 0 0000E+00 | 6,078 13 | 12,156 27 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 8 4899E-01 | 6,078 13 | 12,156.27 | 0 00E+00 | 5 16E+03 | 1.03E+04 |
| Tc-99 | 3 6494E-04 | 6,078 13 | 12,156 27 | 0 00E+00 | 2 22E+00 | 4 44E+00 |
| Th-229 | 1.2928E-12 | 6,078 13 | 12,156 27 | 0 00E+00 | 7 86E-09 | 1 57E-08 |
| Th-230 | 1 6293E-08 | 6,078 13 | 12,156.27 | 0 00E+00 | 9 90E-05 | 1 98E-04 |
| Th-232 | 1 6451E-14 | 6,078 13 | 12,156 27 | 0 00E+00 | 1 00E-10 | 2 00E-10 |
| Tl-208 | 3 4382E-15 | 6,078 13 | 12,156 27 | 0 00E+00 | 2 09E-11 | 4 18E-11 |
| U-232 | 0 0000E+00 | 6,078 13 | 12,156 27 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 9 9425E-10 | 6,078 13 | 12,156 27 | 0 00E+00 | 6 04E-06 | 1.21E-05 |
| U-234 | 6 5575E-05 | 6,078 13 | 12,156 27 | 0 00E+00 | 3 99E-01 | 7 97E-01 |
| U-235 | -1.2944E-06 | 6,078 13 | 0 00 | 5 37E-03 | 0 00E+00 | 5 37E-03 |
| U-236 | 1 1951E-05 | 6,078 13 | 12,156.27 | 0 00E+00 | 7.26E-02 | 1 45E-01 |
| U-238 | -3 0619E-07 | 6,078 13 | 0 00 | 9 71E-01 | 9 69E-01 | 9 71E-01 |
| Y-90 | 8 4928E-01 | 6,078 13 | 12,156 27 | 0 00E+00 | 5 16E+03 | 1 03E+04 |
| Other Radionuclides | | | | | 6 97E+03 | 1 39E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 907E+14 |
| 0 0250 | 1.207E+14 |
| 0 0375 | 1 117E+14 |
| 0 0575 | 1.275E+14 |
| 0 0850 | 6 703E+13 |
| 0 1250 | 4 451E+13 |
| 0.2250 | 5 750E+13 |
| 0 3750 | 2 488E+13 |
| 0 5750 | 5 368E+14 |
| 0 8500 | 5 454E+12 |
| 1 2500 | 2.975E+12 |
| 1 7500 | 1.509E+11 |
| 2.2500 | 1.219E+07 |
| 2 7500 | 2.902E+05 |
| 3 5000 | 2.566E+05 |
| 5 0000 | 1.084E+05 |
| 7 0000 | 1.228E+04 |
| 11 0000 | 1.399E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 04E+02 | 2.07E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | ALUM | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 0 086 | 0 to 5 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except cladding

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 2,891 61 | 6 078 13 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 12 156 27 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 35 | 2 10 |
| Bounding | 0 70 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: SINGLE PASS REACTOR FUEL | [1]Fuel decay start date | 1971 | |
| SNF ID #: 197 | Estimates as of | 2010 | |
| Fuel Units & Descr: 139 - TUBE | Template: | N-Reactor (Graphite Zirc, 0 to 5% U) | |
| Heavy Metal Mass: BOL=407 437kg, EOL=407 006kg | [2]Template Burnup(MWd): | 69600 | |
| ROD Storage Site: HANFORD | Template BOL Heavy Metal Mass (MT) | 11 6 | |
| | Template Decay Time | 35 years | |

Estimated Canister usage

| MCO |
|---|
| 0 14 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 2184E-10 | 454 58 | 909 16 | 0 00E+00 | 1 92E-07 | 3 84E-07 |
| Am-241 | 9 6379E-02 | 454 58 | 909 16 | 0 00E+00 | 4.38E+01 | 8 76E+01 |
| Am-242m | 5 8463E-05 | 454 58 | 909 16 | 0 00E+00 | 2 66E-02 | 5.32E-02 |
| Am-243 | 4 6279E-05 | 454 58 | 909 16 | 0 00E+00 | 2 10E-02 | 4.21E-02 |
| C-14 | 9 2026E-05 | 454 58 | 909 16 | 0 00E+00 | 4 18E-02 | 8 37E-02 |
| Cl-36 | 0 0000E+00 | 454 58 | 909 16 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 0 0000E+00 | 454 58 | 909 16 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 4 5445E-04 | 454 58 | 909 16 | 0 00E+00 | 2 07E-01 | 4 13E-01 |
| Co-60 | 6 3707E-05 | 454 58 | 909 16 | 0 00E+00 | 2 90E-02 | 5 79E-02 |
| Cs-134 | 1 4042E-05 | 454 58 | 909 16 | 0 00E+00 | 6 38E-03 | 1.28E-02 |
| Cs-135 | 1 0066E-05 | 454 58 | 909 16 | 0 00E+00 | 4 58E-03 | 9.15E-03 |
| Cs-137 | 1 1945E+00 | 454 58 | 909 16 | 0 00E+00 | 5 43E+02 | 1 09E+03 |
| Eu-154 | 6 6451E-03 | 454 58 | 909 16 | 0 00E+00 | 3 02E+00 | 6 04E+00 |
| Eu-155 | 2 9052E-04 | 454 58 | 909 16 | 0 00E+00 | 1.32E-01 | 2 64E-01 |
| Fe-55 | 2 8807E-06 | 454 58 | 909 16 | 0 00E+00 | 1.31E-03 | 2 62E-03 |
| H-3 | 2 1063E-03 | 454.58 | 909 16 | 0 00E+00 | 9 57E-01 | 1 91E+00 |
| I-129 | 8 6006E-07 | 454 58 | 909 16 | 0 00E+00 | 3 91E-04 | 7 82E-04 |
| Kr-85 | 2 6739E-02 | 454 58 | 909 16 | 0 00E+00 | 1 22E+01 | 2 43E+01 |
| Np-237 | 8 5589E-06 | 454 58 | 909 16 | 0 00E+00 | 3 89E-03 | 7.78E-03 |
| Pa-231 | 1 2500E-09 | 454 58 | 909 16 | 0 00E+00 | 5 68E-07 | 1 14E-06 |
| Pb-210 | 2 3017E-11 | 454 58 | 909 16 | 0 00E+00 | 1 05E-08 | 2 09E-08 |
| Pm-147 | 5 9856E-04 | 454 58 | 909 16 | 0 00E+00 | 2 72E-01 | 5 44E-01 |
| Pu-238 | 2 0029E-02 | 454 58 | 909 16 | 0 00E+00 | 9 10E+00 | 1 82E+01 |
| Pu-239 | 2 8836E-02 | 454 58 | 909 16 | 0 00E+00 | 1 31E+01 | 2 62E+01 |
| Pu-240 | 2 2802E-02 | 454 58 | 909 16 | 0 00E+00 | 1 04E+01 | 2 07E+01 |
| Pu-241 | 6 1020E-01 | 454 58 | 909 16 | 0 00E+00 | 2 77E+02 | 5 55E+02 |
| Pu-242 | 1 4526E-05 | 454 58 | 909 16 | 0 00E+00 | 6 60E-03 | 1 32E-02 |
| Ra-226 | 9 7701E-11 | 454 58 | 909 16 | 0 00E+00 | 4 44E-08 | 8 88E-08 |
| Ra-228 | 1 1068E-14 | 454 58 | 909 16 | 0 00E+00 | 5 03E-12 | 1 01E-11 |
| Ru-106 | 5 9224E-10 | 454 58 | 909 16 | 0 00E+00 | 2 69E-07 | 5 38E-07 |
| Se-79 | 1 0899E-05 | 454 58 | 909.16 | 0 00E+00 | 4 95E-03 | 9 91E-03 |
| Sn-126 | 0 0000E+00 | 454 58 | 909.16 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 8 4899E-01 | 454 58 | 909 16 | 0 00E+00 | 3 86E+02 | 7 72E+02 |
| Tc-99 | 3 6494E-04 | 454 58 | 909 16 | 0 00E+00 | 1 66E-01 | 3 32E-01 |
| Th-229 | 1.2928E-12 | 454 58 | 909 16 | 0 00E+00 | 5 88E-10 | 1 18E-09 |
| Th-230 | 1 6293E-08 | 454 58 | 909 16 | 0 00E+00 | 7 41E-06 | 1 48E-05 |
| Th-232 | 1 6451E-14 | 454 58 | 909 16 | 0 00E+00 | 7 48E-12 | 1 50E-11 |
| Tl-208 | 3 4382E-15 | 454 58 | 909 16 | 0 00E+00 | 1 56E-12 | 3 13E-12 |
| U-232 | 0 0000E+00 | 454 58 | 909 16 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 9 9425E-10 | 454 58 | 909 16 | 0 00E+00 | 4 52E-07 | 9 04E-07 |
| U-234 | 6 5575E-05 | 454 58 | 909 16 | 0 00E+00 | 2 98E-02 | 5 96E-02 |
| U-235 | -1 2944E-06 | 454 58 | 0 00 | 1 10E-02 | 1 04E-02 | 1 10E-02 |
| U-236 | 1 1951E-05 | 454 58 | 909 16 | 0 00E+00 | 5 43E-03 | 1 09E-02 |
| U-238 | -3 0619E-07 | 454 58 | 0 00 | 1 35E-01 | 1.35E-01 | 1 35E-01 |
| Y-90 | 8 4928E-01 | 454 58 | 909 16 | 0 00E+00 | 3 86E+02 | 7.72E+02 |
| Other Radionuclides | | | | | 5 21E+02 | 1 04E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 418E+13 |
| 0 0250 | 9 029E+12 |
| 0 0375 | 8 352E+12 |
| 0 0575 | 9 532E+12 |
| 0 0850 | 5 013E+12 |
| 0 1250 | 3 329E+12 |
| 0 2250 | 4.301E+12 |
| 0 3750 | 1.861E+12 |
| 0 5750 | 4 015E+13 |
| 0 8500 | 4 079E+11 |
| 1.2500 | 2.225E+11 |
| 1 7500 | 1 128E+10 |
| 2.2500 | 9 124E+05 |
| 2.7500 | 2.208E+04 |
| 3 5000 | 1 953E+04 |
| 5 0000 | 8.247E+03 |
| 7 0000 | 9.352E+02 |
| 11 0000 | 1 066E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7 76E+00 | 1.55E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator: | GRAPHITE | GRAPHITE | This Template was used for the following reasons. |
| Fuel Cladding | ALUM | ZIRC | This fuel matches on all parameters except cladding. |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 1.252 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 407 44 | 454 58 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 909 16 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 19 | 1 12 | 1 00 |
| Bounding | 0 37 | | |

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: SP-100 FUEL
SNF ID #: 777
Fuel Units & Descr 2 - SCRAP
Heavy Metal Mass BOL=2 711kg EOL=2 628kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1992
Estimates as of 2010
Template FERMI (Fast Zirc 10 to 40% U)
[2]Template Burnup(MWd) 58 6725048
Template BOL Heavy Metal Mass (MT) 0 018774
Template Decay Time 15 years

Estimated Canister usage
HIC
2 00

### II. Estimates

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2.1509E-08 | 73 37 | 146 73 | 0 00E+00 | 1 58E-06 | 3 16E-06 |
| Am-241 | 4 6529E-07 | 73 37 | 146 73 | 0 00E+00 | 3 41E-05 | 6 83E-05 |
| Am-242m | 0 0000E+00 | 73 37 | 146 73 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3923E-15 | 73.37 | 146 73 | 0 00E+00 | 6 16E-13 | 1.23E-12 |
| C-14 | 2 1765E-05 | 73 37 | 146 73 | 0 00E+00 | 1 60E-03 | 3 19E-03 |
| Cl-36 | 5 5188E-08 | 73 37 | 146 73 | 0 00E+00 | 4 05E-06 | 8 10E-06 |
| Cm-243 | 2 5208E-14 | 73 37 | 146 73 | 0 00E+00 | 1 85E-12 | 3 70E-12 |
| Cm-244 | 1.1259E-15 | 73 37 | 146 73 | 0 00E+00 | 8 26E-14 | 1 65E-13 |
| Co-60 | 2 9094E-02 | 73 37 | 146 73 | 0 00E+00 | 2 13E+00 | 4 27E+00 |
| Cs-134 | 5 1932E-04 | 73 37 | 146 73 | 0 00E+00 | 3 81E-02 | 7.62E-02 |
| Cs-135 | 4 4996E-05 | 73 37 | 146 73 | 0 00E+00 | 3 30E-03 | 6 60E-03 |
| Cs-137 | 2 1867E+00 | 73 37 | 146 73 | 0 00E+00 | 1 60E+02 | 3.21E+02 |
| Eu-154 | 9 2837E-04 | 73 37 | 146 73 | 0 00E+00 | 6 81E-02 | 1 36E-01 |
| Eu-155 | 2 3180E-02 | 73 37 | 146 73 | 0 00E+00 | 1 70E+00 | 3 40E+00 |
| Fe-55 | 2 9332E-03 | 73 37 | 146 73 | 0 00E+00 | 2 15E-01 | 4 30E-01 |
| H-3 | 1.0871E-02 | 73 37 | 146 73 | 0 00E+00 | 7 98E-01 | 1 60E+00 |
| I-129 | 1 1426E-06 | 73 37 | 146 73 | 0 00E+00 | 8.38E-05 | 1 68E-04 |
| Kr-85 | 1 4068E-01 | 73 37 | 146 73 | 0 00E+00 | 1 03E+01 | 2 06E+01 |
| Np-237 | 3 3099E-06 | 73.37 | 146 73 | 0 00E+00 | 2 43E-04 | 4 86E-04 |
| Pa-231 | 7 8640E-08 | 73 37 | 146 73 | 0 00E+00 | 5 77E-06 | 1 15E-05 |
| Pb-210 | 7 4277E-13 | 73 37 | 146 73 | 0 00E+00 | 5 45E-11 | 1 09E-10 |
| Pm-147 | 2 2856E-01 | 73 37 | 146 73 | 0 00E+00 | 1 68E+01 | 3 35E+01 |
| Pu-238 | 2.0095E-04 | 73 37 | 146 73 | 0 00E+00 | 1.47E-02 | 2.95E-02 |
| Pu-239 | 1 9481E-02 | 73 37 | 146 73 | 0 00E+00 | 1 43E+00 | 2.86E+00 |
| Pu-240 | 6 8056E-05 | 73 37 | 146 73 | 0 00E+00 | 4 99E-03 | 9 99E-03 |
| Pu-241 | 1 0939E-05 | 73.37 | 146 73 | 0 00E+00 | 8 03E-04 | 1 61E-03 |
| Pu-242 | 4 3751E-13 | 73 37 | 146 73 | 0 00E+00 | 3 21E-11 | 6 42E-11 |
| Ra-226 | 4 0428E-12 | 73 37 | 146 73 | 0 00E+00 | 2 97E-10 | 5 93E-10 |
| Ra-228 | 2 1032E-11 | 73 37 | 146 73 | 0 00E+00 | 1 54E-09 | 3 09E-09 |
| Ru-106 | 2 9077E-04 | 73 37 | 146 73 | 0 00E+00 | 2.13E-02 | 4.27E-02 |
| Se-79 | 1.6492E-05 | 73 37 | 146 73 | 0 00E+00 | 1.21E-03 | 2 42E-03 |
| Sn-126 | 3 7564E-05 | 73 37 | 146 73 | 0 00E+00 | 2 76E-03 | 5 51E-03 |
| Sr-90 | 1 9396E+00 | 73 37 | 146 73 | 0 00E+00 | 1 42E+02 | 2 85E+02 |
| Tc-99 | 4 4842E-04 | 73.37 | 146 73 | 0 00E+00 | 3 29E-02 | 6 58E-02 |
| Th-229 | 1 8544E-11 | 73 37 | 146 73 | 0 00E+00 | 1 36E-09 | 2.72E-09 |
| Th-230 | 9 0605E-10 | 73 37 | 146 73 | 0 00E+00 | 6 65E-08 | 1.33E-07 |
| Th-232 | 2 3674E-11 | 73 37 | 146 73 | 0 00E+00 | 1.74E-09 | 3 47E-09 |
| Tl-208 | 7 0323E-09 | 73 37 | 146 73 | 0 00E+00 | 5 16E-07 | 1 03E-06 |
| U-232 | 1.9106E-08 | 73 37 | 146 73 | 0 00E+00 | 1 40E-06 | 2 80E-06 |
| U-233 | 9 6774E-09 | 73 37 | 146 73 | 0 00E+00 | 7 10E-07 | 1 42E-06 |
| U-234 | 4 8796E-06 | 73.37 | 146 73 | 0 00E+00 | 3 58E-04 | 7 16E-04 |
| U-235 | -2 3191E-06 | 73 37 | 0 00 | 1.05E-03 | 8 84E-04 | 1.05E-03 |
| U-236 | 1 2633E-05 | 73 37 | 146 73 | 0 00E+00 | 9 27E-04 | 1 85E-03 |
| U-238 | -9 5407E-08 | 73 37 | 0 00 | 7 47E-04 | 7.40E-04 | 7 47E-04 |
| Y-90 | 1 9396E+00 | 73 37 | 146 73 | 0 00E+00 | 1 42E+02 | 2 85E+02 |
| Other Radionuclides | | | | | 1.59E+02 | 3 19E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0.0150 | 1.573E+13 |
| 0 0250 | 3 335E+12 |
| 0 0375 | 2.899E+12 |
| 0 0575 | 3 044E+12 |
| 0 0850 | 1 871E+12 |
| 0 1250 | 1.209E+12 |
| 0.2250 | 1.579E+12 |
| 0 3750 | 7.230E+11 |
| 0 5750 | 1 199E+13 |
| 0 8500 | 1 157E+11 |
| 1.2500 | 3 554E+11 |
| 1 7500 | 2 942E+09 |
| 2.2500 | 8 416E+06 |
| 2 7500 | 3.845E+05 |
| 3.5000 | 4 439E+04 |
| 5 0000 | 9 910E+00 |
| 7 0000 | 8.573E-01 |
| 11 0000 | 7 972E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.84E+00 | 3.67E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | UNKNOWN | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 18 | 10 to 40 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This template is a good approximation since it is a FAST Uranium fuel

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 73.37 |
| Bounding | | 146 73 |

**Basis for burnup used in estimate**

Nominal burnup calculated from the heavy metal mass destroyed
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 8 66 | |
| Bounding | 17.32 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name TRIGA 8 5/20 FFCR (DORF)
SNF ID #: 315
Fuel Units & Descr. 2 - ELEMENT
Heavy Metal Mass BOL=0 384kg EOL=0 383kg
ROD Storage Site HANFORD

[1]Fuel decay start date: 1989
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20% U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 20 years

Estimated Canister usage. 18"x10'
0 03

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 6436E-09 | 3 74 | 7 48 | 0 00E+00 | 9 89E-09 | 1 98E-08 |
| Am-241 | 3.1429E-03 | 3 74 | 7 48 | 0 00E+00 | 1 18E-02 | 2 35E-02 |
| Am-242m | 1 3195E-06 | 3 74 | 7 48 | 0 00E+00 | 4 94E-06 | 9 88E-06 |
| Am-243 | 1 4753E-07 | 3 74 | 7 48 | 0 00E+00 | 5 52E-07 | 1 10E-06 |
| C-14 | 1 2847E-04 | 3.74 | 7 48 | 0 00E+00 | 4 81E-04 | 9 62E-04 |
| Cl-36 | 2 8120E-06 | 3.74 | 7 48 | 0 00E+00 | 1 05E-05 | 2 10E-05 |
| Cm-243 | 1 2465E-07 | 3 74 | 7 48 | 0 00E+00 | 4 66E-07 | 9 33E-07 |
| Cm-244 | 9 5564E-07 | 3.74 | 7 48 | 0 00E+00 | 3 58E-06 | 7 15E-06 |
| Co-60 | 1 7880E-01 | 3 74 | 7 48 | 0 00E+00 | 6 69E-01 | 1 34E+00 |
| Cs-134 | 5 8692E-04 | 3 74 | 7 48 | 0 00E+00 | 2.20E-03 | 4 39E-03 |
| Cs-135 | 3 2195E-05 | 3 74 | 7 48 | 0 00E+00 | 1.20E-04 | 2 41E-04 |
| Cs-137 | 1 9489E+00 | 3 74 | 7 48 | 0 00E+00 | 7 29E+00 | 1 46E+01 |
| Eu-154 | 4 5895E-03 | 3 74 | 7 48 | 0 00E+00 | 1 72E-02 | 3.44E-02 |
| Eu-155 | 3 6045E-03 | 3 74 | 7 48 | 0 00E+00 | 1 35E-02 | 2 70E-02 |
| Fe-55 | 1 4185E-02 | 3 74 | 7 48 | 0 00E+00 | 5 31E-02 | 1 06E-01 |
| H-3 | 4 7895E-03 | 3 74 | 7 48 | 0 00E+00 | 1 79E-02 | 3 58E-02 |
| I-129 | 7.3684E-07 | 3 74 | 7 48 | 0 00E+00 | 2 76E-06 | 5 52E-06 |
| Kr-85 | 9 5820E-02 | 3.74 | 7 48 | 0 00E+00 | 3 59E-01 | 7 17E-01 |
| Np-237 | 1 2552E-06 | 3.74 | 7 48 | 0 00E+00 | 4 70E-06 | 9 39E-06 |
| Pa-231 | 7 0406E-09 | 3.74 | 7 48 | 0 00E+00 | 2 63E-08 | 5 27E-08 |
| Pb-210 | 5 8000E-14 | 3.74 | 7 48 | 0 00E+00 | 2.17E-13 | 4 34E-13 |
| Pm-147 | 4 0075E-02 | 3 74 | 7 48 | 0 00E+00 | 1.50E-01 | 3 00E-01 |
| Pu-238 | 9 2256E-04 | 3 74 | 7.48 | 0 00E+00 | 3 45E-03 | 6 91E-03 |
| Pu-239 | 5 5278E-03 | 3 74 | 7 48 | 0 00E+00 | 2 07E-02 | 4 14E-02 |
| Pu-240 | 2 1248E-03 | 3 74 | 7 48 | 0 00E+00 | 7 95E-03 | 1 59E-02 |
| Pu-241 | 4 9549E-02 | 3 74 | 7 48 | 0 00E+00 | 1 85E-01 | 3.71E-01 |
| Pu-242 | 2 3128E-07 | 3 74 | 7 48 | 0 00E+00 | 8 66E-07 | 1.73E-06 |
| Ra-226 | 2 4526E-13 | 3 74 | 7 48 | 0 00E+00 | 9 18E-13 | 1 84E-12 |
| Ra-228 | 2 4015E-10 | 3 74 | 7 48 | 0 00E+00 | 8 99E-10 | 1 80E-09 |
| Ru-106 | 3 0602E-06 | 3 74 | 7 48 | 0 00E+00 | 1 15E-05 | 2 29E-05 |
| Se-79 | 1 3015E-05 | 3.74 | 7 48 | 0 00E+00 | 4 87E-05 | 9 74E-05 |
| Sn-126 | 1 2165E-05 | 3.74 | 7 48 | 0 00E+00 | 4 55E-05 | 9 11E-05 |
| Sr-90 | 1 8226E+00 | 3 74 | 7 48 | 0 00E+00 | 6 82E+00 | 1 36E+01 |
| Tc-99 | 4 4241E-04 | 3 74 | 7 48 | 0 00E+00 | 1.66E-03 | 3 31E-03 |
| Th-229 | 3 0962E-10 | 3 74 | 7.48 | 0 00E+00 | 1.16E-09 | 2 32E-09 |
| Th-230 | 4 2346E-11 | 3 74 | 7 48 | 0 00E+00 | 1 58E-10 | 3 17E-10 |
| Th-232 | 2 5278E-10 | 3 74 | 7 48 | 0 00E+00 | 9 46E-10 | 1 89E-09 |
| Tl-208 | 1 5820E-08 | 3 74 | 7 48 | 0 00E+00 | 5 92E-08 | 1.18E-07 |
| U-232 | 4.2647E-08 | 3 74 | 7 48 | 0 00E+00 | 1 60E-07 | 3.19E-07 |
| U-233 | 1.2211E-07 | 3 74 | 7 48 | 0 00E+00 | 4 57E-07 | 9 14E-07 |
| U-234 | 1.9955E-07 | 3 74 | 7 48 | 0 00E+00 | 7 47E-07 | 1 49E-06 |
| U-235 | -2 6194E-06 | 3 74 | 0 00 | 1 64E-04 | 1 54E-04 | 1 64E-04 |
| U-236 | 1.2693E-05 | 3.74 | 7 48 | 0 00E+00 | 4 75E-05 | 9 50E-05 |
| U-238 | -3 6331E-08 | 3 74 | 0 00 | 1 04E-04 | 1 03E-04 | 1 04E-04 |
| Y-90 | 1 8241E+00 | 3 74 | 7 48 | 0 00E+00 | 6 83E+00 | 1 37E+01 |
| Other Radionuclides | | | | | 7 21E+00 | 1 44E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 501E+11 |
| 0 0250 | 1 561E+11 |
| 0 0375 | 1 353E+11 |
| 0 0575 | 1 455E+11 |
| 0 0850 | 8 785E+10 |
| 0 1250 | 5.742E+10 |
| 0.2250 | 7 543E+10 |
| 0 3750 | 3 306E+10 |
| 0 5750 | 5 437E+11 |
| 0.8500 | 6 129E+09 |
| 1.2500 | 1 016E+11 |
| 1 7500 | 1 575E+08 |
| 2.2500 | 5 424E+05 |
| 2.7500 | 5 976E+03 |
| 3 5000 | 3.360E+01 |
| 5 0000 | 4 128E+00 |
| 7 0000 | 4 667E-01 |
| 11 0000 | 5.312E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.36E-02 | 1 87E-01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 792 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 3 74 | 1 15 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 7 48 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.29 | 0 31 |
| Bounding | 0 57 | |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name TRIGA STD (ALUM) HANFORD
SNF ID # 314
Fuel Units & Descr: 66 - ELEMENT
Heavy Metal Mass· BOL=12 342kg EOL=12.203kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1987
Estimates as of 2010
Template TRIGA-Al (LW/U Zrx Alum 10 to 20% U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 00018
Template Decay Time 20 years

Estimated Canister usage 18"x10' 0 59

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 4556E-09 | 421 00 | 842 00 | 0 00E+00 | 1 03E-06 | 2 07E-06 |
| Am-241 | 3 8752E-03 | 421 00 | 842 00 | 0 00E+00 | 1 63E+00 | 3 26E+00 |
| Am-242m | 1 8617E-06 | 421 00 | 842 00 | 0 00E+00 | 7 84E-04 | 1.57E-03 |
| Am-243 | 2 3293E-07 | 421 00 | 842 00 | 0 00E+00 | 9 81E-05 | 1.96E-04 |
| C-14 | 4 3233E-05 | 421 00 | 842 00 | 0 00E+00 | 1.82E-02 | 3 64E-02 |
| Cl-36 | 4 3023E-08 | 421 00 | 842 00 | 0 00E+00 | 1 81E-05 | 3 62E-05 |
| Cm-243 | 1 9053E-07 | 421.00 | 842.00 | 0 00E+00 | 8 02E-05 | 1 60E-04 |
| Cm-244 | 1 7744E-06 | 421.00 | 842 00 | 0 00E+00 | 7 47E-04 | 1 49E-03 |
| Co-60 | 4.3188E-03 | 421 00 | 842 00 | 0 00E+00 | 1 82E+00 | 3 64E+00 |
| Cs-134 | 6.7188E-04 | 421 00 | 842 00 | 0 00E+00 | 2 83E-01 | 5 66E-01 |
| Cs-135 | 3 1549E-05 | 421 00 | 842 00 | 0 00E+00 | 1 33E-02 | 2 66E-02 |
| Cs-137 | 1 9489E+00 | 421 00 | 842 00 | 0 00E+00 | 8 20E+02 | 1 64E+03 |
| Eu-154 | 4 0301E-01 | 421 00 | 842 00 | 0 00E+00 | 1 70E+02 | 3 39E+02 |
| Eu-155 | 5 4000E-02 | 421 00 | 842 00 | 0 00E+00 | 2 27E+01 | 4 55E+01 |
| Fe-55 | 1 5955E-04 | 421 00 | 842 00 | 0 00E+00 | 6 72E-02 | 1 34E-01 |
| H-3 | 4 6571E-03 | 421 00 | 842.00 | 0 00E+00 | 1.96E+00 | 3 92E+00 |
| I-129 | 7 3805E-07 | 421.00 | 842 00 | 0 00E+00 | 3 11E-04 | 6 21E-04 |
| Kr-85 | 9 5684E-02 | 421 00 | 842 00 | 0 00E+00 | 4 03E+01 | 8 06E+01 |
| Np-237 | 1 4618E-06 | 421 00 | 842 00 | 0 00E+00 | 6 15E-04 | 1 23E-03 |
| Pa-231 | 6 4782E-09 | 421 00 | 842 00 | 0 00E+00 | 2 73E-06 | 5 45E-06 |
| Pb-210 | 6 3158E-14 | 421 00 | 842 00 | 0 00E+00 | 2 66E-11 | 5.32E-11 |
| Pm-147 | 3 9564E-02 | 421 00 | 842 00 | 0 00E+00 | 1 67E+01 | 3 33E+01 |
| Pu-238 | 1 2008E-03 | 421 00 | 842 00 | 0 00E+00 | 5 06E-01 | 1.01E+00 |
| Pu-239 | 5 6917E-03 | 421 00 | 842 00 | 0 00E+00 | 2 40E+00 | 4.79E+00 |
| Pu-240 | 2 2617E-03 | 421 00 | 842.00 | 0 00E+00 | 9 52E-01 | 1 90E+00 |
| Pu-241 | 6 1113E-02 | 421.00 | 842 00 | 0 00E+00 | 2.57E+01 | 5 15E+01 |
| Pu-242 | 3 0602E-07 | 421 00 | 842 00 | 0 00E+00 | 1 29E-04 | 2 58E-04 |
| Ra-226 | 2 6707E-13 | 421 00 | 842 00 | 0 00E+00 | 1 12E-10 | 2.25E-10 |
| Ra-228 | 2.2556E-10 | 421 00 | 842 00 | 0 00E+00 | 9 50E-08 | 1.90E-07 |
| Ru-106 | 3 1293E-06 | 421 00 | 842 00 | 0 00E+00 | 1 32E-03 | 2 63E-03 |
| Se-79 | 1 2935E-05 | 421 00 | 842 00 | 0 00E+00 | 5 45E-03 | 1.09E-02 |
| Sn-126 | 1.2238E-05 | 421 00 | 842 00 | 0 00E+00 | 5 15E-03 | 1 03E-02 |
| Sr-90 | 1 8195E+00 | 421 00 | 842 00 | 0 00E+00 | 7 66E+02 | 1.53E+03 |
| Tc-99 | 4 4120E-04 | 421 00 | 842 00 | 0 00E+00 | 1.86E-01 | 3 71E-01 |
| Th-229 | 3 3308E-10 | 421.00 | 842 00 | 0 00E+00 | 1 40E-07 | 2 80E-07 |
| Th-230 | 4 6526E-11 | 421 00 | 842 00 | 0 00E+00 | 1 96E-08 | 3 92E-08 |
| Th-232 | 2 3744E-10 | 421 00 | 842 00 | 0 00E+00 | 1 00E-07 | 2 00E-07 |
| Tl-208 | 1 8195E-08 | 421 00 | 842 00 | 0 00E+00 | 7 66E-06 | 1.53E-05 |
| U-232 | 4 9098E-08 | 421 00 | 842 00 | 0 00E+00 | 2 07E-05 | 4.13E-05 |
| U-233 | 1.3140E-07 | 421 00 | 842 00 | 0 00E+00 | 5 53E-05 | 1.11E-04 |
| U-234 | 2.2571E-07 | 421 00 | 842 00 | 0 00E+00 | 9 50E-05 | 1 90E-04 |
| U-235 | -2 6159E-06 | 421 00 | 0 00 | 5.28E-03 | 4 18E-03 | 5.28E-03 |
| U-236 | 1 2719E-05 | 421 00 | 842 00 | 0 00E+00 | 5.35E-03 | 1 07E-02 |
| U-238 | -3 8857E-08 | 421 00 | 0 00 | 3.33E-03 | 3 31E-03 | 3 33E-03 |
| Y-90 | 1 8211E+00 | 421.00 | 842 00 | 0 00E+00 | 7.67E+02 | 1 53E+03 |
| Other Radionuclides | | | | | 8 82E+02 | 1 76E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8 641E+13 |
| 0 0250 | 1 784E+13 |
| 0 0375 | 1 868E+13 |
| 0 0575 | 1 726E+13 |
| 0 0850 | 1 051E+13 |
| 0 1250 | 1 180E+13 |
| 0.2250 | 9 524E+12 |
| 0 3750 | 3 914E+12 |
| 0 5750 | 6.235E+13 |
| 0.8500 | 6 634E+12 |
| 1.2500 | 7 146E+12 |
| 1 7500 | 2 141E+11 |
| 2.2500 | 3 393E+06 |
| 2 7500 | 5 647E+05 |
| 3 5000 | 3 881E+03 |
| 5 0000 | 4 809E+02 |
| 7 0000 | 5 430E+01 |
| 11 0000 | 6 176E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 09E+01 | 2.19E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE | |
| Fuel Cladding | ALUM | ALUM | |
| BOL HM Constituents | U | U | |
| BOL Enrichment %· | 19 786 | 10 to 20 1 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 421.00 | 132.30 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 842 00 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 92 | 0 31 |
| Bounding | 1 85 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | TRIGA STD 8.5/20 | [1]Fuel decay start date | 1989 |
| SNF ID #: | 233 | Estimates as of. | 2010 |
| Fuel Units & Descr: | 90 - ELEMENT | Template: | TRIGA SS (LW/U Zrx SST, 10 to 20%, U) |
| Heavy Metal Mass. | BOL=17 55kg, EOL=17 19kg | [2]Template Burnup(MWd) | 6 65 |
| ROD Storage Site | HANFORD | Template BOL Heavy Metal Mass (MT) | 0 000195 |
| | | Template Decay Time: | 20 years |

Estimated Canister usage 18"x10' 0 81

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 6436E-09 | 343 66 | 687 32 | 0 00E+00 | 9 08E-07 | 1 82E-06 |
| Am-241 | 3 1429E-03 | 343 66 | 687 32 | 0 00E+00 | 1 08E+00 | 2 16E+00 |
| Am-242m | 1 3195E-06 | 343 66 | 687 32 | 0 00E+00 | 4 53E-04 | 9 07E-04 |
| Am-243 | 1 4753E-07 | 343 66 | 687 32 | 0 00E+00 | 5 07E-05 | 1 01E-04 |
| C-14 | 1 2847E-04 | 343 66 | 687 32 | 0 00E+00 | 4 41E-02 | 8 83E-02 |
| Cl-36 | 2 8120E-06 | 343 66 | 687 32 | 0 00E+00 | 9 66E-04 | 1 93E-03 |
| Cm-243 | 1 2465E-07 | 343 66 | 687 32 | 0 00E+00 | 4 28E-05 | 8 57E-05 |
| Cm-244 | 9 5564E-07 | 343 66 | 687 32 | 0 00E+00 | 3 28E-04 | 6 57E-04 |
| Co-60 | 1 7880E-01 | 343 66 | 687 32 | 0 00E+00 | 6 14E+01 | 1 23E+02 |
| Cs-134 | 5 8692E-04 | 343 66 | 687 32 | 0 00E+00 | 2 02E-01 | 4 03E-01 |
| Cs-135 | 3 2195E-05 | 343 66 | 687 32 | 0 00E+00 | 1 11E-02 | 2 21E-02 |
| Cs-137 | 1 9489E+00 | 343 66 | 687 32 | 0 00E+00 | 6 70E+02 | 1 34E+03 |
| Eu-154 | 4 5895E-03 | 343 66 | 687 32 | 0 00E+00 | 1 58E+00 | 3 15E+00 |
| Eu-155 | 3 6045E-03 | 343 66 | 687.32 | 0 00E+00 | 1.24E+00 | 2 48E+00 |
| Fe-55 | 1 4185E-02 | 343 66 | 687.32 | 0 00E+00 | 4 87E+00 | 9 75E+00 |
| H-3 | 4 7895E-03 | 343 66 | 687.32 | 0 00E+00 | 1 65E+00 | 3 29E+00 |
| I-129 | 7 3684E-07 | 343 66 | 687.32 | 0 00E+00 | 2 53E-04 | 5 06E-04 |
| Kr-85 | 9 5820E-02 | 343 66 | 687.32 | 0 00E+00 | 3.29E+01 | 6 59E+01 |
| Np-237 | 1 2552E-06 | 343 66 | 687.32 | 0 00E+00 | 4 31E-04 | 8 63E-04 |
| Pa-231 | 7 0406E-09 | 343 66 | 687.32 | 0 00E+00 | 2 42E-06 | 4 84E-06 |
| Pb-210 | 5 8000E-14 | 343 66 | 687.32 | 0 00E+00 | 1 99E-11 | 3 99E-11 |
| Pm-147 | 4 0075E-02 | 343 66 | 687.32 | 0 00E+00 | 1 38E+01 | 2 75E+01 |
| Pu-238 | 9.2256E-04 | 343 66 | 687.32 | 0 00E+00 | 3 17E-01 | 6 34E-01 |
| Pu-239 | 5 5278E-03 | 343 66 | 687.32 | 0 00E+00 | 1 90E+00 | 3 80E+00 |
| Pu-240 | 2.1248E-03 | 343 66 | 687.32 | 0 00E+00 | 7 30E-01 | 1 46E+00 |
| Pu-241 | 4 9549E-02 | 343 66 | 687 32 | 0 00E+00 | 1 70E+01 | 3 41E+01 |
| Pu-242 | 2.3128E-07 | 343 66 | 687 32 | 0 00E+00 | 7 95E-05 | 1 59E-04 |
| Ra-226 | 2 4526E-13 | 343 66 | 687 32 | 0 00E+00 | 8 43E-11 | 1 69E-10 |
| Ra-228 | 2 4015E-10 | 343 66 | 687 32 | 0 00E+00 | 8 25E-08 | 1 65E-07 |
| Ru-106 | 3 0602E-06 | 343 66 | 687 32 | 0 00E+00 | 1 05E-03 | 2.10E-03 |
| Se-79 | 1 3015E-05 | 343 66 | 687 32 | 0 00E+00 | 4 47E-03 | 8 95E-03 |
| Sn-126 | 1.2165E-05 | 343 66 | 687 32 | 0 00E+00 | 4 18E-03 | 8 36E-03 |
| Sr-90 | 1 8226E+00 | 343 66 | 687 32 | 0 00E+00 | 6 26E+02 | 1.25E+03 |
| Tc-99 | 4 4241E-04 | 343 66 | 687 32 | 0 00E+00 | 1 52E-01 | 3 04E-01 |
| Th-229 | 3 0962E-10 | 343 66 | 687 32 | 0 00E+00 | 1 06E-07 | 2.13E-07 |
| Th-230 | 4 2346E-11 | 343 66 | 687 32 | 0 00E+00 | 1 46E-08 | 2 91E-08 |
| Th-232 | 2 5278E-10 | 343 66 | 687 32 | 0 00E+00 | 8 69E-08 | 1 74E-07 |
| Tl-208 | 1 5820E-08 | 343 66 | 687 32 | 0 00E+00 | 5 44E-06 | 1 09E-05 |
| U-232 | 4 2647E-08 | 343 66 | 687 32 | 0 00E+00 | 1 47E-05 | 2 93E-05 |
| U-233 | 1 2211E-07 | 343 66 | 687 32 | 0 00E+00 | 4.20E-05 | 8.39E-05 |
| U-234 | 1 9955E-07 | 343 66 | 687 32 | 0 00E+00 | 6 86E-05 | 1.37E-04 |
| U-235 | -2 6194E-06 | 343 66 | 0 00 | 7 59E-03 | 6 68E-03 | 7.59E-03 |
| U-236 | 1 2693E-05 | 343 66 | 687 32 | 0 00E+00 | 4 36E-03 | 8 72E-03 |
| U-238 | -3 6331E-08 | 343 66 | 0 00 | 4 72E-03 | 4 71E-03 | 4 72E-03 |
| Y-90 | 1 8241E+00 | 343 66 | 687.32 | 0 00E+00 | 6 27E+02 | 1 25E+03 |
| Other Radionuclides | | | | | 6 62E+02 | 1 32E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 6 888E+13 |
| 0 0250 | 1 434E+13 |
| 0 0375 | 1.242E+13 |
| 0 0575 | 1.336E+13 |
| 0 0850 | 8 067E+12 |
| 0 1250 | 5.272E+12 |
| 0.2250 | 6 927E+12 |
| 0.3750 | 3 036E+12 |
| 0.5750 | 4 993E+13 |
| 0 8500 | 5 628E+11 |
| 1.2500 | 9 326E+12 |
| 1 7500 | 1 446E+10 |
| 2.2500 | 4 980E+07 |
| 2.7500 | 5 487E+05 |
| 3.5000 | 3 059E+03 |
| 5 0000 | 3 680E+02 |
| 7 0000 | 4 158E+01 |
| 11 0000 | 4 732E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8 60E+00 | 1 72E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 00000115 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 256 56 | 343 66 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 687 32 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.57 | 1 34 |
| Bounding | 1 15 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name TRIGA STD 8 5/20 (HANFORD)
SNF ID # 316
Fuel Units & Descr 33 - ELEMENT
Heavy Metal Mass BOL=6.336kg EOL=6 316kg
ROD Storage Site HANFORD

[1]Fuel decay start date 1989
Estimates as of 2010
Template TRIGA-SS (LW/U Zrx SST 10 to 20% U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 000195
Template Decay Time 20 years

Estimated Canister usage
18"x10'
0 30

### II. Estimates

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 6436E-09 | 30 88 | 61 75 | 0 00E+00 | 8 16E-08 | 1 63E-07 |
| Am-241 | 3 1429E-03 | 30 88 | 61 75 | 0 00E+00 | 9 70E-02 | 1.94E-01 |
| Am-242m | 1 3195E-06 | 30 88 | 61.75 | 0 00E+00 | 4 07E-05 | 8 15E-05 |
| Am-243 | 1 4753E-07 | 30 88 | 61 75 | 0 00E+00 | 4.56E-06 | 9 11E-06 |
| C-14 | 1 2847E-04 | 30 88 | 61 75 | 0 00E+00 | 3 97E-03 | 7 93E-03 |
| Cl-36 | 2 8120E-06 | 30 88 | 61 75 | 0 00E+00 | 8 68E-05 | 1 74E-04 |
| Cm-243 | 1.2465E-07 | 30 88 | 61 75 | 0 00E+00 | 3 85E-06 | 7 70E-06 |
| Cm-244 | 9 5564E-07 | 30 88 | 61 75 | 0 00E+00 | 2 95E-05 | 5 90E-05 |
| Co-60 | 1 7880E-01 | 30 88 | 61 75 | 0 00E+00 | 5 52E+00 | 1 10E+01 |
| Cs-134 | 5 8692E-04 | 30 88 | 61.75 | 0 00E+00 | 1 81E-02 | 3 62E-02 |
| Cs-135 | 3 2195E-05 | 30 88 | 61.75 | 0 00E+00 | 9 94E-04 | 1 99E-03 |
| Cs-137 | 1 9489E+00 | 30 88 | 61 75 | 0 00E+00 | 6 02E+01 | 1.20E+02 |
| Eu-154 | 4 5895E-03 | 30 88 | 61 75 | 0 00E+00 | 1 42E-01 | 2 83E-01 |
| Eu-155 | 3 6045E-03 | 30 88 | 61 75 | 0 00E+00 | 1 11E-01 | 2 23E-01 |
| Fe-55 | 1.4185E-02 | 30 88 | 61 75 | 0 00E+00 | 4 38E-01 | 8 76E-01 |
| H-3 | 4 7895E-03 | 30 88 | 61 75 | 0 00E+00 | 1 48E-01 | 2 96E-01 |
| I-129 | 7 3684E-07 | 30 88 | 61 75 | 0 00E+00 | 2 28E-05 | 4 55E-05 |
| Kr-85 | 9 5820E-02 | 30 88 | 61 75 | 0 00E+00 | 2 96E+00 | 5 92E+00 |
| Np-237 | 1 2552E-06 | 30 88 | 61 75 | 0 00E+00 | 3 88E-05 | 7 75E-05 |
| Pa-231 | 7 0406E-09 | 30 88 | 61 75 | 0 00E+00 | 2.17E-07 | 4 35E-07 |
| Pb-210 | 5 8000E-14 | 30 88 | 61 75 | 0 00E+00 | 1 79E-12 | 3 58E-12 |
| Pm-147 | 4 0075E-02 | 30 88 | 61 75 | 0 00E+00 | 1.24E+00 | 2 47E+00 |
| Pu-238 | 9.2256E-04 | 30 88 | 61 75 | 0 00E+00 | 2 85E-02 | 5 70E-02 |
| Pu-239 | 5 5278E-03 | 30 88 | 61 75 | 0 00E+00 | 1 71E-01 | 3 41E-01 |
| Pu-240 | 2 1248E-03 | 30 88 | 61.75 | 0 00E+00 | 6 56E-02 | 1 31E-01 |
| Pu-241 | 4 9549E-02 | 30 88 | 61.75 | 0 00E+00 | 1 53E+00 | 3 06E+00 |
| Pu-242 | 2 3128E-07 | 30 88 | 61 75 | 0 00E+00 | 7 14E-06 | 1 43E-05 |
| Ra-226 | 2 4526E-13 | 30 88 | 61 75 | 0 00E+00 | 7.57E-12 | 1 51E-11 |
| Ra-228 | 2 4015E-10 | 30 88 | 61 75 | 0 00E+00 | 7.41E-09 | 1 48E-08 |
| Ru-106 | 3 0602E-06 | 30 88 | 61 75 | 0 00E+00 | 9 45E-05 | 1 89E-04 |
| Se-79 | 1.3015E-05 | 30 88 | 61 75 | 0 00E+00 | 4 02E-04 | 8 04E-04 |
| Sn-126 | 1.2165E-05 | 30 88 | 61 75 | 0 00E+00 | 3 76E-04 | 7 51E-04 |
| Sr-90 | 1 8226E+00 | 30 88 | 61 75 | 0 00E+00 | 5 63E+01 | 1 13E+02 |
| Tc-99 | 4 4241E-04 | 30 88 | 61.75 | 0 00E+00 | 1 37E-02 | 2 73E-02 |
| Th-229 | 3 0962E-10 | 30 88 | 61 75 | 0 00E+00 | 9 56E-09 | 1.91E-08 |
| Th-230 | 4.2346E-11 | 30 88 | 61 75 | 0 00E+00 | 1 31E-09 | 2 61E-09 |
| Th-232 | 2 5278E-10 | 30 88 | 61 75 | 0 00E+00 | 7.80E-09 | 1 56E-08 |
| Tl-208 | 1.5820E-08 | 30 88 | 61 75 | 0 00E+00 | 4 88E-07 | 9 77E-07 |
| U-232 | 4.2647E-08 | 30 88 | 61 75 | 0 00E+00 | 1 32E-06 | 2 63E-06 |
| U-233 | 1.2211E-07 | 30 88 | 61 75 | 0 00E+00 | 3 77E-06 | 7 54E-06 |
| U-234 | 1 9955E-07 | 30 88 | 61.75 | 0 00E+00 | 6 16E-06 | 1.23E-05 |
| U-235 | -2 6194E-06 | 30 88 | 0 00 | 2 72E-03 | 2 64E-03 | 2.72E-03 |
| U-236 | 1 2693E-05 | 30 88 | 61 75 | 0 00E+00 | 3 92E-04 | 7.84E-04 |
| U-238 | -3 6331E-08 | 30 88 | 0 00 | 1.71E-03 | 1.70E-03 | 1 71E-03 |
| Y-90 | 1 8241E+00 | 30 88 | 61 75 | 0 00E+00 | 5 63E+01 | 1 13E+02 |
| Other Radionuclides | | | | | 5 95E+01 | 1 19E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 188E+12 |
| 0 0250 | 1.288E+12 |
| 0 0375 | 1 116E+12 |
| 0 0575 | 1.201E+12 |
| 0 0850 | 7.248E+11 |
| 0 1250 | 4 737E+11 |
| 0 2250 | 6.223E+11 |
| 0 3750 | 2 728E+11 |
| 0 5750 | 4 486E+12 |
| 0 8500 | 5 056E+10 |
| 1.2500 | 8 379E+11 |
| 1 7500 | 1.299E+09 |
| 2.2500 | 4 474E+06 |
| 2 7500 | 4 931E+04 |
| 3 5000 | 2 818E+02 |
| 5 0000 | 3 602E+01 |
| 7 0000 | 4 077E+00 |
| 11 0000 | 4 643E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7 73E-01 | 1.54E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 896 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 30 88 | 18 90 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 61 75 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 14 | 0 61 |
| Bounding | 0.29 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | ACRR (PULSED CORE) | [1]Fuel decay start date: | 2035 |
| SNF ID # | 757 | Estimates as of: | 2010 |
| Fuel Units & Descr | 251 - ELEMENT | Template: | Pathfinder (Light Water, SST 60 to 100%, U) |
| Heavy Metal Mass | BOL=120 831kg EOL=120 831kg | [2]Template Burnup(MWd): | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00012882 |
| | | Template Decay Time: | 5 years |

Estimated Canister usage: 18"x10' 2 26

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9667E-09 | 2,282.86 | 4,565 72 | 0 00E+00 | 4 49E-06 | 8 98E-06 |
| Am-241 | 4 9468E-05 | 2,282.86 | 4,565 72 | 0 00E+00 | 1 13E-01 | 2 26E-01 |
| Am-242m | 9 7537E-09 | 2,282.86 | 4,565 72 | 0 00E+00 | 2 23E-05 | 4 45E-05 |
| Am-243 | 9 8802E-10 | 2,282 86 | 4,565.72 | 0 00E+00 | 2.26E-06 | 4 51E-06 |
| C-14 | 2.3095E-04 | 2,282 86 | 4,565.72 | 0 00E+00 | 5.27E-01 | 1 05E+00 |
| Cl-36 | 1.2261E-06 | 2,282 86 | 4 565.72 | 0 00E+00 | 2 80E-03 | 5 60E-03 |
| Cm-243 | 5.1581E-10 | 2,282 86 | 4,565.72 | 0 00E+00 | 1 18E-06 | 2 36E-06 |
| Cm-244 | 7.3012E-09 | 2,282 86 | 4,565.72 | 0 00E+00 | 1 67E-05 | 3 33E-05 |
| Co-60 | 3 6556E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 8 35E+03 | 1 67E+04 |
| Cs-134 | 7.2063E-02 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 65E+02 | 3.29E+02 |
| Cs-135 | 3 0316E-05 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 92E-02 | 1 38E-01 |
| Cs-137 | 2 9002E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 62E+03 | 1.32E+04 |
| Eu-154 | 7 5025E-03 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 71E+01 | 3 43E+01 |
| Eu-155 | 4 6123E-02 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 05E+02 | 2 11E+02 |
| Fe-55 | 3 6439E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 8 32E+03 | 1 66E+04 |
| H-3 | 1 3524E-02 | 2,282 86 | 4,565 72 | 0 00E+00 | 3 09E+01 | 6 17E+01 |
| I-129 | 7 3195E-07 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 67E-03 | 3.34E-03 |
| Kr-85 | 2 8686E-01 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 55E+02 | 1 31E+03 |
| Np-237 | 1 1478E-06 | 2,282 86 | 4,565 72 | 0 00E+00 | 2 62E-03 | 5.24E-03 |
| Pa-231 | 1 0990E-08 | 2,282 86 | 4,565 72 | 0 00E+00 | 2 51E-05 | 5 02E-05 |
| Pb-210 | 8 0782E-15 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 84E-11 | 3 69E-11 |
| Pm-147 | 3 2097E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 7 33E+03 | 1 47E+04 |
| Pu-238 | 3 7404E-04 | 2,282 86 | 4,565 72 | 0 00E+00 | 8 54E-01 | 1 71E+00 |
| Pu-239 | 6 6839E-04 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 53E+00 | 3 05E+00 |
| Pu-240 | 8 7121E-05 | 2,282.86 | 4,565 72 | 0 00E+00 | 1.99E-01 | 3 98E-01 |
| Pu-241 | 3 0283E-03 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 91E+00 | 1 38E+01 |
| Pu-242 | 1 9717E-09 | 2,282.86 | 4,565 72 | 0 00E+00 | 4 50E-06 | 9 00E-06 |
| Ra-226 | 7 3527E-14 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 68E-10 | 3 36E-10 |
| Ra-228 | 6 0965E-12 | 2,282 86 | 4,565.72 | 0 00E+00 | 1 39E-08 | 2 78E-08 |
| Ru-106 | 1 6531E-01 | 2,282 86 | 4,565.72 | 0 00E+00 | 3 77E+02 | 7 55E+02 |
| Se-79 | 1.3228E-05 | 2,282 86 | 4,565 72 | 0 00E+00 | 3 02E-02 | 6 04E-02 |
| Sn-126 | 1.1494E-05 | 2,282 86 | 4,565 72 | 0 00E+00 | 2 62E-02 | 5 25E-02 |
| Sr-90 | 2.7854E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 36E+03 | 1.27E+04 |
| Tc-99 | 4 6656E-04 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 07E+00 | 2.13E+00 |
| Th-229 | 2.9368E-12 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 70E-09 | 1 34E-08 |
| Th-230 | 3.2662E-11 | 2,282 86 | 4,565 72 | 0 00E+00 | 7 46E-08 | 1 49E-07 |
| Th-232 | 8.3045E-12 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 90E-08 | 3 79E-08 |
| Tl-208 | 2 6722E-08 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 10E-05 | 1.22E-04 |
| U-232 | 7 7720E-08 | 2,282 86 | 4,565 72 | 0 00E+00 | 1 77E-04 | 3 55E-04 |
| U-233 | 2 9834E-09 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 81E-06 | 1 36E-05 |
| U-234 | 3 5275E-07 | 2,282 86 | 4,565 72 | 0 00E+00 | 8 05E-04 | 1.61E-03 |
| U-235 | -2.7761E-06 | 2,282 86 | 0 00 | 5.51E-02 | 4 88E-02 | 5 51E-02 |
| U-236 | 1 6190E-05 | 2,282.86 | 4,565 72 | 0 00E+00 | 3 70E-02 | 7 39E-02 |
| U-238 | -2.8547E-09 | 2,282 86 | 0 00 | 3 20E-02 | 3.20E-02 | 3.20E-02 |
| Y-90 | 2 7870E+00 | 2,282 86 | 4,565 72 | 0 00E+00 | 6 36E+03 | 1 27E+04 |
| Other Radionuclides | | | | | 1 20E+04 | 2 40E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 8 978E+14 |
| 0 0250 | 1 915E+14 |
| 0 0375 | 1 709E+14 |
| 0 0575 | 1 718E+14 |
| 0 0850 | 1 089E+14 |
| 0 1250 | 8 686E+13 |
| 0.2250 | 9 015E+13 |
| 0.3750 | 4.376E+13 |
| 0 5750 | 5.305E+14 |
| 0 8500 | 2.569E+13 |
| 1.2500 | 1.240E+15 |
| 1 7500 | 4 378E+11 |
| 2.2500 | 1.253E+12 |
| 2.7500 | 7 109E+09 |
| 3 5000 | 7 847E+08 |
| 5 0000 | 1 891E+02 |
| 7 0000 | 2.123E+01 |
| 11 0000 | 2.406E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.42E+02 | 4.85E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 21 10367543 | 60 to 100 |

**Basis for Parameter Differences**

This Template was used for the following reasons.

This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal: | | 2,282 86 |
| Bounding | | 4,565 72 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 40 | |
| Bounding | 0 81 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | ANP | [1]Fuel decay start date | 1957 |
| SNF ID # | 451 | Estimates as of | 2010 |
| Fuel Units & Descr | 9 - CONCENTRIC TUBES | Template | Pathfinder (Light Water, SST, 60 to 100% U) |
| Heavy Metal Mass | BOL=1 118kg EOL=1 102kg | [2]Template Burnup(MWd) | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 |
| | | Template Decay Time | 50 years |

| Estimated Canister usage 18"x10' |
|---|
| 0 69 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 4276E-08 | 15 30 | 30 61 | 0 00E+00 | 5 25E-07 | 1 05E-06 |
| Am-241 | 1 1458E-04 | 15 30 | 30 61 | 0 00E+00 | 1 75E-03 | 3 51E-03 |
| Am-242m | 7 9468E-09 | 15 30 | 30 61 | 0 00E+00 | 1 22E-07 | 2 43E-07 |
| Am-243 | 9 8386E-10 | 15 30 | 30 61 | 0 00E+00 | 1 51E-08 | 3 01E-08 |
| C-14 | 2 2978E-04 | 15 30 | 30 61 | 0 00E+00 | 3 52E-03 | 7 03E-03 |
| Cl-36 | 1.2261E-06 | 15.30 | 30 61 | 0 00E+00 | 1 88E-05 | 3 75E-05 |
| Cm-243 | 1.7271E-10 | 15 30 | 30 61 | 0 00E+00 | 2 64E-09 | 5 29E-09 |
| Cm-244 | 1.3058E-09 | 15 30 | 30 61 | 0 00E+00 | 2 00E-08 | 4 00E-08 |
| Co-60 | 9 8636E-03 | 15 30 | 30 61 | 0 00E+00 | 1.51E-01 | 3 02E-01 |
| Cs-134 | 1 9617E-08 | 15 30 | 30 61 | 0 00E+00 | 3 00E-07 | 6 00E-07 |
| Cs-135 | 3 0316E-05 | 15 30 | 30 61 | 0.00E+00 | 4 64E-04 | 9 28E-04 |
| Cs-137 | 1 0263E+00 | 15 30 | 30 61 | 0 00E+00 | 1 57E+01 | 3 14E+01 |
| Eu-154 | 2 0017E-04 | 15 30 | 30 61 | 0 00E+00 | 3 06E-03 | 6.13E-03 |
| Eu-155 | 8 5957E-05 | 15 30 | 30 61 | 0 00E+00 | 1 32E-03 | 2 63E-03 |
| Fe-55 | 2 2646E-05 | 15 30 | 30 61 | 0 00E+00 | 3 47E-04 | 6 93E-04 |
| H-3 | 1 0835E-03 | 15 30 | 30 61 | 0 00E+00 | 1 66E-02 | 3 32E-02 |
| I-129 | 7 3195E-07 | 15 30 | 30 61 | 0 00E+00 | 1 12E-05 | 2 24E-05 |
| Kr-85 | 1.5661E-02 | 15 30 | 30 61 | 0 00E+00 | 2 40E-01 | 4 79E-01 |
| Np-237 | 1 1494E-06 | 15 30 | 30 61 | 0 00E+00 | 1.76E-05 | 3 52E-05 |
| Pa-231 | 5 8070E-08 | 15 30 | 30 61 | 0 00E+00 | 8 89E-07 | 1 78E-06 |
| Pb-210 | 1 2985E-12 | 15 30 | 30 61 | 0 00E+00 | 1 99E-11 | 3 97E-11 |
| Pm-147 | 2 2196E-05 | 15 30 | 30 61 | 0 00E+00 | 3 40E-04 | 6 79E-04 |
| Pu-238 | 2 6223E-04 | 15 30 | 30 61 | 0 00E+00 | 4 01E-03 | 8 03E-03 |
| Pu-239 | 6 6739E-04 | 15 30 | 30 61 | 0 00E+00 | 1 02E-02 | 2 04E-02 |
| Pu-240 | 8 6705E-05 | 15 30 | 30 61 | 0 00E+00 | 1 33E-03 | 2 65E-03 |
| Pu-241 | 3 4759E-04 | 15.30 | 30 61 | 0 00E+00 | 5 32E-03 | 1 06E-02 |
| Pu-242 | 1 9717E-09 | 15 30 | 30 61 | 0 00E+00 | 3 02E-08 | 6 03E-08 |
| Ra-226 | 3 0000E-12 | 15 30 | 30 61 | 0 00E+00 | 4 59E-11 | 9 18E-11 |
| Ra-228 | 8 3328E-12 | 15 30 | 30 61 | 0 00E+00 | 1.28E-10 | 2 55E-10 |
| Ru-106 | 6 1464E-15 | 15 30 | 30 61 | 0 00E+00 | 9 41E-14 | 1 88E-13 |
| Se-79 | 1 3221E-05 | 15 30 | 30 61 | 0.00E+00 | 2 02E-04 | 4 05E-04 |
| Sn-126 | 1 1491E-05 | 15 30 | 30 61 | 0 00E+00 | 1 76E-04 | 3 52E-04 |
| Sr-90 | 9 5541E-01 | 15 30 | 30 61 | 0 00E+00 | 1 46E+01 | 2 92E+01 |
| Tc-99 | 4 6656E-04 | 15 30 | 30 61 | 0 00E+00 | 7 14E-03 | 1 43E-02 |
| Th-229 | 1 9085E-11 | 15 30 | 30 61 | 0 00E+00 | 2 92E-10 | 5 84E-10 |
| Th-230 | 2 1913E-10 | 15.30 | 30 61 | 0 00E+00 | 3 35E-09 | 6 71E-09 |
| Th-232 | 8 3478E-12 | 15 30 | 30 61 | 0 00E+00 | 1.28E-10 | 2 55E-10 |
| Tl-208 | 1.8752E-08 | 15 30 | 30 61 | 0 00E+00 | 2 87E-07 | 5 74E-07 |
| U-232 | 5 0782E-08 | 15 30 | 30 61 | 0 00E+00 | 7.77E-07 | 1.55E-06 |
| U-233 | 3.2596E-09 | 15 30 | 30 61 | 0 00E+00 | 4 99E-08 | 9 98E-08 |
| U-234 | 3 9817E-07 | 15 30 | 30 61 | 0 00E+00 | 6 09E-06 | 1.22E-05 |
| U-235 | -2 7761E-06 | 15 30 | 0 00 | 2.25E-03 | 2 21E-03 | 2.25E-03 |
| U-236 | 1 6190E-05 | 15 30 | 30 61 | 0 00E+00 | 2 48E-04 | 4 96E-04 |
| U-238 | -2 8547E-09 | 15 30 | 0 00 | 2 55E-05 | 2 55E-05 | 2 55E-05 |
| Y-90 | 9 5557E-01 | 15.30 | 30 61 | 0 00E+00 | 1 46E+01 | 2 92E+01 |
| Other Radionuclides | | | | | 1 87E+01 | 3 73E+01 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 1 596E+12 |
| 0 0250 | 3 317E+11 |
| 0 0375 | 2.875E+11 |
| 0 0575 | 3.093E+11 |
| 0 0850 | 1.868E+11 |
| 0 1250 | 1.212E+11 |
| 0.2250 | 1 610E+11 |
| 0 3750 | 7 023E+10 |
| 0 5750 | 1 169E+12 |
| 0.8500 | 1 154E+10 |
| 1.2500 | 2 629E+10 |
| 1 7500 | 2 972E+08 |
| 2.2500 | 1 507E+05 |
| 2 7500 | 2 052E+04 |
| 3 5000 | 1 994E+00 |
| 5 0000 | 8.245E-01 |
| 7 0000 | 9 127E-02 |
| 11 0000 | 1.026E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 79E-01 | 3.57E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | This Template was used for the following reasons |
| Fuel Cladding | NICHROME | SST | This fuel matches on all parameters except cladding (SST is conservative) |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93.20218125 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 15 30 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 30 61 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.29 | |
| Bounding | 0 59 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name: | APPR (AGE-2) | [1]Fuel decay start date: | 1959 |
| SNF ID # | 6 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - CANISTER OF SCRAP | Template: | Pathfinder (Light Water, SST, 60 to 100% U) |
| Heavy Metal Mass | BOL=0.246kg, EOL=0.216kg | [2]Template Burnup(MWd) | 6.01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00012882 |
| | | Template Decay Time: | 50 years |

Estimated Canister usage: 18"x10' — 0 08

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 4276E-08 | 28 72 | 57 43 | 0 00E+00 | 9 84E-07 | 1.97E-06 |
| Am-241 | 1.1458E-04 | 28 72 | 57 43 | 0 00E+00 | 3 29E-03 | 6.58E-03 |
| Am-242m | 7 9468E-09 | 28 72 | 57 43 | 0 00E+00 | 2 28E-07 | 4 56E-07 |
| Am-243 | 9 8386E-10 | 28 72 | 57 43 | 0 00E+00 | 2 83E-08 | 5 65E-08 |
| C-14 | 2 2978E-04 | 28 72 | 57.43 | 0 00E+00 | 6 60E-03 | 1 32E-02 |
| Cl-36 | 1.2261E-06 | 28 72 | 57 43 | 0 00E+00 | 3 52E-05 | 7 04E-05 |
| Cm-243 | 1 7271E-10 | 28.72 | 57 43 | 0 00E+00 | 4 96E-09 | 9 92E-09 |
| Cm-244 | 1 3058E-09 | 28 72 | 57 43 | 0 00E+00 | 3 75E-08 | 7 50E-08 |
| Co-60 | 9 8636E-03 | 28.72 | 57 43 | 0 00E+00 | 2 83E-01 | 5 67E-01 |
| Cs-134 | 1 9617E-08 | 28.72 | 57 43 | 0 00E+00 | 5 63E-07 | 1 13E-06 |
| Cs-135 | 3 0316E-05 | 28.72 | 57 43 | 0 00E+00 | 8 71E-04 | 1 74E-03 |
| Cs-137 | 1 0263E+00 | 28.72 | 57 43 | 0 00E+00 | 2 95E+01 | 5 89E+01 |
| Eu-154 | 2 0017E-04 | 28.72 | 57 43 | 0 00E+00 | 5 75E-03 | 1 15E-02 |
| Eu-155 | 8 5957E-05 | 28 72 | 57 43 | 0 00E+00 | 2 47E-03 | 4 94E-03 |
| Fe-55 | 2 2646E-05 | 28 72 | 57 43 | 0 00E+00 | 6 50E-04 | 1 30E-03 |
| H-3 | 1 0835E-03 | 28 72 | 57 43 | 0 00E+00 | 3 11E-02 | 6 22E-02 |
| I-129 | 7 3195E-07 | 28 72 | 57 43 | 0 00E+00 | 2.10E-05 | 4.20E-05 |
| Kr-85 | 1 5661E-02 | 28 72 | 57 43 | 0 00E+00 | 4 50E-01 | 8 99E-01 |
| Np-237 | 1 1494E-06 | 28 72 | 57 43 | 0 00E+00 | 3.30E-05 | 6 60E-05 |
| Pa-231 | 5 8070E-08 | 28 72 | 57 43 | 0 00E+00 | 1.67E-06 | 3.34E-06 |
| Pb-210 | 1 2985E-12 | 28 72 | 57 43 | 0 00E+00 | 3.73E-11 | 7.46E-11 |
| Pm-147 | 2.2196E-05 | 28 72 | 57 43 | 0 00E+00 | 6.37E-04 | 1.27E-03 |
| Pu-238 | 2 6223E-04 | 28 72 | 57 43 | 0 00E+00 | 7 53E-03 | 1.51E-02 |
| Pu-239 | 6 6739E-04 | 28 72 | 57 43 | 0 00E+00 | 1 92E-02 | 3 83E-02 |
| Pu-240 | 8 6705E-05 | 28 72 | 57.43 | 0 00E+00 | 2 49E-03 | 4 98E-03 |
| Pu-241 | 3 4759E-04 | 28 72 | 57.43 | 0.00E+00 | 9 98E-03 | 2 00E-02 |
| Pu-242 | 1 9717E-09 | 28 72 | 57.43 | 0 00E+00 | 5 66E-08 | 1 13E-07 |
| Ra-226 | 3 0000E-12 | 28 72 | 57 43 | 0 00E+00 | 8 62E-11 | 1 72E-10 |
| Ra-228 | 8 3328E-12 | 28 72 | 57 43 | 0 00E+00 | 2 39E-10 | 4 79E-10 |
| Ru-106 | 6 1464E-15 | 28.72 | 57 43 | 0 00E+00 | 1 77E-13 | 3 53E-13 |
| Se-79 | 1 3221E-05 | 28.72 | 57 43 | 0 00E+00 | 3 80E-04 | 7 59E-04 |
| Sn-126 | 1 1491E-05 | 28.72 | 57 43 | 0 00E+00 | 3 30E-04 | 6 60E-04 |
| Sr-90 | 9 5541E-01 | 28.72 | 57 43 | 0 00E+00 | 2.74E+01 | 5 49E+01 |
| Tc-99 | 4 6656E-04 | 28 72 | 57 43 | 0 00E+00 | 1 34E-02 | 2 68E-02 |
| Th-229 | 1 9085E-11 | 28 72 | 57 43 | 0 00E+00 | 5 48E-10 | 1 10E-09 |
| Th-230 | 2 1913E-10 | 28 72 | 57 43 | 0 00E+00 | 6.29E-09 | 1.26E-08 |
| Th-232 | 8 3478E-12 | 28 72 | 57 43 | 0 00E+00 | 2 40E-10 | 4 79E-10 |
| Tl-208 | 1 8752E-08 | 28 72 | 57 43 | 0 00E+00 | 5 39E-07 | 1 08E-06 |
| U-232 | 5 0782E-08 | 28 72 | 57 43 | 0 00E+00 | 1.46E-06 | 2 92E-06 |
| U-233 | 3 2596E-09 | 28 72 | 57 43 | 0 00E+00 | 9.36E-08 | 1 87E-07 |
| U-234 | 3 9817E-07 | 28 72 | 57 43 | 0 00E+00 | 1.14E-05 | 2.29E-05 |
| U-235 | -2 7761E-06 | 28 72 | 0 00 | 4 95E-04 | 4.15E-04 | 4 95E-04 |
| U-236 | 1 6190E-05 | 28 72 | 57.43 | 0 00E+00 | 4 65E-04 | 9.30E-04 |
| U-238 | -2 8547E-09 | 28 72 | 0 00 | 5 81E-06 | 5 73E-06 | 5 81E-06 |
| Y-90 | 9 5557E-01 | 28 72 | 57 43 | 0 00E+00 | 2 74E+01 | 5 49E+01 |
| Other Radionuclides | | | | | 3 50E+01 | 7 00E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.995E+12 |
| 0 0250 | 6.224E+11 |
| 0 0375 | 5.396E+11 |
| 0 0575 | 5.804E+11 |
| 0 0850 | 3.506E+11 |
| 0 1250 | 2.274E+11 |
| 0.2250 | 3 021E+11 |
| 0.3750 | 1 318E+11 |
| 0.5750 | 2.194E+12 |
| 0.8500 | 2.166E+10 |
| 1.2500 | 4 934E+10 |
| 1 7500 | 5.578E+08 |
| 2.2500 | 2.827E+05 |
| 2.7500 | 3 851E+04 |
| 3 5000 | 3 391E+00 |
| 5 0000 | 1 400E+00 |
| 7 0000 | 1.547E-01 |
| 11 0000 | 1 736E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.35E-01 | 6.70E-01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 92 987 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 28 72 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 57 43 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 2 50 | |
| Bounding | 5 00 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name ARKANSAS
SNF ID # 7
Fuel Units & Descr 3 - SCRAP
Heavy Metal Mass BOL=12 6kg EOL=11 895kg
ROD Storage Site INEEL

[1]Fuel decay start date 1986
Estimates as of 2010
Template PWR (Light Water, Zirc 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 20 years

Estimated Canister usage 18"x10'
0 17

### II. Estimates

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 5 0630E-10 | 670 42 | 1,340 84 | 0 00E+00 | 3 39E-07 | 6 79E-07 |
| Am-241 | 1 1489E-01 | 670 42 | 1,340 84 | 0 00E+00 | 7.70E+01 | 1 54E+02 |
| Am-242m | 3 0733E-04 | 670 42 | 1,340 84 | 0 00E+00 | 2 06E-01 | 4.12E-01 |
| Am-243 | 6 2661E-04 | 670 42 | 1,340 84 | 0 00E+00 | 4 20E-01 | 8 40E-01 |
| C-14 | 4 7997E-05 | 670 42 | 1,340 84 | 0 00E+00 | 3 22E-02 | 6 44E-02 |
| Cl-36 | 8 0313E-07 | 670 42 | 1,340 84 | 0 00E+00 | 5 38E-04 | 1 08E-03 |
| Cm-243 | 3 6127E-04 | 670 42 | 1,340 84 | 0 00E+00 | 2 42E-01 | 4 84E-01 |
| Cm-244 | 8 6999E-02 | 670 42 | 1,340 84 | 0 00E+00 | 5 83E+01 | 1 17E+02 |
| Co-60 | 1 8379E-02 | 670 42 | 1,340 84 | 0 00E+00 | 1.23E+01 | 2 46E+01 |
| Cs-134 | 6 2548E-03 | 670 42 | 1,340 84 | 0 00E+00 | 4 19E+00 | 8 39E+00 |
| Cs-135 | 1 4433E-05 | 670 42 | 1,340 84 | 0 00E+00 | 9 68E-03 | 1.94E-02 |
| Cs-137 | 1 9767E+00 | 670 42 | 1,340 84 | 0 00E+00 | 1 33E+03 | 2 65E+03 |
| Eu-154 | 6 7603E-02 | 670 42 | 1,340 84 | 0 00E+00 | 4 53E+01 | 9 06E+01 |
| Eu-155 | 1 4373E-02 | 670 42 | 1,340 84 | 0 00E+00 | 9 64E+00 | 1 93E+01 |
| Fe-55 | 2 3466E-03 | 670 42 | 1,340 84 | 0 00E+00 | 1 57E+00 | 3 15E+00 |
| H-3 | 4 8143E-02 | 670 42 | 1,340 84 | 0 00E+00 | 3 23E+01 | 6 46E+01 |
| I-129 | 9 8288E-07 | 670 42 | 1,340 84 | 0 00E+00 | 6 59E-04 | 1 32E-03 |
| Kr-85 | 7 4386E-02 | 670 42 | 1,340 84 | 0 00E+00 | 4 99E+01 | 9 97E+01 |
| Np-237 | 1.0145E-05 | 670 42 | 1,340 84 | 0 00E+00 | 6 80E-03 | 1.36E-02 |
| Pa-231 | 1 0258E-09 | 670 42 | 1,340 84 | 0 00E+00 | 6 88E-07 | 1.38E-06 |
| Pb-210 | 1 4163E-11 | 670 42 | 1,340 84 | 0 00E+00 | 9 50E-09 | 1 90E-08 |
| Pm-147 | 1 9170E-02 | 670 42 | 1,340 84 | 0 00E+00 | 1 29E+01 | 2 57E+01 |
| Pu-238 | 8 3915E-02 | 670 42 | 1,340 84 | 0 00E+00 | 5 63E+01 | 1 13E+02 |
| Pu-239 | 1 1628E-02 | 670 42 | 1,340 84 | 0 00E+00 | 7 80E+00 | 1 56E+01 |
| Pu-240 | 1 5050E-02 | 670 42 | 1,340 84 | 0 00E+00 | 1.01E+01 | 2 02E+01 |
| Pu-241 | 1 8524E+00 | 670 42 | 1,340 84 | 0 00E+00 | 1.24E+03 | 2 48E+03 |
| Pu-242 | 6 4260E-05 | 670 42 | 1,340 84 | 0 00E+00 | 4 31E-02 | 8 62E-02 |
| Ra-226 | 6 0562E-11 | 670 42 | 1,340 84 | 0 00E+00 | 4 06E-08 | 8 12E-08 |
| Ra-228 | 4 9919E-12 | 670 42 | 1,340 84 | 0 00E+00 | 3 35E-09 | 6 69E-09 |
| Ru-106 | 1 8330E-05 | 670 42 | 1,340 84 | 0 00E+00 | 1 23E-02 | 2 46E-02 |
| Se-79 | 1 2379E-05 | 670 42 | 1,340 84 | 0 00E+00 | 8 30E-03 | 1 66E-02 |
| Sn-126 | 2 5210E-05 | 670 42 | 1,340 84 | 0 00E+00 | 1 69E-02 | 3 38E-02 |
| Sr-90 | 1 3098E+00 | 670 42 | 1,340 84 | 0 00E+00 | 8 78E+02 | 1 76E+03 |
| Tc-99 | 3 9357E-04 | 670 42 | 1,340 84 | 0 00E+00 | 2 64E-01 | 5 28E-01 |
| Th-229 | 6.2968E-11 | 670 42 | 1,340 84 | 0 00E+00 | 4 22E-08 | 8 44E-08 |
| Th-230 | 1 0362E-08 | 670 42 | 1,340 84 | 0 00E+00 | 6 95E-06 | 1 39E-05 |
| Th-232 | 5.2891E-12 | 670 42 | 1,340 84 | 0 00E+00 | 3 55E-09 | 7 09E-09 |
| Tl-208 | 1 9977E-07 | 670 42 | 1,340 84 | 0 00E+00 | 1 34E-04 | 2 68E-04 |
| U-232 | 5 4490E-07 | 670 42 | 1,340 84 | 0.00E+00 | 3 65E-04 | 7 31E-04 |
| U-233 | 2 3934E-08 | 670 42 | 1,340 84 | 0 00E+00 | 1 60E-05 | 3 21E-05 |
| U-234 | 4 4816E-05 | 670 42 | 1,340 84 | 0 00E+00 | 3 00E-02 | 6 01E-02 |
| U-235 | -1 4492E-06 | 670 42 | 0 00 | 7 90E-04 | 0 00E+00 | 7 90E-04 |
| U-236 | 7.5711E-06 | 670 42 | 1,340 84 | 0 00E+00 | 5 08E-03 | 1.02E-02 |
| U-238 | -2 6129E-07 | 670 42 | 0 00 | 4 11E-03 | 3 94E-03 | 4 11E-03 |
| Y-90 | 1.3101E+00 | 670 42 | 1,340 84 | 0 00E+00 | 8 78E+02 | 1 76E+03 |
| Other Radionuclides | | | | | 1 27E+03 | 2 54E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 026E+14 |
| 0 0250 | 2 089E+13 |
| 0 0375 | 2 041E+13 |
| 0 0575 | 2 144E+13 |
| 0 0850 | 1 175E+13 |
| 0 1250 | 8 898E+12 |
| 0 2250 | 1 007E+13 |
| 0 3750 | 4.342E+12 |
| 0.5750 | 9 858E+13 |
| 0.8500 | 2.555E+12 |
| 1.2500 | 3 836E+12 |
| 1 7500 | 7 062E+10 |
| 2.2500 | 1 637E+07 |
| 2 7500 | 1 149E+07 |
| 3 5000 | 1 701E+06 |
| 5 0000 | 7 164E+05 |
| 7 0000 | 8.259E+04 |
| 11 0000 | 9 488E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 01E+01 | 4 02E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences. |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2 9 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 592.20 | 670 42 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 1 340 84 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.52 | 1 13 |
| Bounding | 3.04 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: ARMF (PLATES)
SNF ID #: 8
Fuel Units & Descr: 15 - FLAT PLATES IN CAN
Heavy Metal Mass: BOL=0 198kg EOL=0 198kg
ROD Storage Site: SRS

[1]Fuel decay start date: 1987
Estimates as of: 2010
Template: ATR (Light Water, Alum , 60 to 100% U)
[2]Template Burnup(MWd): 367.2
Template BOL Heavy Metal Mass (MT): 0 00116689
Template Decay Time: 20 years

Estimated Canister usage: 18"x10": 1 00

### II. Estimates

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 6 6313E-10 | 0 02 | 0 05 | 0 00E+00 | 1 51E-11 | 3 02E-11 |
| Am-241 | 2 0060E-03 | 0 02 | 0 05 | 0 00E+00 | 4 57E-05 | 9 14E-05 |
| Am-242m | 4 2429E-07 | 0 02 | 0 05 | 0 00E+00 | 9 66E-09 | 1 93E-08 |
| Am-243 | 1 4899E-06 | 0 02 | 0 05 | 0 00E+00 | 3 39E-08 | 6 79E-08 |
| C-14 | 5.7135E-09 | 0 02 | 0 05 | 0 00E+00 | 1 30E-10 | 2 60E-10 |
| Cl-36 | 1.3124E-32 | 0 02 | 0 05 | 0 00E+00 | 2 99E-34 | 5 98E-34 |
| Cm-243 | 1 6443E-07 | 0 02 | 0 05 | 0 00E+00 | 3 74E-09 | 7 49E-09 |
| Cm-244 | 2 9330E-05 | 0 02 | 0 05 | 0 00E+00 | 6 68E-07 | 1 34E-06 |
| Co-60 | 5 3186E-06 | 0 02 | 0 05 | 0 00E+00 | 1 21E-07 | 2 42E-07 |
| Cs-134 | 3 1563E-03 | 0 02 | 0 05 | 0 00E+00 | 7 19E-05 | 1 44E-04 |
| Cs-135 | 3 4477E-06 | 0 02 | 0 05 | 0 00E+00 | 7 85E-08 | 1 57E-07 |
| Cs-137 | 2 0313E+00 | 0 02 | 0 05 | 0 00E+00 | 4 63E-02 | 9 25E-02 |
| Eu-154 | 2 4513E-02 | 0 02 | 0 05 | 0 00E+00 | 5 58E-04 | 1.12E-03 |
| Eu-155 | 4 8175E-03 | 0 02 | 0 05 | 0 00E+00 | 1 10E-04 | 2.19E-04 |
| Fe-55 | 1 2397E-04 | 0 02 | 0 05 | 0 00E+00 | 2 82E-06 | 5 65E-06 |
| H-3 | 4 5697E-03 | 0 02 | 0 05 | 0 00E+00 | 1 04E-04 | 2.08E-04 |
| I-129 | 7 5300E-07 | 0 02 | 0 05 | 0 00E+00 | 1.71E-08 | 3 43E-08 |
| Kr-85 | 1 0850E-01 | 0 02 | 0 05 | 0 00E+00 | 2 47E-03 | 4 94E-03 |
| Np-237 | 9 5561E-06 | 0 02 | 0 05 | 0 00E+00 | 2 18E-07 | 4 35E-07 |
| Pa-231 | 2 0359E-09 | 0 02 | 0 05 | 0 00E+00 | 4 64E-11 | 9 27E-11 |
| Pb-210 | 4 9728E-11 | 0 02 | 0 05 | 0 00E+00 | 1 13E-12 | 2.26E-12 |
| Pm-147 | 4 8502E-02 | 0 02 | 0 05 | 0 00E+00 | 1 10E-03 | 2 21E-03 |
| Pu-238 | 1 8254E-02 | 0 02 | 0 05 | 0 00E+00 | 4 16E-04 | 8 31E-04 |
| Pu-239 | 4 2810E-04 | 0 02 | 0 05 | 0 00E+00 | 9 75E-06 | 1 95E-05 |
| Pu-240 | 2 4368E-04 | 0 02 | 0 05 | 0 00E+00 | 5 55E-06 | 1 11E-05 |
| Pu-241 | 3 3415E-02 | 0 02 | 0 05 | 0 00E+00 | 7 61E-04 | 1 52E-03 |
| Pu-242 | 3 6329E-07 | 0 02 | 0 05 | 0 00E+00 | 8 27E-09 | 1 65E-08 |
| Ra-226 | 2 2854E-10 | 0.02 | 0 05 | 0 00E+00 | 5 20E-12 | 1 04E-11 |
| Ra-228 | 1 2426E-14 | 0 02 | 0 05 | 0 00E+00 | 2 83E-16 | 5 66E-16 |
| Ru-106 | 6 3589E-06 | 0 02 | 0 05 | 0 00E+00 | 1 45E-07 | 2 90E-07 |
| Se-79 | 1 2933E-05 | 0 02 | 0 05 | 0 00E+00 | 2 94E-07 | 5 89E-07 |
| Sn-126 | 1 1574E-05 | 0 02 | 0 05 | 0 00E+00 | 2 64E-07 | 5.27E-07 |
| Sr-90 | 1 9248E+00 | 0 02 | 0 05 | 0 00E+00 | 4.38E-02 | 8.77E-02 |
| Tc-99 | 4 2239E-04 | 0 02 | 0 05 | 0 00E+00 | 9 62E-06 | 1 92E-05 |
| Th-229 | 5 0953E-12 | 0 02 | 0 05 | 0 00E+00 | 1 16E-13 | 2 32E-13 |
| Th-230 | 4 1885E-08 | 0 02 | 0 05 | 0 00E+00 | 9 54E-10 | 1 91E-09 |
| Th-232 | 1 9270E-14 | 0 02 | 0 05 | 0 00E+00 | 4.39E-16 | 8 78E-16 |
| Tl-208 | 4 6024E-08 | 0 02 | 0 05 | 0 00E+00 | 1 05E-09 | 2 10E-09 |
| U-232 | 1.2582E-07 | 0 02 | 0 05 | 0 00E+00 | 2 86E-09 | 5 73E-09 |
| U-233 | 2 5825E-09 | 0 02 | 0 05 | 0 00E+00 | 5 88E-11 | 1 18E-10 |
| U-234 | 1 8450E-04 | 0 02 | 0.05 | 0 00E+00 | 4 20E-06 | 8 40E-06 |
| U-235 | -2 7235E-06 | 0 02 | 0 00 | 3 93E-04 | 3 93E-04 | 3 93E-04 |
| U-236 | 1 5493E-05 | 0.02 | 0 05 | 0 00E+00 | 3 53E-07 | 7 06E-07 |
| U-238 | -4 2851E-09 | 0 02 | 0 00 | 5.39E-06 | 5 39E-06 | 5 39E-06 |
| Y-90 | 1 9254E+00 | 0 02 | 0 05 | 0 00E+00 | 4 38E-02 | 8 77E-02 |
| Other Radionuclides | | | | | 4 40E-02 | 8 81E-02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 816E+09 |
| 0 0250 | 9 996E+08 |
| 0 0375 | 8 719E+08 |
| 0 0575 | 9 338E+08 |
| 0 0850 | 5 655E+08 |
| 0 1250 | 3.841E+08 |
| 0 2250 | 4 948E+08 |
| 0 3750 | 2.120E+08 |
| 0 5750 | 3 457E+09 |
| 0 8500 | 5 845E+07 |
| 1.2500 | 3.338E+07 |
| 1 7500 | 1 532E+06 |
| 2 2500 | 1 345E+02 |
| 2 7500 | 7 602E+01 |
| 3.5000 | 3 910E-01 |
| 5 0000 | 3 743E-02 |
| 7 0000 | 4 178E-03 |
| 11 0000 | 4 716E-04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.53E-04 | 1 10E-03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 91 89393939 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal: | 0 02 | |
| Bounding | | 0 05 |

Basis for burnup used in estimate:

Nominal burnup taken directly from SFD (converted to MWd)

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | 0 00 |
| Bounding | 0 00 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name ARMF/CFRMF MARK I
SNF ID # 9
Fuel Units & Descr 56 15 FLAT PLATES
Heavy Metal Mass BOL=11.29kg EOL=11.29kg
ROD Storage Site SRS

[1]Fuel decay start date 1991
Estimates as of 2010
Template ATR (Light Water Alum , 60 to 100%, U)
[2]Template Burnup(MWd) 367 2
Template BOL Heavy Metal Mass (MT) 0 00116689
Template Decay Time 15 years

Estimated Canister usage 18"x10' 2 33

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 5861E-10 | 1 30 | 13 74 | 0 00E+00 | 5.95E-10 | 6 30E-09 |
| Am-241 | 1 7832E-03 | 1 30 | 13 74 | 0 00E+00 | 2 32E-03 | 2.45E-02 |
| Am-242m | 4 3410E-07 | 1 30 | 13 74 | 0 00E+00 | 5 64E-07 | 5 96E-06 |
| Am-243 | 1 4907E-06 | 1 30 | 13 74 | 0 00E+00 | 1 94E-06 | 2 05E-05 |
| C-14 | 5 7162E-09 | 1 30 | 13 74 | 0 00E+00 | 7 42E-09 | 7 85E-08 |
| Cl-36 | 1.3124E-32 | 1.30 | 13 74 | 0 00E+00 | 1 70E-32 | 1 80E-31 |
| Cm-243 | 1 8568E-07 | 1.30 | 13 74 | 0 00E+00 | 2 41E-07 | 2 55E-06 |
| Cm-244 | 3 5512E-05 | 1.30 | 13 74 | 0 00E+00 | 4 61E-05 | 4 88E-04 |
| Co-60 | 1 0261E-05 | 1 30 | 13 74 | 0 00E+00 | 1 33E-05 | 1 41E-04 |
| Cs-134 | 1 6931E-02 | 1 30 | 13 74 | 0 00E+00 | 2.20E-02 | 2 33E-01 |
| Cs-135 | 3 4477E-06 | 1 30 | 13 74 | 0 00E+00 | 4 48E-06 | 4 74E-05 |
| Cs-137 | 2 2800E+00 | 1 30 | 13 74 | 0 00E+00 | 2 96E+00 | 3 13E+01 |
| Eu-154 | 3 6656E-02 | 1 30 | 13 74 | 0 00E+00 | 4 76E-02 | 5 04E-01 |
| Eu-155 | 9 6841E-03 | 1 30 | 13 74 | 0 00E+00 | 1.26E-02 | 1.33E-01 |
| Fe-55 | 4 6977E-04 | 1.30 | 13 74 | 0 00E+00 | 6 10E-04 | 6 45E-03 |
| H-3 | 6 0485E-03 | 1.30 | 13 74 | 0 00E+00 | 7 85E-03 | 8 31E-02 |
| I-129 | 7.5300E-07 | 1.30 | 13 74 | 0 00E+00 | 9 78E-07 | 1 03E-05 |
| Kr-85 | 1 4989E-01 | 1 30 | 13 74 | 0 00E+00 | 1 95E-01 | 2 06E+00 |
| Np-237 | 9 5534E-06 | 1 30 | 13 74 | 0 00E+00 | 1 24E-05 | 1 31E-04 |
| Pa-231 | 1 6550E-09 | 1 30 | 13 74 | 0 00E+00 | 2 15E-09 | 2 27E-08 |
| Pb-210 | 2 6631E-11 | 1 30 | 13 74 | 0 00E+00 | 3 46E-11 | 3 66E-10 |
| Pm-147 | 1 8156E-01 | 1 30 | 13 74 | 0 00E+00 | 2.36E-01 | 2 49E+00 |
| Pu-238 | 1 8990E-02 | 1 30 | 13 74 | 0 00E+00 | 2.47E-02 | 2 61E-01 |
| Pu-239 | 4.2838E-04 | 1 30 | 13 74 | 0 00E+00 | 5 56E-04 | 5 89E-03 |
| Pu-240 | 2 4379E-04 | 1 30 | 13 74 | 0 00E+00 | 3 17E-04 | 3 35E-03 |
| Pu-241 | 4.2511E-02 | 1.30 | 13 74 | 0 00E+00 | 5 52E-02 | 5 84E-01 |
| Pu-242 | 3 6329E-07 | 1.30 | 13 74 | 0 00E+00 | 4 72E-07 | 4 99E-06 |
| Ra-226 | 1 4725E-10 | 1.30 | 13 74 | 0 00E+00 | 1 91E-10 | 2 02E-09 |
| Ra-228 | 8 9760E-15 | 1 30 | 13 74 | 0 00E+00 | 1 17E-14 | 1 23E-13 |
| Ru-106 | 1 9752E-04 | 1 30 | 13 74 | 0 00E+00 | 2 56E-04 | 2 71E-03 |
| Se-79 | 1 2933E-05 | 1 30 | 13 74 | 0 00E+00 | 1 68E-05 | 1 78E-04 |
| Sn-126 | 1 1574E-05 | 1 30 | 13 74 | 0 00E+00 | 1 50E-05 | 1.59E-04 |
| Sr-90 | 2 1680E+00 | 1 30 | 13.74 | 0 00E+00 | 2 81E+00 | 2 98E+01 |
| Tc-99 | 4 2239E-04 | 1 30 | 13 74 | 0 00E+00 | 5 48E-04 | 5 80E-03 |
| Th-229 | 3 9270E-12 | 1.30 | 13 74 | 0 00E+00 | 5 10E-12 | 5 40E-11 |
| Th-230 | 3 3578E-08 | 1.30 | 13 74 | 0 00E+00 | 4 36E-08 | 4 61E-07 |
| Th-232 | 1 5452E-14 | 1.30 | 13 74 | 0 00E+00 | 2 01E-14 | 2 12E-13 |
| Tl-208 | 4 6705E-08 | 1.30 | 13 74 | 0 00E+00 | 6 06E-08 | 6 42E-07 |
| U-232 | 1 3045E-07 | 1 30 | 13 74 | 0 00E+00 | 1 69E-07 | 1 79E-06 |
| U-233 | 2 3739E-09 | 1 30 | 13 74 | 0 00E+00 | 3 08E-09 | 3.26E-08 |
| U-234 | 1 8423E-04 | 1 30 | 13 74 | 0 00E+00 | 2 39E-04 | 2.53E-03 |
| U-235 | -2 7235E-06 | 1 30 | 0 00 | 2 25E-02 | 2 25E-02 | 2.25E-02 |
| U-236 | 1 5493E-05 | 1 30 | 13 74 | 0 00E+00 | 2 01E-05 | 2 13E-04 |
| U-238 | -4.2851E-09 | 1 30 | 0 00 | 2 92E-04 | 2 92E-04 | 2 92E-04 |
| Y-90 | 2 1686E+00 | 1.30 | 13 74 | 0 00E+00 | 2 82E+00 | 2 98E+01 |
| Other Radionuclides | | | | | 2 82E+00 | 2 99E+01 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 1 639E+12 |
| 0 0250 | 3 418E+11 |
| 0 0375 | 2.985E+11 |
| 0 0575 | 3 183E+11 |
| 0 0850 | 1.928E+11 |
| 0 1250 | 1.323E+11 |
| 0 2250 | 1 665E+11 |
| 0 3750 | 7.276E+10 |
| 0 5750 | 1 181E+12 |
| 0.8500 | 2.805E+10 |
| 1.2500 | 1 417E+10 |
| 1 7500 | 5 938E+08 |
| 2.2500 | 7 428E+05 |
| 2 7500 | 4 465E+04 |
| 3 5000 | 2 840E+03 |
| 5 0000 | 7 537E+00 |
| 7 0000 | 8 368E-01 |
| 11 0000 | 9 412E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.57E-02 | 3.72E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 92.29270621 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate. |
|---|---|---|---|
| Nominal | 1 30 | | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 13 74 | | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | 0 00 |
| Bounding | 0 00 | 0 00 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: ARMF/CFRMF MARK I LL
SNF ID #: 10
Fuel Units & Descr: 2 - 15 FLAT PLATES
Heavy Metal Mass: BOL=0 236kg EOL=0.236kg
ROD Storage Site: SRS

[1]Fuel decay start date: 1991
Estimates as of: 2010
Template: ATR (Light Water, Alum , 60 to 100%, U)
[2]Template Burnup(MWd): 367.2
Template BOL Heavy Metal Mass (MT): 0 00116689
Template Decay Time: 15 years

Estimated Canister usage 18"x10': 0 08

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 5861E-10 | 0 03 | 0 29 | 0 00E+00 | 1 24E-11 | 1 32E-10 |
| Am-241 | 1 7832E-03 | 0 03 | 0.29 | 0 00E+00 | 4 84E-05 | 5 12E-04 |
| Am-242m | 4 3410E-07 | 0 03 | 0.29 | 0 00E+00 | 1 18E-08 | 1 25E-07 |
| Am-243 | 1 4907E-06 | 0 03 | 0.29 | 0 00E+00 | 4 05E-08 | 4 28E-07 |
| C-14 | 5 7162E-09 | 0 03 | 0.29 | 0 00E+00 | 1 55E-10 | 1 64E-09 |
| Cl-36 | 1 3124E-32 | 0 03 | 0.29 | 0 00E+00 | 3 56E-34 | 3 77E-33 |
| Cm-243 | 1 8568E-07 | 0 03 | 0 29 | 0 00E+00 | 5 04E-09 | 5 33E-08 |
| Cm-244 | 3 5512E-05 | 0 03 | 0 29 | 0 00E+00 | 9 64E-07 | 1 02E-05 |
| Co-60 | 1 0261E-05 | 0 03 | 0.29 | 0 00E+00 | 2 78E-07 | 2 95E-06 |
| Cs-134 | 1 6931E-02 | 0 03 | 0.29 | 0 00E+00 | 4 60E-04 | 4 86E-03 |
| Cs-135 | 3 4477E-06 | 0 03 | 0.29 | 0 00E+00 | 9 36E-08 | 9 90E-07 |
| Cs-137 | 2.2800E+00 | 0 03 | 0.29 | 0 00E+00 | 6 19E-02 | 6 55E-01 |
| Eu-154 | 3 6656E-02 | 0 03 | 0.29 | 0 00E+00 | 9 95E-04 | 1 05E-02 |
| Eu-155 | 9 6841E-03 | 0 03 | 0.29 | 0 00E+00 | 2 63E-04 | 2.78E-03 |
| Fe-55 | 4 6977E-04 | 0 03 | 0.29 | 0 00E+00 | 1 27E-05 | 1 35E-04 |
| H-3 | 6 0485E-03 | 0 03 | 0 29 | 0 00E+00 | 1 64E-04 | 1.74E-03 |
| I-129 | 7 5300E-07 | 0 03 | 0 29 | 0 00E+00 | 2 04E-08 | 2.16E-07 |
| Kr-85 | 1 4989E-01 | 0 03 | 0.29 | 0 00E+00 | 4 07E-03 | 4.31E-02 |
| Np-237 | 9 5534E-06 | 0 03 | 0 29 | 0 00E+00 | 2 59E-07 | 2.74E-06 |
| Pa-231 | 1 6550E-09 | 0 03 | 0.29 | 0 00E+00 | 4 49E-11 | 4 75E-10 |
| Pb-210 | 2 6631E-11 | 0 03 | 0 29 | 0 00E+00 | 7.23E-13 | 7 65E-12 |
| Pm-147 | 1 8156E-01 | 0 03 | 0 29 | 0 00E+00 | 4 93E-03 | 5.21E-02 |
| Pu-238 | 1 8990E-02 | 0 03 | 0 29 | 0 00E+00 | 5.15E-04 | 5 45E-03 |
| Pu-239 | 4 2838E-04 | 0 03 | 0 29 | 0 00E+00 | 1.16E-05 | 1.23E-04 |
| Pu-240 | 2 4379E-04 | 0 03 | 0 29 | 0 00E+00 | 6 62E-06 | 7 00E-05 |
| Pu-241 | 4.2511E-02 | 0 03 | 0 29 | 0 00E+00 | 1 15E-03 | 1.22E-02 |
| Pu-242 | 3 6329E-07 | 0 03 | 0 29 | 0 00E+00 | 9 86E-09 | 1 04E-07 |
| Ra-226 | 1 4725E-10 | 0.03 | 0 29 | 0 00E+00 | 4 00E-12 | 4.23E-11 |
| Ra-228 | 8 9760E-15 | 0.03 | 0 29 | 0 00E+00 | 2 44E-16 | 2 58E-15 |
| Ru-106 | 1 9752E-04 | 0 03 | 0 29 | 0 00E+00 | 5 36E-06 | 5 67E-05 |
| Se-79 | 1.2933E-05 | 0 03 | 0 29 | 0 00E+00 | 3 51E-07 | 3 71E-06 |
| Sn-126 | 1 1574E-05 | 0 03 | 0 29 | 0 00E+00 | 3 14E-07 | 3 32E-06 |
| Sr-90 | 2 1680E+00 | 0 03 | 0.29 | 0 00E+00 | 5 88E-02 | 6 23E-01 |
| Tc-99 | 4.2239E-04 | 0 03 | 0.29 | 0 00E+00 | 1 15E-05 | 1 21E-04 |
| Th-229 | 3 9270E-12 | 0 03 | 0.29 | 0 00E+00 | 1 07E-13 | 1 13E-12 |
| Th-230 | 3 3578E-08 | 0 03 | 0.29 | 0 00E+00 | 9 11E-10 | 9 64E-09 |
| Th-232 | 1 5452E-14 | 0 03 | 0.29 | 0 00E+00 | 4 19E-16 | 4 44E-15 |
| Tl-208 | 4 6705E-08 | 0 03 | 0.29 | 0 00E+00 | 1 27E-09 | 1 34E-08 |
| U-232 | 1.3045E-07 | 0 03 | 0.29 | 0 00E+00 | 3 54E-09 | 3 75E-08 |
| U-233 | 2 3739E-09 | 0 03 | 0.29 | 0 00E+00 | 6 44E-11 | 6 82E-10 |
| U-234 | 1 8423E-04 | 0 03 | 0.29 | 0 00E+00 | 5 00E-06 | 5 29E-05 |
| U-235 | -2 7235E-06 | 0 03 | 0 00 | 4 75E-04 | 4 75E-04 | 4 75E-04 |
| U-236 | 1 5493E-05 | 0 03 | 0.29 | 0 00E+00 | 4 20E-07 | 4 45E-06 |
| U-238 | -4.2851E-09 | 0 03 | 0 00 | 5 38E-06 | 5 38E-06 | 5 38E-06 |
| Y-90 | 2 1686E+00 | 0 03 | 0.29 | 0 00E+00 | 5 89E-02 | 6 23E-01 |
| Other Radionuclides | | | | | 5 90E-02 | 6 25E-01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 427E+10 |
| 0 0250 | 7 145E+09 |
| 0 0375 | 6.239E+09 |
| 0 0575 | 6 653E+09 |
| 0 0850 | 4 031E+09 |
| 0 1250 | 2 766E+09 |
| 0.2250 | 3 481E+09 |
| 0.3750 | 1 521E+09 |
| 0.5750 | 2 469E+10 |
| 0.8500 | 5 864E+08 |
| 1.2500 | 2.962E+08 |
| 1 7500 | 1.241E+07 |
| 2.2500 | 1 553E+04 |
| 2.7500 | 9.333E+02 |
| 3.5000 | 5 936E+01 |
| 5.0000 | 1 559E-01 |
| 7 0000 | 1 731E-02 |
| 11 0000 | 1 946E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7 47E-04 | 7 79E-03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93.22 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 0 03 | |
| Bounding | 0 29 | |

Basis for burnup used in estimate:

Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | 0 00 |
| Bounding | 0 00 | 0 00 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. ARMF/CFRMF MARK II
SNF ID # 11
Fuel Units & Descr 8 - 15 FLAT PLATES
Heavy Metal Mass BOL=1 164kg EOL=1 164kg
ROD Storage Site SRS

[1]Fuel decay start date 1991
Estimates as of. 2010
Template ATR (Light Water Alum 60 to 100% U)
[2]Template Burnup(MWd) 367 2
Template BOL Heavy Metal Mass (MT) 0 00116689
Template Decay Time 15 years

Estimated Canister usage: 18"x10' 0 33

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 5861E-10 | 0.13 | 1 42 | 0 00E+00 | 6 14E-11 | 6 50E-10 |
| Am-241 | 1 7832E-03 | 0 13 | 1 42 | 0 00E+00 | 2.39E-04 | 2 53E-03 |
| Am-242m | 4.3410E-07 | 0 13 | 1 42 | 0 00E+00 | 5 81E-08 | 6 15E-07 |
| Am-243 | 1 4907E-06 | 0 13 | 1 42 | 0 00E+00 | 2 00E-07 | 2 11E-06 |
| C-14 | 5 7162E-09 | 0 13 | 1 42 | 0 00E+00 | 7 65E-10 | 8 10E-09 |
| Cl-36 | 1 3124E-32 | 0 13 | 1 42 | 0 00E+00 | 1 76E-33 | 1 86E-32 |
| Cm-243 | 1 8568E-07 | 0 13 | 1.42 | 0 00E+00 | 2 49E-08 | 2 63E-07 |
| Cm-244 | 3 5512E-05 | 0 13 | 1 42 | 0 00E+00 | 4 75E-06 | 5 03E-05 |
| Co-60 | 1 0261E-05 | 0 13 | 1 42 | 0 00E+00 | 1 37E-06 | 1.45E-05 |
| Cs-134 | 1 6931E-02 | 0 13 | 1 42 | 0 00E+00 | 2 27E-03 | 2 40E-02 |
| Cs-135 | 3 4477E-06 | 0.13 | 1 42 | 0 00E+00 | 4 62E-07 | 4 88E-06 |
| Cs-137 | 2.2800E+00 | 0 13 | 1 42 | 0 00E+00 | 3 05E-01 | 3 23E+00 |
| Eu-154 | 3 6656E-02 | 0 13 | 1 42 | 0 00E+00 | 4 91E-03 | 5 19E-02 |
| Eu-155 | 9 6841E-03 | 0 13 | 1 42 | 0 00E+00 | 1.30E-03 | 1 37E-02 |
| Fe-55 | 4 6977E-04 | 0 13 | 1 42 | 0 00E+00 | 6 29E-05 | 6 65E-04 |
| H-3 | 6 0485E-03 | 0 13 | 1 42 | 0 00E+00 | 8 10E-04 | 8 57E-03 |
| I-129 | 7 5300E-07 | 0 13 | 1.42 | 0 00E+00 | 1 01E-07 | 1 07E-06 |
| Kr-85 | 1 4989E-01 | 0 13 | 1 42 | 0 00E+00 | 2 01E-02 | 2 12E-01 |
| Np-237 | 9 5534E-06 | 0 13 | 1 42 | 0 00E+00 | 1 28E-06 | 1.35E-05 |
| Pa-231 | 1 6550E-09 | 0 13 | 1 42 | 0 00E+00 | 2.22E-10 | 2.34E-09 |
| Pb-210 | 2 6631E-11 | 0 13 | 1 42 | 0 00E+00 | 3 56E-12 | 3 77E-11 |
| Pm-147 | 1 8156E-01 | 0 13 | 1 42 | 0 00E+00 | 2 43E-02 | 2 57E-01 |
| Pu-238 | 1 8990E-02 | 0 13 | 1 42 | 0 00E+00 | 2.54E-03 | 2 69E-02 |
| Pu-239 | 4 2838E-04 | 0 13 | 1 42 | 0 00E+00 | 5 73E-05 | 6 07E-04 |
| Pu-240 | 2 4379E-04 | 0 13 | 1 42 | 0 00E+00 | 3 26E-05 | 3 45E-04 |
| Pu-241 | 4 2511E-02 | 0 13 | 1.42 | 0 00E+00 | 5 69E-03 | 6 02E-02 |
| Pu-242 | 3 6329E-07 | 0 13 | 1.42 | 0 00E+00 | 4 86E-08 | 5 15E-07 |
| Ra-226 | 1 4725E-10 | 0 13 | 1 42 | 0 00E+00 | 1 97E-11 | 2 09E-10 |
| Ra-228 | 8 9760E-15 | 0 13 | 1 42 | 0 00E+00 | 1 20E-15 | 1.27E-14 |
| Ru-106 | 1 9752E-04 | 0 13 | 1 42 | 0 00E+00 | 2 64E-05 | 2 80E-04 |
| Se-79 | 1.2933E-05 | 0 13 | 1 42 | 0 00E+00 | 1 73E-06 | 1 83E-05 |
| Sn-126 | 1.1574E-05 | 0 13 | 1 42 | 0 00E+00 | 1.55E-06 | 1 64E-05 |
| Sr-90 | 2.1680E+00 | 0 13 | 1 42 | 0 00E+00 | 2.90E-01 | 3 07E+00 |
| Tc-99 | 4 2239E-04 | 0 13 | 1 42 | 0 00E+00 | 5 65E-05 | 5 98E-04 |
| Th-229 | 3 9270E-12 | 0 13 | 1 42 | 0 00E+00 | 5.26E-13 | 5 56E-12 |
| Th-230 | 3 3578E-08 | 0 13 | 1 42 | 0 00E+00 | 4 49E-09 | 4 76E-08 |
| Th-232 | 1 5452E-14 | 0 13 | 1.42 | 0 00E+00 | 2 07E-15 | 2 19E-14 |
| Tl-208 | 4 6705E-08 | 0 13 | 1 42 | 0 00E+00 | 6 25E-09 | 6 62E-08 |
| U-232 | 1 3045E-07 | 0.13 | 1 42 | 0 00E+00 | 1 75E-08 | 1.85E-07 |
| U-233 | 2 3739E-09 | 0 13 | 1 42 | 0 00E+00 | 3 18E-10 | 3.36E-09 |
| U-234 | 1 8423E-04 | 0 13 | 1 42 | 0 00E+00 | 2 47E-05 | 2 61E-04 |
| U-235 | -2 7235E-06 | 0 13 | 0 00 | 2 34E-03 | 2.34E-03 | 2 34E-03 |
| U-236 | 1.5493E-05 | 0 13 | 1 42 | 0 00E+00 | 2 07E-06 | 2 19E-05 |
| U-238 | -4 2851E-09 | 0 13 | 0 00 | 2 69E-05 | 2 69E-05 | 2 69E-05 |
| Y-90 | 2 1686E+00 | 0 13 | 1 42 | 0 00E+00 | 2 90E-01 | 3 07E+00 |
| Other Radionuclides | | | | | 2 91E-01 | 3 08E+00 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 690E+11 |
| 0 0250 | 3.524E+10 |
| 0 0375 | 3 077E+10 |
| 0 0575 | 3.281E+10 |
| 0 0850 | 1 988E+10 |
| 0 1250 | 1 364E+10 |
| 0.2250 | 1 717E+10 |
| 0 3750 | 7 502E+09 |
| 0 5750 | 1 218E+11 |
| 0 8500 | 2.892E+09 |
| 1 2500 | 1 461E+09 |
| 1 7500 | 6 122E+07 |
| 2.2500 | 7 659E+04 |
| 2 7500 | 4 603E+03 |
| 3 5000 | 2 928E+02 |
| 5 0000 | 7 699E-01 |
| 7.0000 | 8 545E-02 |
| 11 0000 | 9 608E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 88E-03 | 3.84E-02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 12714777 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 0 13 | |
| Bounding | 1 42 | |

**Basis for burnup used in estimate:**

Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | 0 00 |
| Bounding | 0 00 | 0 00 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: ARMF/CFRMF MARK III | [1]Fuel decay start date | 1991 | Estimated Canister usage |
| SNF ID #: 12 | Estimates as of | 2010 | 18"x10" |
| Fuel Units & Descr: 4 - 15 FLAT PLATES | Template | ATR (Light Water Alum , 60 to 100%, U) | 0 17 |
| Heavy Metal Mass: BOL=0 096kg, EOL=0 096kg | [2]Template Burnup(MWd) | 367.2 | |
| ROD Storage Site: SRS | Template BOL Heavy Metal Mass (MT) | 0 00116689 | |
| | Template Decay Time: | 15 years | |

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 4 5861E-10 | 0 01 | 0 12 | 0 00E+00 | 5 06E-12 | 5 36E-11 |
| Am-241 | 1 7832E-03 | 0 01 | 0 12 | 0 00E+00 | 1.97E-05 | 2 08E-04 |
| Am-242m | 4 3410E-07 | 0 01 | 0 12 | 0 00E+00 | 4 79E-09 | 5 07E-08 |
| Am-243 | 1 4907E-06 | 0 01 | 0 12 | 0 00E+00 | 1.65E-08 | 1 74E-07 |
| C-14 | 5 7162E-09 | 0 01 | 0 12 | 0 00E+00 | 6.31E-11 | 6 68E-10 |
| Cl-36 | 1 3124E-32 | 0 01 | 0 12 | 0 00E+00 | 1 45E-34 | 1 53E-33 |
| Cm-243 | 1 8568E-07 | 0 01 | 0 12 | 0 00E+00 | 2 05E-09 | 2 17E-08 |
| Cm-244 | 3 5512E-05 | 0 01 | 0 12 | 0 00E+00 | 3 92E-07 | 4 15E-06 |
| Co-60 | 1 0261E-05 | 0 01 | 0 12 | 0 00E+00 | 1 13E-07 | 1.20E-06 |
| Cs-134 | 1 6931E-02 | 0 01 | 0 12 | 0 00E+00 | 1 87E-04 | 1 98E-03 |
| Cs-135 | 3 4477E-06 | 0 01 | 0.12 | 0 00E+00 | 3 81E-08 | 4 03E-07 |
| Cs-137 | 2 2800E+00 | 0 01 | 0 12 | 0 00E+00 | 2 52E-02 | 2 66E-01 |
| Eu-154 | 3 6656E-02 | 0.01 | 0.12 | 0 00E+00 | 4 05E-04 | 4.28E-03 |
| Eu-155 | 9 6841E-03 | 0.01 | 0 12 | 0 00E+00 | 1 07E-04 | 1 13E-03 |
| Fe-55 | 4 6977E-04 | 0 01 | 0 12 | 0 00E+00 | 5 19E-06 | 5 49E-05 |
| H-3 | 6 0485E-03 | 0 01 | 0 12 | 0 00E+00 | 6 68E-05 | 7 07E-04 |
| I-129 | 7 5300E-07 | 0 01 | 0 12 | 0 00E+00 | 8 31E-09 | 8 80E-08 |
| Kr-85 | 1 4989E-01 | 0 01 | 0 12 | 0 00E+00 | 1 65E-03 | 1.75E-02 |
| Np-237 | 9 5534E-06 | 0 01 | 0 12 | 0 00E+00 | 1 05E-07 | 1.12E-06 |
| Pa-231 | 1 6550E-09 | 0 01 | 0 12 | 0 00E+00 | 1 83E-11 | 1 93E-10 |
| Pb-210 | 2 6631E-11 | 0 01 | 0 12 | 0 00E+00 | 2 94E-13 | 3 11E-12 |
| Pm-147 | 1 8156E-01 | 0 01 | 0 12 | 0 00E+00 | 2 00E-03 | 2 12E-02 |
| Pu-238 | 1 8990E-02 | 0 01 | 0 12 | 0 00E+00 | 2 10E-04 | 2 22E-03 |
| Pu-239 | 4 2838E-04 | 0 01 | 0 12 | 0 00E+00 | 4 73E-06 | 5 00E-05 |
| Pu-240 | 2 4379E-04 | 0 01 | 0 12 | 0 00E+00 | 2 69E-06 | 2 85E-05 |
| Pu-241 | 4 2511E-02 | 0 01 | 0 12 | 0 00E+00 | 4 69E-04 | 4 97E-03 |
| Pu-242 | 3 6329E-07 | 0 01 | 0 12 | 0 00E+00 | 4 01E-09 | 4 24E-08 |
| Ra-226 | 1 4725E-10 | 0 01 | 0 12 | 0 00E+00 | 1 63E-12 | 1 72E-11 |
| Ra-228 | 8 9760E-15 | 0 01 | 0 12 | 0 00E+00 | 9 91E-17 | 1 05E-15 |
| Ru-106 | 1 9752E-04 | 0 01 | 0 12 | 0 00E+00 | 2 18E-06 | 2 31E-05 |
| Se-79 | 1.2933E-05 | 0 01 | 0 12 | 0 00E+00 | 1 43E-07 | 1 51E-06 |
| Sn-126 | 1 1574E-05 | 0 01 | 0 12 | 0 00E+00 | 1.28E-07 | 1 35E-06 |
| Sr-90 | 2 1680E+00 | 0 01 | 0 12 | 0 00E+00 | 2 39E-02 | 2 53E-01 |
| Tc-99 | 4 2239E-04 | 0 01 | 0 12 | 0 00E+00 | 4 66E-06 | 4 93E-05 |
| Th-229 | 3 9270E-12 | 0 01 | 0.12 | 0 00E+00 | 4 34E-14 | 4 59E-13 |
| Th-230 | 3 3578E-08 | 0 01 | 0.12 | 0 00E+00 | 3 71E-10 | 3 92E-09 |
| Th-232 | 1 5452E-14 | 0 01 | 0.12 | 0 00E+00 | 1 71E-16 | 1 81E-15 |
| Tl-208 | 4 6705E-08 | 0 01 | 0 12 | 0 00E+00 | 5 16E-10 | 5 46E-09 |
| U-232 | 1.3045E-07 | 0 01 | 0 12 | 0 00E+00 | 1 44E-09 | 1 52E-08 |
| U-233 | 2 3739E-09 | 0 01 | 0 12 | 0 00E+00 | 2 62E-11 | 2.77E-10 |
| U-234 | 1 8423E-04 | 0 01 | 0 12 | 0 00E+00 | 2 03E-06 | 2.15E-05 |
| U-235 | -2 7235E-06 | 0 01 | 0 00 | 1 90E-04 | 1 90E-04 | 1.90E-04 |
| U-236 | 1 5493E-05 | 0 01 | 0 12 | 0 00E+00 | 1 71E-07 | 1.81E-06 |
| U-238 | -4.2851E-09 | 0 01 | 0 00 | 2 69E-06 | 2 69E-06 | 2.69E-06 |
| Y-90 | 2 1686E+00 | 0 01 | 0 12 | 0 00E+00 | 2 39E-02 | 2 53E-01 |
| Other Radionuclides | | | | | 2.40E-02 | 2 54E-01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 394E+10 |
| 0 0250 | 2 907E+09 |
| 0 0375 | 2 538E+09 |
| 0 0575 | 2 706E+09 |
| 0 0850 | 1 640E+09 |
| 0 1250 | 1 125E+09 |
| 0.2250 | 1 416E+09 |
| 0 3750 | 6 187E+08 |
| 0 5750 | 1 004E+10 |
| 0 8500 | 2.385E+08 |
| 1 2500 | 1.205E+08 |
| 1 7500 | 5 049E+06 |
| 2.2500 | 6.317E+03 |
| 2 7500 | 3 796E+02 |
| 3 5000 | 2 415E+01 |
| 5 0000 | 6 454E-02 |
| 7 0000 | 7 167E-03 |
| 11 0000 | 8 062E-04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 04E-04 | 3 17E-03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 91 66666667 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 0 01 | |
| Bounding | 0 12 | |

Basis for burnup used in estimate:

Nominal burnup taken directly from SFD (converted to MWd)

Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.00 | 0 00 |
| Bounding | 0 00 | 0 00 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | | |
|---|---|---|---|---|
| Fuel Name | ATR | [1]Fuel decay start date. | 1985 | |
| SNF ID # | 15 | Estimates as of | 2010 | |
| Fuel Units & Descr | 1576 - 19 CURVED PLATES | Template | ATR (Light Water Alum 60 to 100% U) | |
| Heavy Metal Mass | BOL=1818 704kg EOL=1313 754kg | [2]Template Burnup(MWd) | 367.2 | |
| ROD Storage Site | SRS | Template BOL Heavy Metal Mass (MT) | 0 00116689 | |
| | | Template Decay Time | 25 years | |

Estimated Canister usage
18"x10'
78 80

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 1465E-09 | 480 779 86 | 961,559 72 | 0 00E+00 | 5 51E-04 | 1 10E-03 |
| Am-241 | 2 3056E-03 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 11E+03 | 2 22E+03 |
| Am-242m | 4 1476E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 99E-01 | 3 99E-01 |
| Am-243 | 1 4894E-06 | 480 779 86 | 961,559 72 | 0 00E+00 | 7 16E-01 | 1 43E+00 |
| C-14 | 5 7108E-09 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 75E-03 | 5 49E-03 |
| Cl-36 | 1.3124E-32 | 480,779 86 | 961,559 72 | 0 00E+00 | 6 31E-27 | 1 26E-26 |
| Cm-243 | 1 4562E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 7 00E-02 | 1 40E-01 |
| Cm-244 | 2 4221E-05 | 480 779 86 | 961,559 72 | 0 00E+00 | 1 16E+01 | 2 33E+01 |
| Co-60 | 2 7560E-06 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 33E+00 | 2 65E+00 |
| Cs-134 | 5 8851E-04 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 83E+02 | 5 66E+02 |
| Cs-135 | 3 4477E-06 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 66E+00 | 3 32E+00 |
| Cs-137 | 1 8099E+00 | 480,779 86 | 961,559 72 | 0 00E+00 | 8 70E+05 | 1 74E+06 |
| Eu-154 | 1 6386E-02 | 480,779 86 | 961,559 72 | 0 00E+00 | 7 88E+03 | 1 58E+04 |
| Eu-155 | 2 3957E-03 | 480,779 86 | 961,559 72 | 0 00E+00 | 1.15E+03 | 2 30E+03 |
| Fe-55 | 3 2707E-05 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 57E+01 | 3 14E+01 |
| H-3 | 3 4504E-03 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 66E+03 | 3 32E+03 |
| I-129 | 7 5300E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 3 62E-01 | 7.24E-01 |
| Kr-85 | 7 8540E-02 | 480,779 86 | 961,559 72 | 0 00E+00 | 3 78E+04 | 7 55E+04 |
| Np-237 | 9 5615E-06 | 480,779 86 | 961,559 72 | 0 00E+00 | 4 60E+00 | 9 19E+00 |
| Pa-231 | 2 7968E-09 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 34E-03 | 2.69E-03 |
| Pb-210 | 1 2612E-10 | 480,779 86 | 961,559 72 | 0 00E+00 | 6 06E-05 | 1.21E-04 |
| Pm-147 | 1 2952E-02 | 480,779 86 | 961,559 72 | 0 00E+00 | 6 23E+03 | 1.25E+04 |
| Pu-238 | 1 7549E-02 | 480,779 86 | 961,559 72 | 0 00E+00 | 8 44E+03 | 1 69E+04 |
| Pu-239 | 4 2810E-04 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 06E+02 | 4.12E+02 |
| Pu-240 | 2 4357E-04 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 17E+02 | 2.34E+02 |
| Pu-241 | 2 6277E-02 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 26E+04 | 2.53E+04 |
| Pu-242 | 3 6329E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 75E-01 | 3 49E-01 |
| Ra-226 | 4 4444E-10 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 14E-04 | 4.27E-04 |
| Ra-228 | 1.9714E-14 | 480,779 86 | 961,559 72 | 0 00E+00 | 9 48E-09 | 1 90E-08 |
| Ru-106 | 2 0477E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 9 84E-02 | 1 97E-01 |
| Se-79 | 1.2933E-05 | 480,779 86 | 961,559 72 | 0 00E+00 | 6 22E+00 | 1.24E+01 |
| Sn-126 | 1 1574E-05 | 480,779 86 | 961,559 72 | 0 00E+00 | 5 56E+00 | 1 11E+01 |
| Sr-90 | 1 7092E+00 | 480,779 86 | 961,559 72 | 0 00E+00 | 8 22E+05 | 1 64E+06 |
| Tc-99 | 4.2239E-04 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 03E+02 | 4 06E+02 |
| Th-229 | 7 7260E-12 | 480,779 86 | 961,559 72 | 0 00E+00 | 3 71E-06 | 7 43E-06 |
| Th-230 | 5 8497E-08 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 81E-02 | 5 62E-02 |
| Th-232 | 2 6906E-14 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 29E-08 | 2 59E-08 |
| Tl-208 | 4 4336E-08 | 480,779 86 | 961,559 72 | 0 00E+00 | 2 13E-02 | 4 26E-02 |
| U-232 | 1.2037E-07 | 480,779 86 | 961,559 72 | 0 00E+00 | 5 79E-02 | 1 16E-01 |
| U-233 | 3 0011E-09 | 480,779 86 | 961,559 72 | 0 00E+00 | 1 44E-03 | 2 89E-03 |
| U-234 | 1 8497E-04 | 480,779 86 | 961,559 72 | 0 00E+00 | 8 89E+01 | 1 78E+02 |
| U-235 | -2 7235E-06 | 480,779 86 | 0 00 | 3 66E+00 | 2 35E+00 | 3 66E+00 |
| U-236 | 1 5493E-05 | 480,779 86 | 961,559 72 | 0 00E+00 | 7 45E+00 | 1 49E+01 |
| U-238 | -4 2851E-09 | 480,779 86 | 0 00 | 4 18E-02 | 3 98E-02 | 4 18E-02 |
| Y-90 | 1 7094E+00 | 480,779 86 | 961,559 72 | 0 00E+00 | 8.22E+05 | 1 64E+06 |
| Other Radionuclides | | | | | 8.28E+05 | 1 66E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8 998E+16 |
| 0 0250 | 1 869E+16 |
| 0 0375 | 1 628E+16 |
| 0 0575 | 1 748E+16 |
| 0 0850 | 1 055E+16 |
| 0 1250 | 7 065E+15 |
| 0 2250 | 9 106E+15 |
| 0 3750 | 3 959E+15 |
| 0 5750 | 6 490E+16 |
| 0 8500 | 9 352E+14 |
| 1 2500 | 5.201E+14 |
| 1 7500 | 2.569E+13 |
| 2.2500 | 1 831E+09 |
| 2.7500 | 1.500E+09 |
| 3 5000 | 1 132E+06 |
| 5 0000 | 3.806E+05 |
| 7 0000 | 4 188E+04 |
| 11 0000 | 4 685E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.02E+04 | 2.03E+04 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ALUM | ALUM | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93 154 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 480 779 86 | 478 197 82 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 961 559 72 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 84 | 0 99 | 1 02 |
| Bounding | 1 68 | | |

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | ATR | [1]Fuel decay start date | 2035 |
| SNF ID #: | 16 | Estimates as of | 2010 |
| Fuel Units & Descr | 4132 - 19 CURVED PLATES | Template | ATR (Light Water Alum , 60 to 100%, U) |
| Heavy Metal Mass: | BOL=4768 328kg, EOL=3705 991kg | [2]Template Burnup(MWd) | 367.2 |
| ROD Storage Site: | SRS | Template BOL Heavy Metal Mass (MT) | 0 00116689 |
| | | Template Decay Time: | 5 years |

Estimated Canister usage 18"x10' 206 60

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 4545E-10 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 48E-04 | 2 96E-04 |
| Am-241 | 1 1190E-03 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 14E+03 | 2 28E+03 |
| Am-242m | 4 5425E-07 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 4 62E-01 | 9 24E-01 |
| Am-243 | 1 4921E-06 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 52E+00 | 3 04E+00 |
| C-14 | 5 7244E-09 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 5 82E-03 | 1 16E-02 |
| Cl-36 | 1 3124E-32 | 1,017,446 76 | 2,034 893 51 | 0 00E+00 | 1 34E-26 | 2 67E-26 |
| Cm-243 | 2 3676E-07 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 2 41E-01 | 4 82E-01 |
| Cm-244 | 5 2042E-05 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 5.30E+01 | 1 06E+02 |
| Co-60 | 3 8208E-05 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 3 89E+01 | 7 77E+01 |
| Cs-134 | 4 8693E-01 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 4 95E+05 | 9 91E+05 |
| Cs-135 | 3 4477E-06 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 3 51E+00 | 7 02E+00 |
| Cs-137 | 2 8731E+00 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 2 92E+06 | 5 85E+06 |
| Eu-154 | 8 2053E-02 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 8 35E+04 | 1 67E+05 |
| Eu-155 | 3 9134E-02 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 3 98E+04 | 7 96E+04 |
| Fe-55 | 6 7429E-03 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 6 86E+03 | 1.37E+04 |
| H-3 | 1 0599E-02 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 1 08E+04 | 2 16E+04 |
| I-129 | 7 5300E-07 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 7 66E-01 | 1 53E+00 |
| Kr-85 | 2 8595E-01 | 1,017,446.76 | 2,034,893 51 | 0 00E+00 | 2 91E+05 | 5 82E+05 |
| Np-237 | 9 5479E-06 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 9 71E+00 | 1 94E+01 |
| Pa-231 | 8 9297E-10 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 9 09E-04 | 1 82E-03 |
| Pb-210 | 3.7609E-12 | 1,017 446 76 | 2,034,893 51 | 0 00E+00 | 3 83E-06 | 7 65E-06 |
| Pm-147 | 2 5452E+00 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 2 59E+06 | 5 18E+06 |
| Pu-238 | 2 0550E-02 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 2 09E+04 | 4 18E+04 |
| Pu-239 | 4.2838E-04 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 4 36E+02 | 8 72E+02 |
| Pu-240 | 2 4401E-04 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 2 48E+02 | 4 97E+02 |
| Pu-241 | 6 8764E-02 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 7 00E+04 | 1 40E+05 |
| Pu-242 | 3 6329E-07 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 3 70E-01 | 7 39E-01 |
| Ra-226 | 3 8045E-11 | 1,017,446 76 | 2,034 893 51 | 0 00E+00 | 3 87E-05 | 7 74E-05 |
| Ra-228 | 2 9902E-15 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 3 04E-09 | 6 08E-09 |
| Ru-106 | 1.9055E-01 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 94E+05 | 3 88E+05 |
| Se-79 | 1 2936E-05 | 1,017,446 76 | 2,034 893 51 | 0 00E+00 | 1 32E+01 | 2 63E+01 |
| Sn-126 | 1.1574E-05 | 1,017,446 76 | 2,034,893.51 | 0 00E+00 | 1 18E+01 | 2 36E+01 |
| Sr-90 | 2 7505E+00 | 1,017,446 76 | 2,034,893.51 | 0 00E+00 | 2 80E+06 | 5 60E+06 |
| Tc-99 | 4 2239E-04 | 1,017,446 76 | 2,034,893.51 | 0 00E+00 | 4 30E+02 | 8 60E+02 |
| Th-229 | 1 8848E-12 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 92E-06 | 3 84E-06 |
| Th-230 | 1 7042E-08 | 1,017,446 76 | 2,034 893 51 | 0 00E+00 | 1 73E-02 | 3 47E-02 |
| Th-232 | 7 8132E-15 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 7 95E-09 | 1 59E-08 |
| Tl-208 | 4 4063E-08 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 4 48E-02 | 8 97E-02 |
| U-232 | 1 3151E-07 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1.34E-01 | 2.68E-01 |
| U-233 | 1 9564E-09 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1.99E-03 | 3 98E-03 |
| U-234 | 1 8371E-04 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 87E+02 | 3 74E+02 |
| U-235 | -2 7235E-06 | 1,017,446 76 | 0 00 | 9 60E+00 | 6 83E+00 | 9 60E+00 |
| U-236 | 1 5493E-05 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 1 58E+01 | 3 15E+01 |
| U-238 | -4 2851E-09 | 1,017,446 76 | 0 00 | 1 10E-01 | 1.05E-01 | 1.10E-01 |
| Y-90 | 2 7505E+00 | 1,017,446 76 | 2,034,893 51 | 0 00E+00 | 2 80E+06 | 5 60E+06 |
| Other Radionuclides | | | | | 5 23E+06 | 1 05E+07 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 926E+17 |
| 0 0250 | 8 458E+16 |
| 0 0375 | 7.805E+16 |
| 0 0575 | 7 674E+16 |
| 0 0850 | 4 892E+16 |
| 0 1250 | 4.237E+16 |
| 0 2250 | 4 147E+16 |
| 0 3750 | 2 007E+16 |
| 0 5750 | 2 757E+17 |
| 0 8500 | 3 861E+16 |
| 1.2500 | 7 183E+15 |
| 1 7500 | 3 012E+14 |
| 2.2500 | 6 318E+14 |
| 2.7500 | 3 635E+12 |
| 3.5000 | 4 031E+11 |
| 5 0000 | 1 206E+06 |
| 7 0000 | 1 344E+05 |
| 11 0000 | 1 515E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 16E+04 | 1 03E+05 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 154 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate. |
|---|---|---|---|
| Nominal | 1 017 446 76 | 1 006 053 94 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 2 034 893 51 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 68 | 0 99 |
| Bounding | 1.36 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name ATR
SNF ID # 843
Fuel Units & Descr 128 - 19 CURVED PLATES
Heavy Metal Mass BOL=147 712kg EOL=99 392kg
ROD Storage Site SRS

[1]Fuel decay start date 1985
Estimates as of 2010
Template ATR (Light Water Alum 60 to 100% U)
[2]Template Burnup(MWd) 367 2
Template BOL Heavy Metal Mass (MT) 0 00116689
Template Decay Time 25 years

Estimated Canister usage
18"x10'
6 40

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventones(Ci) | $y_b$: Bounding Fuel Inventones(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 1465E-09 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 26E-05 | 1 05E-04 |
| Am-241 | 2 3056E-03 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 06E+02 | 2 12E+02 |
| Am-242m | 4 1476E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 90E-02 | 3 81E-02 |
| Am-243 | 1 4894E-06 | 45,921 00 | 91,842 00 | 0 00E+00 | 6 84E-02 | 1.37E-01 |
| C-14 | 5 7108E-09 | 45,921 00 | 91,842 00 | 0 00E+00 | 2 62E-04 | 5.24E-04 |
| Cl-36 | 1 3124E-32 | 45,921 00 | 91,842 00 | 0 00E+00 | 6 03E-28 | 1.21E-27 |
| Cm-243 | 1 4562E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 6 69E-03 | 1 34E-02 |
| Cm-244 | 2 4221E-05 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 11E+00 | 2.22E+00 |
| Co-60 | 2 7560E-06 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 27E-01 | 2 53E-01 |
| Cs-134 | 5 8851E-04 | 45,921 00 | 91,842 00 | 0 00E+00 | 2 70E+01 | 5 40E+01 |
| Cs-135 | 3 4477E-06 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 58E-01 | 3 17E-01 |
| Cs-137 | 1.8099E+00 | 45,921.00 | 91,842 00 | 0 00E+00 | 8 31E+04 | 1 66E+05 |
| Eu-154 | 1 6386E-02 | 45,921 00 | 91,842 00 | 0 00E+00 | 7 52E+02 | 1 50E+03 |
| Eu-155 | 2.3957E-03 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 10E+02 | 2 20E+02 |
| Fe-55 | 3 2707E-05 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 50E+00 | 3 00E+00 |
| H-3 | 3 4504E-03 | 45,921 00 | 91,842 00 | 0 00E+00 | 1.58E+02 | 3 17E+02 |
| I-129 | 7 5300E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 3 46E-02 | 6 92E-02 |
| Kr-85 | 7 8540E-02 | 45,921 00 | 91,842 00 | 0 00E+00 | 3 61E+03 | 7.21E+03 |
| Np-237 | 9 5615E-06 | 45,921 00 | 91,842 00 | 0 00E+00 | 4 39E-01 | 8 78E-01 |
| Pa-231 | 2 7968E-09 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 28E-04 | 2 57E-04 |
| Pb-210 | 1 2612E-10 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 79E-06 | 1 16E-05 |
| Pm-147 | 1.2952E-02 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 95E+02 | 1 19E+03 |
| Pu-238 | 1.7549E-02 | 45,921 00 | 91,842 00 | 0 00E+00 | 8 06E+02 | 1 61E+03 |
| Pu-239 | 4.2810E-04 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 97E+01 | 3 93E+01 |
| Pu-240 | 2 4357E-04 | 45 921 00 | 91,842 00 | 0 00E+00 | 1 12E+01 | 2 24E+01 |
| Pu-241 | 2 6277E-02 | 45,921 00 | 91,842 00 | 0 00E+00 | 1.21E+03 | 2 41E+03 |
| Pu-242 | 3 6329E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 67E-02 | 3 34E-02 |
| Ra-226 | 4 4444E-10 | 45,921 00 | 91,842 00 | 0 00E+00 | 2 04E-05 | 4 08E-05 |
| Ra-228 | 1 9714E-14 | 45,921 00 | 91,842 00 | 0 00E+00 | 9 05E-10 | 1 81E-09 |
| Ru-106 | 2 0477E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 9 40E-03 | 1 88E-02 |
| Se-79 | 1 2933E-05 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 94E-01 | 1 19E+00 |
| Sn-126 | 1 1574E-05 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 31E-01 | 1 06E+00 |
| Sr-90 | 1.7092E+00 | 45 921.00 | 91,842 00 | 0 00E+00 | 7 85E+04 | 1 57E+05 |
| Tc-99 | 4.2239E-04 | 45 921 00 | 91,842 00 | 0 00E+00 | 1 94E+01 | 3 88E+01 |
| Th-229 | 7.7260E-12 | 45,921 00 | 91,842 00 | 0 00E+00 | 3 55E-07 | 7 10E-07 |
| Th-230 | 5 8497E-08 | 45,921 00 | 91,842 00 | 0 00E+00 | 2 69E-03 | 5 37E-03 |
| Th-232 | 2 6906E-14 | 45,921 00 | 91,842 00 | 0 00E+00 | 1.24E-09 | 2 47E-09 |
| Tl-208 | 4 4336E-08 | 45,921 00 | 91,842 00 | 0 00E+00 | 2 04E-03 | 4 07E-03 |
| U-232 | 1 2037E-07 | 45,921 00 | 91,842 00 | 0 00E+00 | 5 53E-03 | 1.11E-02 |
| U-233 | 3 0011E-09 | 45,921 00 | 91,842 00 | 0 00E+00 | 1 38E-04 | 2 76E-04 |
| U-234 | 1 8497E-04 | 45,921 00 | 91,842 00 | 0 00E+00 | 8 49E+00 | 1.70E+01 |
| U-235 | -2 7235E-06 | 45,921.00 | 0 00 | 2 97E-01 | 1 72E-01 | 2 97E-01 |
| U-236 | 1.5493E-05 | 45,921 00 | 91,842 00 | 0 00E+00 | 7 11E-01 | 1 42E+00 |
| U-238 | -4 2851E-09 | 45,921 00 | 0 00 | 3 40E-03 | 3 20E-03 | 3 40E-03 |
| Y-90 | 1 7094E+00 | 45,921 00 | 91,842 00 | 0 00E+00 | 7 85E+04 | 1 57E+05 |
| Other Radionuclides | | | | | 7 91E+04 | 1 58E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8 594E+15 |
| 0 0250 | 1 785E+15 |
| 0 0375 | 1 555E+15 |
| 0 0575 | 1 670E+15 |
| 0 0850 | 1 007E+15 |
| 0 1250 | 6 748E+14 |
| 0 2250 | 8 698E+14 |
| 0 3750 | 3 781E+14 |
| 0 5750 | 6 199E+15 |
| 0 8500 | 8 933E+13 |
| 1.2500 | 4 968E+13 |
| 1 7500 | 2 454E+12 |
| 2.2500 | 1 749E+08 |
| 2 7500 | 1 432E+08 |
| 3 5000 | 1 081E+05 |
| 5 0000 | 3 635E+04 |
| 7 0000 | 4 000E+03 |
| 11 0000 | 4 474E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 71E+02 | 1 94E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ALUM | ALUM | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93 1542461 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 45 921 00 | 45 759 98 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 91 842 00 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 99 | 1 00 |
| Bounding | 1 98 | |

Estimated EOL HM/Given EOL HM: 1 03

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BCD B-17 (TURKEY POINT 3) | [1]Fuel decay start date: | 1975 |
| SNF ID # | 19 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - 15 X 15 ROD ARRAY | Template | PWR (Light Water, Zirc 0 to 5%, U) |
| Heavy Metal Mass | BOL=458 98kg EOL=411 809kg | [2]Template Burnup(MWd): | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage: Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 44,857 39 | 89,714 78 | 0 00E+00 | 3 94E-05 | 7.87E-05 |
| Am-241 | 1 4352E-01 | 44,857 39 | 89,714 78 | 0 00E+00 | 6 44E+03 | 1 29E+04 |
| Am-242m | 2 8698E-04 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 29E+01 | 2 57E+01 |
| Am-243 | 6 2565E-04 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 81E+01 | 5 61E+01 |
| C-14 | 4 7901E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 15E+00 | 4 30E+00 |
| Cl-36 | 8 0297E-07 | 44,857 39 | 89,714 78 | 0 00E+00 | 3 60E-02 | 7.20E-02 |
| Cm-243 | 2 5081E-04 | 44,857 39 | 89,714 78 | 0 00E+00 | 1.13E+01 | 2 25E+01 |
| Cm-244 | 4 9015E-02 | 44,857 39 | 89,714 78 | 0 00E+00 | 2.20E+03 | 4 40E+03 |
| Co-60 | 2 5581E-03 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 15E+02 | 2 30E+02 |
| Cs-134 | 4 0536E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 82E+00 | 3 64E+00 |
| Cs-135 | 1 4433E-05 | 44,857.39 | 89,714 78 | 0 00E+00 | 6 47E-01 | 1 29E+00 |
| Cs-137 | 1 3979E+00 | 44,857 39 | 89,714 78 | 0 00E+00 | 6.27E+04 | 1 25E+05 |
| Eu-154 | 2 0203E-02 | 44,857.39 | 89,714 78 | 0 00E+00 | 9 06E+02 | 1 81E+03 |
| Eu-155 | 1.7684E-03 | 44,857.39 | 89,714 78 | 0 00E+00 | 7 93E+01 | 1 59E+02 |
| Fe-55 | 4 3136E-05 | 44 857.39 | 89,714 78 | 0 00E+00 | 1 93E+00 | 3 87E+00 |
| H-3 | 2 0769E-02 | 44 857.39 | 89,714 78 | 0 00E+00 | 9 32E+02 | 1 86E+03 |
| I-129 | 9 8288E-07 | 44,857.39 | 89,714 78 | 0 00E+00 | 4 41E-02 | 8 82E-02 |
| Kr-85 | 2 8214E-02 | 44,857.39 | 89,714 78 | 0 00E+00 | 1.27E+03 | 2 53E+03 |
| Np-237 | 1.1218E-05 | 44,857.39 | 89,714 78 | 0 00E+00 | 5 03E-01 | 1 01E+00 |
| Pa-231 | 1.3036E-09 | 44 857.39 | 89,714 78 | 0 00E+00 | 5 85E-05 | 1 17E-04 |
| Pb-210 | 8.5078E-11 | 44,857.39 | 89,714 78 | 0 00E+00 | 3 82E-06 | 7 63E-06 |
| Pm-147 | 3 6531E-04 | 44,857 39 | 89,714.78 | 0 00E+00 | 1 64E+01 | 3 28E+01 |
| Pu-238 | 7 4564E-02 | 44,857 39 | 89,714 78 | 0 00E+00 | 3 34E+03 | 6 69E+03 |
| Pu-239 | 1 1623E-02 | 44,857 39 | 89,714.78 | 0 00E+00 | 5 21E+02 | 1 04E+03 |
| Pu-240 | 1 5132E-02 | 44,857 39 | 89,714.78 | 0 00E+00 | 6 79E+02 | 1 36E+03 |
| Pu-241 | 9 0036E-01 | 44,857 39 | 89,714.78 | 0 00E+00 | 4 04E+04 | 8 08E+04 |
| Pu-242 | 6 4260E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 88E+00 | 5 77E+00 |
| Ra-226 | 2 2804E-10 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 02E-05 | 2 05E-05 |
| Ra-228 | 5 2713E-12 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 36E-07 | 4 73E-07 |
| Ru-106 | 6 1160E-10 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 74E-05 | 5 49E-05 |
| Se-79 | 1 2377E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 5 55E-01 | 1.11E+00 |
| Sn-126 | 2 5210E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 13E+00 | 2 26E+00 |
| Sr-90 | 9 1667E-01 | 44,857 39 | 89,714 78 | 0 00E+00 | 4 11E+04 | 8.22E+04 |
| Tc-99 | 3 9357E-04 | 44,857 39 | 89,714 78 | 0 00E+00 | 1.77E+01 | 3 53E+01 |
| Th-229 | 1 2057E-10 | 44,857 39 | 89,714 78 | 0 00E+00 | 5 41E-06 | 1 08E-05 |
| Th-230 | 2 1043E-08 | 44,857 39 | 89,714 78 | 0 00E+00 | 9 44E-04 | 1 89E-03 |
| Th-232 | 5 2972E-12 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 38E-07 | 4 75E-07 |
| Tl-208 | 1 7474E-07 | 44,857 39 | 89,714 78 | 0 00E+00 | 7 84E-03 | 1.57E-02 |
| U-232 | 4 7368E-07 | 44,857 39 | 89,714 78 | 0 00E+00 | 2 12E-02 | 4.25E-02 |
| U-233 | 2 5097E-08 | 44,857 39 | 89,714 78 | 0 00E+00 | 1 13E-03 | 2.25E-03 |
| U-234 | 5 0000E-05 | 44,857 39 | 89,714 78 | 0 00E+00 | 2.24E+00 | 4 49E+00 |
| U-235 | -1 4489E-06 | 44,857 39 | 0 00 | 2 54E-02 | 0 00E+00 | 2 54E-02 |
| U-236 | 7 5824E-06 | 44,857.39 | 89,714 78 | 0 00E+00 | 3 40E-01 | 6 80E-01 |
| U-238 | -2 6129E-07 | 44,857.39 | 0 00 | 1 50E-01 | 1 39E-01 | 1 50E-01 |
| Y-90 | 9 1699E-01 | 44,857.39 | 89,714 78 | 0 00E+00 | 4 11E+04 | 8 23E+04 |
| Other Radionuclides | | | | | 6 02E+04 | 1 20E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 827E+15 |
| 0 0250 | 9 734E+14 |
| 0 0375 | 9 284E+14 |
| 0 0575 | 1 073E+15 |
| 0 0850 | 5 401E+14 |
| 0 1250 | 3 748E+14 |
| 0.2250 | 4 632E+14 |
| 0.3750 | 1 992E+14 |
| 0 5750 | 4 632E+15 |
| 0.8500 | 6 408E+13 |
| 1.2500 | 6.295E+13 |
| 1 7500 | 1.885E+12 |
| 2.2500 | 3 035E+08 |
| 2 7500 | 6.219E+08 |
| 3.5000 | 6 403E+07 |
| 5.0000 | 2 738E+07 |
| 7 0000 | 3 155E+06 |
| 11 0000 | 3 624E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 03E+03 | 2 06E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 560002614 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate* |
|---|---|---|---|
| Nominal | 11 779 72 | 44 857 39 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding* | | 89 714 78 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 2.79 | 3.81 |
| Bounding | 5 58 | |

Estimated EOL HM/Given EOL HM: 1 05

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

# Fuel Radionuclide Inventory Worksheet

## I. Fuel and Template Information

Fuel Name BER-II TRIGA (FLIP LEU 45/20) (GERMANY)
SNF ID # 236
Fuel Units & Descr 21 - 4 X 4 ROD ARRAY
Heavy Metal Mass BOL=9 196kg EOL=9 192kg
ROD Storage Site- INEEL

[1]Fuel decay start date 1982
Estimates as of 2010
Template TRIGA-SS (LW/U-Zrx SST 10 to 20% U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 000195
Template Decay Time 25 years

Estimated Canister usage
18"x10'
2 63

## II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 1459E-09 | 22 40 | 9 41 | 0 00E+00 | 9 29E-08 | 3 90E-08 |
| Am-241 | 3 5850E-03 | 22 40 | 9 41 | 0 00E+00 | 8 03E-02 | 3 37E-02 |
| Am-242m | 1.2899E-06 | 22 40 | 9 41 | 0 00E+00 | 2.89E-05 | 1.21E-05 |
| Am-243 | 1 4747E-07 | 22 40 | 9 41 | 0 00E+00 | 3 30E-06 | 1.39E-06 |
| C-14 | 1.2839E-04 | 22 40 | 9 41 | 0 00E+00 | 2 88E-03 | 1.21E-03 |
| Cl-36 | 2 8120E-06 | 22 40 | 9 41 | 0 00E+00 | 6 30E-05 | 2 65E-05 |
| Cm-243 | 1 1038E-07 | 22 40 | 9 41 | 0 00E+00 | 2 47E-06 | 1 04E-06 |
| Cm-244 | 7 8917E-07 | 22 40 | 9 41 | 0 00E+00 | 1 77E-05 | 7 42E-06 |
| Co-60 | 9 2647E-02 | 22 40 | 9 41 | 0 00E+00 | 2 08E+00 | 8 72E-01 |
| Cs-134 | 1 0940E-04 | 22 40 | 9 41 | 0 00E+00 | 2 45E-03 | 1 03E-03 |
| Cs-135 | 3 2195E-05 | 22 40 | 9 41 | 0 00E+00 | 7 21E-04 | 3 03E-04 |
| Cs-137 | 1.7368E+00 | 22 40 | 9 41 | 0 00E+00 | 3 89E+01 | 1 63E+01 |
| Eu-154 | 3 0677E-03 | 22 40 | 9 41 | 0 00E+00 | 6 87E-02 | 2 89E-02 |
| Eu-155 | 1 7925E-03 | 22 40 | 9 41 | 0 00E+00 | 4 02E-02 | 1 69E-02 |
| Fe-55 | 3 7444E-03 | 22 40 | 9 41 | 0 00E+00 | 8.39E-02 | 3 52E-02 |
| H-3 | 3 6180E-03 | 22 40 | 9 41 | 0 00E+00 | 8 10E-02 | 3 40E-02 |
| I-129 | 7 3684E-07 | 22 40 | 9 41 | 0 00E+00 | 1 65E-05 | 6 93E-06 |
| Kr-85 | 6 9368E-02 | 22 40 | 9 41 | 0 00E+00 | 1 55E+00 | 6 53E-01 |
| Np-237 | 1 2662E-06 | 22 40 | 9 41 | 0 00E+00 | 2 84E-05 | 1 19E-05 |
| Pa-231 | 9 1654E-09 | 22 40 | 9 41 | 0 00E+00 | 2 05E-07 | 8 62E-08 |
| Pb-210 | 1 3728E-13 | 22 40 | 9 41 | 0 00E+00 | 3 08E-12 | 1 29E-12 |
| Pm-147 | 1 0702E-02 | 22 40 | 9 41 | 0 00E+00 | 2 40E-01 | 1 01E-01 |
| Pu-238 | 8 8692E-04 | 22 40 | 9 41 | 0 00E+00 | 1 99E-02 | 8 34E-03 |
| Pu-239 | 5 5263E-03 | 22.40 | 9 41 | 0 00E+00 | 1 24E-01 | 5.20E-02 |
| Pu-240 | 2 1233E-03 | 22 40 | 9 41 | 0 00E+00 | 4 76E-02 | 2 00E-02 |
| Pu-241 | 3 8962E-02 | 22 40 | 9 41 | 0 00E+00 | 8 73E-01 | 3 67E-01 |
| Pu-242 | 2 3128E-07 | 22 40 | 9 41 | 0 00E+00 | 5 18E-06 | 2 18E-06 |
| Ra-226 | 4 6752E-13 | 22 40 | 9 41 | 0 00E+00 | 1 05E-11 | 4 40E-12 |
| Ra-228 | 2 4827E-10 | 22 40 | 9 41 | 0 00E+00 | 5 56E-09 | 2 34E-09 |
| Ru-106 | 9 8526E-08 | 22 40 | 9 41 | 0 00E+00 | 2 21E-06 | 9 27E-07 |
| Se-79 | 1 3015E-05 | 22 40 | 9 41 | 0 00E+00 | 2 92E-04 | 1 22E-04 |
| Sn-126 | 1 2165E-05 | 22 40 | 9 41 | 0 00E+00 | 2 73E-04 | 1 14E-04 |
| Sr-90 | 1 6195E+00 | 22 40 | 9 41 | 0 00E+00 | 3 63E+01 | 1 52E+01 |
| Tc-99 | 4 4241E-04 | 22 40 | 9 41 | 0 00E+00 | 9 91E-03 | 4 16E-03 |
| Th-229 | 4 2451E-10 | 22 40 | 9 41 | 0 00E+00 | 9 51E-09 | 3 99E-09 |
| Th-230 | 6 1398E-11 | 22 40 | 9 41 | 0 00E+00 | 1.38E-09 | 5 78E-10 |
| Th-232 | 2.5278E-10 | 22 40 | 9 41 | 0 00E+00 | 5 66E-09 | 2 38E-09 |
| Tl-208 | 1.5098E-08 | 22 40 | 9 41 | 0 00E+00 | 3.38E-07 | 1 42E-07 |
| U-232 | 4 0662E-08 | 22 40 | 9 41 | 0 00E+00 | 9 11E-07 | 3 83E-07 |
| U-233 | 1.2217E-07 | 22 40 | 9 41 | 0 00E+00 | 2 74E-06 | 1 15E-06 |
| U-234 | 2 2391E-07 | 22 40 | 9 41 | 0 00E+00 | 5 02E-06 | 2 11E-06 |
| U-235 | -2 6194E-06 | 22 40 | 0 00 | 8 75E-03 | 8 69E-03 | 8 75E-03 |
| U-236 | 1 2695E-05 | 22 40 | 9 41 | 0 00E+00 | 2 84E-04 | 1.19E-04 |
| U-238 | -3 6331E-08 | 22 40 | 0 00 | 1 73E-03 | 1 73E-03 | 1.73E-03 |
| Y-90 | 1 6195E+00 | 22 40 | 9 41 | 0 00E+00 | 3 63E+01 | 1 52E+01 |
| Other Radionuclides | | | | | 3 85E+01 | 1.62E+01 |

### Gamma Sources

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8 352E+11 |
| 0 0250 | 1 736E+11 |
| 0 0375 | 1 506E+11 |
| 0 0575 | 1 622E+11 |
| 0 0850 | 9 779E+10 |
| 0 1250 | 6.383E+10 |
| 0.2250 | 8 426E+10 |
| 0.3750 | 3 672E+10 |
| 0 5750 | 6 087E+11 |
| 0 8500 | 6.536E+09 |
| 1 2500 | 6 711E+10 |
| 1 7500 | 1 701E+08 |
| 2.2500 | 3 587E+05 |
| 2 7500 | 6 076E+03 |
| 3 5000 | 2.206E+01 |
| 5 0000 | 8.961E+00 |
| 7.0000 | 1 020E+00 |
| 11 0000 | 1 165E-01 |

### Thermal Power

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 76E-01 | 2 00E-01 |
| Total | Total |

## III. Template Selection Summary, Burnup Summary, and Checks

### Template Selection Summary

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 44 026 | 10 to 20 1 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment.

### Burnup Summary (MWd)[2]

| | From SFD | Estimated | Basis for burnup used in estimate* |
|---|---|---|---|
| Nominal | 22 40 | 4 01 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 9 41 | 8 02 | Bounding burnup taken directly from SFD (converted to MWd) |

### Checks

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 07 | 0 18 |
| Bounding | 0 03 | 0 85 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BMI (CPI-24) | [1]Fuel decay start date: | 1961 |
| SNF ID # | 774 | Estimates as of | 2010 |
| Fuel Units & Descr | 2 - CANISTER OF SCRAP | Template | Pathfinder (Light Water, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL= , EOL=0 559kg | [2]Template Burnup(MWd): | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00012882 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x10' 0 15

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 528 25 | 528 25 | 0 00E+00 | 1 23E-05 | 1 23E-05 |
| Am-241 | 1 1135E-04 | 528 25 | 528 25 | 0 00E+00 | 5 88E-02 | 5 88E-02 |
| Am-242m | 8 5075E-09 | 528.25 | 528 25 | 0 00E+00 | 4 49E-06 | 4 49E-06 |
| Am-243 | 9 8519E-10 | 528.25 | 528 25 | 0 00E+00 | 5.20E-07 | 5 20E-07 |
| C-14 | 2 3012E-04 | 528.25 | 528 25 | 0 00E+00 | 1 22E-01 | 1 22E-01 |
| Cl-36 | 1 2261E-06 | 528.25 | 528 25 | 0 00E+00 | 6 48E-04 | 6 48E-04 |
| Cm-243 | 2 4875E-10 | 528.25 | 528.25 | 0 00E+00 | 1.31E-07 | 1 31E-07 |
| Cm-244 | 2 3178E-09 | 528.25 | 528.25 | 0 00E+00 | 1.22E-06 | 1.22E-06 |
| Co-60 | 7 0849E-02 | 528.25 | 528.25 | 0 00E+00 | 3 74E+01 | 3 74E+01 |
| Cs-134 | 3 0266E-06 | 528.25 | 528.25 | 0 00E+00 | 1 60E-03 | 1 60E-03 |
| Cs-135 | 3 0316E-05 | 528.25 | 528.25 | 0 00E+00 | 1 60E-02 | 1.60E-02 |
| Cs-137 | 1 4511E+00 | 528.25 | 528.25 | 0 00E+00 | 7 67E+02 | 7 67E+02 |
| Eu-154 | 6 6955E-04 | 528.25 | 528.25 | 0 00E+00 | 3 54E-01 | 3 54E-01 |
| Eu-155 | 6 9850E-04 | 528.25 | 528.25 | 0 00E+00 | 3 69E-01 | 3 69E-01 |
| Fe-55 | 1 2318E-03 | 528.25 | 528.25 | 0 00E+00 | 6 51E-01 | 6 51E-01 |
| H-3 | 2 5141E-03 | 528.25 | 528.25 | 0 00E+00 | 1 33E+00 | 1 33E+00 |
| I-129 | 7 3195E-07 | 528 25 | 528.25 | 0 00E+00 | 3 87E-04 | 3 87E-04 |
| Kr-85 | 4 1281E-02 | 528 25 | 528 25 | 0 00E+00 | 2 18E+01 | 2 18E+01 |
| Np-237 | 1.1489E-06 | 528 25 | 528 25 | 0 00E+00 | 6 07E-04 | 6 07E-04 |
| Pa-231 | 4 5241E-08 | 528 25 | 528 25 | 0 00E+00 | 2 39E-05 | 2 39E-05 |
| Pb-210 | 6 4476E-13 | 528 25 | 528 25 | 0 00E+00 | 3 41E-10 | 3 41E-10 |
| Pm-147 | 1 1651E-03 | 528 25 | 528 25 | 0 00E+00 | 6 15E-01 | 6 15E-01 |
| Pu-238 | 2 9517E-04 | 528 25 | 528 25 | 0 00E+00 | 1 56E-01 | 1 56E-01 |
| Pu-239 | 6 6772E-04 | 528 25 | 528 25 | 0 00E+00 | 3 53E-01 | 3 53E-01 |
| Pu-240 | 8 6839E-05 | 528 25 | 528.25 | 0 00E+00 | 4 59E-02 | 4 59E-02 |
| Pu-241 | 7 1514E-04 | 528.25 | 528 25 | 0 00E+00 | 3 78E-01 | 3 78E-01 |
| Pu-242 | 1 9717E-09 | 528 25 | 528 25 | 0 00E+00 | 1 04E-06 | 1 04E-06 |
| Ra-226 | 1 7654E-12 | 528 25 | 528 25 | 0 00E+00 | 9 33E-10 | 9 33E-10 |
| Ra-228 | 8 2928E-12 | 528.25 | 528.25 | 0 00E+00 | 4 38E-09 | 4 38E-09 |
| Ru-106 | 1 8419E-10 | 528.25 | 528.25 | 0 00E+00 | 9 73E-08 | 9 73E-08 |
| Se-79 | 1 3223E-05 | 528.25 | 528.25 | 0 00E+00 | 6 98E-03 | 6 98E-03 |
| Sn-126 | 1 1493E-05 | 528.25 | 528.25 | 0 00E+00 | 6 07E-03 | 6 07E-03 |
| Sr-90 | 1 3649E+00 | 528.25 | 528.25 | 0 00E+00 | 7 21E+02 | 7 21E+02 |
| Tc-99 | 4 6656E-04 | 528.25 | 528.25 | 0 00E+00 | 2 46E-01 | 2 46E-01 |
| Th-229 | 1 4547E-11 | 528.25 | 528 25 | 0 00E+00 | 7 68E-09 | 7 68E-09 |
| Th-230 | 1 6617E-10 | 528 25 | 528 25 | 0 00E+00 | 8 78E-08 | 8 78E-08 |
| Th-232 | 8 3361E-12 | 528 25 | 528 25 | 0 00E+00 | 4 40E-09 | 4 40E-09 |
| Tl-208 | 2 1664E-08 | 528 25 | 528 25 | 0 00E+00 | 1 14E-05 | 1 14E-05 |
| U-232 | 5 8669E-08 | 528 25 | 528 25 | 0 00E+00 | 3 10E-05 | 3 10E-05 |
| U-233 | 3.1847E-09 | 528 25 | 528 25 | 0 00E+00 | 1 68E-06 | 1 68E-06 |
| U-234 | 3 8769E-07 | 528 25 | 528 25 | 0 00E+00 | 2 05E-04 | 2 05E-04 |
| U-235 | -2 7761E-06 | 528 25 | 0 00 | 2.26E-03 | 7 92E-04 | 2 26E-03 |
| U-236 | 1 6190E-05 | 528 25 | 528 25 | 0 00E+00 | 8 55E-03 | 8 55E-03 |
| U-238 | -2 8547E-09 | 528.25 | 0 00 | 2 44E-05 | 2 29E-05 | 2 44E-05 |
| Y-90 | 1 3652E+00 | 528.25 | 528 25 | 0 00E+00 | 7.21E+02 | 7.21E+02 |
| Other Radionuclides | | | | | 8.72E+02 | 8 72E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3.943E+13 |
| 0 0250 | 8 193E+12 |
| 0 0375 | 7 087E+12 |
| 0 0575 | 7 639E+12 |
| 0 0850 | 4 615E+12 |
| 0 1250 | 2.997E+12 |
| 0.2250 | 3 973E+12 |
| 0.3750 | 1 733E+12 |
| 0 5750 | 2.854E+13 |
| 0 8500 | 2.889E+11 |
| 1.2500 | 2 872E+12 |
| 1 7500 | 7 453E+09 |
| 2.2500 | 1 547E+07 |
| 2.7500 | 4 473E+05 |
| 3 5000 | 3 154E+01 |
| 5 0000 | 1.297E+01 |
| 7 0000 | 1 432E+00 |
| 11 0000 | 1 607E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.22E+00 | 9.22E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 528.25 |
| Bounding | | 528.25 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

# Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name BMI (CPI 38)
SNF ID #: 20
Fuel Units & Descr: 1 - CANISTER OF SCRAP
Heavy Metal Mass BOL= - EOL=1.286kg
ROD Storage Site INEEL

[1]Fuel decay start date 1961
Estimates as of 2010
Template Pathfinder (Light Water SST 60 to 100% U)
[2]Template Burnup(MWd) 6 01
Template BOL Heavy Metal Mass (MT) 0 00012882
Template Decay Time 35 years

Estimated Canister usage 18"x10' 0 08

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 84E-05 | 2 84E-05 |
| Am-241 | 1.1135E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 35E-01 | 1 35E-01 |
| Am-242m | 8 5075E-09 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 03E-05 | 1 03E-05 |
| Am-243 | 9 8519E-10 | 1,215 10 | 1,215 10 | 0 00E+00 | 1.20E-06 | 1.20E-06 |
| C-14 | 2 3012E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 80E-01 | 2 80E-01 |
| Cl-36 | 1 2261E-06 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 49E-03 | 1 49E-03 |
| Cm-243 | 2 4875E-10 | 1,215 10 | 1,215 10 | 0 00E+00 | 3 02E-07 | 3 02E-07 |
| Cm-244 | 2 3178E-09 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 82E-06 | 2 82E-06 |
| Co-60 | 7 0849E-02 | 1,215 10 | 1,215 10 | 0 00E+00 | 8 61E+01 | 8 61E+01 |
| Cs-134 | 3 0266E-06 | 1,215.10 | 1,215 10 | 0 00E+00 | 3 68E-03 | 3 68E-03 |
| Cs-135 | 3 0316E-05 | 1,215 10 | 1,215 10 | 0 00E+00 | 3 68E-02 | 3 68E-02 |
| Cs-137 | 1 4511E+00 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 76E+03 | 1 76E+03 |
| Eu-154 | 6 6955E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 8.14E-01 | 8 14E-01 |
| Eu-155 | 6 9850E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 8 49E-01 | 8 49E-01 |
| Fe-55 | 1 2318E-03 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 50E+00 | 1 50E+00 |
| H-3 | 2 5141E-03 | 1,215 10 | 1,215 10 | 0 00E+00 | 3 05E+00 | 3 05E+00 |
| I-129 | 7 3195E-07 | 1,215 10 | 1,215 10 | 0 00E+00 | 8 89E-04 | 8 89E-04 |
| Kr-85 | 4 1281E-02 | 1,215.10 | 1,215 10 | 0 00E+00 | 5 02E+01 | 5 02E+01 |
| Np-237 | 1.1489E-06 | 1,215 10 | 1,215 10 | 0.00E+00 | 1 40E-03 | 1 40E-03 |
| Pa-231 | 4.5241E-08 | 1,215 10 | 1,215 10 | 0 00E+00 | 5 50E-05 | 5 50E-05 |
| Pb-210 | 6 4476E-13 | 1,215 10 | 1,215 10 | 0 00E+00 | 7 83E-10 | 7 83E-10 |
| Pm-147 | 1 1651E-03 | 1 215 10 | 1,215 10 | 0 00E+00 | 1 42E+00 | 1 42E+00 |
| Pu-238 | 2 9517E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 3 59E-01 | 3 59E-01 |
| Pu-239 | 6 6772E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 8 11E-01 | 8 11E-01 |
| Pu-240 | 8 6839E-05 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 06E-01 | 1 06E-01 |
| Pu-241 | 7 1514E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 8 69E-01 | 8 69E-01 |
| Pu-242 | 1 9717E-09 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 40E-06 | 2 40E-06 |
| Ra-226 | 1.7654E-12 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 15E-09 | 2 15E-09 |
| Ra-228 | 8.2928E-12 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 01E-08 | 1 01E-08 |
| Ru-106 | 1 8419E-10 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 24E-07 | 2 24E-07 |
| Se-79 | 1 3223E-05 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 61E-02 | 1 61E-02 |
| Sn-126 | 1 1493E-05 | 1,215 10 | 1 215 10 | 0 00E+00 | 1.40E-02 | 1 40E-02 |
| Sr-90 | 1 3649E+00 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 66E+03 | 1 66E+03 |
| Tc-99 | 4 6656E-04 | 1,215 10 | 1,215 10 | 0 00E+00 | 5 67E-01 | 5 67E-01 |
| Th-229 | 1 4547E-11 | 1,215 10 | 1,215.10 | 0 00E+00 | 1 77E-08 | 1 77E-08 |
| Th-230 | 1 6617E-10 | 1,215 10 | 1,215.10 | 0.00E+00 | 2 02E-07 | 2 02E-07 |
| Th-232 | 8 3361E-12 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 01E-08 | 1 01E-08 |
| Tl-208 | 2 1664E-08 | 1,215 10 | 1,215 10 | 0 00E+00 | 2 63E-05 | 2 63E-05 |
| U-232 | 5 8669E-08 | 1,215 10 | 1,215 10 | 0 00E+00 | 7 13E-05 | 7 13E-05 |
| U-233 | 3 1847E-09 | 1,215 10 | 1,215 10 | 0 00E+00 | 3 87E-06 | 3 87E-06 |
| U-234 | 3 8769E-07 | 1,215 10 | 1,215 10 | 0 00E+00 | 4 71E-04 | 4 71E-04 |
| U-235 | -2 7761E-06 | 1,215 10 | 0 00 | 5 20E-03 | 1.82E-03 | 5.20E-03 |
| U-236 | 1 6190E-05 | 1,215.10 | 1,215 10 | 0 00E+00 | 1 97E-02 | 1.97E-02 |
| U-238 | -2 8547E-09 | 1,215.10 | 0 00 | 5 62E-05 | 5 27E-05 | 5 62E-05 |
| Y-90 | 1.3652E+00 | 1,215 10 | 1,215 10 | 0 00E+00 | 1 66E+03 | 1 66E+03 |
| Other Radionuclides | | | | | 2 01E+03 | 2 01E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 069E+13 |
| 0 0250 | 1 885E+13 |
| 0 0375 | 1 630E+13 |
| 0 0575 | 1 757E+13 |
| 0 0850 | 1 062E+13 |
| 0 1250 | 6 893E+12 |
| 0.2250 | 9 138E+12 |
| 0 3750 | 3.986E+12 |
| 0 5750 | 6.566E+13 |
| 0 8500 | 6 646E+11 |
| 1.2500 | 6 606E+12 |
| 1 7500 | 1 714E+10 |
| 2.2500 | 3 559E+07 |
| 2 7500 | 1 029E+06 |
| 3 5000 | 7.255E+01 |
| 5 0000 | 2 984E+01 |
| 7 0000 | 3.295E+00 |
| 11 0000 | 3 697E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 12E+01 | 2.12E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | This Template was used for the following reasons |
| Fuel Cladding | HASTELLOY | SST | This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown) |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 1 215 10 | Nominal burnup set equal to bounding burnup |
| Bounding | | 1,215 10 | Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | BORAX V (SUPERHEATER) | [1]Fuel decay start date | 1964 |
| SNF ID # | 22 | Estimates as of: | 2010 |
| Fuel Units & Descr | 36 - 20 FLAT PLATES | Template: | Pathfinder (Light Water, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=22 014kg EOL=20 833kg | [2]Template Burnup(MWd) | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00012882 |
| | | Template Decay Time: | 35 years |

Estimated Canister usage 18"x10' 2 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 60E-05 | 5.21E-05 |
| Am-241 | 1 1135E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 24E-01 | 2 48E-01 |
| Am-242m | 8 5075E-09 | 1,115 44 | 2,230 88 | 0 00E+00 | 9 49E-06 | 1.90E-05 |
| Am-243 | 9 8519E-10 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 10E-06 | 2.20E-06 |
| C-14 | 2 3012E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 57E-01 | 5.13E-01 |
| Cl-36 | 1 2261E-06 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 37E-03 | 2.74E-03 |
| Cm-243 | 2 4875E-10 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 77E-07 | 5 55E-07 |
| Cm-244 | 2 3178E-09 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 59E-06 | 5 17E-06 |
| Co-60 | 7 0849E-02 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 90E+01 | 1 58E+02 |
| Cs-134 | 3 0266E-06 | 1,115 44 | 2,230 88 | 0 00E+00 | 3 38E-03 | 6 75E-03 |
| Cs-135 | 3 0316E-05 | 1,115 44 | 2,230 88 | 0 00E+00 | 3 38E-02 | 6 76E-02 |
| Cs-137 | 1 4511E+00 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 62E+03 | 3 24E+03 |
| Eu-154 | 6 6955E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 47E-01 | 1 49E+00 |
| Eu-155 | 6 9850E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 79E-01 | 1 56E+00 |
| Fe-55 | 1.2318E-03 | 1,115 44 | 2,230 88 | 0 00E+00 | 1.37E+00 | 2 75E+00 |
| H-3 | 2 5141E-03 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 80E+00 | 5 61E+00 |
| I-129 | 7 3195E-07 | 1,115 44 | 2,230 88 | 0 00E+00 | 8.16E-04 | 1 63E-03 |
| Kr-85 | 4 1281E-02 | 1,115 44 | 2,230 88 | 0 00E+00 | 4 60E+01 | 9 21E+01 |
| Np-237 | 1 1489E-06 | 1,115 44 | 2,230 88 | 0 00E+00 | 1.28E-03 | 2 56E-03 |
| Pa-231 | 4 5241E-08 | 1,115 44 | 2,230 88 | 0 00E+00 | 5 05E-05 | 1 01E-04 |
| Pb-210 | 6 4476E-13 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 19E-10 | 1 44E-09 |
| Pm-147 | 1 1651E-03 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 30E+00 | 2 60E+00 |
| Pu-238 | 2 9517E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 3 29E-01 | 6 58E-01 |
| Pu-239 | 6 6772E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 45E-01 | 1 49E+00 |
| Pu-240 | 8 6839E-05 | 1,115 44 | 2,230 88 | 0 00E+00 | 9 69E-02 | 1 94E-01 |
| Pu-241 | 7 1514E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 7 98E-01 | 1 60E+00 |
| Pu-242 | 1 9717E-09 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 20E-06 | 4 40E-06 |
| Ra-226 | 1 7654E-12 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 97E-09 | 3.94E-09 |
| Ra-228 | 8 2928E-12 | 1,115 44 | 2,230 88 | 0 00E+00 | 9 25E-09 | 1 85E-08 |
| Ru-106 | 1 8419E-10 | 1,115 44 | 2,230 88 | 0 00E+00 | 2 05E-07 | 4.11E-07 |
| Se-79 | 1 3223E-05 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 47E-02 | 2 95E-02 |
| Sn-126 | 1.1493E-05 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 28E-02 | 2 56E-02 |
| Sr-90 | 1 3649E+00 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 52E+03 | 3 04E+03 |
| Tc-99 | 4 6656E-04 | 1,115 44 | 2,230 88 | 0 00E+00 | 5 20E-01 | 1 04E+00 |
| Th-229 | 1 4547E-11 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 62E-08 | 3.25E-08 |
| Th-230 | 1 6617E-10 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 85E-07 | 3 71E-07 |
| Th-232 | 8 3361E-12 | 1,115 44 | 2,230 88 | 0 00E+00 | 9 30E-09 | 1 86E-08 |
| Tl-208 | 2.1664E-08 | 1,115 44 | 2,230 88 | 0 00E+00 | 2.42E-05 | 4 83E-05 |
| U-232 | 5 8669E-08 | 1,115 44 | 2,230 88 | 0 00E+00 | 6.54E-05 | 1 31E-04 |
| U-233 | 3.1847E-09 | 1,115 44 | 2,230 88 | 0 00E+00 | 3 55E-06 | 7 10E-06 |
| U-234 | 3 8769E-07 | 1,115 44 | 2 230 88 | 0 00E+00 | 4 32E-04 | 8 65E-04 |
| U-235 | -2.7761E-06 | 1,115 44 | 0 00 | 4 42E-02 | 4 11E-02 | 4 42E-02 |
| U-236 | 1 6190E-05 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 81E-02 | 3 61E-02 |
| U-238 | -2 8547E-09 | 1,115 44 | 0 00 | 5 18E-04 | 5 15E-04 | 5 18E-04 |
| Y-90 | 1 3652E+00 | 1,115 44 | 2,230 88 | 0 00E+00 | 1 52E+03 | 3 05E+03 |
| Other Radionuclides | | | | | 1 84E+03 | 3 68E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 665E+14 |
| 0 0250 | 3 460E+13 |
| 0 0375 | 2 993E+13 |
| 0 0575 | 3.226E+13 |
| 0 0850 | 1 949E+13 |
| 0 1250 | 1.266E+13 |
| 0.2250 | 1 678E+13 |
| 0.3750 | 7 318E+12 |
| 0.5750 | 1.205E+14 |
| 0 8500 | 1.220E+12 |
| 1.2500 | 1.213E+13 |
| 1 7500 | 3.147E+10 |
| 2.2500 | 6 535E+07 |
| 2.7500 | 1 889E+06 |
| 3.5000 | 1 366E+02 |
| 5 0000 | 5 621E+01 |
| 7 0000 | 6 209E+00 |
| 11 0000 | 6 970E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 95E+01 | 3 90E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences* |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | SST | SST | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93 00081766 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate* |
|---|---|---|---|
| Nominal | | 1 115 44 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 2,230 88 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 1 09 | | 1 00 |
| Bounding | 2.17 | | |

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BR 3 | [1]Fuel decay start date | 1981 |
| SNF ID # | 927 | Estimates as of | 2010 |
| Fuel Units & Descr | 16 ROD | Template | PWR (Light Water Zirc 0 to 5% U) |
| Heavy Metal Mass | BOL=5 6kg EOL=5 11kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

| Estimated Canister usage 18"x15' |
|---|
| 1 00 |

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 465 59 | 931 17 | 0 00E+00 | 3 09E-07 | 6 18E-07 |
| Am-241 | 1 3144E-01 | 465 59 | 931 17 | 0 00E+00 | 6 12E+01 | 1.22E+02 |
| Am-242m | 3 0039E-04 | 465.59 | 931 17 | 0 00E+00 | 1 40E-01 | 2 80E-01 |
| Am-243 | 6.2629E-04 | 465 59 | 931 17 | 0 00E+00 | 2 92E-01 | 5 83E-01 |
| C-14 | 4 7965E-05 | 465 59 | 931 17 | 0 00E+00 | 2 23E-02 | 4 47E-02 |
| Cl-36 | 8 0297E-07 | 465 59 | 931 17 | 0 00E+00 | 3 74E-04 | 7 48E-04 |
| Cm-243 | 3 1993E-04 | 465 59 | 931 17 | 0 00E+00 | 1 49E-01 | 2 98E-01 |
| Cm-244 | 7 1851E-02 | 465 59 | 931.17 | 0 00E+00 | 3 35E+01 | 6 69E+01 |
| Co-60 | 9 5220E-03 | 465 59 | 931.17 | 0 00E+00 | 4 43E+00 | 8 87E+00 |
| Cs-134 | 1 1662E-03 | 465 59 | 931.17 | 0 00E+00 | 5 43E-01 | 1 09E+00 |
| Cs-135 | 1 4433E-05 | 465 59 | 931 17 | 0 00E+00 | 6 72E-03 | 1 34E-02 |
| Cs-137 | 1 7603E+00 | 465 59 | 931 17 | 0 00E+00 | 8 20E+02 | 1.64E+03 |
| Eu-154 | 4 5203E-02 | 465 59 | 931 17 | 0 00E+00 | 2 10E+01 | 4 21E+01 |
| Eu-155 | 7 1479E-03 | 465 59 | 931 17 | 0 00E+00 | 3 33E+00 | 6 66E+00 |
| Fe-55 | 6 1919E-04 | 465 59 | 931 17 | 0 00E+00 | 2 88E-01 | 5 77E-01 |
| H-3 | 3 6386E-02 | 465 59 | 931 17 | 0 00E+00 | 1 69E+01 | 3 39E+01 |
| I-129 | 9 8288E-07 | 465 59 | 931 17 | 0 00E+00 | 4 58E-04 | 9 15E-04 |
| Kr-85 | 5 3844E-02 | 465 59 | 931 17 | 0 00E+00 | 2 51E+01 | 5 01E+01 |
| Np-237 | 1 0546E-05 | 465 59 | 931 17 | 0 00E+00 | 4 91E-03 | 9 82E-03 |
| Pa-231 | 1 1370E-09 | 465 59 | 931.17 | 0 00E+00 | 5 29E-07 | 1.06E-06 |
| Pb-210 | 3 3624E-11 | 465 59 | 931.17 | 0 00E+00 | 1 57E-08 | 3 13E-08 |
| Pm-147 | 5 1211E-03 | 465 59 | 931.17 | 0 00E+00 | 2 38E+00 | 4 77E+00 |
| Pu-238 | 8 0669E-02 | 465 59 | 931 17 | 0 00E+00 | 3 76E+01 | 7.51E+01 |
| Pu-239 | 1 1626E-02 | 465 59 | 931 17 | 0 00E+00 | 5 41E+00 | 1 08E+01 |
| Pu-240 | 1 5097E-02 | 465 59 | 931 17 | 0 00E+00 | 7 03E+00 | 1 41E+01 |
| Pu-241 | 1 4567E+00 | 465 59 | 931 17 | 0 00E+00 | 6 78E+02 | 1 36E+03 |
| Pu-242 | 6 4260E-05 | 465 59 | 931 17 | 0 00E+00 | 2.99E-02 | 5 98E-02 |
| Ra-226 | 1.1392E-10 | 465 59 | 931 17 | 0 00E+00 | 5.30E-08 | 1 06E-07 |
| Ra-228 | 5.1841E-12 | 465 59 | 931 17 | 0 00E+00 | 2 41E-09 | 4 83E-09 |
| Ru-106 | 5 9012E-07 | 465 59 | 931 17 | 0 00E+00 | 2 75E-04 | 5 50E-04 |
| Se-79 | 1.2379E-05 | 465 59 | 931 17 | 0 00E+00 | 5 76E-03 | 1.15E-02 |
| Sn-126 | 2 5210E-05 | 465 59 | 931 17 | 0 00E+00 | 1 17E-02 | 2 35E-02 |
| Sr-90 | 1 1630E+00 | 465 59 | 931 17 | 0 00E+00 | 5 41E+02 | 1 08E+03 |
| Tc-99 | 3 9357E-04 | 465 59 | 931.17 | 0 00E+00 | 1 83E-01 | 3 66E-01 |
| Th-229 | 8 5691E-11 | 465 59 | 931 17 | 0 00E+00 | 3 99E-08 | 7 98E-08 |
| Th-230 | 1 4493E-08 | 465 59 | 931.17 | 0 00E+00 | 6 75E-06 | 1 35E-05 |
| Th-232 | 5 2923E-12 | 465 59 | 931 17 | 0 00E+00 | 2 46E-09 | 4 93E-09 |
| Tl-208 | 1 9202E-07 | 465.59 | 931 17 | 0 00E+00 | 8 94E-05 | 1 79E-04 |
| U-232 | 5.2083E-07 | 465 59 | 931 17 | 0 00E+00 | 2 42E-04 | 4 85E-04 |
| U-233 | 2 4386E-08 | 465 59 | 931 17 | 0 00E+00 | 1 14E-05 | 2 27E-05 |
| U-234 | 4 7012E-05 | 465 59 | 931 17 | 0 00E+00 | 2 19E-02 | 4 38E-02 |
| U-235 | -1 4492E-06 | 465 59 | 0 00 | 3 46E-03 | 2 78E-03 | 3 46E-03 |
| U-236 | 7.5759E-06 | 465 59 | 931 17 | 0 00E+00 | 3 53E-03 | 7.05E-03 |
| U-238 | -2 6129E-07 | 465 59 | 0 00 | 1.34E-03 | 1 22E-03 | 1.34E-03 |
| Y-90 | 1 1631E+00 | 465 59 | 931 17 | 0 00E+00 | 5 42E+02 | 1 08E+03 |
| Other Radionuclides | | | | | 7 87E+02 | 1.57E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 332E+13 |
| 0 0250 | 1.282E+13 |
| 0 0375 | 1.241E+13 |
| 0 0575 | 1 354E+13 |
| 0 0850 | 7 175E+12 |
| 0 1250 | 5.241E+12 |
| 0.2250 | 6 159E+12 |
| 0 3750 | 2 643E+12 |
| 0 5750 | 6 073E+13 |
| 0 8500 | 1 199E+12 |
| 1 2500 | 1 619E+12 |
| 1 7500 | 3 548E+10 |
| 2.2500 | 6 552E+06 |
| 2 7500 | 7 365E+06 |
| 3 5000 | 9 650E+05 |
| 5 0000 | 4 124E+05 |
| 7 0000 | 4 755E+04 |
| 11 0000 | 5 462E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.28E+01 | 2 55E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 28 57142857 | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 465 59 |
| Bounding | | 931 17 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 2 38 | |
| Bounding | 4 75 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: BR-3 FUEL
SNF ID #: 340
Fuel Units & Descr: 16 - ROD
Heavy Metal Mass: BOL=7 536kg EOL=7 064kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1994
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 15 years

Estimated Canister usage 18"x10': 0 12

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 2135E-10 | 448 85 | 897 70 | 0 00E+00 | 1 89E-07 | 3 78E-07 |
| Am-241 | 1 0257E-01 | 448 85 | 897 70 | 0 00E+00 | 4 60E+01 | 9 21E+01 |
| Am-242m | 3 1444E-04 | 448 85 | 897 70 | 0 00E+00 | 1 41E-01 | 2 82E-01 |
| Am-243 | 6 2694E-04 | 448 85 | 897 70 | 0 00E+00 | 2 81E-01 | 5 63E-01 |
| C-14 | 4 8030E-05 | 448 85 | 897 70 | 0 00E+00 | 2 16E-02 | 4 31E-02 |
| Cl-36 | 8 0313E-07 | 448 85 | 897 70 | 0 00E+00 | 3 60E-04 | 7.21E-04 |
| Cm-243 | 4 0795E-04 | 448 85 | 897 70 | 0 00E+00 | 1 83E-01 | 3 66E-01 |
| Cm-244 | 1 0533E-01 | 448 85 | 897 70 | 0 00E+00 | 4 73E+01 | 9 46E+01 |
| Co-60 | 3 5449E-02 | 448 85 | 897 70 | 0 00E+00 | 1 59E+01 | 3 18E+01 |
| Cs-134 | 3.3543E-02 | 448 85 | 897 70 | 0 00E+00 | 1 51E+01 | 3 01E+01 |
| Cs-135 | 1 4433E-05 | 448.85 | 897 70 | 0 00E+00 | 6 48E-03 | 1 30E-02 |
| Cs-137 | 2.2190E+00 | 448 85 | 897 70 | 0 00E+00 | 9 96E+02 | 1 99E+03 |
| Eu-154 | 1 0111E-01 | 448 85 | 897 70 | 0 00E+00 | 4 54E+01 | 9 08E+01 |
| Eu-155 | 2 8892E-02 | 448.85 | 897 70 | 0 00E+00 | 1 30E+01 | 2 59E+01 |
| Fe-55 | 8 8889E-03 | 448 85 | 897 70 | 0 00E+00 | 3 99E+00 | 7 98E+00 |
| H-3 | 6 3727E-02 | 448 85 | 897 70 | 0 00E+00 | 2 86E+01 | 5 72E+01 |
| I-129 | 9 8288E-07 | 448 85 | 897 70 | 0 00E+00 | 4 41E-04 | 8 82E-04 |
| Kr-85 | 1 0276E-01 | 448 85 | 897 70 | 0 00E+00 | 4 61E+01 | 9 22E+01 |
| Np-237 | 9 9693E-06 | 448 85 | 897 70 | 0 00E+00 | 4 47E-03 | 8 95E-03 |
| Pa-231 | 9 7028E-10 | 448 85 | 897 70 | 0 00E+00 | 4.36E-07 | 8 71E-07 |
| Pb-210 | 8 0862E-12 | 448 85 | 897 70 | 0 00E+00 | 3 63E-09 | 7.26E-09 |
| Pm-147 | 7 1786E-02 | 448 85 | 897 70 | 0 00E+00 | 3 22E+01 | 6.44E+01 |
| Pu-238 | 8 7274E-02 | 448 85 | 897 70 | 0 00E+00 | 3 92E+01 | 7 83E+01 |
| Pu-239 | 1 1630E-02 | 448 85 | 897 70 | 0 00E+00 | 5 22E+00 | 1 04E+01 |
| Pu-240 | 1 5016E-02 | 448 85 | 897 70 | 0 00E+00 | 6 74E+00 | 1.35E+01 |
| Pu-241 | 2 3563E+00 | 448 85 | 897 70 | 0 00E+00 | 1 06E+03 | 2.12E+03 |
| Pu-242 | 6 4260E-05 | 448 85 | 897 70 | 0 00E+00 | 2 88E-02 | 5 77E-02 |
| Ra-226 | 4 0407E-11 | 448 85 | 897 70 | 0 00E+00 | 1 81E-08 | 3 63E-08 |
| Ra-228 | 4 7917E-12 | 448 85 | 897 70 | 0 00E+00 | 2 15E-09 | 4 30E-09 |
| Ru-106 | 5 6928E-04 | 448 85 | 897 70 | 0 00E+00 | 2 56E-01 | 5 11E-01 |
| Se-79 | 1 2380E-05 | 448 85 | 897 70 | 0 00E+00 | 5 56E-03 | 1 11E-02 |
| Sn-126 | 2 5210E-05 | 448 85 | 897 70 | 0 00E+00 | 1.13E-02 | 2.26E-02 |
| Sr-90 | 1 4751E+00 | 448 85 | 897 70 | 0 00E+00 | 6 62E+02 | 1.32E+03 |
| Tc-99 | 3 9357E-04 | 448 85 | 897 70 | 0 00E+00 | 1.77E-01 | 3 53E-01 |
| Th-229 | 5 1744E-11 | 448 85 | 897 70 | 0 00E+00 | 2 32E-08 | 4 65E-08 |
| Th-230 | 8 3721E-09 | 448 85 | 897 70 | 0 00E+00 | 3 76E-06 | 7 52E-06 |
| Th-232 | 5 2859E-12 | 448 85 | 897 70 | 0 00E+00 | 2 37E-09 | 4 75E-09 |
| Tl-208 | 2 0397E-07 | 448 85 | 897 70 | 0 00E+00 | 9 16E-05 | 1 83E-04 |
| U-232 | 5 6638E-07 | 448 85 | 897 70 | 0 00E+00 | 2 54E-04 | 5 08E-04 |
| U-233 | 2 3708E-08 | 448 85 | 897 70 | 0 00E+00 | 1 06E-05 | 2 13E-05 |
| U-234 | 4 3653E-05 | 448 85 | 897 70 | 0 00E+00 | 1 96E-02 | 3 92E-02 |
| U-235 | -1 4494E-06 | 448 85 | 0 00 | 1 35E-03 | 6 98E-04 | 1 35E-03 |
| U-236 | 7 5694E-06 | 448 85 | 897 70 | 0 00E+00 | 3 40E-03 | 6 80E-03 |
| U-238 | -2 6129E-07 | 448 85 | 0 00 | 2 32E-03 | 2 21E-03 | 2 32E-03 |
| Y-90 | 1 4755E+00 | 448 85 | 897 70 | 0 00E+00 | 6 62E+02 | 1 32E+03 |
| Other Radionuclides | | | | | 9 60E+02 | 1 92E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 763E+13 |
| 0 0250 | 1 599E+13 |
| 0 0375 | 1 575E+13 |
| 0 0575 | 1 596E+13 |
| 0 0850 | 9 022E+12 |
| 0 1250 | 7 131E+12 |
| 0.2250 | 7 690E+12 |
| 0 3750 | 3.388E+12 |
| 0 5750 | 7 544E+13 |
| 0 8500 | 3 098E+12 |
| 1.2500 | 4 362E+12 |
| 1 7500 | 6 645E+10 |
| 2.2500 | 5.701E+07 |
| 2 7500 | 1.205E+07 |
| 3.5000 | 1 885E+06 |
| 5 0000 | 5 789E+05 |
| 7 0000 | 6 674E+04 |
| 11 0000 | 7 667E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.51E+01 | 3 01E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 8.280254777 | 0 to 5 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches PWR Template on all but one parameter (enrichment) making PWR a reasonable match.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 293 90 | 448 85 |
| Bounding | 316 51 | 897 70 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 70 | 1 53 |
| Bounding | 3 40 | 2.84 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: BRP-B
SNF ID #: 23
Fuel Units & Descr: 2 - 11 X 11 ROD ARRAY
Heavy Metal Mass: BOL=262 681kg EOL=250 073kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1972
Estimates as of: 2010
Template: PWR (Light Water Zirc 0 to 5% U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 05E-05 | 2.10E-05 |
| Am-241 | 1.4352E-01 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 72E+03 | 3 44E+03 |
| Am-242m | 2 8698E-04 | 11,990 37 | 23,980 74 | 0 00E+00 | 3 44E+00 | 6 88E+00 |
| Am-243 | 6 2565E-04 | 11,990 37 | 23,980 74 | 0 00E+00 | 7 50E+00 | 1 50E+01 |
| C-14 | 4 7901E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 5 74E-01 | 1.15E+00 |
| Cl-36 | 8 0297E-07 | 11,990 37 | 23,980 74 | 0 00E+00 | 9 63E-03 | 1 93E-02 |
| Cm-243 | 2 5081E-04 | 11,990.37 | 23,980 74 | 0 00E+00 | 3 01E+00 | 6 01E+00 |
| Cm-244 | 4 9015E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 5 88E+02 | 1 18E+03 |
| Co-60 | 2 5581E-03 | 11,990 37 | 23,980 74 | 0 00E+00 | 3 07E+01 | 6 13E+01 |
| Cs-134 | 4 0536E-05 | 11,990 37 | 23 980 74 | 0 00E+00 | 4 86E-01 | 9 72E-01 |
| Cs-135 | 1 4433E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 73E-01 | 3 46E-01 |
| Cs-137 | 1 3979E+00 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 68E+04 | 3 35E+04 |
| Eu-154 | 2.0203E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 2 42E+02 | 4 84E+02 |
| Eu-155 | 1 7684E-03 | 11,990 37 | 23,980 74 | 0 00E+00 | 2 12E+01 | 4 24E+01 |
| Fe-55 | 4 3136E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 5 17E-01 | 1 03E+00 |
| H-3 | 2 0769E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 2 49E+02 | 4 98E+02 |
| I-129 | 9 8288E-07 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 18E-02 | 2.36E-02 |
| Kr-85 | 2 8214E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 3 38E+02 | 6 77E+02 |
| Np-237 | 1 1218E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 35E-01 | 2 69E-01 |
| Pa-231 | 1 3036E-09 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 56E-05 | 3 13E-05 |
| Pb-210 | 8 5078E-11 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 02E-06 | 2 04E-06 |
| Pm-147 | 3 6531E-04 | 11,990 37 | 23,980 74 | 0 00E+00 | 4 38E+00 | 8 76E+00 |
| Pu-238 | 7 4564E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 8 94E+02 | 1 79E+03 |
| Pu-239 | 1.1623E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 39E+02 | 2 79E+02 |
| Pu-240 | 1.5132E-02 | 11,990 37 | 23,980 74 | 0 00E+00 | 1.81E+02 | 3 63E+02 |
| Pu-241 | 9 0036E-01 | 11,990 37 | 23,980 74 | 0 00E+00 | 1.08E+04 | 2 16E+04 |
| Pu-242 | 6 4260E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 7 71E-01 | 1 54E+00 |
| Ra-226 | 2.2804E-10 | 11,990 37 | 23,980 74 | 0 00E+00 | 2 73E-06 | 5 47E-06 |
| Ra-228 | 5 2713E-12 | 11,990.37 | 23,980 74 | 0 00E+00 | 6 32E-08 | 1.26E-07 |
| Ru-106 | 6 1160E-10 | 11,990 37 | 23,980 74 | 0 00E+00 | 7 33E-06 | 1 47E-05 |
| Se-79 | 1 2377E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 48E-01 | 2 97E-01 |
| Sn-126 | 2 5210E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 3 02E-01 | 6 05E-01 |
| Sr-90 | 9 1667E-01 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 10E+04 | 2.20E+04 |
| Tc-99 | 3 9357E-04 | 11,990 37 | 23,980 74 | 0 00E+00 | 4 72E+00 | 9 44E+00 |
| Th-229 | 1.2057E-10 | 11,990 37 | 23,980 74 | 0 00E+00 | 1 45E-06 | 2 89E-06 |
| Th-230 | 2.1043E-08 | 11,990 37 | 23,980 74 | 0 00E+00 | 2.52E-04 | 5 05E-04 |
| Th-232 | 5.2972E-12 | 11,990 37 | 23,980 74 | 0 00E+00 | 6.35E-08 | 1.27E-07 |
| Tl-208 | 1 7474E-07 | 11,990 37 | 23,980 74 | 0 00E+00 | 2 10E-03 | 4 19E-03 |
| U-232 | 4 7368E-07 | 11,990 37 | 23,980 74 | 0 00E+00 | 5 68E-03 | 1.14E-02 |
| U-233 | 2 5097E-08 | 11,990 37 | 23,980 74 | 0 00E+00 | 3 01E-04 | 6 02E-04 |
| U-234 | 5 0000E-05 | 11,990 37 | 23,980 74 | 0 00E+00 | 6 00E-01 | 1.20E+00 |
| U-235 | -1 4489E-06 | 11,990 37 | 0 00 | 1 69E-02 | 0 00E+00 | 1 69E-02 |
| U-236 | 7 5824E-06 | 11,990 37 | 23,980 74 | 0 00E+00 | 9 09E-02 | 1 82E-01 |
| U-238 | -2.6129E-07 | 11,990 37 | 0 00 | 8 57E-02 | 8 25E-02 | 8 57E-02 |
| Y-90 | 9 1699E-01 | 11,990 37 | 23 980 74 | 0 00E+00 | 1 10E+04 | 2.20E+04 |
| Other Radionuclides | | | | | 1 61E+04 | 3 22E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.290E+15 |
| 0 0250 | 2 602E+14 |
| 0 0375 | 2 482E+14 |
| 0 0575 | 2 867E+14 |
| 0 0850 | 1 444E+14 |
| 0 1250 | 1 002E+14 |
| 0.2250 | 1 238E+14 |
| 0 3750 | 5 324E+13 |
| 0 5750 | 1 238E+15 |
| 0 8500 | 1 713E+13 |
| 1 2500 | 1 683E+13 |
| 1 7500 | 5 039E+11 |
| 2.2500 | 8 113E+07 |
| 2 7500 | 1 662E+08 |
| 3.5000 | 1 712E+07 |
| 5 0000 | 7.318E+06 |
| 7 0000 | 8 434E+05 |
| 11 0000 | 9 687E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 76E+02 | 5.52E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 982 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 5,310 89 | 11 990 37 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 5 318 51 | 23 980 74 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 30 | 2.26 |
| Bounding | 2 61 | 4 51 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BRP-C | [1]Fuel decay start date | 1968 |
| SNF ID # | 24 | Estimates as of: | 2010 |
| Fuel Units & Descr | 4 - 11 X 11 ROD ARRAY | Template: | PWR (Light Water, Zirc, 0 to 5% U) |
| Heavy Metal Mass | BOL=468 948kg EOL=459 844kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00176911 |
| | | Template Decay Time: | 35 years |

Estimated
Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 11,298 83 | 11,722.29 | 0 00E+00 | 9 92E-06 | 1 03E-05 |
| Am-241 | 1 4352E-01 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 62E+03 | 1 68E+03 |
| Am-242m | 2 8698E-04 | 11,298 83 | 11,722.29 | 0 00E+00 | 3 24E+00 | 3 36E+00 |
| Am-243 | 6 2565E-04 | 11,298 83 | 11,722.29 | 0 00E+00 | 7 07E+00 | 7 33E+00 |
| C-14 | 4 7901E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 5 41E-01 | 5 62E-01 |
| Cl-36 | 8 0297E-07 | 11,298 83 | 11,722.29 | 0 00E+00 | 9 07E-03 | 9 41E-03 |
| Cm-243 | 2 5081E-04 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 83E+00 | 2 94E+00 |
| Cm-244 | 4 9015E-02 | 11,298 83 | 11,722.29 | 0 00E+00 | 5 54E+02 | 5 75E+02 |
| Co-60 | 2 5581E-03 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 89E+01 | 3 00E+01 |
| Cs-134 | 4 0536E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 4 58E-01 | 4 75E-01 |
| Cs-135 | 1 4433E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 63E-01 | 1 69E-01 |
| Cs-137 | 1 3979E+00 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 58E+04 | 1 64E+04 |
| Eu-154 | 2 0203E-02 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 28E+02 | 2.37E+02 |
| Eu-155 | 1 7684E-03 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 00E+01 | 2 07E+01 |
| Fe-55 | 4 3136E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 4 87E-01 | 5 06E-01 |
| H-3 | 2 0769E-02 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 35E+02 | 2 43E+02 |
| I-129 | 9 8288E-07 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 11E-02 | 1 15E-02 |
| Kr-85 | 2 8214E-02 | 11,298 83 | 11,722.29 | 0 00E+00 | 3 19E+02 | 3 31E+02 |
| Np-237 | 1 1218E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 27E-01 | 1 31E-01 |
| Pa-231 | 1 3036E-09 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 47E-05 | 1 53E-05 |
| Pb-210 | 8 5078E-11 | 11,298 83 | 11,722.29 | 0 00E+00 | 9 61E-07 | 9 97E-07 |
| Pm-147 | 3 6531E-04 | 11,298 83 | 11,722.29 | 0 00E+00 | 4 13E+00 | 4.28E+00 |
| Pu-238 | 7 4564E-02 | 11,298 83 | 11,722 29 | 0 00E+00 | 8 42E+02 | 8 74E+02 |
| Pu-239 | 1 1623E-02 | 11,298 83 | 11,722 29 | 0 00E+00 | 1 31E+02 | 1.36E+02 |
| Pu-240 | 1 5132E-02 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 71E+02 | 1 77E+02 |
| Pu-241 | 9 0036E-01 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 02E+04 | 1 06E+04 |
| Pu-242 | 6 4260E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 7 26E-01 | 7 53E-01 |
| Ra-226 | 2 2804E-10 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 58E-06 | 2 67E-06 |
| Ra-228 | 5 2713E-12 | 11,298 83 | 11,722.29 | 0 00E+00 | 5 96E-08 | 6 18E-08 |
| Ru-106 | 6 1160E-10 | 11,298 83 | 11,722 29 | 0 00E+00 | 6 91E-06 | 7.17E-06 |
| Se-79 | 1 2377E-05 | 11,298 83 | 11,722 29 | 0 00E+00 | 1 40E-01 | 1 45E-01 |
| Sn-126 | 2 5210E-05 | 11,298 83 | 11,722.29 | 0 00E+00 | 2 85E-01 | 2 96E-01 |
| Sr-90 | 9 1667E-01 | 11,298 83 | 11,722.29 | 0 00E+00 | 1 04E+04 | 1 07E+04 |
| Tc-99 | 3 9357E-04 | 11,298 83 | 11,722.29 | 0 00E+00 | 4 45E+00 | 4 61E+00 |
| Th-229 | 1 2057E-10 | 11,298 83 | 11,722 29 | 0 00E+00 | 1 36E-06 | 1 41E-06 |
| Th-230 | 2 1043E-08 | 11,298 83 | 11,722 29 | 0 00E+00 | 2 38E-04 | 2.47E-04 |
| Th-232 | 5 2972E-12 | 11,298 83 | 11,722 29 | 0 00E+00 | 5 99E-08 | 6.21E-08 |
| Tl-208 | 1 7474E-07 | 11,298.83 | 11,722 29 | 0 00E+00 | 1 97E-03 | 2.05E-03 |
| U-232 | 4 7368E-07 | 11,298.83 | 11,722 29 | 0 00E+00 | 5 35E-03 | 5 55E-03 |
| U-233 | 2 5097E-08 | 11,298 83 | 11,722 29 | 0 00E+00 | 2 84E-04 | 2 94E-04 |
| U-234 | 5 0000E-05 | 11,298 83 | 11,722 29 | 0 00E+00 | 5 65E-01 | 5 86E-01 |
| U-235 | -1 4489E-06 | 11,298 83 | 0 00 | 3 67E-02 | 2 04E-02 | 3 67E-02 |
| U-236 | 7 5824E-06 | 11,298 83 | 11,722 29 | 0 00E+00 | 8 57E-02 | 8.89E-02 |
| U-238 | -2 6129E-07 | 11,298 83 | 0 00 | 1 52E-01 | 1 49E-01 | 1 52E-01 |
| Y-90 | 9 1699E-01 | 11,298 83 | 11,722 29 | 0 00E+00 | 1 04E+04 | 1 07E+04 |
| Other Radionuclides | | | | | 1 52E+04 | 1 57E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 307E+14 |
| 0 0250 | 1 272E+14 |
| 0 0375 | 1 213E+14 |
| 0 0575 | 1 402E+14 |
| 0 0850 | 7 057E+13 |
| 0 1250 | 4 897E+13 |
| 0.2250 | 6 052E+13 |
| 0 3750 | 2 602E+13 |
| 0 5750 | 6 053E+14 |
| 0 8500 | 8 373E+12 |
| 1 2500 | 8.225E+12 |
| 1 7500 | 2 463E+11 |
| 2.2500 | 3 966E+07 |
| 2.7500 | 8 126E+07 |
| 3 5000 | 8 367E+06 |
| 5 0000 | 3.577E+06 |
| 7 0000 | 4 123E+05 |
| 11 0000 | 4 736E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.60E+02 | 2.70E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 3 626 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 11 298 83 | 8 657 09 | Nominal burnup taken directly from SFD (converted to MWd). |
| Bounding | 11,722.29 | 17,314 19 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 69 | 0 77 | 0 99 |
| Bounding | 0 71 | 1 48 | |

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | BRP-D1 | [1]Fuel decay start date | 1968 |
| SNF ID # | 25 | Estimates as of | 2010 |
| Fuel Units & Descr | 4 - 9 X 9 ROD ARRAY | Template | PWR (Light Water Zirc 0 to 5% U) |
| Heavy Metal Mass | BOL=548.282kg EOL=508 336kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage
Bare Fuel Transfer

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 33E-05 | 6 67E-05 |
| Am-241 | 1.4352E-01 | 37,986 38 | 75,972 75 | 0 00E+00 | 5 45E+03 | 1 09E+04 |
| Am-242m | 2 8698E-04 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 09E+01 | 2 18E+01 |
| Am-243 | 6.2565E-04 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 38E+01 | 4 75E+01 |
| C-14 | 4 7901E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 82E+00 | 3 64E+00 |
| Cl-36 | 8 0297E-07 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 05E-02 | 6 10E-02 |
| Cm-243 | 2.5081E-04 | 37,986 38 | 75,972 75 | 0 00E+00 | 9 53E+00 | 1 91E+01 |
| Cm-244 | 4 9015E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 86E+03 | 3 72E+03 |
| Co-60 | 2 5581E-03 | 37,986 38 | 75,972 75 | 0 00E+00 | 9 72E+01 | 1 94E+02 |
| Cs-134 | 4 0536E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 54E+00 | 3 08E+00 |
| Cs-135 | 1 4433E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 5 48E-01 | 1 10E+00 |
| Cs-137 | 1.3979E+00 | 37,986 38 | 75,972 75 | 0 00E+00 | 5 31E+04 | 1 06E+05 |
| Eu-154 | 2 0203E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 7 67E+02 | 1.53E+03 |
| Eu-155 | 1 7684E-03 | 37,986 38 | 75 972 75 | 0 00E+00 | 6 72E+01 | 1.34E+02 |
| Fe-55 | 4 3136E-05 | 37,986 38 | 75 972 75 | 0 00E+00 | 1 64E+00 | 3 28E+00 |
| H-3 | 2 0769E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 7 89E+02 | 1 58E+03 |
| I-129 | 9 8288E-07 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 73E-02 | 7 47E-02 |
| Kr-85 | 2 8214E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 07E+03 | 2 14E+03 |
| Np-237 | 1 1218E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 4 26E-01 | 8 52E-01 |
| Pa-231 | 1 3036E-09 | 37,986 38 | 75,972 75 | 0 00E+00 | 4 95E-05 | 9 90E-05 |
| Pb-210 | 8 5078E-11 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 23E-06 | 6 46E-06 |
| Pm-147 | 3 6531E-04 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 39E+01 | 2.78E+01 |
| Pu-238 | 7 4564E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 83E+03 | 5 66E+03 |
| Pu-239 | 1 1623E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 4 42E+02 | 8 83E+02 |
| Pu-240 | 1 5132E-02 | 37,986 38 | 75,972 75 | 0 00E+00 | 5 75E+02 | 1.15E+03 |
| Pu-241 | 9 0036E-01 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 42E+04 | 6 84E+04 |
| Pu-242 | 6 4260E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 44E+00 | 4 88E+00 |
| Ra-226 | 2 2804E-10 | 37,986 38 | 75,972 75 | 0 00E+00 | 8 66E-06 | 1 73E-05 |
| Ra-228 | 5.2713E-12 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 00E-07 | 4 00E-07 |
| Ru-106 | 6 1160E-10 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 32E-05 | 4 65E-05 |
| Se-79 | 1 2377E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 4 70E-01 | 9 40E-01 |
| Sn-126 | 2 5210E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 9 58E-01 | 1.92E+00 |
| Sr-90 | 9 1667E-01 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 48E+04 | 6 96E+04 |
| Tc-99 | 3 9357E-04 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 50E+01 | 2.99E+01 |
| Th-229 | 1 2057E-10 | 37,986.38 | 75,972 75 | 0 00E+00 | 4 58E-06 | 9 16E-06 |
| Th-230 | 2 1043E-08 | 37,986.38 | 75,972 75 | 0 00E+00 | 7 99E-04 | 1 60E-03 |
| Th-232 | 5 2972E-12 | 37,986.38 | 75,972 75 | 0 00E+00 | 2 01E-07 | 4 02E-07 |
| Tl-208 | 1 7474E-07 | 37,986 38 | 75,972 75 | 0 00E+00 | 6 64E-03 | 1 33E-02 |
| U-232 | 4 7368E-07 | 37,986.38 | 75,972 75 | 0 00E+00 | 1 80E-02 | 3 60E-02 |
| U-233 | 2 5097E-08 | 37,986 38 | 75,972 75 | 0 00E+00 | 9 53E-04 | 1 91E-03 |
| U-234 | 5 0000E-05 | 37,986 38 | 75,972 75 | 0 00E+00 | 1 90E+00 | 3 80E+00 |
| U-235 | -1 4489E-06 | 37,986 38 | 0 00 | 3 40E-02 | 0 00E+00 | 3 40E-02 |
| U-236 | 7 5824E-06 | 37,986 38 | 75,972 75 | 0 00E+00 | 2 88E-01 | 5 76E-01 |
| U-238 | -2 6129E-07 | 37,986 38 | 0 00 | 1 79E-01 | 1 69E-01 | 1 79E-01 |
| Y-90 | 9 1699E-01 | 37,986 38 | 75,972 75 | 0 00E+00 | 3 48E+04 | 6 97E+04 |
| Other Radionuclides | | | | | 5 10E+04 | 1 02E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 088E+15 |
| 0 0250 | 8 243E+14 |
| 0 0375 | 7 862E+14 |
| 0 0575 | 9 084E+14 |
| 0 0850 | 4 574E+14 |
| 0 1250 | 3 174E+14 |
| 0.2250 | 3 922E+14 |
| 0 3750 | 1 687E+14 |
| 0 5750 | 3 923E+15 |
| 0 8500 | 5 427E+13 |
| 1.2500 | 5 331E+13 |
| 1 7500 | 1 596E+12 |
| 2.2500 | 2 570E+08 |
| 2 7500 | 5.266E+08 |
| 3 5000 | 5 422E+07 |
| 5 0000 | 2.318E+07 |
| 7 0000 | 2 672E+06 |
| 11 0000 | 3 069E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8 74E+02 | 1 75E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2.873 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 900 83 | 37 986 38 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 926 60 | 75 972 75 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 98 | 42 17 |
| Bounding | 3 96 | 81 99 |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name BRP-D2
SNF ID # 26
Fuel Units & Descr 2 - 7 X 7 ROD ARRAY
Heavy Metal Mass BOL=233 593kg EOL=217 098kg
ROD Storage Site INEEL

[1]Fuel decay start date 1968
Estimates as of: 2010
Template: PWR (Light Water, Zirc 0 to 5%, U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 35 years

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 15 685 20 | 31,370 41 | 0 00E+00 | 1 38E-05 | 2 75E-05 |
| Am-241 | 1 4352E-01 | 15,685 20 | 31,370 41 | 0 00E+00 | 2.25E+03 | 4 50E+03 |
| Am-242m | 2 8698E-04 | 15,685 20 | 31,370 41 | 0 00E+00 | 4 50E+00 | 9 00E+00 |
| Am-243 | 6.2565E-04 | 15,685 20 | 31,370 41 | 0 00E+00 | 9 81E+00 | 1 96E+01 |
| C-14 | 4.7901E-05 | 15,685 20 | 31,370 41 | 0 00E+00 | 7 51E-01 | 1 50E+00 |
| Cl-36 | 8 0297E-07 | 15,685 20 | 31,370 41 | 0 00E+00 | 1 26E-02 | 2 52E-02 |
| Cm-243 | 2 5081E-04 | 15,685 20 | 31,370 41 | 0 00E+00 | 3 93E+00 | 7 87E+00 |
| Cm-244 | 4 9015E-02 | 15,685 20 | 31,370 41 | 0 00E+00 | 7 69E+02 | 1 54E+03 |
| Co-60 | 2 5581E-03 | 15,685 20 | 31,370 41 | 0 00E+00 | 4 01E+01 | 8 02E+01 |
| Cs-134 | 4 0536E-05 | 15,685 20 | 31,370 41 | 0 00E+00 | 6 36E-01 | 1 27E+00 |
| Cs-135 | 1 4433E-05 | 15,685 20 | 31,370 41 | 0 00E+00 | 2 26E-01 | 4 53E-01 |
| Cs-137 | 1 3979E+00 | 15,685 20 | 31,370 41 | 0 00E+00 | 2 19E+04 | 4 39E+04 |
| Eu-154 | 2 0203E-02 | 15,685 20 | 31,370 41 | 0 00E+00 | 3 17E+02 | 6 34E+02 |
| Eu-155 | 1 7684E-03 | 15,685 20 | 31,370 41 | 0 00E+00 | 2 77E+01 | 5 55E+01 |
| Fe-55 | 4 3136E-05 | 15,685.20 | 31,370 41 | 0 00E+00 | 6 77E-01 | 1 35E+00 |
| H-3 | 2 0769E-02 | 15,685.20 | 31,370 41 | 0 00E+00 | 3 26E+02 | 6 52E+02 |
| I-129 | 9 8288E-07 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 54E-02 | 3 08E-02 |
| Kr-85 | 2 8214E-02 | 15,685.20 | 31,370 41 | 0 00E+00 | 4 43E+02 | 8 85E+02 |
| Np-237 | 1 1218E-05 | 15,685.20 | 31,370 41 | 0 00E+00 | 1.76E-01 | 3 52E-01 |
| Pa-231 | 1 3036E-09 | 15,685.20 | 31,370 41 | 0 00E+00 | 2 04E-05 | 4 09E-05 |
| Pb-210 | 8 5078E-11 | 15,685.20 | 31,370 41 | 0 00E+00 | 1.33E-06 | 2 67E-06 |
| Pm-147 | 3 6531E-04 | 15,685.20 | 31,370 41 | 0 00E+00 | 5 73E+00 | 1 15E+01 |
| Pu-238 | 7 4564E-02 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 17E+03 | 2 34E+03 |
| Pu-239 | 1 1623E-02 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 82E+02 | 3 65E+02 |
| Pu-240 | 1 5132E-02 | 15,685 20 | 31,370 41 | 0 00E+00 | 2 37E+02 | 4 75E+02 |
| Pu-241 | 9 0036E-01 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 41E+04 | 2 82E+04 |
| Pu-242 | 6 4260E-05 | 15,685 20 | 31,370 41 | 0 00E+00 | 1 01E+00 | 2 02E+00 |
| Ra-226 | 2.2804E-10 | 15,685.20 | 31,370 41 | 0 00E+00 | 3 58E-06 | 7 15E-06 |
| Ra-228 | 5 2713E-12 | 15,685.20 | 31,370 41 | 0 00E+00 | 8.27E-08 | 1 65E-07 |
| Ru-106 | 6 1160E-10 | 15,685 20 | 31,370 41 | 0 00E+00 | 9 59E-06 | 1 92E-05 |
| Se-79 | 1.2377E-05 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 94E-01 | 3 88E-01 |
| Sn-126 | 2 5210E-05 | 15,685.20 | 31,370 41 | 0 00E+00 | 3 95E-01 | 7 91E-01 |
| Sr-90 | 9 1667E-01 | 15,685 20 | 31,370 41 | 0 00E+00 | 1 44E+04 | 2 88E+04 |
| Tc-99 | 3 9357E-04 | 15,685 20 | 31,370 41 | 0 00E+00 | 6 17E+00 | 1.23E+01 |
| Th-229 | 1.2057E-10 | 15,685 20 | 31,370 41 | 0 00E+00 | 1 89E-06 | 3.78E-06 |
| Th-230 | 2 1043E-08 | 15,685 20 | 31,370 41 | 0 00E+00 | 3 30E-04 | 6 60E-04 |
| Th-232 | 5 2972E-12 | 15,685 20 | 31,370 41 | 0 00E+00 | 8 31E-08 | 1 66E-07 |
| Tl-208 | 1 7474E-07 | 15,685 20 | 31,370 41 | 0 00E+00 | 2 74E-03 | 5 48E-03 |
| U-232 | 4 7368E-07 | 15,685 20 | 31,370 41 | 0 00E+00 | 7 43E-03 | 1 49E-02 |
| U-233 | 2 5097E-08 | 15,685 20 | 31,370 41 | 0 00E+00 | 3 94E-04 | 7 87E-04 |
| U-234 | 5 0000E-05 | 15,685.20 | 31,370 41 | 0 00E+00 | 7 84E-01 | 1.57E+00 |
| U-235 | -1 4489E-06 | 15,685.20 | 0 00 | 1 42E-02 | 0 00E+00 | 1 42E-02 |
| U-236 | 7 5824E-06 | 15,685.20 | 31,370 41 | 0 00E+00 | 1 19E-01 | 2 38E-01 |
| U-238 | -2 6129E-07 | 15,685 20 | 0 00 | 7 63E-02 | 7 22E-02 | 7 63E-02 |
| Y-90 | 9 1699E-01 | 15,685 20 | 31,370 41 | 0 00E+00 | 1 44E+04 | 2 88E+04 |
| Other Radionuclides | | | | | 2 11E+04 | 4 21E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 688E+15 |
| 0 0250 | 3 404E+14 |
| 0 0375 | 3.246E+14 |
| 0 0575 | 3 751E+14 |
| 0 0850 | 1.889E+14 |
| 0 1250 | 1 311E+14 |
| 0.2250 | 1 620E+14 |
| 0.3750 | 6 964E+13 |
| 0.5750 | 1 620E+15 |
| 0 8500 | 2.241E+13 |
| 1.2500 | 2.201E+13 |
| 1 7500 | 6 591E+11 |
| 2.2500 | 1 061E+08 |
| 2 7500 | 2 174E+08 |
| 3 5000 | 2 239E+07 |
| 5 0000 | 9 573E+06 |
| 7 0000 | 1 103E+06 |
| 11 0000 | 1 267E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 61E+02 | 7.22E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 811 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 1 061 91 | 15 685.20 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 1 641 46 | 31 370 41 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 92 | 14 77 |
| Bounding | 3 84 | 19 11 |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BRP-E | [1]Fuel decay start date | 1972 |
| SNF ID # | 27 | Estimates as of | 2010 |
| Fuel Units & Descr | 18 - 9 X 9 ROD ARRAY | Template | PWR (Light Water, Zirc, 0 to 5% U) |
| Heavy Metal Mass | BOL=2443 466kg EOL=2420 588kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 56E-05 | 2 96E-05 |
| Am-241 | 1 4352E-01 | 29,160 32 | 33,700 28 | 0 00E+00 | 4 19E+03 | 4 84E+03 |
| Am-242m | 2 8698E-04 | 29,160 32 | 33,700 28 | 0 00E+00 | 8 37E+00 | 9 67E+00 |
| Am-243 | 6 2565E-04 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 82E+01 | 2 11E+01 |
| C-14 | 4 7901E-05 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 40E+00 | 1 61E+00 |
| Cl-36 | 8 0297E-07 | 29,160 32 | 33,700 28 | 0 00E+00 | 2.34E-02 | 2 71E-02 |
| Cm-243 | 2 5081E-04 | 29,160 32 | 33,700 28 | 0 00E+00 | 7 31E+00 | 8 45E+00 |
| Cm-244 | 4 9015E-02 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 43E+03 | 1 65E+03 |
| Co-60 | 2 5581E-03 | 29,160 32 | 33,700 28 | 0 00E+00 | 7 46E+01 | 8 62E+01 |
| Cs-134 | 4 0536E-05 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 18E+00 | 1 37E+00 |
| Cs-135 | 1 4433E-05 | 29,160.32 | 33,700 28 | 0 00E+00 | 4 21E-01 | 4 86E-01 |
| Cs-137 | 1.3979E+00 | 29,160.32 | 33,700.28 | 0 00E+00 | 4 08E+04 | 4 71E+04 |
| Eu-154 | 2 0203E-02 | 29,160 32 | 33 700 28 | 0 00E+00 | 5 89E+02 | 6 81E+02 |
| Eu-155 | 1.7684E-03 | 29,160 32 | 33,700 28 | 0 00E+00 | 5 16E+01 | 5 96E+01 |
| Fe-55 | 4.3136E-05 | 29 160 32 | 33,700.28 | 0 00E+00 | 1.26E+00 | 1 45E+00 |
| H-3 | 2 0769E-02 | 29,160 32 | 33,700 28 | 0 00E+00 | 6 06E+02 | 7 00E+02 |
| I-129 | 9 8288E-07 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 87E-02 | 3 31E-02 |
| Kr-85 | 2 8214E-02 | 29,160 32 | 33,700.28 | 0 00E+00 | 8 23E+02 | 9 51E+02 |
| Np-237 | 1 1218E-05 | 29,160 32 | 33,700.28 | 0 00E+00 | 3 27E-01 | 3 78E-01 |
| Pa-231 | 1 3036E-09 | 29,160 32 | 33,700 28 | 0 00E+00 | 3 80E-05 | 4 39E-05 |
| Pb-210 | 8 5078E-11 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 48E-06 | 2 87E-06 |
| Pm-147 | 3 6531E-04 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 07E+01 | 1 23E+01 |
| Pu-238 | 7 4564E-02 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 17E+03 | 2 51E+03 |
| Pu-239 | 1 1623E-02 | 29,160 32 | 33,700 28 | 0 00E+00 | 3 39E+02 | 3 92E+02 |
| Pu-240 | 1 5132E-02 | 29,160 32 | 33,700 28 | 0 00E+00 | 4 41E+02 | 5 10E+02 |
| Pu-241 | 9 0036E-01 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 63E+04 | 3 03E+04 |
| Pu-242 | 6 4260E-05 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 87E+00 | 2.17E+00 |
| Ra-226 | 2 2804E-10 | 29,160 32 | 33,700 28 | 0 00E+00 | 6 65E-06 | 7 68E-06 |
| Ra-228 | 5 2713E-12 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 54E-07 | 1 78E-07 |
| Ru-106 | 6 1160E-10 | 29,160 32 | 33,700 28 | 0 00E+00 | 1 78E-05 | 2 06E-05 |
| Se-79 | 1 2377E-05 | 29,160.32 | 33,700 28 | 0 00E+00 | 3 61E-01 | 4 17E-01 |
| Sn-126 | 2 5210E-05 | 29 160.32 | 33,700 28 | 0 00E+00 | 7 35E-01 | 8 50E-01 |
| Sr-90 | 9.1667E-01 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 67E+04 | 3 09E+04 |
| Tc-99 | 3 9357E-04 | 29,160 32 | 33 700 28 | 0 00E+00 | 1 15E+01 | 1.33E+01 |
| Th-229 | 1.2057E-10 | 29,160 32 | 33,700.28 | 0 00E+00 | 3.52E-06 | 4 06E-06 |
| Th-230 | 2 1043E-08 | 29,160 32 | 33,700 28 | 0 00E+00 | 6.14E-04 | 7 09E-04 |
| Th-232 | 5.2972E-12 | 29,160 32 | 33,700 28 | 0 00E+00 | 1.54E-07 | 1 79E-07 |
| Tl-208 | 1 7474E-07 | 29,160 32 | 33,700.28 | 0 00E+00 | 5 10E-03 | 5 89E-03 |
| U-232 | 4 7368E-07 | 29,160 32 | 33,700.28 | 0 00E+00 | 1.38E-02 | 1 60E-02 |
| U-233 | 2 5097E-08 | 29,160 32 | 33,700 28 | 0 00E+00 | 7.32E-04 | 8 46E-04 |
| U-234 | 5 0000E-05 | 29,160 32 | 33,700.28 | 0 00E+00 | 1.46E+00 | 1 69E+00 |
| U-235 | -1 4489E-06 | 29,160 32 | 0 00 | 1 58E-01 | 1 16E-01 | 1 58E-01 |
| U-236 | 7 5824E-06 | 29,160 32 | 33,700 28 | 0 00E+00 | 2.21E-01 | 2 56E-01 |
| U-238 | -2 6129E-07 | 29,160 32 | 0 00 | 7 97E-01 | 7 89E-01 | 7 97E-01 |
| Y-90 | 9 1699E-01 | 29,160 32 | 33,700 28 | 0 00E+00 | 2 67E+04 | 3 09E+04 |
| Other Radionuclides | | | | | 3 91E+04 | 4 52E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 813E+15 |
| 0 0250 | 3 657E+14 |
| 0 0375 | 3 487E+14 |
| 0 0575 | 4 029E+14 |
| 0 0850 | 2 029E+14 |
| 0 1250 | 1 408E+14 |
| 0.2250 | 1 740E+14 |
| 0 3750 | 7 481E+13 |
| 0 5750 | 1 740E+15 |
| 0 8500 | 2 407E+13 |
| 1.2500 | 2.365E+13 |
| 1 7500 | 7 081E+11 |
| 2 2500 | 1 140E+08 |
| 2 7500 | 2 336E+08 |
| 3 5000 | 2 406E+07 |
| 5 0000 | 1 029E+07 |
| 7 0000 | 1 185E+06 |
| 11 0000 | 1 362E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6 71E+02 | 7 75E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 995 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 29 160 32 | 21 755.90 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 33 700 28 | 43,511 79 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 34 | 0 75 |
| Bounding | 0 39 | 1.29 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | BRP-EG | [1]Fuel decay start date: | 1973 |
| SNF ID #: | 28 | Estimates as of | 2010 |
| Fuel Units & Descr: | 33 - 9 X 9 ROD ARRAY | Template | PWR (Light Water Zirc, 0 to 5% U) |
| Heavy Metal Mass | BOL=4566 956kg, EOL=4419.278kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated
Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 23E-04 | 2 46E-04 |
| Am-241 | 1 4352E-01 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 02E+04 | 4 03E+04 |
| Am-242m | 2 8698E-04 | 140,435 08 | 280,870 16 | 0 00E+00 | 4 03E+01 | 8 06E+01 |
| Am-243 | 6 2565E-04 | 140,435 08 | 280,870 16 | 0 00E+00 | 8 79E+01 | 1 76E+02 |
| C-14 | 4 7901E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 6 73E+00 | 1 35E+01 |
| Cl-36 | 8 0297E-07 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 13E-01 | 2 26E-01 |
| Cm-243 | 2 5081E-04 | 140,435 08 | 280,870 16 | 0 00E+00 | 3 52E+01 | 7 04E+01 |
| Cm-244 | 4 9015E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 6 88E+03 | 1 38E+04 |
| Co-60 | 2 5581E-03 | 140,435 08 | 280,870 16 | 0 00E+00 | 3 59E+02 | 7 19E+02 |
| Cs-134 | 4 0536E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 5 69E+00 | 1 14E+01 |
| Cs-135 | 1 4433E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 03E+00 | 4 05E+00 |
| Cs-137 | 1 3979E+00 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 96E+05 | 3 93E+05 |
| Eu-154 | 2 0203E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 84E+03 | 5 67E+03 |
| Eu-155 | 1 7684E-03 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 48E+02 | 4 97E+02 |
| Fe-55 | 4 3136E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 6 06E+00 | 1.21E+01 |
| H-3 | 2 0769E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 92E+03 | 5 83E+03 |
| I-129 | 9 8288E-07 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 38E-01 | 2 76E-01 |
| Kr-85 | 2 8214E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 3 96E+03 | 7 92E+03 |
| Np-237 | 1 1218E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 58E+00 | 3 15E+00 |
| Pa-231 | 1 3036E-09 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 83E-04 | 3 66E-04 |
| Pb-210 | 8 5078E-11 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 19E-05 | 2 39E-05 |
| Pm-147 | 3 6531E-04 | 140,435 08 | 280,870 16 | 0 00E+00 | 5 13E+01 | 1 03E+02 |
| Pu-238 | 7 4564E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 05E+04 | 2 09E+04 |
| Pu-239 | 1 1623E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 63E+03 | 3 26E+03 |
| Pu-240 | 1 5132E-02 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 13E+03 | 4 25E+03 |
| Pu-241 | 9 0036E-01 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 26E+05 | 2 53E+05 |
| Pu-242 | 6 4260E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 9 02E+00 | 1 80E+01 |
| Ra-226 | 2 2804E-10 | 140,435 08 | 280,870 16 | 0 00E+00 | 3 20E-05 | 6 40E-05 |
| Ra-228 | 5 2713E-12 | 140,435 08 | 280,870 16 | 0 00E+00 | 7 40E-07 | 1 48E-06 |
| Ru-106 | 6 1160E-10 | 140,435 08 | 280,870 16 | 0 00E+00 | 8 59E-05 | 1 72E-04 |
| Se-79 | 1 2377E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 1.74E+00 | 3 48E+00 |
| Sn-126 | 2 5210E-05 | 140,435 08 | 280,870 16 | 0 00E+00 | 3.54E+00 | 7 08E+00 |
| Sr-90 | 9 1667E-01 | 140,435 08 | 280,870 16 | 0 00E+00 | 1.29E+05 | 2 57E+05 |
| Tc-99 | 3 9357E-04 | 140,435 08 | 280,870 16 | 0 00E+00 | 5 53E+01 | 1 11E+02 |
| Th-229 | 1 2057E-10 | 140,435 08 | 280,870 16 | 0 00E+00 | 1 69E-05 | 3 39E-05 |
| Th-230 | 2 1043E-08 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 96E-03 | 5 91E-03 |
| Th-232 | 5.2972E-12 | 140,435 08 | 280,870 16 | 0 00E+00 | 7 44E-07 | 1 49E-06 |
| Tl-208 | 1 7474E-07 | 140,435 08 | 280,870 16 | 0 00E+00 | 2 45E-02 | 4 91E-02 |
| U-232 | 4 7368E-07 | 140,435 08 | 280,870 16 | 0 00E+00 | 6 65E-02 | 1 33E-01 |
| U-233 | 2 5097E-08 | 140,435 08 | 280,870 16 | 0 00E+00 | 3 52E-03 | 7 05E-03 |
| U-234 | 5 0000E-05 | 140,435 08 | 280 870 16 | 0 00E+00 | 7 02E+00 | 1 40E+01 |
| U-235 | -1 4489E-06 | 140,435 08 | 0 00 | 3.47E-01 | 1 43E-01 | 3 47E-01 |
| U-236 | 7 5824E-06 | 140,435 08 | 280,870 16 | 0 00E+00 | 1.06E+00 | 2.13E+00 |
| U-238 | -2 6129E-07 | 140,435 08 | 0 00 | 1 48E+00 | 1 44E+00 | 1 48E+00 |
| Y-90 | 9 1699E-01 | 140,435 08 | 280 870 16 | 0 00E+00 | 1.29E+05 | 2 58E+05 |
| Other Radionuclides | | | | | 1 89E+05 | 3 77E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 511E+16 |
| 0 0250 | 3 047E+15 |
| 0 0375 | 2 907E+15 |
| 0 0575 | 3 358E+15 |
| 0 0850 | 1 691E+15 |
| 0 1250 | 1 173E+15 |
| 0.2250 | 1 450E+15 |
| 0 3750 | 6.235E+14 |
| 0 5750 | 1 450E+16 |
| 0 8500 | 2 006E+14 |
| 1.2500 | 1 971E+14 |
| 1 7500 | 5 902E+12 |
| 2.2500 | 9 503E+08 |
| 2.7500 | 1 947E+09 |
| 3 5000 | 2 005E+08 |
| 5.0000 | 8.571E+07 |
| 7 0000 | 9 879E+06 |
| 11 0000 | 1 135E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.23E+03 | 6.46E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 3 513 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 60.840 99 | 140 435 08 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 83.858 44 | 280 870 16 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 88 | 2.31 |
| Bounding | 1 76 | 3.35 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | BRP-EG/F | [1]Fuel decay start date | 1973 |
| SNF ID # | 1081 | Estimates as of | 2010 |
| Fuel Units & Descr | 4 - 9 X 9 ROD ARRAY | Template | PWR (Light Water Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=553 686kg EOL=541 107kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage: Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 05E-05 | 2 10E-05 |
| Am-241 | 1 4352E-01 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 72E+03 | 3 43E+03 |
| Am-242m | 2 8698E-04 | 11,962 22 | 23,924 45 | 0 00E+00 | 3 43E+00 | 6 87E+00 |
| Am-243 | 6 2565E-04 | 11,962 22 | 23,924 45 | 0 00E+00 | 7 48E+00 | 1 50E+01 |
| C-14 | 4 7901E-05 | 11,962 22 | 23,924 45 | 0 00E+00 | 5 73E-01 | 1 15E+00 |
| Cl-36 | 8 0297E-07 | 11,962 22 | 23,924 45 | 0 00E+00 | 9 61E-03 | 1 92E-02 |
| Cm-243 | 2 5081E-04 | 11,962 22 | 23,924 45 | 0 00E+00 | 3 00E+00 | 6 00E+00 |
| Cm-244 | 4 9015E-02 | 11,962 22 | 23,924 45 | 0 00E+00 | 5 86E+02 | 1 17E+03 |
| Co-60 | 2 5581E-03 | 11,962 22 | 23,924 45 | 0 00E+00 | 3 06E+01 | 6 12E+01 |
| Cs-134 | 4 0536E-05 | 11,962.22 | 23,924 45 | 0 00E+00 | 4 85E-01 | 9 70E-01 |
| Cs-135 | 1.4433E-05 | 11,962.22 | 23,924 45 | 0 00E+00 | 1 73E-01 | 3 45E-01 |
| Cs-137 | 1.3979E+00 | 11,962.22 | 23,924 45 | 0 00E+00 | 1 67E+04 | 3 34E+04 |
| Eu-154 | 2 0203E-02 | 11,962 22 | 23,924 45 | 0 00E+00 | 2 42E+02 | 4 83E+02 |
| Eu-155 | 1 7684E-03 | 11,962.22 | 23,924 45 | 0 00E+00 | 2 12E+01 | 4.23E+01 |
| Fe-55 | 4 3136E-05 | 11,962.22 | 23,924 45 | 0 00E+00 | 5 16E-01 | 1 03E+00 |
| H-3 | 2 0769E-02 | 11,962 22 | 23,924 45 | 0 00E+00 | 2 48E+02 | 4 97E+02 |
| I-129 | 9 8288E-07 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 18E-02 | 2 35E-02 |
| Kr-85 | 2 8214E-02 | 11,962 22 | 23,924 45 | 0 00E+00 | 3 38E+02 | 6 75E+02 |
| Np-237 | 1 1218E-05 | 11,962 22 | 23 924 45 | 0 00E+00 | 1 34E-01 | 2 68E-01 |
| Pa-231 | 1 3036E-09 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 56E-05 | 3 12E-05 |
| Pb-210 | 8 5078E-11 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 02E-06 | 2 04E-06 |
| Pm-147 | 3 6531E-04 | 11,962.22 | 23,924 45 | 0 00E+00 | 4 37E+00 | 8 74E+00 |
| Pu-238 | 7 4564E-02 | 11,962.22 | 23,924 45 | 0 00E+00 | 8 92E+02 | 1 78E+03 |
| Pu-239 | 1.1623E-02 | 11,962.22 | 23,924 45 | 0 00E+00 | 1 39E+02 | 2.78E+02 |
| Pu-240 | 1.5132E-02 | 11,962.22 | 23,924 45 | 0 00E+00 | 1 81E+02 | 3 62E+02 |
| Pu-241 | 9 0036E-01 | 11,962.22 | 23,924 45 | 0 00E+00 | 1.08E+04 | 2 15E+04 |
| Pu-242 | 6 4260E-05 | 11,962.22 | 23,924 45 | 0 00E+00 | 7 69E-01 | 1 54E+00 |
| Ra-226 | 2 2804E-10 | 11,962.22 | 23,924 45 | 0 00E+00 | 2 73E-06 | 5 46E-06 |
| Ra-228 | 5 2713E-12 | 11,962 22 | 23,924 45 | 0 00E+00 | 6 31E-08 | 1 26E-07 |
| Ru-106 | 6 1160E-10 | 11,962 22 | 23,924 45 | 0 00E+00 | 7 32E-06 | 1 46E-05 |
| Se-79 | 1 2377E-05 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 48E-01 | 2 96E-01 |
| Sn-126 | 2 5210E-05 | 11,962 22 | 23,924 45 | 0 00E+00 | 3 02E-01 | 6 03E-01 |
| Sr-90 | 9 1667E-01 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 10E+04 | 2 19E+04 |
| Tc-99 | 3 9357E-04 | 11,962 22 | 23,924 45 | 0 00E+00 | 4 71E+00 | 9 42E+00 |
| Th-229 | 1 2057E-10 | 11,962.22 | 23,924 45 | 0 00E+00 | 1 44E-06 | 2 88E-06 |
| Th-230 | 2 1043E-08 | 11,962.22 | 23,924 45 | 0 00E+00 | 2 52E-04 | 5 03E-04 |
| Th-232 | 5 2972E-12 | 11,962.22 | 23,924 45 | 0 00E+00 | 6 34E-08 | 1.27E-07 |
| Tl-208 | 1 7474E-07 | 11,962.22 | 23,924 45 | 0 00E+00 | 2 09E-03 | 4 18E-03 |
| U-232 | 4 7368E-07 | 11,962.22 | 23,924 45 | 0 00E+00 | 5 67E-03 | 1 13E-02 |
| U-233 | 2.5097E-08 | 11,962.22 | 23,924 45 | 0 00E+00 | 3 00E-04 | 6 00E-04 |
| U-234 | 5 0000E-05 | 11,962.22 | 23 924 45 | 0 00E+00 | 5 98E-01 | 1.20E+00 |
| U-235 | -1 4489E-06 | 11,962 22 | 0 00 | 4 16E-02 | 2 43E-02 | 4 16E-02 |
| U-236 | 7.5824E-06 | 11,962 22 | 23 924 45 | 0 00E+00 | 9 07E-02 | 1 81E-01 |
| U-238 | -2 6129E-07 | 11,962 22 | 0 00 | 1 80E-01 | 1 76E-01 | 1 80E-01 |
| Y-90 | 9 1699E-01 | 11,962 22 | 23,924 45 | 0 00E+00 | 1 10E+04 | 2 19E+04 |
| Other Radionuclides | | | | | 1 61E+04 | 3 21E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.287E+15 |
| 0 0250 | 2 596E+14 |
| 0 0375 | 2 476E+14 |
| 0 0575 | 2 861E+14 |
| 0 0850 | 1 440E+14 |
| 0 1250 | 9 995E+13 |
| 0 2250 | 1 235E+14 |
| 0 3750 | 5 311E+13 |
| 0 5750 | 1 235E+15 |
| 0 8500 | 1 709E+13 |
| 1.2500 | 1 679E+13 |
| 1 7500 | 5 027E+11 |
| 2.2500 | 8 094E+07 |
| 2 7500 | 1 658E+08 |
| 3 5000 | 1 708E+07 |
| 5 0000 | 7.301E+06 |
| 7 0000 | 8 415E+05 |
| 11 0000 | 9 665E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.75E+02 | 5 50E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 3 478 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 8,552 79 | 11,962.22 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 8 583.24 | 23 924 45 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 62 | 1 40 |
| Bounding | 1 23 | 2 79 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | BRP EP | [1]Fuel decay start date | 1974 |
| SNF ID # | 29 | Estimates as of. | 2010 |
| Fuel Units & Descr | 3 - 9 X 9 ROD ARRAY | Template | (Worst Case) |
| Heavy Metal Mass | BOL=369 99kg EOL=351 853kg | [2]Template Burnup(MWd) | 62 5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00186865 |
| | | Template Decay Time | 35 years |

Estimated Canister usage Bare Fuel Transfer

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3072E-06 | 17,236 64 | 34,473 28 | 0 00E+00 | 3 98E-02 | 7 95E-02 |
| Am-241 | 8 4448E+00 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 46E+05 | 2 91E+05 |
| Am-242m | 1 6848E-02 | 17,236 64 | 34,473.28 | 0 00E+00 | 2 90E+02 | 5 81E+02 |
| Am-243 | 1 6320E-02 | 17,236 64 | 34,473 28 | 0 00E+00 | 2 81E+02 | 5 63E+02 |
| C-14 | 1 2090E-01 | 17,236 64 | 34,473 28 | 0 00E+00 | 2 08E+03 | 4 17E+03 |
| Cl-36 | 2 2849E-03 | 17,236 64 | 34,473.28 | 0 00E+00 | 3 94E+01 | 7 88E+01 |
| Cm-243 | 8 6624E-04 | 17,236 64 | 34,473 28 | 0 00E+00 | 1 49E+01 | 2 99E+01 |
| Cm-244 | 1 6848E-01 | 17,236 64 | 34,473 28 | 0 00E+00 | 2 90E+03 | 5 81E+03 |
| Co-60 | 2 8086E+01 | 17,236 64 | 34,473 28 | 0 00E+00 | 4 84E+05 | 9 68E+05 |
| Cs-134 | 3 4148E-04 | 17,236 64 | 34,473 28 | 0 00E+00 | 5 89E+00 | 1.18E+01 |
| Cs-135 | 4 3976E-04 | 17,236 64 | 34 473.28 | 0 00E+00 | 7.58E+00 | 1 52E+01 |
| Cs-137 | 2 1049E+01 | 17,236 64 | 34,473 28 | 0 00E+00 | 3 63E+05 | 7.26E+05 |
| Eu-154 | 1 2500E+00 | 17,236 64 | 34,473.28 | 0 00E+00 | 2.15E+04 | 4 31E+04 |
| Eu-155 | 6 8986E-02 | 17,236 64 | 34,473.28 | 0 00E+00 | 1.19E+03 | 2.38E+03 |
| Fe-55 | 2 9308E-01 | 17,236 64 | 34,473.28 | 0 00E+00 | 5 05E+03 | 1 01E+04 |
| H-3 | 2 4311E-01 | 17,236 64 | 34,473.28 | 0 00E+00 | 4.19E+03 | 8 38E+03 |
| I-129 | 1 0618E-05 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 83E-01 | 3 66E-01 |
| Kr-85 | 5 9882E-01 | 17,236 64 | 34,473.28 | 0 00E+00 | 1.03E+04 | 2 06E+04 |
| Np-237 | 1 5668E-04 | 17,236 64 | 34,473.28 | 0 00E+00 | 2.70E+00 | 5 40E+00 |
| Pa-231 | 2 8656E-06 | 17,236 64 | 34,473 28 | 0 00E+00 | 4 94E-02 | 9 88E-02 |
| Pb-210 | 2 3918E-08 | 17,236 64 | 34,473.28 | 0 00E+00 | 4 12E-04 | 8 25E-04 |
| Pm-147 | 1 6900E-02 | 17,236 64 | 34,473.28 | 0 00E+00 | 2 91E+02 | 5 83E+02 |
| Pu-238 | -8 6120E-01 | 17,236 64 | 0 00 | 4 75E+04 | 3.27E+04 | 4 75E+04 |
| Pu-239 | -4 8440E-02 | 17,236 64 | 0 00 | 5 75E+03 | 4 92E+03 | 5 75E+03 |
| Pu-240 | -3 0095E-01 | 17,236 64 | 0 00 | 7 35E+03 | 2 16E+03 | 7 35E+03 |
| Pu-241 | -1 0411E+02 | 17,236 64 | 0 00 | 1 89E+06 | 9 65E+04 | 1 89E+06 |
| Pu-242 | -1.1381E-04 | 17,236 64 | 0 00 | 3 18E+01 | 2 98E+01 | 3 18E+01 |
| Ra-226 | 6 4400E-08 | 17,236 64 | 34,473 28 | 0 00E+00 | 1.11E-03 | 2 22E-03 |
| Ra-228 | 5 9952E-07 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 03E-02 | 2 07E-02 |
| Ru-106 | 8 5526E-07 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 47E-02 | 2 95E-02 |
| Se-79 | 1 9181E-04 | 17,236 64 | 34,473.28 | 0 00E+00 | 3 31E+00 | 6 61E+00 |
| Sn-126 | 1 6671E-04 | 17,236 64 | 34,473.28 | 0 00E+00 | 2 87E+00 | 5 75E+00 |
| Sr-90 | 1 9799E+01 | 17,236 64 | 34,473 28 | 0 00E+00 | 3 41E+05 | 6 83E+05 |
| Tc-99 | 6 7678E-03 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 17E+02 | 2.33E+02 |
| Th-229 | 1 7488E-06 | 17,236 64 | 34,473.28 | 0 00E+00 | 3 01E-02 | 6 03E-02 |
| Th-230 | 5 8704E-06 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 01E-01 | 2 02E-01 |
| Th-232 | 6 0208E-07 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 04E-02 | 2 08E-02 |
| Tl-208 | 8 7573E-05 | 17,236 64 | 34,473.28 | 0 00E+00 | 1 51E+00 | 3 02E+00 |
| U-232 | 2 3706E-04 | 17,236 64 | 34,473 28 | 0 00E+00 | 4 09E+00 | 8 17E+00 |
| U-233 | 3 6128E-04 | 17,236 64 | 34,473.28 | 0 00E+00 | 6.23E+00 | 1.25E+01 |
| U-234 | 1 2788E-02 | 17,236 64 | 34,473.28 | 0 00E+00 | 2.20E+02 | 4 41E+02 |
| U-235 | 5 7486E-04 | 17,236 64 | 34,473.28 | 1.59E-01 | 1 01E+01 | 2 00E+01 |
| U-236 | 2 3485E-04 | 17,236 64 | 34,473.28 | 0 00E+00 | 4 05E+00 | 8 10E+00 |
| U-238 | 1 1581E-04 | 17,236 64 | 34,473.28 | 1.98E-02 | 2 02E+00 | 4 01E+00 |
| Y-90 | 1 9804E+01 | 17,236 64 | 34,473.28 | 0 00E+00 | 3 41E+05 | 6 83E+05 |
| Other Radionuclides | | | | | 1 06E+06 | 2 13E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 255E+16 |
| 0 0250 | 8 407E+15 |
| 0 0375 | 7 344E+15 |
| 0 0575 | 1 156E+16 |
| 0 0850 | 4 510E+15 |
| 0 1250 | 3 535E+15 |
| 0.2250 | 3 907E+15 |
| 0.3750 | 1 671E+15 |
| 0 5750 | 2 717E+16 |
| 0 8500 | 1 038E+15 |
| 1.2500 | 7.259E+16 |
| 1 7500 | 3 211E+13 |
| 2.2500 | 3 807E+11 |
| 2 7500 | 1 073E+11 |
| 3 5000 | 9 147E+07 |
| 5 0000 | 3 883E+07 |
| 7 0000 | 4 444E+06 |
| 11 0000 | 5 083E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 83E+04 | 3 60E+04 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | ZIRC | SST/Inconel |
| BOL HM Constituents | Pu and U | U Th & Pu |
| BOL Enrichment % | 0 7 | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 6 607 65 | 17,236 64 |
| Bounding | 7 131 56 | 34,473.28 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 39 | 2 61 |
| Bounding | 2 79 | 4 83 |

Estimated EOL HM/Given EOL HM: 31 12

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name BRP-F
SNF ID # 30
Fuel Units & Descr 13 - 9 X 9 ROD ARRAY
Heavy Metal Mass BOL=1799 104kg EOL=1756 759kg
ROD Storage Site INEEL

[1]Fuel decay start date 1974
Estimates as of. 2010
Template PWR (Light Water Zirc 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 35 years

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 53E-05 | 7 07E-05 |
| Am-241 | 1 4352E-01 | 40,268 00 | 80,535 99 | 0 00E+00 | 5 78E+03 | 1 16E+04 |
| Am-242m | 2 8698E-04 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 16E+01 | 2 31E+01 |
| Am-243 | 6 2565E-04 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 52E+01 | 5 04E+01 |
| C-14 | 4 7901E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 93E+00 | 3 86E+00 |
| Cl-36 | 8 0297E-07 | 40,268 00 | 80,535 99 | 0 00E+00 | 3.23E-02 | 6 47E-02 |
| Cm-243 | 2 5081E-04 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 01E+01 | 2 02E+01 |
| Cm-244 | 4 9015E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 1.97E+03 | 3 95E+03 |
| Co-60 | 2 5581E-03 | 40,268 00 | 80,535 99 | 0 00E+00 | 1.03E+02 | 2.06E+02 |
| Cs-134 | 4 0536E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 1.63E+00 | 3 26E+00 |
| Cs-135 | 1 4433E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 5 81E-01 | 1 16E+00 |
| Cs-137 | 1.3979E+00 | 40,268 00 | 80,535 99 | 0 00E+00 | 5 63E+04 | 1 13E+05 |
| Eu-154 | 2 0203E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 8 14E+02 | 1 63E+03 |
| Eu-155 | 1 7684E-03 | 40,268 00 | 80,535 99 | 0 00E+00 | 7 12E+01 | 1 42E+02 |
| Fe-55 | 4 3136E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 74E+00 | 3 47E+00 |
| H-3 | 2 0769E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 8 36E+02 | 1 67E+03 |
| I-129 | 9 8288E-07 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 96E-02 | 7 92E-02 |
| Kr-85 | 2 8214E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 14E+03 | 2 27E+03 |
| Np-237 | 1 1218E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 4 52E-01 | 9 03E-01 |
| Pa-231 | 1 3036E-09 | 40,268 00 | 80,535 99 | 0 00E+00 | 5.25E-05 | 1 05E-04 |
| Pb-210 | 8 5078E-11 | 40,268 00 | 80,535.99 | 0 00E+00 | 3 43E-06 | 6 85E-06 |
| Pm-147 | 3 6531E-04 | 40,268 00 | 80,535 99 | 0 00E+00 | 1.47E+01 | 2 94E+01 |
| Pu-238 | 7.4564E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 00E+03 | 6 01E+03 |
| Pu-239 | 1 1623E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 4 68E+02 | 9 36E+02 |
| Pu-240 | 1 5132E-02 | 40,268 00 | 80,535 99 | 0 00E+00 | 6 09E+02 | 1 22E+03 |
| Pu-241 | 9 0036E-01 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 63E+04 | 7 25E+04 |
| Pu-242 | 6 4260E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 59E+00 | 5 18E+00 |
| Ra-226 | 2 2804E-10 | 40,268 00 | 80,535 99 | 0 00E+00 | 9 18E-06 | 1 84E-05 |
| Ra-228 | 5 2713E-12 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 12E-07 | 4 25E-07 |
| Ru-106 | 6 1160E-10 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 46E-05 | 4 93E-05 |
| Se-79 | 1.2377E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 4.98E-01 | 9 97E-01 |
| Sn-126 | 2 5210E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 02E+00 | 2 03E+00 |
| Sr-90 | 9 1667E-01 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 69E+04 | 7.38E+04 |
| Tc-99 | 3 9357E-04 | 40,268 00 | 80,535 99 | 0 00E+00 | 1.58E+01 | 3 17E+01 |
| Th-229 | 1.2057E-10 | 40,268 00 | 80,535 99 | 0 00E+00 | 4 86E-06 | 9 71E-06 |
| Th-230 | 2 1043E-08 | 40,268 00 | 80,535 99 | 0 00E+00 | 8 47E-04 | 1 69E-03 |
| Th-232 | 5.2972E-12 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 13E-07 | 4 27E-07 |
| Tl-208 | 1 7474E-07 | 40,268 00 | 80,535 99 | 0 00E+00 | 7 04E-03 | 1 41E-02 |
| U-232 | 4 7368E-07 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 91E-02 | 3 81E-02 |
| U-233 | 2 5097E-08 | 40,268 00 | 80,535 99 | 0 00E+00 | 1 01E-03 | 2 02E-03 |
| U-234 | 5 0000E-05 | 40,268 00 | 80,535 99 | 0 00E+00 | 2 01E+00 | 4 03E+00 |
| U-235 | -1 4489E-06 | 40,268 00 | 0 00 | 1.37E-01 | 7 83E-02 | 1.37E-01 |
| U-236 | 7.5824E-06 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 05E-01 | 6.11E-01 |
| U-238 | -2 6129E-07 | 40,268 00 | 0 00 | 5 83E-01 | 5.73E-01 | 5 83E-01 |
| Y-90 | 9 1699E-01 | 40,268 00 | 80,535 99 | 0 00E+00 | 3 69E+04 | 7.39E+04 |
| Other Radionuclides | | | | | 5 41E+04 | 1.08E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 333E+15 |
| 0 0250 | 8 738E+14 |
| 0 0375 | 8 334E+14 |
| 0 0575 | 9 630E+14 |
| 0 0850 | 4 849E+14 |
| 0 1250 | 3 365E+14 |
| 0 2250 | 4 158E+14 |
| 0.3750 | 1 788E+14 |
| 0 5750 | 4 158E+15 |
| 0 8500 | 5 753E+13 |
| 1.2500 | 5 651E+13 |
| 1 7500 | 1 692E+12 |
| 2.2500 | 2 725E+08 |
| 2 7500 | 5 583E+08 |
| 3 5000 | 5 748E+07 |
| 5 0000 | 2 458E+07 |
| 7 0000 | 2 833E+06 |
| 11 0000 | 3 253E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.26E+02 | 1.85E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 3 515 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 18 908 58 | 40,268 00 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 25 797 35 | 80 535 99 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 64 | 2 13 |
| Bounding | 1 28 | 3 12 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: BRP-F-PU
SNF ID #: 1082
Fuel Units & Descr: 2 - 9 X 9 ROD ARRAY
Heavy Metal Mass: BOL=269 592kg, EOL=263 82kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1974
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5% U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 5,489 09 | 10,978 18 | 0 00E+00 | 4 82E-06 | 9 63E-06 |
| Am-241 | 1 4352E-01 | 5,489 09 | 10,978 18 | 0 00E+00 | 7 88E+02 | 1 58E+03 |
| Am-242m | 2 8698E-04 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 58E+00 | 3 15E+00 |
| Am-243 | 6 2565E-04 | 5,489 09 | 10,978 18 | 0 00E+00 | 3 43E+00 | 6 87E+00 |
| C-14 | 4 7901E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 63E-01 | 5 26E-01 |
| Cl-36 | 8 0297E-07 | 5,489 09 | 10,978 18 | 0 00E+00 | 4 41E-03 | 8 82E-03 |
| Cm-243 | 2 5081E-04 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 38E+00 | 2 75E+00 |
| Cm-244 | 4 9015E-02 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 69E+02 | 5 38E+02 |
| Co-60 | 2 5581E-03 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 40E+01 | 2,81E+01 |
| Cs-134 | 4 0536E-05 | 5 489 09 | 10,978 18 | 0 00E+00 | 2 23E-01 | 4 45E-01 |
| Cs-135 | 1 4433E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 7 92E-02 | 1 58E-01 |
| Cs-137 | 1.3979E+00 | 5,489 09 | 10,978 18 | 0 00E+00 | 7 67E+03 | 1 53E+04 |
| Eu-154 | 2 0203E-02 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 11E+02 | 2 22E+02 |
| Eu-155 | 1 7684E-03 | 5,489 09 | 10,978 18 | 0 00E+00 | 9 71E+00 | 1 94E+01 |
| Fe-55 | 4 3136E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 37E-01 | 4 74E-01 |
| H-3 | 2 0769E-02 | 5,489.09 | 10,978 18 | 0 00E+00 | 1 14E+02 | 2.28E+02 |
| I-129 | 9 8288E-07 | 5,489 09 | 10,978 18 | 0 00E+00 | 5 40E-03 | 1 08E-02 |
| Kr-85 | 2 8214E-02 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 55E+02 | 3 10E+02 |
| Np-237 | 1 1218E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 6 16E-02 | 1.23E-01 |
| Pa-231 | 1 3036E-09 | 5,489 09 | 10,978 18 | 0 00E+00 | 7 16E-06 | 1 43E-05 |
| Pb-210 | 8 5078E-11 | 5,489 09 | 10,978 18 | 0 00E+00 | 4 67E-07 | 9 34E-07 |
| Pm-147 | 3 6531E-04 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 01E+00 | 4 01E+00 |
| Pu-238 | 7 4564E-02 | 5,489.09 | 10,978 18 | 0 00E+00 | 4 09E+02 | 8 19E+02 |
| Pu-239 | 1 1623E-02 | 5,489 09 | 10,978 18 | 0 00E+00 | 6 38E+01 | 1 28E+02 |
| Pu-240 | 1 5132E-02 | 5,489 09 | 10,978 18 | 0 00E+00 | 8 31E+01 | 1 66E+02 |
| Pu-241 | 9 0036E-01 | 5 489 09 | 10,978 18 | 0 00E+00 | 4 94E+03 | 9 88E+03 |
| Pu-242 | 6 4260E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 3 53E-01 | 7 05E-01 |
| Ra-226 | 2 2804E-10 | 5 489 09 | 10,978 18 | 0 00E+00 | 1 25E-06 | 2 50E-06 |
| Ra-228 | 5 2713E-12 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 89E-08 | 5 79E-08 |
| Ru-106 | 6 1160E-10 | 5,489.09 | 10,978 18 | 0 00E+00 | 3 36E-06 | 6 71E-06 |
| Se-79 | 1 2377E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 6 79E-02 | 1.36E-01 |
| Sn-126 | 2 5210E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 38E-01 | 2 77E-01 |
| Sr-90 | 9 1667E-01 | 5,489.09 | 10,978 18 | 0 00E+00 | 5 03E+03 | 1 01E+04 |
| Tc-99 | 3 9357E-04 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 16E+00 | 4 32E+00 |
| Th-229 | 1 2057E-10 | 5,489 09 | 10,978 18 | 0 00E+00 | 6 62E-07 | 1.32E-06 |
| Th-230 | 2 1043E-08 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 16E-04 | 2 31E-04 |
| Th-232 | 5 2972E-12 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 91E-08 | 5 82E-08 |
| Tl-208 | 1 7474E-07 | 5,489 09 | 10,978 18 | 0 00E+00 | 9 59E-04 | 1 92E-03 |
| U-232 | 4 7368E-07 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 60E-03 | 5.20E-03 |
| U-233 | 2 5097E-08 | 5,489 09 | 10,978 18 | 0 00E+00 | 1 38E-04 | 2 76E-04 |
| U-234 | 5 0000E-05 | 5,489 09 | 10,978 18 | 0 00E+00 | 2 74E-01 | 5 49E-01 |
| U-235 | -1 4489E-06 | 5,489 09 | 0 00 | 2 05E-02 | 1 26E-02 | 2 05E-02 |
| U-236 | 7 5824E-06 | 5,489 09 | 10,978 18 | 0 00E+00 | 4 16E-02 | 8 32E-02 |
| U-238 | -2 6129E-07 | 5,489 09 | 0 00 | 8 74E-02 | 8 60E-02 | 8 74E-02 |
| Y-90 | 9 1699E-01 | 5,489 09 | 10,978 18 | 0 00E+00 | 5 03E+03 | 1 01E+04 |
| Other Radionuclides | | | | | 7 37E+03 | 1 47E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 5 907E+14 |
| 0 0250 | 1 191E+14 |
| 0 0375 | 1 136E+14 |
| 0 0575 | 1 313E+14 |
| 0 0850 | 6 609E+13 |
| 0 1250 | 4 586E+13 |
| 0.2250 | 5 668E+13 |
| 0.3750 | 2 437E+13 |
| 0 5750 | 5 668E+14 |
| 0 8500 | 7 842E+12 |
| 1.2500 | 7 703E+12 |
| 1 7500 | 2.307E+11 |
| 2.2500 | 3 714E+07 |
| 2 7500 | 7 610E+07 |
| 3 5000 | 7 836E+06 |
| 5 0000 | 3.350E+06 |
| 7 0000 | 3 861E+05 |
| 11 0000 | 4 435E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.26E+02 | 2.53E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 3 525 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 4,154 69 | 5 489 09 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 4 193.24 | 10 978 18 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 58 | 1.32 |
| Bounding | 1 16 | 2 62 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | CONNECTICUT YANKEE (S004) | [1]Fuel decay start date | 1975 |
| SNF ID # | 34 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - 15 X 15 ROD ARRAY | Template | Pathfinder (Light Water SST, 60 to 100% U) |
| Heavy Metal Mass | BOL=407 843kg EOL=393 774kg | [2]Template Burnup(MWd) | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 |
| | | Template Decay Time | 35 years |

Estimated Canister usage
Bare Fuel Transfer

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2.3344E-08 | 13,290.34 | 26,580 68 | 0 00E+00 | 3 10E-04 | 6 21E-04 |
| Am-241 | 1 1135E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 48E+00 | 2 96E+00 |
| Am-242m | 8 5075E-09 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 13E-04 | 2 26E-04 |
| Am-243 | 9 8519E-10 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 31E-05 | 2 62E-05 |
| C-14 | 2 3012E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 3 06E+00 | 6 12E+00 |
| Cl-36 | 1 2261E-06 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 63E-02 | 3 26E-02 |
| Cm-243 | 2 4875E-10 | 13,290 34 | 26,580 68 | 0 00E+00 | 3 31E-06 | 6 61E-06 |
| Cm-244 | 2 3178E-09 | 13,290 34 | 26,580 68 | 0 00E+00 | 3 08E-05 | 6 16E-05 |
| Co-60 | 7 0849E-02 | 13,290 34 | 26,580 68 | 0 00E+00 | 9 42E+02 | 1 88E+03 |
| Cs-134 | 3 0266E-06 | 13,290 34 | 26 580 68 | 0 00E+00 | 4 02E-02 | 8 04E-02 |
| Cs-135 | 3 0316E-05 | 13,290 34 | 26,580 68 | 0 00E+00 | 4 03E-01 | 8 06E-01 |
| Cs-137 | 1 4511E+00 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 93E+04 | 3 86E+04 |
| Eu-154 | 6 6955E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 8 90E+00 | 1 78E+01 |
| Eu-155 | 6 9850E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 9.28E+00 | 1.86E+01 |
| Fe-55 | 1.2318E-03 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 64E+01 | 3.27E+01 |
| H-3 | 2 5141E-03 | 13,290 34 | 26,580 68 | 0 00E+00 | 3 34E+01 | 6 68E+01 |
| I-129 | 7.3195E-07 | 13,290 34 | 26,580 68 | 0 00E+00 | 9 73E-03 | 1 95E-02 |
| Kr-85 | 4 1281E-02 | 13,290 34 | 26,580 68 | 0 00E+00 | 5 49E+02 | 1 10E+03 |
| Np-237 | 1 1489E-06 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 53E-02 | 3 05E-02 |
| Pa-231 | 4 5241E-08 | 13,290 34 | 26,580 68 | 0 00E+00 | 6 01E-04 | 1 20E-03 |
| Pb-210 | 6 4476E-13 | 13,290 34 | 26,580 68 | 0 00E+00 | 8 57E-09 | 1 71E-08 |
| Pm-147 | 1 1651E-03 | 13,290 34 | 26,580 68 | 0.00E+00 | 1 55E+01 | 3 10E+01 |
| Pu-238 | 2 9517E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 3 92E+00 | 7 85E+00 |
| Pu-239 | 6 6772E-04 | 13,290 34 | 26 580 68 | 0 00E+00 | 8 87E+00 | 1 77E+01 |
| Pu-240 | 8 6839E-05 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 15E+00 | 2 31E+00 |
| Pu-241 | 7 1514E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 9 50E+00 | 1 90E+01 |
| Pu-242 | 1 9717E-09 | 13,290 34 | 26,580 68 | 0 00E+00 | 2 62E-05 | 5.24E-05 |
| Ra-226 | 1 7654E-12 | 13,290 34 | 26,580 68 | 0 00E+00 | 2 35E-08 | 4 69E-08 |
| Ra-228 | 8 2928E-12 | 13,290 34 | 26,580 68 | 0 00E+00 | 1.10E-07 | 2.20E-07 |
| Ru-106 | 1 8419E-10 | 13,290 34 | 26,580 68 | 0 00E+00 | 2 45E-06 | 4 90E-06 |
| Se-79 | 1 3223E-05 | 13,290 34 | 26,580 68 | 0 00E+00 | 1.76E-01 | 3 51E-01 |
| Sn-126 | 1.1493E-05 | 13,290 34 | 26,580 68 | 0 00E+00 | 1.53E-01 | 3 05E-01 |
| Sr-90 | 1.3649E+00 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 81E+04 | 3 63E+04 |
| Tc-99 | 4 6656E-04 | 13,290 34 | 26,580 68 | 0 00E+00 | 6 20E+00 | 1.24E+01 |
| Th-229 | 1.4547E-11 | 13,290.34 | 26,580 68 | 0 00E+00 | 1 93E-07 | 3 87E-07 |
| Th-230 | 1 6617E-10 | 13,290.34 | 26,580 68 | 0 00E+00 | 2.21E-06 | 4 42E-06 |
| Th-232 | 8 3361E-12 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 11E-07 | 2 22E-07 |
| Tl-208 | 2 1664E-08 | 13,290 34 | 26 580 68 | 0 00E+00 | 2 88E-04 | 5 76E-04 |
| U-232 | 5 8669E-08 | 13,290 34 | 26,580 68 | 0 00E+00 | 7 80E-04 | 1 56E-03 |
| U-233 | 3 1847E-09 | 13,290 34 | 26 580 68 | 0 00E+00 | 4 23E-05 | 8 47E-05 |
| U-234 | 3 8769E-07 | 13,290 34 | 26,580 68 | 0 00E+00 | 5 15E-03 | 1.03E-02 |
| U-235 | -2 7761E-06 | 13,290 34 | 0 00 | 3 53E-02 | 0 00E+00 | 3 53E-02 |
| U-236 | 1 6190E-05 | 13,290 34 | 26 580 68 | 0 00E+00 | 2 15E-01 | 4.30E-01 |
| U-238 | -2 8547E-09 | 13,290 34 | 0 00 | 1 32E-01 | 1 32E-01 | 1.32E-01 |
| Y-90 | 1 3652E+00 | 13,290 34 | 26,580 68 | 0 00E+00 | 1 81E+04 | 3 63E+04 |
| Other Radionuclides | | | | | 2 19E+04 | 4 39E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 984E+15 |
| 0 0250 | 4 123E+14 |
| 0 0375 | 3 566E+14 |
| 0 0575 | 3 844E+14 |
| 0 0850 | 2.322E+14 |
| 0 1250 | 1 508E+14 |
| 0.2250 | 1 999E+14 |
| 0 3750 | 8 720E+13 |
| 0 5750 | 1 436E+15 |
| 0 8500 | 1 454E+13 |
| 1.2500 | 1.445E+14 |
| 1 7500 | 3 750E+11 |
| 2.2500 | 7 786E+08 |
| 2 7500 | 2.251E+07 |
| 3 5000 | 2.279E+03 |
| 5 0000 | 9 503E+02 |
| 7 0000 | 1 063E+02 |
| 11 0000 | 1.203E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.32E+02 | 4 64E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 4 000000037 | 60 to 100 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches Pathfinder Template on all but one parameter (enrichment) making Pathfinder a reasonable match

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 13 139 89 | 13,290 34 |
| Bounding | | 26 580 68 |

**Basis for burnup used in estimate**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 70 | 1 01 |
| Bounding | 1 40 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | CP-5 CONVERTER CYLINDERS | [1]Fuel decay start date | 1979 |
| SNF ID #: | 36 | Estimates as of | 2010 |
| Fuel Units & Descr. | 2 - CONVERTER CYLINDERS | Template | HFBR (Heavy Water, Zirc , 0 to 5% U) |
| Heavy Metal Mass. | BOL=1.231kg EOL=1.206kg | [2]Template Burnup(MWd) | 5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00034251 |
| | | Template Decay Time | 25 years |

Estimated Canister usage

| HIC |
|---|
| 1 00 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 1940E-09 | 24.54 | 49 08 | 0 00E+00 | 7 84E-08 | 1 57E-07 |
| Am-241 | 2 0920E-02 | 24 54 | 49 08 | 0 00E+00 | 5 13E-01 | 1 03E+00 |
| Am-242m | 3 7060E-06 | 24 54 | 49 08 | 0 00E+00 | 9 09E-05 | 1 82E-04 |
| Am-243 | 2 0600E-06 | 24 54 | 49 08 | 0 00E+00 | 5 06E-05 | 1 01E-04 |
| C-14 | 1 1278E-03 | 24.54 | 49 08 | 0 00E+00 | 2 77E-02 | 5 54E-02 |
| Cl-36 | 8 3760E-11 | 24.54 | 49 08 | 0 00E+00 | 2 06E-09 | 4 11E-09 |
| Cm-243 | 6 4200E-07 | 24.54 | 49 08 | 0 00E+00 | 1 58E-05 | 3 15E-05 |
| Cm-244 | 1 5322E-05 | 24.54 | 49 08 | 0 00E+00 | 3 76E-04 | 7 52E-04 |
| Co-60 | 2 4000E-01 | 24 54 | 49 08 | 0 00E+00 | 5 89E+00 | 1 18E+01 |
| Cs-134 | 2 2840E-04 | 24 54 | 49 08 | 0 00E+00 | 5 60E-03 | 1 12E-02 |
| Cs-135 | 7 9140E-06 | 24 54 | 49 08 | 0 00E+00 | 1 94E-04 | 3 88E-04 |
| Cs-137 | 1 8038E+00 | 24 54 | 49 08 | 0 00E+00 | 4 43E+01 | 8 85E+01 |
| Eu-154 | 1 5200E-02 | 24 54 | 49 08 | 0 00E+00 | 3 73E-01 | 7 46E-01 |
| Eu-155 | 2 5420E-03 | 24.54 | 49 08 | 0 00E+00 | 6 24E-02 | 1 25E-01 |
| Fe-55 | 8 2660E-04 | 24 54 | 49 08 | 0 00E+00 | 2 03E-02 | 4 06E-02 |
| H-3 | 4 1740E-02 | 24 54 | 49 08 | 0 00E+00 | 1 02E+00 | 2 05E+00 |
| I-129 | 7 5020E-07 | 24 54 | 49 08 | 0 00E+00 | 1 84E-05 | 3 68E-05 |
| Kr-85 | 7 2960E-02 | 24 54 | 49 08 | 0 00E+00 | 1 79E+00 | 3 58E+00 |
| Np-237 | 5 4700E-06 | 24 54 | 49 08 | 0 00E+00 | 1 34E-04 | 2 68E-04 |
| Pa-231 | 6 2740E-09 | 24 54 | 49 08 | 0 00E+00 | 1 54E-07 | 3 08E-07 |
| Pb-210 | 1 7004E-09 | 24 54 | 49 08 | 0 00E+00 | 4 17E-08 | 8 35E-08 |
| Pm-147 | 1 3972E-02 | 24 54 | 49 08 | 0 00E+00 | 3 43E-01 | 6 86E-01 |
| Pu-238 | 6 9520E-03 | 24.54 | 49 08 | 0 00E+00 | 1 71E-01 | 3 41E-01 |
| Pu-239 | 1 8748E-02 | 24 54 | 49 08 | 0 00E+00 | 4 60E-01 | 9.20E-01 |
| Pu-240 | 8 3640E-03 | 24 54 | 49 08 | 0 00E+00 | 2 05E-01 | 4 10E-01 |
| Pu-241 | 2 3640E-01 | 24 54 | 49 08 | 0 00E+00 | 5 80E+00 | 1 16E+01 |
| Pu-242 | 2 0400E-06 | 24.54 | 49 08 | 0 00E+00 | 5 01E-05 | 1 00E-04 |
| Ra-226 | 5 8960E-09 | 24 54 | 49 08 | 0 00E+00 | 1 45E-07 | 2 89E-07 |
| Ra-228 | 1 1638E-09 | 24 54 | 49 08 | 0 00E+00 | 2 86E-08 | 5 71E-08 |
| Ru-106 | 3 1580E-07 | 24 54 | 49 08 | 0 00E+00 | 7 75E-06 | 1 55E-05 |
| Se-79 | 1 2524E-05 | 24 54 | 49 08 | 0 00E+00 | 3 07E-04 | 6 15E-04 |
| Sn-126 | 1 2054E-05 | 24 54 | 49 08 | 0 00E+00 | 2 96E-04 | 5 92E-04 |
| Sr-90 | 1 6036E+00 | 24 54 | 49 08 | 0 00E+00 | 3 94E+01 | 7 87E+01 |
| Tc-99 | 4 4140E-04 | 24 54 | 49 08 | 0 00E+00 | 1 08E-02 | 2.17E-02 |
| Th-229 | 3 0560E-09 | 24 54 | 49 08 | 0 00E+00 | 7 50E-08 | 1.50E-07 |
| Th-230 | 7 5960E-07 | 24 54 | 49 08 | 0 00E+00 | 1 86E-05 | 3 73E-05 |
| Th-232 | 1 1926E-09 | 24 54 | 49 08 | 0 00E+00 | 2 93E-08 | 5 85E-08 |
| Tl-208 | 5 0820E-08 | 24 54 | 49 08 | 0 00E+00 | 1 25E-06 | 2 49E-06 |
| U-232 | 1 3656E-07 | 24 54 | 49 08 | 0 00E+00 | 3 35E-06 | 6 70E-06 |
| U-233 | 9 1580E-07 | 24 54 | 49 08 | 0 00E+00 | 2 25E-05 | 4 49E-05 |
| U-234 | 2 3440E-03 | 24 54 | 49 08 | 0 00E+00 | 5 75E-02 | 1.15E-01 |
| U-235 | -2 3316E-06 | 24 54 | 0 00 | 2 47E-03 | 2 42E-03 | 2.47E-03 |
| U-236 | 2 6620E-05 | 24 54 | 49 08 | 0 00E+00 | 6 53E-04 | 1.31E-03 |
| U-238 | -1 3291E-07 | 24 54 | 0 00 | 2 90E-05 | 2 57E-05 | 2 90E-05 |
| Y-90 | 1 6040E+00 | 24 54 | 49 08 | 0 00E+00 | 3 94E+01 | 7 87E+01 |
| Other Radionuclides | | | | | 4 22E+01 | 8 44E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 362E+12 |
| 0 0250 | 9 060E+11 |
| 0 0375 | 7 966E+11 |
| 0 0575 | 8 552E+11 |
| 0 0850 | 5 077E+11 |
| 0 1250 | 3 395E+11 |
| 0.2250 | 4 370E+11 |
| 0 3750 | 1 910E+11 |
| 0 5750 | 3.296E+12 |
| 0 8500 | 4 429E+10 |
| 1.2500 | 8 963E+11 |
| 1 7500 | 1 226E+09 |
| 2.2500 | 4 708E+06 |
| 2 7500 | 1 023E+05 |
| 3 5000 | 2 724E+02 |
| 5 0000 | 1 077E+02 |
| 7 0000 | 1 212E+01 |
| 11 0000 | 1 376E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.20E-01 | 1.24E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | HEAVY WATER | HEAVY WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents: | U | U |
| BOL Enrichment %: | 93 | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal. | | 24 54 |
| Bounding | | 49 08 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 37 | |
| Bounding | 2 73 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | DOE TEST & EXPERIMENTAL (ALUM) | [1]Fuel decay start date | 1979 |
| SNF ID # | 42 | Estimates as of | 2010 |
| Fuel Units & Descr | 10 - CANISTER OF SCRAP | Template | (Worst Case) |
| Heavy Metal Mass | BOL= EOL=31 05kg | [2]Template Burnup(MWd) | 62 5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00186865 |
| | | Template Decay Time | 25 years |

Estimated Canister usage: 18"x10' — 0 08

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 80E-02 | 5 80E-02 |
| Am-241 | 7 8064E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 30E+05 | 2 30E+05 |
| Am-242m | 1 7632E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 20E+02 | 5 20E+02 |
| Am-243 | 1 6336E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 82E+02 | 4 82E+02 |
| C-14 | 1 2101E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 57E+03 | 3 57E+03 |
| Cl-36 | 2 2849E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 74E+01 | 6 74E+01 |
| Cm-243 | 1 1046E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 26E+01 | 3 26E+01 |
| Cm-244 | 2 4704E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 29E+03 | 7.29E+03 |
| Co-60 | 1 0466E+02 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 09E+06 | 3 09E+06 |
| Cs-134 | 9 8289E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 90E+02 | 2 90E+02 |
| Cs-135 | 4 3976E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 30E+01 | 1 30E+01 |
| Cs-137 | 2 6526E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 83E+05 | 7 83E+05 |
| Eu-154 | 2 7975E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 26E+04 | 8.26E+04 |
| Eu-155 | 2 7881E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 23E+03 | 8 23E+03 |
| Fe-55 | 4 2151E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 24E+05 | 1 24E+05 |
| H-3 | 4 2599E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 26E+04 | 1 26E+04 |
| I-129 | 1 0618E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 13E-01 | 3 13E-01 |
| Kr-85 | 1 1426E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 37E+04 | 3 37E+04 |
| Np-237 | 1 5647E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 62E+00 | 4 62E+00 |
| Pa-231 | 2 8624E-06 | 29,508 45 | 29 508 45 | 0 00E+00 | 8 45E-02 | 8 45E-02 |
| Pb-210 | 9 2770E-09 | 29,508 45 | 29 508 45 | 0 00E+00 | 2 74E-04 | 2 74E-04 |
| Pm-147 | 2 3690E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 99E+03 | 6 99E+03 |
| Pu-238 | -6 1800E-01 | 29,508 45 | 0 00 | 7 98E+03 | 0 00E+00 | 7 98E+03 |
| Pu-239 | -4 8280E-02 | 29,508 45 | 0 00 | 9 66E+02 | 0 00E+00 | 9 66E+02 |
| Pu-240 | -3 0095E-01 | 29 508 45 | 0 00 | 1 23E+03 | 0 00E+00 | 1 23E+03 |
| Pu-241 | -7 4000E+01 | 29,508 45 | 0 00 | 3 17E+05 | 0 00E+00 | 3 17E+05 |
| Pu-242 | -1 1381E-04 | 29,508 45 | 0 00 | 5 34E+00 | 1 98E+00 | 5 34E+00 |
| Ra-226 | 3.2167E-08 | 29,508 45 | 29,508 45 | 0 00E+00 | 9 49E-04 | 9 49E-04 |
| Ra-228 | 5 9024E-07 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 74E-02 | 1 74E-02 |
| Ru-106 | 3 9140E-06 | 29 508 45 | 29,508 45 | 0 00E+00 | 1 15E-01 | 1 15E-01 |
| Se-79 | 1 9184E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 66E+00 | 5 66E+00 |
| Sn-126 | 1 6671E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 92E+00 | 4 92E+00 |
| Sr-90 | 2 5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7 41E+05 |
| Tc-99 | 6 7678E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 00E+02 | 2 00E+02 |
| Th-229 | 1 2398E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 66E-02 | 3 66E-02 |
| Th-230 | 4.1442E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 22E-01 | 1.22E-01 |
| Th-232 | -4 2431E-09 | 29,508 45 | 0 00 | 1.26E-03 | 1.13E-03 | 1.26E-03 |
| Tl-208 | 9 6478E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 85E+00 | 2 85E+00 |
| U-232 | 2 6103E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 70E+00 | 7 70E+00 |
| U-233 | 3 6128E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 07E+01 | 1 07E+01 |
| U-234 | 1.2788E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 77E+02 | 3 77E+02 |
| U-235 | 5 7486E-04 | 29,508 45 | 29,508 45 | 2 67E-02 | 1 70E+01 | 1 70E+01 |
| U-236 | 2.3485E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 93E+00 | 6 93E+00 |
| U-238 | 1.1581E-04 | 29,508 45 | 29,508 45 | 3.32E-03 | 3 42E+00 | 3 42E+00 |
| Y-90 | 2.5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7 41E+05 |
| Other Radionuclides | | | | | 2 07E+06 | 2 07E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 941E+16 |
| 0 0250 | 9 792E+15 |
| 0 0375 | 8 736E+15 |
| 0 0575 | 1 192E+16 |
| 0 0850 | 5 156E+15 |
| 0 1250 | 4 484E+15 |
| 0.2250 | 4 380E+15 |
| 0 3750 | 1 846E+15 |
| 0 5750 | 2 945E+16 |
| 0 8500 | 1 774E+15 |
| 1.2500 | 2 303E+17 |
| 1 7500 | 5 579E+13 |
| 2.2500 | 1.212E+12 |
| 2 7500 | 1 038E+11 |
| 3 5000 | 1 061E+08 |
| 5 0000 | 4 516E+07 |
| 7 0000 | 5 185E+06 |
| 11 0000 | 5 941E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.59E+04 | 6 62E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | (Worst Case) |
| Fuel Cladding | ALUM | SST/Inconel |
| BOL HM Constituents | Other | U, Th & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences**

This fuel didn't closely match any existing templates therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 29.508 45 |
| Bounding | | 29 508 45 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 586 76

[1]Reactor shutdown core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: DOE TEST & EXPERIMENTAL (SST)
SNF ID #: 857
Fuel Units & Descr: 10 - CANISTER OF SCRAP
Heavy Metal Mass: BOL= , EOL=31 05kg
ROD Storage Site: INEEL

[1]Fuel decay start date 1979
Estimates as of. 2010
Template. (Worst Case)
[2]Template Burnup(MWd) 62 5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 25 years

Estimated Canister usage 18"x10' 0 08

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 1 9648E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 80E-02 | 5 80E-02 |
| Am-241 | 7 8064E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 30E+05 | 2 30E+05 |
| Am-242m | 1 7632E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 20E+02 | 5 20E+02 |
| Am-243 | 1 6336E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 82E+02 | 4 82E+02 |
| C-14 | 1 2101E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 57E+03 | 3 57E+03 |
| Cl-36 | 2 2849E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 74E+01 | 6 74E+01 |
| Cm-243 | 1 1046E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 26E+01 | 3 26E+01 |
| Cm-244 | 2 4704E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 29E+03 | 7 29E+03 |
| Co-60 | 1 0466E+02 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 09E+06 | 3 09E+06 |
| Cs-134 | 9 8289E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 90E+02 | 2 90E+02 |
| Cs-135 | 4 3976E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 30E+01 | 1 30E+01 |
| Cs-137 | 2 6526E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 83E+05 | 7 83E+05 |
| Eu-154 | 2 7975E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 26E+04 | 8 26E+04 |
| Eu-155 | 2 7881E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 23E+03 | 8 23E+03 |
| Fe-55 | 4.2151E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 24E+05 | 1 24E+05 |
| H-3 | 4.2599E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 26E+04 | 1.26E+04 |
| I-129 | 1 0618E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 13E-01 | 3 13E-01 |
| Kr-85 | 1.1426E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 37E+04 | 3 37E+04 |
| Np-237 | 1 5647E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 62E+00 | 4 62E+00 |
| Pa-231 | 2 8624E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 45E-02 | 8 45E-02 |
| Pb-210 | 9 2770E-09 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 74E-04 | 2 74E-04 |
| Pm-147 | 2 3690E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 99E+03 | 6 99E+03 |
| Pu-238 | -6 1800E-01 | 29,508 45 | 0 00 | 7.98E+03 | 0 00E+00 | 7 98E+03 |
| Pu-239 | -4 8280E-02 | 29,508.45 | 0 00 | 9 66E+02 | 0 00E+00 | 9 66E+02 |
| Pu-240 | -3 0095E-01 | 29,508 45 | 0 00 | 1.23E+03 | 0 00E+00 | 1 23E+03 |
| Pu-241 | -7 4000E+01 | 29,508.45 | 0 00 | 3 17E+05 | 0 00E+00 | 3 17E+05 |
| Pu-242 | -1 1381E-04 | 29,508.45 | 0 00 | 5.34E+00 | 1 98E+00 | 5 34E+00 |
| Ra-226 | 3 2167E-08 | 29,508 45 | 29,508 45 | 0.00E+00 | 9 49E-04 | 9 49E-04 |
| Ra-228 | 5 9024E-07 | 29,508.45 | 29,508 45 | 0 00E+00 | 1 74E-02 | 1 74E-02 |
| Ru-106 | 3 9140E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 15E-01 | 1 15E-01 |
| Se-79 | 1 9184E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 66E+00 | 5 66E+00 |
| Sn-126 | 1 6671E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 92E+00 | 4 92E+00 |
| Sr-90 | 2.5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7 41E+05 |
| Tc-99 | 6 7678E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 00E+02 | 2 00E+02 |
| Th-229 | 1.2398E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 66E-02 | 3 66E-02 |
| Th-230 | 4.1442E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 22E-01 | 1 22E-01 |
| Th-232 | -4 2431E-09 | 29,508 45 | 0 00 | 1.26E-03 | 1 13E-03 | 1 26E-03 |
| Tl-208 | 9 6478E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 85E+00 | 2 85E+00 |
| U-232 | 2 6103E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 70E+00 | 7 70E+00 |
| U-233 | 3 6128E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 07E+01 | 1 07E+01 |
| U-234 | 1 2788E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 77E+02 | 3 77E+02 |
| U-235 | 5.7486E-04 | 29,508 45 | 29,508.45 | 2 67E-02 | 1.70E+01 | 1 70E+01 |
| U-236 | 2 3485E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 93E+00 | 6 93E+00 |
| U-238 | 1 1581E-04 | 29,508 45 | 29,508 45 | 3 32E-03 | 3 42E+00 | 3 42E+00 |
| Y-90 | 2 5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7 41E+05 |
| Other Radionuclides | | | | | 2 07E+06 | 2 07E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 941E+16 |
| 0 0250 | 9 792E+15 |
| 0 0375 | 8 736E+15 |
| 0 0575 | 1 192E+16 |
| 0 0850 | 5 156E+15 |
| 0 1250 | 4 484E+15 |
| 0.2250 | 4.380E+15 |
| 0 3750 | 1 846E+15 |
| 0 5750 | 2.945E+16 |
| 0 8500 | 1 774E+15 |
| 1.2500 | 2 303E+17 |
| 1 7500 | 5 579E+13 |
| 2.2500 | 1 212E+12 |
| 2.7500 | 1 038E+11 |
| 3 5000 | 1 061E+08 |
| 5 0000 | 4 516E+07 |
| 7 0000 | 5 185E+06 |
| 11 0000 | 5 941E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6 59E+04 | 6.62E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Other | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 29,508 45 |
| Bounding | | 29 508 45 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14 21 | |
| Bounding | 14 21 | |

Estimated EOL HM/Given EOL HM: 586 76

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | DOE TEST & EXPERIMENTAL (ZIRC) | [1]Fuel decay start date | 1979 |
| SNF ID # | 858 | Estimates as of. | 2010 |
| Fuel Units & Descr | 10 - CANISTER OF SCRAP | Template- | (Worst Case) |
| Heavy Metal Mass | BOL= EOL=31 05kg | [2]Template Burnup(MWd) | 62.5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00186865 |
| | | Template Decay Time | 25 years |

Estimated Canister usage-
18"x10'
0 08

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 29,508 45 | 29 508 45 | 0 00E+00 | 5 80E-02 | 5 80E-02 |
| Am-241 | 7 8064E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 30E+05 | 2 30E+05 |
| Am-242m | 1.7632E-02 | 29 508 45 | 29,508 45 | 0 00E+00 | 5 20E+02 | 5 20E+02 |
| Am-243 | 1 6336E-02 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 82E+02 | 4 82E+02 |
| C-14 | 1 2101E-01 | 29 508 45 | 29,508 45 | 0 00E+00 | 3 57E+03 | 3 57E+03 |
| Cl-36 | 2 2849E-03 | 29 508 45 | 29,508 45 | 0 00E+00 | 6 74E+01 | 6 74E+01 |
| Cm-243 | 1 1046E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 26E+01 | 3.26E+01 |
| Cm-244 | 2 4704E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7.29E+03 | 7 29E+03 |
| Co-60 | 1 0466E+02 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 09E+06 | 3 09E+06 |
| Cs-134 | 9 8289E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 90E+02 | 2 90E+02 |
| Cs-135 | 4 3976E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 30E+01 | 1 30E+01 |
| Cs-137 | 2 6526E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 83E+05 | 7 83E+05 |
| Eu-154 | 2 7975E+00 | 29 508 45 | 29,508 45 | 0 00E+00 | 8 26E+04 | 8 26E+04 |
| Eu-155 | 2 7881E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 23E+03 | 8 23E+03 |
| Fe-55 | 4.2151E+00 | 29 508 45 | 29,508 45 | 0 00E+00 | 1 24E+05 | 1 24E+05 |
| H-3 | 4 2599E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 26E+04 | 1.26E+04 |
| I-129 | 1 0618E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 13E-01 | 3 13E-01 |
| Kr-85 | 1 1426E+00 | 29,508 45 | 29,508 45 | 0 00E+00 | 3.37E+04 | 3 37E+04 |
| Np-237 | 1 5647E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 62E+00 | 4 62E+00 |
| Pa-231 | 2 8624E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 8 45E-02 | 8 45E-02 |
| Pb-210 | 9 2770E-09 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 74E-04 | 2 74E-04 |
| Pm-147 | 2.3690E-01 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 99E+03 | 6 99E+03 |
| Pu-238 | -6 1800E-01 | 29,508 45 | 0 00 | 7.98E+03 | 0 00E+00 | 7 98E+03 |
| Pu-239 | -4 8280E-02 | 29,508 45 | 0 00 | 9 66E+02 | 0 00E+00 | 9 66E+02 |
| Pu-240 | -3 0095E-01 | 29,508 45 | 0 00 | 1 23E+03 | 0 00E+00 | 1.23E+03 |
| Pu-241 | -7 4000E+01 | 29,508 45 | 0 00 | 3 17E+05 | 0 00E+00 | 3 17E+05 |
| Pu-242 | -1 1381E-04 | 29,508 45 | 0 00 | 5 34E+00 | 1 98E+00 | 5.34E+00 |
| Ra-226 | 3 2167E-08 | 29,508 45 | 29,508 45 | 0 00E+00 | 9 49E-04 | 9 49E-04 |
| Ra-228 | 5 9024E-07 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 74E-02 | 1 74E-02 |
| Ru-106 | 3 9140E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 15E-01 | 1 15E-01 |
| Se-79 | 1 9184E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 5 66E+00 | 5 66E+00 |
| Sn-126 | 1 6671E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 4 92E+00 | 4 92E+00 |
| Sr-90 | 2 5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7 41E+05 |
| Tc-99 | 6 7678E-03 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 00E+02 | 2 00E+02 |
| Th-229 | 1.2398E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 3 66E-02 | 3 66E-02 |
| Th-230 | 4 1442E-06 | 29,508 45 | 29,508 45 | 0 00E+00 | 1.22E-01 | 1.22E-01 |
| Th-232 | -4 2431E-09 | 29,508 45 | 0.00 | 1 26E-03 | 1 13E-03 | 1.26E-03 |
| Tl-208 | 9 6478E-05 | 29,508 45 | 29,508 45 | 0 00E+00 | 2 85E+00 | 2 85E+00 |
| U-232 | 2 6103E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 70E+00 | 7 70E+00 |
| U-233 | 3 6128E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 1 07E+01 | 1 07E+01 |
| U-234 | 1.2788E-02 | 29 508 45 | 29,508 45 | 0 00E+00 | 3 77E+02 | 3 77E+02 |
| U-235 | 5 7486E-04 | 29,508 45 | 29,508 45 | 2 67E-02 | 1 70E+01 | 1 70E+01 |
| U-236 | 2.3485E-04 | 29,508 45 | 29,508 45 | 0 00E+00 | 6 93E+00 | 6 93E+00 |
| U-238 | 1 1581E-04 | 29,508 45 | 29,508 45 | 3 32E-03 | 3 42E+00 | 3 42E+00 |
| Y-90 | 2 5126E+01 | 29,508 45 | 29,508 45 | 0 00E+00 | 7 41E+05 | 7.41E+05 |
| Other Radionuclides | | | | | 2 07E+06 | 2 07E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg_MeV | |
| 0 0150 | 4 941E+16 |
| 0 0250 | 9 792E+15 |
| 0 0375 | 8 736E+15 |
| 0 0575 | 1 192E+16 |
| 0 0850 | 5 156E+15 |
| 0 1250 | 4 484E+15 |
| 0.2250 | 4 380E+15 |
| 0 3750 | 1 846E+15 |
| 0 5750 | 2.945E+16 |
| 0 8500 | 1 774E+15 |
| 1.2500 | 2 303E+17 |
| 1 7500 | 5 579E+13 |
| 2.2500 | 1.212E+12 |
| 2 7500 | 1 038E+11 |
| 3 5000 | 1 061E+08 |
| 5 0000 | 4 516E+07 |
| 7.0000 | 5 185E+06 |
| 11 0000 | 5 941E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.59E+04 | 6.62E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator- | FAST | (Worst Case) |
| Fuel Cladding | ZIRC | SST/Inconel |
| BOL HM Constituents | Other | U Th & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 29 508 45 |
| Bounding | | 29 508 45 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 586 76

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name. DRCT | | [1]Fuel decay start date | 1981 |
| SNF ID # 701 | | Estimates as of· | 2010 |
| Fuel Units & Descr 2856 - ROD | | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass BOL=6338 892kg EOL=6144 97kg | | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site· INEEL | | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time· | 25 years |

Estimated Canister usage 18"x15' 3 50

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 185,919 70 | 224,650 33 | 0 00E+00 | 1.23E-04 | 1 49E-04 |
| Am-241 | 1 3144E-01 | 185,919 70 | 224,650.33 | 0 00E+00 | 2 44E+04 | 2 95E+04 |
| Am-242m | 3 0039E-04 | 185,919.70 | 224,650 33 | 0 00E+00 | 5 58E+01 | 6 75E+01 |
| Am-243 | 6 2629E-04 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 16E+02 | 1 41E+02 |
| C-14 | 4 7965E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 8 92E+00 | 1 08E+01 |
| Cl-36 | 8 0297E-07 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 49E-01 | 1 80E-01 |
| Cm-243 | 3 1993E-04 | 185,919 70 | 224,650 33 | 0 00E+00 | 5 95E+01 | 7.19E+01 |
| Cm-244 | 7.1851E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 34E+04 | 1 61E+04 |
| Co-60 | 9 5220E-03 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 77E+03 | 2.14E+03 |
| Cs-134 | 1.1662E-03 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 17E+02 | 2 62E+02 |
| Cs-135 | 1 4433E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 68E+00 | 3 24E+00 |
| Cs-137 | 1 7603E+00 | 185,919 70 | 224,650 33 | 0 00E+00 | 3 27E+05 | 3 95E+05 |
| Eu-154 | 4 5203E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 8 40E+03 | 1 02E+04 |
| Eu-155 | 7 1479E-03 | 185,919 70 | 224,650 33 | 0 00E+00 | 1.33E+03 | 1 61E+03 |
| Fe-55 | 6 1919E-04 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 15E+02 | 1 39E+02 |
| H-3 | 3 6386E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 6 76E+03 | 8 17E+03 |
| I-129 | 9 8288E-07 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 83E-01 | 2 21E-01 |
| Kr-85 | 5 3844E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 00E+04 | 1 21E+04 |
| Np-237 | 1 0546E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 96E+00 | 2 37E+00 |
| Pa-231 | 1 1370E-09 | 185,919 70 | 224,650.33 | 0 00E+00 | 2 11E-04 | 2 55E-04 |
| Pb-210 | 3 3624E-11 | 185,919 70 | 224,650.33 | 0 00E+00 | 6 25E-06 | 7 55E-06 |
| Pm-147 | 5 1211E-03 | 185,919 70 | 224,650 33 | 0 00E+00 | 9 52E+02 | 1 15E+03 |
| Pu-238 | 8 0669E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 50E+04 | 1 81E+04 |
| Pu-239 | 1 1626E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 16E+03 | 2 61E+03 |
| Pu-240 | 1 5097E-02 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 81E+03 | 3.39E+03 |
| Pu-241 | 1 4567E+00 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 71E+05 | 3.27E+05 |
| Pu-242 | 6 4260E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 19E+01 | 1 44E+01 |
| Ra-226 | 1.1392E-10 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 12E-05 | 2.56E-05 |
| Ra-228 | 5 1841E-12 | 185,919 70 | 224,650 33 | 0 00E+00 | 9 64E-07 | 1.16E-06 |
| Ru-106 | 5 9012E-07 | 185,919 70 | 224,650 33 | 0 00E+00 | 1.10E-01 | 1 33E-01 |
| Se-79 | 1.2379E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 30E+00 | 2 78E+00 |
| Sn-126 | 2 5210E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 4 69E+00 | 5 66E+00 |
| Sr-90 | 1 1630E+00 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 16E+05 | 2 61E+05 |
| Tc-99 | 3 9357E-04 | 185,919 70 | 224,650 33 | 0 00E+00 | 7 32E+01 | 8 84E+01 |
| Th-229 | 8 5691E-11 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 59E-05 | 1 93E-05 |
| Th-230 | 1 4493E-08 | 185,919 70 | 224,650.33 | 0 00E+00 | 2 69E-03 | 3 26E-03 |
| Th-232 | 5 2923E-12 | 185,919 70 | 224,650.33 | 0 00E+00 | 9 84E-07 | 1 19E-06 |
| Tl-208 | 1 9202E-07 | 185,919 70 | 224,650.33 | 0 00E+00 | 3 57E-02 | 4 31E-02 |
| U-232 | 5 2083E-07 | 185,919 70 | 224,650.33 | 0 00E+00 | 9 68E-02 | 1 17E-01 |
| U-233 | 2 4386E-08 | 185,919.70 | 224,650 33 | 0 00E+00 | 4 53E-03 | 5 48E-03 |
| U-234 | 4 7012E-05 | 185,919 70 | 224,650 33 | 0 00E+00 | 8 74E+00 | 1 06E+01 |
| U-235 | -1 4492E-06 | 185,919 70 | 0 00 | 3 60E-01 | 9 10E-02 | 3 60E-01 |
| U-236 | 7 5759E-06 | 185,919 70 | 224,650 33 | 0 00E+00 | 1 41E+00 | 1 70E+00 |
| U-238 | -2 6129E-07 | 185,919 70 | 0 00 | 2 07E+00 | 2 03E+00 | 2 07E+00 |
| Y-90 | 1 1631E+00 | 185,919 70 | 224,650 33 | 0 00E+00 | 2 16E+05 | 2 61E+05 |
| Other Radionuclides | | | | | 3 14E+05 | 3 80E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 528E+16 |
| 0 0250 | 3 094E+15 |
| 0 0375 | 2 994E+15 |
| 0 0575 | 3 267E+15 |
| 0 0850 | 1 731E+15 |
| 0 1250 | 1.264E+15 |
| 0 2250 | 1 486E+15 |
| 0 3750 | 6 376E+14 |
| 0 5750 | 1 465E+16 |
| 0 8500 | 2.892E+14 |
| 1.2500 | 3 906E+14 |
| 1 7500 | 8 559E+12 |
| 2.2500 | 1 581E+09 |
| 2 7500 | 1 777E+09 |
| 3.5000 | 2.328E+08 |
| 5.0000 | 9 951E+07 |
| 7 0000 | 1 147E+07 |
| 11 0000 | 1.318E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 10E+03 | 6 16E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 631414612 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 185 919 70 | 184 411 03 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 224 650 33 | 368 822 06 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 84 | 0 99 |
| Bounding | 1 01 | 1 64 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | DRCT | [1]Fuel decay start date | 1981 |
| SNF ID # | 756 | Estimates as of | 2010 |
| Fuel Units & Descr | 6936 - ROD | Template | PWR (Light Water Zirc 0 to 5% U) |
| Heavy Metal Mass | BOL=15512 364kg EOL=15006 036kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage

| 18"x15' |
|---|
| 8 50 |

### II. Estimates

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 6 6376E-10 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 20E-04 | 6 39E-04 |
| Am-241 | 1.3144E-01 | 481,493 98 | 962,987 96 | 0 00E+00 | 6.33E+04 | 1 27E+05 |
| Am-242m | 3 0039E-04 | 481,493 98 | 962,987 96 | 0 00E+00 | 1 45E+02 | 2 89E+02 |
| Am-243 | 6 2629E-04 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 02E+02 | 6 03E+02 |
| C-14 | 4 7965E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 31E+01 | 4 62E+01 |
| Cl-36 | 8 0297E-07 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 87E-01 | 7 73E-01 |
| Cm-243 | 3 1993E-04 | 481,493 98 | 962,987.96 | 0 00E+00 | 1 54E+02 | 3 08E+02 |
| Cm-244 | 7 1851E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 46E+04 | 6 92E+04 |
| Co-60 | 9 5220E-03 | 481,493 98 | 962,987.96 | 0 00E+00 | 4 58E+03 | 9 17E+03 |
| Cs-134 | 1 1662E-03 | 481,493 98 | 962,987.96 | 0 00E+00 | 5 62E+02 | 1 12E+03 |
| Cs-135 | 1 4433E-05 | 481,493 98 | 962,987.96 | 0 00E+00 | 6 95E+00 | 1 39E+01 |
| Cs-137 | 1 7603E+00 | 481,493 98 | 962,987.96 | 0 00E+00 | 8 48E+05 | 1 70E+06 |
| Eu-154 | 4 5203E-02 | 481,493 98 | 962,987.96 | 0 00E+00 | 2 18E+04 | 4 35E+04 |
| Eu-155 | 7 1479E-03 | 481,493 98 | 962,987.96 | 0 00E+00 | 3 44E+03 | 6 88E+03 |
| Fe-55 | 6 1919E-04 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 98E+02 | 5 96E+02 |
| H-3 | 3 6386E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 1 75E+04 | 3 50E+04 |
| I-129 | 9 8288E-07 | 481,493 98 | 962,987 96 | 0 00E+00 | 4 73E-01 | 9 47E-01 |
| Kr-85 | 5 3844E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 59E+04 | 5 19E+04 |
| Np-237 | 1 0546E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 08E+00 | 1 02E+01 |
| Pa-231 | 1 1370E-09 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 47E-04 | 1.09E-03 |
| Pb-210 | 3 3624E-11 | 481,493 98 | 962,987 96 | 0 00E+00 | 1 62E-05 | 3 24E-05 |
| Pm-147 | 5 1211E-03 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 47E+03 | 4 93E+03 |
| Pu-238 | 8 0669E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 88E+04 | 7.77E+04 |
| Pu-239 | 1 1626E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 60E+03 | 1.12E+04 |
| Pu-240 | 1 5097E-02 | 481,493 98 | 962,987 96 | 0 00E+00 | 7 27E+03 | 1 45E+04 |
| Pu-241 | 1 4567E+00 | 481,493 98 | 962,987 96 | 0 00E+00 | 7 01E+05 | 1 40E+06 |
| Pu-242 | 6 4260E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 09E+01 | 6 19E+01 |
| Ra-226 | 1 1392E-10 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 49E-05 | 1 10E-04 |
| Ra-228 | 5 1841E-12 | 481,493 98 | 962,987 96 | 0 00E+00 | 2.50E-06 | 4 99E-06 |
| Ru-106 | 5 9012E-07 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 84E-01 | 5 68E-01 |
| Se-79 | 1.2379E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 96E+00 | 1 19E+01 |
| Sn-126 | 2 5210E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 1.21E+01 | 2 43E+01 |
| Sr-90 | 1 1630E+00 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 60E+05 | 1 12E+06 |
| Tc-99 | 3 9357E-04 | 481,493 98 | 962,987 96 | 0 00E+00 | 1 90E+02 | 3 79E+02 |
| Th-229 | 8 5691E-11 | 481 493 98 | 962,987 96 | 0 00E+00 | 4 13E-05 | 8 25E-05 |
| Th-230 | 1 4493E-08 | 481,493 98 | 962,987 96 | 0 00E+00 | 6 98E-03 | 1 40E-02 |
| Th-232 | 5 2923E-12 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 55E-06 | 5 10E-06 |
| Tl-208 | 1.9202E-07 | 481,493 98 | 962,987 96 | 0 00E+00 | 9 25E-02 | 1 85E-01 |
| U-232 | 5.2083E-07 | 481,493 98 | 962,987 96 | 0 00E+00 | 2 51E-01 | 5 02E-01 |
| U-233 | 2 4386E-08 | 481,493 98 | 962,987 96 | 0 00E+00 | 1 17E-02 | 2 35E-02 |
| U-234 | 4 7012E-05 | 481,493 98 | 962,987 96 | 0 00E+00 | 2.26E+01 | 4 53E+01 |
| U-235 | -1 4492E-06 | 481,493 98 | 0 00 | 9 81E-01 | 2 83E-01 | 9 81E-01 |
| U-236 | 7 5759E-06 | 481,493 98 | 962,987 96 | 0 00E+00 | 3 65E+00 | 7 30E+00 |
| U-238 | -2 6129E-07 | 481,493 98 | 0 00 | 5 06E+00 | 4 94E+00 | 5 06E+00 |
| Y-90 | 1 1631E+00 | 481,493 98 | 962,987 96 | 0 00E+00 | 5 60E+05 | 1 12E+06 |
| Other Radionuclides | | | | | 8 13E+05 | 1 63E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 549E+16 |
| 0 0250 | 1 326E+16 |
| 0 0375 | 1.284E+16 |
| 0 0575 | 1 400E+16 |
| 0 0850 | 7 420E+15 |
| 0 1250 | 5 420E+15 |
| 0.2250 | 6 370E+15 |
| 0 3750 | 2 733E+15 |
| 0 5750 | 6.280E+16 |
| 0 8500 | 1.240E+15 |
| 1.2500 | 1 674E+15 |
| 1 7500 | 3 669E+13 |
| 2.2500 | 6 776E+09 |
| 2 7500 | 7 616E+09 |
| 3 5000 | 9 980E+08 |
| 5 0000 | 4.265E+08 |
| 7 0000 | 4 917E+07 |
| 11 0000 | 5 648E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.32E+04 | 2.64E+04 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences. |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2 925317534 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 454 977 64 | 481 493 98 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 549 758 18 | 962 987 96 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 89 | 1 06 |
| Bounding | 1 77 | 1 75 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. DRESDEN I (E00161)
SNF ID #: 928
Fuel Units & Descr: 1 - 6 X 6 ROD ARRAY
Heavy Metal Mass BOL=111.5kg EOL=109 853kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1973
Estimates as of: 2010
Template: PWR (Light Water, Zirc 0 to 5% U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated
Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 37E-06 | 2 75E-06 |
| Am-241 | 1.4352E-01 | 1,566.22 | 3,132 44 | 0 00E+00 | 2.25E+02 | 4.50E+02 |
| Am-242m | 2 8698E-04 | 1,566 22 | 3,132 44 | 0 00E+00 | 4 49E-01 | 8 99E-01 |
| Am-243 | 6.2565E-04 | 1,566.22 | 3,132 44 | 0 00E+00 | 9 80E-01 | 1 96E+00 |
| C-14 | 4 7901E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 7 50E-02 | 1 50E-01 |
| Cl-36 | 8 0297E-07 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 26E-03 | 2 52E-03 |
| Cm-243 | 2 5081E-04 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 93E-01 | 7 86E-01 |
| Cm-244 | 4 9015E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 7 68E+01 | 1 54E+02 |
| Co-60 | 2 5581E-03 | 1,566 22 | 3,132 44 | 0 00E+00 | 4 01E+00 | 8 01E+00 |
| Cs-134 | 4 0536E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 6 35E-02 | 1 27E-01 |
| Cs-135 | 1 4433E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 26E-02 | 4 52E-02 |
| Cs-137 | 1 3979E+00 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 19E+03 | 4 38E+03 |
| Eu-154 | 2 0203E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 16E+01 | 6 33E+01 |
| Eu-155 | 1 7684E-03 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 77E+00 | 5 54E+00 |
| Fe-55 | 4 3136E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 6 76E-02 | 1 35E-01 |
| H-3 | 2 0769E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 25E+01 | 6 51E+01 |
| I-129 | 9 8288E-07 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 54E-03 | 3 08E-03 |
| Kr-85 | 2 8214E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 4 42E+01 | 8 84E+01 |
| Np-237 | 1 1218E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 76E-02 | 3 51E-02 |
| Pa-231 | 1 3036E-09 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 04E-06 | 4 08E-06 |
| Pb-210 | 8 5078E-11 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 33E-07 | 2 67E-07 |
| Pm-147 | 3 6531E-04 | 1,566.22 | 3,132 44 | 0 00E+00 | 5 72E-01 | 1.14E+00 |
| Pu-238 | 7 4564E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 17E+02 | 2 34E+02 |
| Pu-239 | 1 1623E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 82E+01 | 3 64E+01 |
| Pu-240 | 1 5132E-02 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 37E+01 | 4 74E+01 |
| Pu-241 | 9 0036E-01 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 41E+03 | 2 82E+03 |
| Pu-242 | 6 4260E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 01E-01 | 2 01E-01 |
| Ra-226 | 2 2804E-10 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 57E-07 | 7 14E-07 |
| Ra-228 | 5 2713E-12 | 1,566.22 | 3,132 44 | 0 00E+00 | 8 26E-09 | 1 65E-08 |
| Ru-106 | 6 1160E-10 | 1,566.22 | 3,132 44 | 0 00E+00 | 9 58E-07 | 1 92E-06 |
| Se-79 | 1 2377E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 94E-02 | 3 88E-02 |
| Sn-126 | 2 5210E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 95E-02 | 7 90E-02 |
| Sr-90 | 9 1667E-01 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 44E+03 | 2 87E+03 |
| Tc-99 | 3 9357E-04 | 1,566.22 | 3,132 44 | 0 00E+00 | 6 16E-01 | 1 23E+00 |
| Th-229 | 1 2057E-10 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 89E-07 | 3 78E-07 |
| Th-230 | 2 1043E-08 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 30E-05 | 6 59E-05 |
| Th-232 | 5 2972E-12 | 1,566.22 | 3,132 44 | 0 00E+00 | 8 30E-09 | 1 66E-08 |
| Tl-208 | 1 7474E-07 | 1,566.22 | 3,132 44 | 0 00E+00 | 2 74E-04 | 5 47E-04 |
| U-232 | 4 7368E-07 | 1,566.22 | 3,132 44 | 0 00E+00 | 7 42E-04 | 1 48E-03 |
| U-233 | 2 5097E-08 | 1,566.22 | 3,132 44 | 0 00E+00 | 3 93E-05 | 7 86E-05 |
| U-234 | 5 0000E-05 | 1,566.22 | 3,132 44 | 0 00E+00 | 7 83E-02 | 1 57E-01 |
| U-235 | -1 4489E-06 | 1,566.22 | 0 00 | 3 62E-03 | 1 35E-03 | 3 62E-03 |
| U-236 | 7 5824E-06 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 19E-02 | 2 38E-02 |
| U-238 | -2 6129E-07 | 1,566.22 | 0 00 | 3 69E-02 | 3 65E-02 | 3 69E-02 |
| Y-90 | 9 1699E-01 | 1,566.22 | 3,132 44 | 0 00E+00 | 1 44E+03 | 2 87E+03 |
| Other Radionuclides | | | | | 2 10E+03 | 4 20E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 685E+14 |
| 0 0250 | 3.399E+13 |
| 0 0375 | 3.242E+13 |
| 0 0575 | 3 745E+13 |
| 0 0850 | 1 886E+13 |
| 0 1250 | 1 309E+13 |
| 0 2250 | 1 617E+13 |
| 0 3750 | 6 954E+12 |
| 0 5750 | 1 617E+14 |
| 0 8500 | 2.238E+12 |
| 1 2500 | 2 198E+12 |
| 1 7500 | 6.582E+10 |
| 2.2500 | 1 060E+07 |
| 2 7500 | 2.171E+07 |
| 3 5000 | 2.236E+06 |
| 5 0000 | 9 560E+05 |
| 7 0000 | 1 102E+05 |
| 11 0000 | 1.265E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 60E+01 | 7.21E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 1 50044843 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 1 533 13 | 1,566.22 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 3,132.44 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 40 | 1 02 |
| Bounding | 0 80 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name DRESDEN I (UN0064)
SNF ID #: 47
Fuel Units & Descr: 1 - 6 X 6 ROD ARRAY
Heavy Metal Mass BOL=58 847kg EOL=57 281kg
ROD Storage Site INEEL

[1]Fuel decay start date 1973
Estimates as of 2010
Template PWR (Light Water Zirc 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 35 years

Estimated Canister usage
Bare Fuel Transfer

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 31E-06 | 2 61E-06 |
| Am-241 | 1 4352E-01 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 14E+02 | 4.27E+02 |
| Am-242m | 2 8698E-04 | 1,489 19 | 2,978 38 | 0 00E+00 | 4 27E-01 | 8 55E-01 |
| Am-243 | 6 2565E-04 | 1,489 19 | 2,978 38 | 0 00E+00 | 9 32E-01 | 1 86E+00 |
| C-14 | 4 7901E-05 | 1,489 19 | 2,978.38 | 0 00E+00 | 7 13E-02 | 1 43E-01 |
| Cl-36 | 8 0297E-07 | 1,489 19 | 2,978.38 | 0 00E+00 | 1 20E-03 | 2 39E-03 |
| Cm-243 | 2.5081E-04 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 74E-01 | 7 47E-01 |
| Cm-244 | 4 9015E-02 | 1,489 19 | 2,978 38 | 0.00E+00 | 7 30E+01 | 1 46E+02 |
| Co-60 | 2 5581E-03 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 81E+00 | 7 62E+00 |
| Cs-134 | 4 0536E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 6 04E-02 | 1.21E-01 |
| Cs-135 | 1 4433E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 15E-02 | 4 30E-02 |
| Cs-137 | 1 3979E+00 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 08E+03 | 4 16E+03 |
| Eu-154 | 2 0203E-02 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 01E+01 | 6 02E+01 |
| Eu-155 | 1 7684E-03 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 63E+00 | 5.27E+00 |
| Fe-55 | 4 3136E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 6 42E-02 | 1.28E-01 |
| H-3 | 2 0769E-02 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 09E+01 | 6 19E+01 |
| I-129 | 9 8288E-07 | 1,489 19 | 2,978.38 | 0 00E+00 | 1 46E-03 | 2 93E-03 |
| Kr-85 | 2 8214E-02 | 1,489 19 | 2,978 38 | 0 00E+00 | 4 20E+01 | 8 40E+01 |
| Np-237 | 1.1218E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 67E-02 | 3 34E-02 |
| Pa-231 | 1.3036E-09 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 94E-06 | 3 88E-06 |
| Pb-210 | 8 5078E-11 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 27E-07 | 2 53E-07 |
| Pm-147 | 3 6531E-04 | 1,489 19 | 2,978 38 | 0 00E+00 | 5 44E-01 | 1 09E+00 |
| Pu-238 | 7 4564E-02 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 11E+02 | 2 22E+02 |
| Pu-239 | 1 1623E-02 | 1 489 19 | 2,978 38 | 0 00E+00 | 1 73E+01 | 3 46E+01 |
| Pu-240 | 1 5132E-02 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 25E+01 | 4 51E+01 |
| Pu-241 | 9 0036E-01 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 34E+03 | 2.68E+03 |
| Pu-242 | 6 4260E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 9 57E-02 | 1 91E-01 |
| Ra-226 | 2 2804E-10 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 40E-07 | 6 79E-07 |
| Ra-228 | 5 2713E-12 | 1,489 19 | 2,978.38 | 0 00E+00 | 7.85E-09 | 1 57E-08 |
| Ru-106 | 6 1160E-10 | 1,489 19 | 2,978 38 | 0 00E+00 | 9 11E-07 | 1 82E-06 |
| Se-79 | 1 2377E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 84E-02 | 3 69E-02 |
| Sn-126 | 2 5210E-05 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 75E-02 | 7 51E-02 |
| Sr-90 | 9 1667E-01 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 37E+03 | 2 73E+03 |
| Tc-99 | 3 9357E-04 | 1,489 19 | 2,978 38 | 0 00E+00 | 5 86E-01 | 1 17E+00 |
| Th-229 | 1 2057E-10 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 80E-07 | 3 59E-07 |
| Th-230 | 2 1043E-08 | 1,489 19 | 2,978 38 | 0 00E+00 | 3 13E-05 | 6.27E-05 |
| Th-232 | 5 2972E-12 | 1,489 19 | 2,978 38 | 0 00E+00 | 7 89E-09 | 1 58E-08 |
| Tl-208 | 1 7474E-07 | 1,489 19 | 2,978 38 | 0 00E+00 | 2 60E-04 | 5 20E-04 |
| U-232 | 4 7368E-07 | 1,489 19 | 2,978.38 | 0 00E+00 | 7.05E-04 | 1 41E-03 |
| U-233 | 2 5097E-08 | 1,489 19 | 2,978.38 | 0 00E+00 | 3 74E-05 | 7 47E-05 |
| U-234 | 5 0000E-05 | 1,489 19 | 2,978.38 | 0 00E+00 | 7 45E-02 | 1 49E-01 |
| U-235 | -1 4489E-06 | 1,489 19 | 0 00 | 1 91E-03 | 0 00E+00 | 1 91E-03 |
| U-236 | 7 5824E-06 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 13E-02 | 2 26E-02 |
| U-238 | -2 6129E-07 | 1,489 19 | 0 00 | 1 95E-02 | 1 91E-02 | 1 95E-02 |
| Y-90 | 9 1699E-01 | 1,489 19 | 2,978 38 | 0 00E+00 | 1 37E+03 | 2 73E+03 |
| Other Radionuclides | | | | | 2 00E+03 | 4 00E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 603E+14 |
| 0 0250 | 3 232E+13 |
| 0 0375 | 3 082E+13 |
| 0 0575 | 3 561E+13 |
| 0 0850 | 1 793E+13 |
| 0 1250 | 1.244E+13 |
| 0 2250 | 1.538E+13 |
| 0 3750 | 6 612E+12 |
| 0 5750 | 1 538E+14 |
| 0 8500 | 2 127E+12 |
| 1.2500 | 2 090E+12 |
| 1 7500 | 6 258E+10 |
| 2.2500 | 1 008E+07 |
| 2 7500 | 2 065E+07 |
| 3 5000 | 2 126E+06 |
| 5 0000 | 9 089E+05 |
| 7 0000 | 1 048E+05 |
| 11 0000 | 1.203E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.43E+01 | 6.85E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 1 5005013 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 823 86 | 1 489 19 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 2,978 38 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 72 | 1 81 |
| Bounding | 1 45 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | DRESII, HBR, BR 3 BRP TMI | [1]Fuel decay start date: | 1979 |
| SNF ID #. | 50 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - CANISTER OF SCRAP | Template | PWR (Light Water, Zirc, 0 to 5% U) |
| Heavy Metal Mass | BOL= EOL=19 608kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage

| 18"x10' |
|---|
| 0 01 |

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 24E-05 | 1 24E-05 |
| Am-241 | 1 3144E-01 | 18,646.28 | 18,646 28 | 0 00E+00 | 2 45E+03 | 2 45E+03 |
| Am-242m | 3 0039E-04 | 18,646 28 | 18,646 28 | 0 00E+00 | 5 60E+00 | 5 60E+00 |
| Am-243 | 6.2629E-04 | 18,646.28 | 18,646 28 | 0 00E+00 | 1 17E+01 | 1 17E+01 |
| C-14 | 4 7965E-05 | 18,646.28 | 18,646 28 | 0 00E+00 | 8 94E-01 | 8 94E-01 |
| Cl-36 | 8 0297E-07 | 18,646.28 | 18,646 28 | 0 00E+00 | 1.50E-02 | 1 50E-02 |
| Cm-243 | 3.1993E-04 | 18,646 28 | 18,646 28 | 0 00E+00 | 5 97E+00 | 5 97E+00 |
| Cm-244 | 7 1851E-02 | 18,646.28 | 18,646 28 | 0 00E+00 | 1 34E+03 | 1 34E+03 |
| Co-60 | 9 5220E-03 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 78E+02 | 1 78E+02 |
| Cs-134 | 1 1662E-03 | 18,646.28 | 18,646 28 | 0 00E+00 | 2 17E+01 | 2 17E+01 |
| Cs-135 | 1 4433E-05 | 18,646.28 | 18,646 28 | 0 00E+00 | 2 69E-01 | 2 69E-01 |
| Cs-137 | 1 7603E+00 | 18,646 28 | 18,646 28 | 0 00E+00 | 3 28E+04 | 3 28E+04 |
| Eu-154 | 4 5203E-02 | 18,646.28 | 18,646 28 | 0 00E+00 | 8 43E+02 | 8 43E+02 |
| Eu-155 | 7 1479E-03 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 33E+02 | 1 33E+02 |
| Fe-55 | 6 1919E-04 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 15E+01 | 1 15E+01 |
| H-3 | 3 6386E-02 | 18,646 28 | 18 646 28 | 0 00E+00 | 6 78E+02 | 6 78E+02 |
| I-129 | 9 8288E-07 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 83E-02 | 1 83E-02 |
| Kr-85 | 5 3844E-02 | 18,646.28 | 18,646 28 | 0 00E+00 | 1 00E+03 | 1 00E+03 |
| Np-237 | 1 0546E-05 | 18,646 28 | 18,646 28 | 0 00E+00 | 1 97E-01 | 1 97E-01 |
| Pa-231 | 1 1370E-09 | 18,646 28 | 18,646 28 | 0 00E+00 | 2 12E-05 | 2 12E-05 |
| Pb-210 | 3 3624E-11 | 18,646 28 | 18,646.28 | 0 00E+00 | 6 27E-07 | 6 27E-07 |
| Pm-147 | 5 1211E-03 | 18,646 28 | 18,646 28 | 0 00E+00 | 9 55E+01 | 9 55E+01 |
| Pu-238 | 8 0669E-02 | 18,646 28 | 18,646.28 | 0 00E+00 | 1 50E+03 | 1 50E+03 |
| Pu-239 | 1 1626E-02 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 17E+02 | 2 17E+02 |
| Pu-240 | 1 5097E-02 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 82E+02 | 2 82E+02 |
| Pu-241 | 1 4567E+00 | 18,646 28 | 18,646 28 | 0 00E+00 | 2 72E+04 | 2 72E+04 |
| Pu-242 | 6 4260E-05 | 18,646 28 | 18,646.28 | 0 00E+00 | 1 20E+00 | 1.20E+00 |
| Ra-226 | 1 1392E-10 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 12E-06 | 2 12E-06 |
| Ra-228 | 5 1841E-12 | 18,646 28 | 18,646.28 | 0 00E+00 | 9 67E-08 | 9 67E-08 |
| Ru-106 | 5 9012E-07 | 18,646 28 | 18,646.28 | 0 00E+00 | 1 10E-02 | 1 10E-02 |
| Se-79 | 1 2379E-05 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 31E-01 | 2 31E-01 |
| Sn-126 | 2 5210E-05 | 18,646 28 | 18,646.28 | 0 00E+00 | 4 70E-01 | 4 70E-01 |
| Sr-90 | 1 1630E+00 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 17E+04 | 2.17E+04 |
| Tc-99 | 3 9357E-04 | 18,646 28 | 18,646.28 | 0 00E+00 | 7 34E+00 | 7.34E+00 |
| Th-229 | 8 5691E-11 | 18,646 28 | 18,646.28 | 0 00E+00 | 1 60E-06 | 1 60E-06 |
| Th-230 | 1 4493E-08 | 18,646 28 | 18,646.28 | 0 00E+00 | 2 70E-04 | 2 70E-04 |
| Th-232 | 5 2923E-12 | 18,646 28 | 18,646.28 | 0 00E+00 | 9 87E-08 | 9 87E-08 |
| Tl-208 | 1 9202E-07 | 18,646 28 | 18,646.28 | 0 00E+00 | 3 58E-03 | 3 58E-03 |
| U-232 | 5 2083E-07 | 18,646 28 | 18,646.28 | 0 00E+00 | 9 71E-03 | 9 71E-03 |
| U-233 | 2 4386E-08 | 18,646.28 | 18,646.28 | 0 00E+00 | 4 55E-04 | 4 55E-04 |
| U-234 | 4 7012E-05 | 18,646 28 | 18,646 28 | 0 00E+00 | 8 77E-01 | 8 77E-01 |
| U-235 | -1 4492E-06 | 18,646 28 | 0 00 | 2 71E-03 | 0 00E+00 | 2 71E-03 |
| U-236 | 7 5759E-06 | 18 646.28 | 18,646.28 | 0 00E+00 | 1 41E-01 | 1 41E-01 |
| U-238 | -2 6129E-07 | 18,646.28 | 0 00 | 1 28E-02 | 7 88E-03 | 1.28E-02 |
| Y-90 | 1 1631E+00 | 18,646 28 | 18,646 28 | 0 00E+00 | 2 17E+04 | 2.17E+04 |
| Other Radionuclides | | | | | 3 15E+04 | 3.15E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1.268E+15 |
| 0 0250 | 2.568E+14 |
| 0 0375 | 2 485E+14 |
| 0 0575 | 2.711E+14 |
| 0 0850 | 1 437E+14 |
| 0 1250 | 1 050E+14 |
| 0.2250 | 1.233E+14 |
| 0 3750 | 5.292E+13 |
| 0 5750 | 1.216E+15 |
| 0 8500 | 2 400E+13 |
| 1.2500 | 3.242E+13 |
| 1 7500 | 7 104E+11 |
| 2.2500 | 1 312E+08 |
| 2 7500 | 1 475E+08 |
| 3.5000 | 1 932E+07 |
| 5 0000 | 8.259E+06 |
| 7 0000 | 9 521E+05 |
| 11 0000 | 1 094E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 11E+02 | 5 11E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 18 646 28 |
| Bounding | | 18 646 28 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 13 58 | |
| Bounding | 13 58 | |

Estimated EOL HM/Given EOL HM: 1 59

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name EBR-II NITRIDE FUEL EXPER
SNF ID # 363
Fuel Units & Descr: 64 - ROD
Heavy Metal Mass BOL= EOL=9 587kg
ROD Storage Site INEEL

[1]Fuel decay start date 1994
Estimates as of 2010
Template FFTF (FAST SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011 2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage
18"x10'
0 32

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 833 80 | 1,563 38 | 0 00E+00 | 1.15E-09 | 2 15E-09 |
| Am-241 | 7 9527E-02 | 833 80 | 1,563 38 | 2 01E+01 | 8 64E+01 | 1 44E+02 |
| Am-242m | 2 1053E-03 | 833 80 | 1,563 38 | 0 00E+00 | 1.76E+00 | 3 29E+00 |
| Am-243 | 1 0760E-04 | 833 80 | 1,563 38 | 0 00E+00 | 8 97E-02 | 1 68E-01 |
| C-14 | 2 6141E-05 | 833 80 | 1,563 38 | 0 00E+00 | 2 18E-02 | 4 09E-02 |
| Cl-36 | 3 4243E-10 | 833 80 | 1,563 38 | 0 00E+00 | 2 86E-07 | 5 35E-07 |
| Cm-243 | 6 6092E-04 | 833 80 | 1,563 38 | 0 00E+00 | 5 51E-01 | 1 03E+00 |
| Cm-244 | 2 9933E-03 | 833 80 | 1,563 38 | 0 00E+00 | 2 50E+00 | 4 68E+00 |
| Co-60 | 1 5934E-02 | 833 80 | 1,563 38 | 0 00E+00 | 1 33E+01 | 2 49E+01 |
| Cs-134 | 4 6356E-02 | 833 80 | 1,563 38 | 0 00E+00 | 3 87E+01 | 7 25E+01 |
| Cs-135 | 4 7693E-05 | 833 80 | 1,563 38 | 0 00E+00 | 3 98E-02 | 7 46E-02 |
| Cs-137 | 2 1113E+00 | 833 80 | 1,563 38 | 0 00E+00 | 1 76E+03 | 3 30E+03 |
| Eu-154 | 4 8092E-02 | 833 80 | 1,563 38 | 0 00E+00 | 4 01E+01 | 7 52E+01 |
| Eu-155 | 6 8447E-02 | 833 80 | 1,563 38 | 0 00E+00 | 5 71E+01 | 1 07E+02 |
| Fe-55 | 5 8479E-03 | 833 80 | 1,563 38 | 0 00E+00 | 4 88E+00 | 9 14E+00 |
| H-3 | 8 9300E-03 | 833 80 | 1,563 38 | 0 00E+00 | 7.45E+00 | 1 40E+01 |
| I-129 | 1.2891E-06 | 833 80 | 1,563 38 | 0 00E+00 | 1 07E-03 | 2 02E-03 |
| Kr-85 | 7 0941E-02 | 833 80 | 1,563 38 | 0 00E+00 | 5 92E+01 | 1.11E+02 |
| Np-237 | 2 6541E-06 | 833 80 | 1,563 38 | 0 00E+00 | 2 21E-03 | 4 15E-03 |
| Pa-231 | 4 8970E-12 | 833 80 | 1,563 38 | 0 00E+00 | 4 08E-09 | 7 66E-09 |
| Pb-210 | 2 2170E-13 | 833 80 | 1,563 38 | 0 00E+00 | 1 85E-10 | 3 47E-10 |
| Pm-147 | 2 3617E-01 | 833 80 | 1,563 38 | 0 00E+00 | 1 97E+02 | 3 69E+02 |
| Pu-238 | 2 8636E-02 | 833 80 | 1,563 38 | 0 00E+00 | 2 39E+01 | 4 48E+01 |
| Pu-239 | -3 5520E-02 | 833 80 | 0 00 | 1 65E+02 | 1 35E+02 | 1 65E+02 |
| Pu-240 | 2 0790E-02 | 833 80 | 1,563 38 | 8 38E+01 | 1 01E+02 | 1 16E+02 |
| Pu-241 | -4 8316E-01 | 833 80 | 0 00 | 3 76E+03 | 3 36E+03 | 3 76E+03 |
| Pu-242 | 1.1052E-05 | 833 80 | 1,563 38 | 2.24E-02 | 3 16E-02 | 3 96E-02 |
| Ra-226 | 5 7471E-13 | 833 80 | 1,563 38 | 0 00E+00 | 4 79E-10 | 8 98E-10 |
| Ra-228 | 5 4957E-17 | 833 80 | 1,563.38 | 0 00E+00 | 4 58E-14 | 8 59E-14 |
| Ru-106 | 1 4582E-02 | 833 80 | 1,563.38 | 0 00E+00 | 1.22E+01 | 2.28E+01 |
| Se-79 | 1 0137E-05 | 833 80 | 1,563 38 | 0 00E+00 | 8 45E-03 | 1 58E-02 |
| Sn-126 | 4 3922E-05 | 833 80 | 1,563 38 | 0 00E+00 | 3 66E-02 | 6 87E-02 |
| Sr-90 | 7 6329E-01 | 833 80 | 1,563 38 | 0 00E+00 | 6 36E+02 | 1 19E+03 |
| Tc-99 | 3 9412E-04 | 833 80 | 1,563 38 | 0 00E+00 | 3 29E-01 | 6 16E-01 |
| Th-229 | 1 6457E-12 | 833 80 | 1,563 38 | 0 00E+00 | 1 37E-09 | 2 57E-09 |
| Th-230 | 1 8822E-10 | 833 80 | 1,563 38 | 0 00E+00 | 1.57E-07 | 2 94E-07 |
| Th-232 | 9 7601E-17 | 833 80 | 1,563 38 | 0 00E+00 | 8 14E-14 | 1 53E-13 |
| Tl-208 | 5.2722E-07 | 833 80 | 1,563 38 | 0 00E+00 | 4 40E-04 | 8.24E-04 |
| U-232 | 1.4925E-06 | 833 80 | 1,563 38 | 0 00E+00 | 1.24E-03 | 2.33E-03 |
| U-233 | 2.1113E-10 | 833 80 | 1,563 38 | 0 00E+00 | 1 76E-07 | 3 30E-07 |
| U-234 | 1 9528E-06 | 833 80 | 1,563.38 | 0 00E+00 | 1 63E-03 | 3 05E-03 |
| U-235 | -9 7920E-09 | 833 80 | 0 00 | 3 39E-05 | 2 57E-05 | 3 39E-05 |
| U-236 | 1 1570E-07 | 833 80 | 1,563 38 | 0 00E+00 | 9 65E-05 | 1 81E-04 |
| U-238 | -1 7914E-07 | 833 80 | 0 00 | 2 47E-03 | 2 32E-03 | 2 47E-03 |
| Y-90 | 7 6329E-01 | 833 80 | 1,563 38 | 0 00E+00 | 6 36E+02 | 1 19E+03 |
| Other Radionuclides | | | | | 1 81E+03 | 3 39E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.854E+13 |
| 0 0250 | 1 695E+13 |
| 0 0375 | 1 939E+13 |
| 0 0575 | 1 647E+13 |
| 0 0850 | 9 659E+12 |
| 0 1250 | 7.213E+12 |
| 0 2250 | 7 314E+12 |
| 0 3750 | 3 760E+12 |
| 0 5750 | 1.256E+14 |
| 0 8500 | 4 205E+12 |
| 1 2500 | 3 661E+12 |
| 1 7500 | 6 015E+10 |
| 2.2500 | 2 024E+09 |
| 2 7500 | 2 112E+08 |
| 3 5000 | 2.384E+07 |
| 5 0000 | 5 764E+04 |
| 7.0000 | 6.595E+03 |
| 11 0000 | 7.553E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.54E+01 | 4 19E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 833 80 |
| Bounding | | 1,563 38 |

**Basis for burnup used in estimate**

Nominal burnup taken from SFD and converted to MWd using BOL=10 423kg
Bounding burnup taken from SFD and converted to MWd using BOL=10 423kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 53 | |
| Bounding | 0 99 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | EBR-II OXIDE FUEL EXPER | [1]Fuel decay start date | 1994 |
| SNF ID #: | 364 | Estimates as of | 2010 |
| Fuel Units & Descr: | 992 - ROD | Template | FFTF (FAST, SST 10 to 30% Pu & U) |
| Heavy Metal Mass: | BOL= EOL=92 454kg | [2]Template Burnup(MWd) | 5011 2 |
| ROD Storage Site: | INEEL | Template BOL Heavy Metal Mass (MT). | 0 0329181 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x10' 4 96

**II. Estimates**

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 8,040 82 | 20,102 04 | 0 00E+00 | 1.10E-08 | 2 76E-08 |
| Am-241 | 7 9527E-02 | 8,040 82 | 20,102 04 | 1 94E+02 | 8 33E+02 | 1.79E+03 |
| Am-242m | 2 1053E-03 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 69E+01 | 4.23E+01 |
| Am-243 | 1 0760E-04 | 8,040 82 | 20,102 04 | 0 00E+00 | 8.65E-01 | 2.16E+00 |
| C-14 | 2 6141E-05 | 8,040 82 | 20,102 04 | 0 00E+00 | 2 10E-01 | 5.25E-01 |
| Cl-36 | 3 4243E-10 | 8,040 82 | 20,102 04 | 0 00E+00 | 2.75E-06 | 6 88E-06 |
| Cm-243 | 6 6092E-04 | 8,040 82 | 20,102 04 | 0 00E+00 | 5 31E+00 | 1 33E+01 |
| Cm-244 | 2 9933E-03 | 8,040 82 | 20,102 04 | 0 00E+00 | 2 41E+01 | 6 02E+01 |
| Co-60 | 1 5934E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 28E+02 | 3.20E+02 |
| Cs-134 | 4 6356E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 3 73E+02 | 9 32E+02 |
| Cs-135 | 4 7693E-05 | 8,040 82 | 20,102 04 | 0 00E+00 | 3 83E-01 | 9 59E-01 |
| Cs-137 | 2 1113E+00 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 70E+04 | 4 24E+04 |
| Eu-154 | 4 8092E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 3 87E+02 | 9 67E+02 |
| Eu-155 | 6 8447E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 5 50E+02 | 1 38E+03 |
| Fe-55 | 5 8479E-03 | 8,040 82 | 20,102 04 | 0 00E+00 | 4 70E+01 | 1.18E+02 |
| H-3 | 8 9300E-03 | 8,040 82 | 20,102 04 | 0 00E+00 | 7 18E+01 | 1 80E+02 |
| I-129 | 1.2891E-06 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 04E-02 | 2 59E-02 |
| Kr-85 | 7 0941E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 5 70E+02 | 1 43E+03 |
| Np-237 | 2 6541E-06 | 8,040 82 | 20,102 04 | 0 00E+00 | 2.13E-02 | 5 34E-02 |
| Pa-231 | 4 8970E-12 | 8,040 82 | 20,102 04 | 0 00E+00 | 3 94E-08 | 9 84E-08 |
| Pb-210 | 2.2170E-13 | 8,040 82 | 20,102 04 | 0 00E+00 | 1.78E-09 | 4 46E-09 |
| Pm-147 | 2 3617E-01 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 90E+03 | 4 75E+03 |
| Pu-238 | 2 8636E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 2 30E+02 | 5 76E+02 |
| Pu-239 | -3 5520E-02 | 8,040 82 | 0 00 | 1 59E+03 | 1 31E+03 | 1 59E+03 |
| Pu-240 | 2 0790E-02 | 8,040 82 | 20,102 04 | 8 09E+02 | 9 76E+02 | 1.23E+03 |
| Pu-241 | -4 8316E-01 | 8,040 82 | 0 00 | 3 63E+04 | 3.24E+04 | 3 63E+04 |
| Pu-242 | 1 1052E-05 | 8,040 82 | 20,102 04 | 2 16E-01 | 3 04E-01 | 4 38E-01 |
| Ra-226 | 5 7471E-13 | 8,040 82 | 20,102 04 | 0 00E+00 | 4 62E-09 | 1 16E-08 |
| Ra-228 | 5 4957E-17 | 8,040 82 | 20,102 04 | 0 00E+00 | 4 42E-13 | 1 10E-12 |
| Ru-106 | 1 4582E-02 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 17E+02 | 2 93E+02 |
| Se-79 | 1 0137E-05 | 8,040 82 | 20,102 04 | 0 00E+00 | 8.15E-02 | 2 04E-01 |
| Sn-126 | 4 3922E-05 | 8,040 82 | 20,102 04 | 0 00E+00 | 3.53E-01 | 8 83E-01 |
| Sr-90 | 7 6329E-01 | 8,040 82 | 20,102 04 | 0 00E+00 | 6 14E+03 | 1 53E+04 |
| Tc-99 | 3 9412E-04 | 8,040 82 | 20,102 04 | 0 00E+00 | 3 17E+00 | 7 92E+00 |
| Th-229 | 1 6457E-12 | 8,040 82 | 20,102 04 | 0 00E+00 | 1.32E-08 | 3 31E-08 |
| Th-230 | 1 8822E-10 | 8,040 82 | 20,102 04 | 0 00E+00 | 1.51E-06 | 3 78E-06 |
| Th-232 | 9 7601E-17 | 8,040 82 | 20,102 04 | 0 00E+00 | 7 85E-13 | 1 96E-12 |
| Tl-208 | 5.2722E-07 | 8,040 82 | 20,102 04 | 0 00E+00 | 4.24E-03 | 1 06E-02 |
| U-232 | 1 4925E-06 | 8,040 82 | 20,102 04 | 0 00E+00 | 1.20E-02 | 3 00E-02 |
| U-233 | 2.1113E-10 | 8,040.82 | 20,102 04 | 0 00E+00 | 1.70E-06 | 4 24E-06 |
| U-234 | 1.9528E-06 | 8,040 82 | 20,102 04 | 0 00E+00 | 1 57E-02 | 3 93E-02 |
| U-235 | -9 7920E-09 | 8,040 82 | 0 00 | 3 27E-04 | 2 48E-04 | 3 27E-04 |
| U-236 | 1.1570E-07 | 8,040 82 | 20,102 04 | 0 00E+00 | 9 30E-04 | 2 33E-03 |
| U-238 | -1 7914E-07 | 8,040 82 | 0 00 | 2 38E-02 | 2.23E-02 | 2 38E-02 |
| Y-90 | 7 6329E-01 | 8,040 82 | 20,102 04 | 0 00E+00 | 6.14E+03 | 1 53E+04 |
| Other Radionuclides | | | | | 1.74E+04 | 4 36E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 006E+15 |
| 0 0250 | 2 179E+14 |
| 0 0375 | 2 493E+14 |
| 0 0575 | 2 109E+14 |
| 0 0850 | 1 242E+14 |
| 0 1250 | 9 275E+13 |
| 0.2250 | 9 405E+13 |
| 0.3750 | 4 835E+13 |
| 0.5750 | 1 615E+15 |
| 0.8500 | 5 407E+13 |
| 1.2500 | 4 708E+13 |
| 1 7500 | 7 733E+11 |
| 2.2500 | 2 603E+10 |
| 2 7500 | 2 715E+09 |
| 3 5000 | 3 064E+08 |
| 5 0000 | 6 771E+05 |
| 7 0000 | 7 752E+04 |
| 11 0000 | 8 879E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.45E+02 | 5 11E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 8 040.82 |
| Bounding | | 20 102 04 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=100.51kg

Bounding burnup taken from SFD and converted to MWd using BOL=100.51kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 53 | |
| Bounding | 1.31 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: EBR II OXIDE FUEL EXPER
SNF ID #: 345
Fuel Units & Descr: 571 - ROD
Heavy Metal Mass BOL= , EOL=56 986kg
ROD Storage Site INEEL

[1]Fuel decay start date 1994
Estimates as of 2010
Template FFTF (FAST SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011.2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 15 years

Estimated Canister usage
18"x10'
2 86

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 4,956 09 | 12,390.22 | 0 00E+00 | 6 81E-09 | 1 70E-08 |
| Am-241 | 7 9527E-02 | 4,956 09 | 12,390 22 | 1 19E+02 | 5 14E+02 | 1 10E+03 |
| Am-242m | 2 1053E-03 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 04E+01 | 2 61E+01 |
| Am-243 | 1 0760E-04 | 4,956 09 | 12,390 22 | 0 00E+00 | 5 33E-01 | 1 33E+00 |
| C-14 | 2 6141E-05 | 4,956 09 | 12 390 22 | 0 00E+00 | 1 30E-01 | 3 24E-01 |
| Cl-36 | 3 4243E-10 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 70E-06 | 4 24E-06 |
| Cm-243 | 6 6092E-04 | 4,956 09 | 12,390 22 | 0 00E+00 | 3 28E+00 | 8 19E+00 |
| Cm-244 | 2.9933E-03 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 48E+01 | 3 71E+01 |
| Co-60 | 1.5934E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 7 90E+01 | 1 97E+02 |
| Cs-134 | 4 6356E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 30E+02 | 5 74E+02 |
| Cs-135 | 4 7693E-05 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 36E-01 | 5 91E-01 |
| Cs-137 | 2 1113E+00 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 05E+04 | 2 62E+04 |
| Eu-154 | 4 8092E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 38E+02 | 5 96E+02 |
| Eu-155 | 6 8447E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 3 39E+02 | 8 48E+02 |
| Fe-55 | 5 8479E-03 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 90E+01 | 7.25E+01 |
| H-3 | 8 9300E-03 | 4,956 09 | 12,390 22 | 0 00E+00 | 4 43E+01 | 1 11E+02 |
| I-129 | 1.2891E-06 | 4,956 09 | 12,390 22 | 0 00E+00 | 6 39E-03 | 1 60E-02 |
| Kr-85 | 7 0941E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 3 52E+02 | 8 79E+02 |
| Np-237 | 2 6541E-06 | 4,956 09 | 12,390 22 | 0 00E+00 | 1.32E-02 | 3.29E-02 |
| Pa-231 | 4 8970E-12 | 4 956 09 | 12,390 22 | 0 00E+00 | 2 43E-08 | 6 07E-08 |
| Pb-210 | 2 2170E-13 | 4,956 09 | 12,390 22 | 0 00E+00 | 1.10E-09 | 2 75E-09 |
| Pm-147 | 2 3617E-01 | 4 956 09 | 12,390 22 | 0 00E+00 | 1 17E+03 | 2 93E+03 |
| Pu-238 | 2 8636E-02 | 4 956 09 | 12,390 22 | 0 00E+00 | 1 42E+02 | 3 55E+02 |
| Pu-239 | -3 5520E-02 | 4,956 09 | 0 00 | 9 81E+02 | 8 04E+02 | 9 81E+02 |
| Pu-240 | 2 0790E-02 | 4,956 09 | 12,390 22 | 4 98E+02 | 6 01E+02 | 7 56E+02 |
| Pu-241 | -4 8316E-01 | 4 956 09 | 0 00 | 2 24E+04 | 2 00E+04 | 2 24E+04 |
| Pu-242 | 1 1052E-05 | 4,956 09 | 12,390 22 | 1 33E-01 | 1 88E-01 | 2 70E-01 |
| Ra-226 | 5 7471E-13 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 85E-09 | 7 12E-09 |
| Ra-228 | 5 4957E-17 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 72E-13 | 6 81E-13 |
| Ru-106 | 1 4582E-02 | 4,956 09 | 12,390 22 | 0 00E+00 | 7.23E+01 | 1 81E+02 |
| Se-79 | 1 0137E-05 | 4,956 09 | 12,390 22 | 0 00E+00 | 5 02E-02 | 1 26E-01 |
| Sn-126 | 4 3922E-05 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 18E-01 | 5 44E-01 |
| Sr-90 | 7 6329E-01 | 4,956 09 | 12,390 22 | 0 00E+00 | 3 78E+03 | 9 46E+03 |
| Tc-99 | 3 9412E-04 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 95E+00 | 4 88E+00 |
| Th-229 | 1 6457E-12 | 4,956 09 | 12,390 22 | 0 00E+00 | 8 16E-09 | 2 04E-08 |
| Th-230 | 1.8822E-10 | 4,956 09 | 12,390 22 | 0 00E+00 | 9 33E-07 | 2 33E-06 |
| Th-232 | 9 7601E-17 | 4,956 09 | 12,390 22 | 0 00E+00 | 4 84E-13 | 1.21E-12 |
| Tl-208 | 5.2722E-07 | 4,956 09 | 12,390 22 | 0 00E+00 | 2 61E-03 | 6 53E-03 |
| U-232 | 1 4925E-06 | 4,956 09 | 12,390 22 | 0 00E+00 | 7 40E-03 | 1 85E-02 |
| U-233 | 2 1113E-10 | 4,956 09 | 12,390 22 | 0 00E+00 | 1 05E-06 | 2 62E-06 |
| U-234 | 1 9528E-06 | 4,956 09 | 12,390 22 | 0 00E+00 | 9 68E-03 | 2.42E-02 |
| U-235 | -9 7920E-09 | 4,956 09 | 0 00 | 2 01E-04 | 1 53E-04 | 2 01E-04 |
| U-236 | 1 1570E-07 | 4,956 09 | 12,390 22 | 0 00E+00 | 5.73E-04 | 1 43E-03 |
| U-238 | -1 7914E-07 | 4,956 09 | 0 00 | 1 47E-02 | 1.38E-02 | 1 47E-02 |
| Y-90 | 7 6329E-01 | 4,956 09 | 12,390 22 | 0 00E+00 | 3 78E+03 | 9 46E+03 |
| Other Radionuclides | | | | | 1 07E+04 | 2 69E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6.203E+14 |
| 0 0250 | 1.343E+14 |
| 0 0375 | 1 536E+14 |
| 0 0575 | 1.300E+14 |
| 0 0850 | 7 655E+13 |
| 0 1250 | 5 717E+13 |
| 0.2250 | 5 797E+13 |
| 0 3750 | 2 980E+13 |
| 0 5750 | 9 957E+14 |
| 0 8500 | 3 333E+13 |
| 1 2500 | 2 902E+13 |
| 1 7500 | 4 767E+11 |
| 2.2500 | 1 604E+10 |
| 2 7500 | 1 674E+09 |
| 3 5000 | 1 888E+08 |
| 5 0000 | 4 173E+05 |
| 7 0000 | 4 778E+04 |
| 11 0000 | 5 473E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.51E+02 | 3 15E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 4 956 09 |
| Bounding | | 12,390.22 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=61 951kg
Bounding burnup taken from SFD and converted to MWd using BOL=61 951kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 53 | |
| Bounding | 1 31 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name FAST REACTOR FUEL
SNF ID #: 906
Fuel Units & Descr: 1 - CANISTER OF SCRAP
Heavy Metal Mass BOL=9 044kg EOL=5 812kg
ROD Storage Site INEEL

[1]Fuel decay start date 1985
Estimates as of 2010
Template (Worst Case)
[2]Template Burnup(MWd): 62.5
Template BOL Heavy Metal Mass (MT) 0 00186865
Template Decay Time 25 years

Estimated Canister usage 18"x10' 0 08

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 3,071 54 | 6,143 08 | 0 00E+00 | 6 03E-03 | 1 21E-02 |
| Am-241 | 7 8064E+00 | 3,071 54 | 6,143 08 | 0 00E+00 | 2 40E+04 | 4 80E+04 |
| Am-242m | 1 7632E-02 | 3,071.54 | 6,143 08 | 0 00E+00 | 5 42E+01 | 1 08E+02 |
| Am-243 | 1 6336E-02 | 3,071.54 | 6,143 08 | 0 00E+00 | 5 02E+01 | 1 00E+02 |
| C-14 | 1 2101E-01 | 3,071.54 | 6,143 08 | 0 00E+00 | 3 72E+02 | 7 43E+02 |
| Cl-36 | 2 2849E-03 | 3,071.54 | 6,143 08 | 0 00E+00 | 7 02E+00 | 1 40E+01 |
| Cm-243 | 1 1046E-03 | 3,071.54 | 6,143 08 | 0 00E+00 | 3 39E+00 | 6 79E+00 |
| Cm-244 | 2 4704E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 7 59E+02 | 1 52E+03 |
| Co-60 | 1 0466E+02 | 3,071.54 | 6,143 08 | 0 00E+00 | 3 21E+05 | 6 43E+05 |
| Cs-134 | 9 8289E-03 | 3,071.54 | 6,143 08 | 0 00E+00 | 3 02E+01 | 6 04E+01 |
| Cs-135 | 4 3976E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 1 35E+00 | 2 70E+00 |
| Cs-137 | 2 6526E+01 | 3,071 54 | 6,143 08 | 0 00E+00 | 8 15E+04 | 1 63E+05 |
| Eu-154 | 2 7975E+00 | 3,071 54 | 6,143 08 | 0 00E+00 | 8 59E+03 | 1 72E+04 |
| Eu-155 | 2 7881E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 8 56E+02 | 1 71E+03 |
| Fe-55 | 4 2151E+00 | 3,071 54 | 6,143 08 | 0 00E+00 | 1 29E+04 | 2 59E+04 |
| H-3 | 4 2599E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 1 31E+03 | 2 62E+03 |
| I-129 | 1 0618E-05 | 3,071 54 | 6,143 08 | 0 00E+00 | 3.26E-02 | 6 52E-02 |
| Kr-85 | 1 1426E+00 | 3,071 54 | 6,143 08 | 0 00E+00 | 3 51E+03 | 7 02E+03 |
| Np-237 | 1 5647E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 4 81E-01 | 9 61E-01 |
| Pa-231 | 2 8624E-06 | 3,071 54 | 6,143 08 | 0 00E+00 | 8.79E-03 | 1.76E-02 |
| Pb-210 | 9 2770E-09 | 3,071 54 | 6,143 08 | 0 00E+00 | 2 85E-05 | 5.70E-05 |
| Pm-147 | 2 3690E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 7 28E+02 | 1 46E+03 |
| Pu-238 | 3 2240E+00 | 3,071 54 | 6,143 08 | 0 00E+00 | 9 90E+03 | 1 98E+04 |
| Pu-239 | 4 1664E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 1 28E+03 | 2 56E+03 |
| Pu-240 | 2 9264E-01 | 3,071 54 | 6,143 08 | 0 00E+00 | 8 99E+02 | 1 80E+03 |
| Pu-241 | 7 8816E+01 | 3,071 54 | 6,143 08 | 0 00E+00 | 2 42E+05 | 4 84E+05 |
| Pu-242 | 2 4560E-03 | 3,071 54 | 6,143 08 | 0 00E+00 | 7 54E+00 | 1 51E+01 |
| Ra-226 | 3 2167E-08 | 3,071 54 | 6,143 08 | 0 00E+00 | 9 88E-05 | 1 98E-04 |
| Ra-228 | 5 9024E-07 | 3,071 54 | 6,143 08 | 0 00E+00 | 1 81E-03 | 3 63E-03 |
| Ru-106 | 3 9140E-06 | 3,071 54 | 6,143 08 | 0 00E+00 | 1.20E-02 | 2 40E-02 |
| Se-79 | 1 9184E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 5 89E-01 | 1.18E+00 |
| Sn-126 | 1 6671E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 5 12E-01 | 1 02E+00 |
| Sr-90 | 2 5126E+01 | 3,071 54 | 6,143 08 | 0 00E+00 | 7.72E+04 | 1.54E+05 |
| Tc-99 | 6.7678E-03 | 3,071 54 | 6,143 08 | 0 00E+00 | 2.08E+01 | 4 16E+01 |
| Th-229 | 1.2398E-06 | 3,071 54 | 6,143 08 | 0 00E+00 | 3 81E-03 | 7 62E-03 |
| Th-230 | 4.1442E-06 | 3,071 54 | 6,143 08 | 0 00E+00 | 1.27E-02 | 2 55E-02 |
| Th-232 | -4 2431E-09 | 3,071 54 | 0 00 | 1 83E-04 | 1 70E-04 | 1 83E-04 |
| Tl-208 | 9 6478E-05 | 3,071 54 | 6,143 08 | 0 00E+00 | 2 96E-01 | 5 93E-01 |
| U-232 | 2 6103E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 8 02E-01 | 1 60E+00 |
| U-233 | 3 6128E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 1.11E+00 | 2 22E+00 |
| U-234 | 1.2788E-02 | 3,071 54 | 6,143 08 | 0 00E+00 | 3 93E+01 | 7 86E+01 |
| U-235 | 5.7486E-04 | 3,071 54 | 6,143 08 | 3 89E-03 | 1 77E+00 | 3 54E+00 |
| U-236 | 2.3485E-04 | 3,071 54 | 6,143 08 | 0 00E+00 | 7 21E-01 | 1 44E+00 |
| U-238 | 1.1581E-04 | 3,071 54 | 6,143 08 | 4 84E-04 | 3 56E-01 | 7 12E-01 |
| Y-90 | 2 5126E+01 | 3,071 54 | 6,143 08 | 0 00E+00 | 7 72E+04 | 1 54E+05 |
| Other Radionuclides | | | | | 2 15E+05 | 4 31E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 042E+16 |
| 0 0250 | 2 038E+15 |
| 0 0375 | 1 819E+15 |
| 0 0575 | 2 482E+15 |
| 0 0850 | 1 073E+15 |
| 0 1250 | 9 336E+14 |
| 0.2250 | 9 118E+14 |
| 0 3750 | 3 843E+14 |
| 0 5750 | 6 130E+15 |
| 0 8500 | 3 694E+14 |
| 1 2500 | 4 794E+16 |
| 1 7500 | 1 161E+13 |
| 2.2500 | 2 524E+11 |
| 2 7500 | 2 162E+10 |
| 3 5000 | 2 421E+07 |
| 5.0000 | 1 029E+07 |
| 7 0000 | 1 179E+06 |
| 11 0000 | 1 350E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.26E+03 | 1 45E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Th and U | U, Th, & Pu |
| BOL Enrichment % | 7 592 | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 904 40 | 3 071 54 |
| Bounding | | 6 143 08 |

**Basis for burnup used in estimate.**

Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 15 | 3 40 |
| Bounding | 20 31 | |

Estimated EOL HM/Given EOL HM: 331 59

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name FAST REACTOR FUEL (U/PUC)
SNF ID # 1029
Fuel Units & Descr 11 - CANISTER OF SCRAP
Heavy Metal Mass BOL=13.33kg EOL=11 095kg
ROD Storage Site INEEL

[1]Fuel decay start date 1985
Estimates as of 2010
Template FFTF (FAST, SST 10 to 30% Pu & U)
[2]Template Burnup(MWd) 5011 2
Template BOL Heavy Metal Mass (MT) 0 0329181
Template Decay Time 25 years

Estimated Canister usage 18"x10'
0 85

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 4503E-12 | 3,998 94 | 7,997.88 | 0 00E+00 | 1.38E-08 | 2.76E-08 |
| Am-241 | 9 5092E-02 | 3,998 94 | 7,997 88 | 2 57E+01 | 4 06E+02 | 7 86E+02 |
| Am-242m | 2 0118E-03 | 3,998 94 | 7,997 88 | 0 00E+00 | 8 05E+00 | 1 61E+01 |
| Am-243 | 1 0750E-04 | 3,998 94 | 7,997 88 | 0 00E+00 | 4.30E-01 | 8 60E-01 |
| C-14 | 2 6108E-05 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 04E-01 | 2 09E-01 |
| Cl-36 | 3 4243E-10 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 37E-06 | 2 74E-06 |
| Cm-243 | 5 1824E-04 | 3,998 94 | 7,997 88 | 0 00E+00 | 2 07E+00 | 4 14E+00 |
| Cm-244 | 2 1572E-03 | 3,998 94 | 7,997 88 | 0 00E+00 | 8 63E+00 | 1 73E+01 |
| Co-60 | 5 6258E-03 | 3 998 94 | 7,997 88 | 0 00E+00 | 2 25E+01 | 4 50E+01 |
| Cs-134 | 2 5942E-03 | 3 998 94 | 7,997 88 | 0 00E+00 | 1 04E+01 | 2 07E+01 |
| Cs-135 | 4 7693E-05 | 3,998 94 | 7,997.88 | 0 00E+00 | 1 91E-01 | 3 81E-01 |
| Cs-137 | 1 7121E+00 | 3,998 94 | 7,997.88 | 0 00E+00 | 6 85E+03 | 1 37E+04 |
| Eu-154 | 2 5217E-02 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 01E+02 | 2 02E+02 |
| Eu-155 | 2 2684E-02 | 3,998 94 | 7,997 88 | 0 00E+00 | 9 07E+01 | 1 81E+02 |
| Fe-55 | 6 3362E-04 | 3,998 94 | 7,997 88 | 0 00E+00 | 2 53E+00 | 5 07E+00 |
| H-3 | 5 6054E-03 | 3,998 94 | 7,997 88 | 0 00E+00 | 2.24E+01 | 4 48E+01 |
| I-129 | 1.2891E-06 | 3,998 94 | 7,997 88 | 0 00E+00 | 5 16E-03 | 1 03E-02 |
| Kr-85 | 4 1743E-02 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 67E+02 | 3 34E+02 |
| Np-237 | 3.2028E-06 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 28E-02 | 2 56E-02 |
| Pa-231 | 8 5429E-12 | 3,998 94 | 7,997 88 | 0 00E+00 | 3 42E-08 | 6 83E-08 |
| Pb-210 | 7 3535E-13 | 3 998 94 | 7,997.88 | 0 00E+00 | 2 94E-09 | 5 88E-09 |
| Pm-147 | 2 6110E-02 | 3,998 94 | 7,997.88 | 0 00E+00 | 1 04E+02 | 2 09E+02 |
| Pu-238 | 2 3318E-02 | 3,998 94 | 7,997.88 | 0 00E+00 | 9 32E+01 | 1 86E+02 |
| Pu-239 | -3 5520E-02 | 3,998 94 | 0 00 | 2 11E+02 | 6 89E+01 | 2 11E+02 |
| Pu-240 | 2 0757E-02 | 3,998 94 | 7,997 88 | 1 07E+02 | 1 90E+02 | 2 73E+02 |
| Pu-241 | -1 1127E+00 | 3,998 94 | 0 00 | 4 81E+03 | 3 63E+02 | 4 81E+03 |
| Pu-242 | 1 1152E-05 | 3,998 94 | 7,997 88 | 2 86E-02 | 7.32E-02 | 1 18E-01 |
| Ra-226 | 2 8297E-12 | 3,998 94 | 7,997 88 | 0 00E+00 | 1.13E-08 | 2.26E-08 |
| Ra-228 | 1.3510E-16 | 3,998 94 | 7,997 88 | 0 00E+00 | 5 40E-13 | 1 08E-12 |
| Ru-106 | 2.5110E-05 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 00E-01 | 2 01E-01 |
| Se-79 | 1 0134E-05 | 3,998 94 | 7,997 88 | 0 00E+00 | 4 05E-02 | 8 11E-02 |
| Sn-126 | 4 3902E-05 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 76E-01 | 3 51E-01 |
| Sr-90 | 6 1529E-01 | 3,998 94 | 7,997 88 | 0 00E+00 | 2 46E+03 | 4 92E+03 |
| Tc-99 | 3 9412E-04 | 3,998 94 | 7,997.88 | 0 00E+00 | 1 58E+00 | 3 15E+00 |
| Th-229 | 2 0554E-12 | 3,998 94 | 7,997.88 | 0 00E+00 | 8 22E-09 | 1 64E-08 |
| Th-230 | 5 3680E-10 | 3,998 94 | 7,997.88 | 0 00E+00 | 2 15E-06 | 4.29E-06 |
| Th-232 | 1 9522E-16 | 3,998 94 | 7,997 88 | 0 00E+00 | 7 81E-13 | 1 56E-12 |
| Tl-208 | 5 1046E-07 | 3,998 94 | 7,997 88 | 0 00E+00 | 2 04E-03 | 4 08E-03 |
| U-232 | 1 3883E-06 | 3,998 94 | 7,997 88 | 0 00E+00 | 5 55E-03 | 1 11E-02 |
| U-233 | 3 7516E-10 | 3,998 94 | 7,997 88 | 0 00E+00 | 1 50E-06 | 3 00E-06 |
| U-234 | 3 1909E-06 | 3,998 94 | 7,997 88 | 0 00E+00 | 1.28E-02 | 2 55E-02 |
| U-235 | -8 7842E-09 | 3,998.94 | 0 00 | 4 33E-05 | 8 19E-06 | 4 33E-05 |
| U-236 | 1 4813E-07 | 3,998 94 | 7,997 88 | 0 00E+00 | 5 92E-04 | 1 18E-03 |
| U-238 | -1 7914E-07 | 3,998 94 | 0 00 | 3.15E-03 | 2 44E-03 | 3 15E-03 |
| Y-90 | 6 1529E-01 | 3,998 94 | 7,997.88 | 0 00E+00 | 2 46E+03 | 4 92E+03 |
| Other Radionuclides | | | | | 6 88E+03 | 1 38E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 149E+14 |
| 0 0250 | 6 385E+13 |
| 0 0375 | 7 490E+13 |
| 0 0575 | 6 858E+13 |
| 0 0850 | 3 612E+13 |
| 0 1250 | 2.597E+13 |
| 0 2250 | 2 886E+13 |
| 0 3750 | 1.259E+13 |
| 0 5750 | 5 020E+14 |
| 0 8500 | 6.202E+12 |
| 1.2500 | 7 999E+12 |
| 1 7500 | 1 676E+11 |
| 2.2500 | 3 570E+07 |
| 2 7500 | 1 455E+08 |
| 3 5000 | 6 264E+05 |
| 5 0000 | 1 777E+05 |
| 7 0000 | 2 034E+04 |
| 11 0000 | 2.329E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.64E+01 | 1.51E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | 31 101 | 10 to 30 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment (very close to 30%)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 3 998 94 | 2,231 05 |
| Bounding | | 7,997 88 |

**Basis for burnup used in estimate**

Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 97 | 0 56 |
| Bounding | 3 94 | |

Estimated EOL HM/Given EOL HM: 0 83

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: FERMI CORE I & 2 (CORE FOIL)
SNF ID #: 457
Fuel Units & Descr: 136 - ROD
Heavy Metal Mass: BOL=18 21kg EOL=17 734kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1972
Estimates as of: 2010
Template: FERMI (Fast, Zirc, 10 to 40% U)
[2]Template Burnup(MWd): 58 6725048
Template BOL Heavy Metal Mass (MT): 0 018774
Template Decay Time: 35 years

Estimated Canister usage: 18"x10" 0 04

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 419 74 | 839 48 | 0 00E+00 | 4 03E-05 | 8 07E-05 |
| Am-241 | 6 5601E-07 | 419 74 | 839 48 | 0 00E+00 | 2 75E-04 | 5 51E-04 |
| Am-242m | 0 0000E+00 | 419 74 | 839 48 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 419 74 | 839 48 | 0 00E+00 | 3 52E-12 | 7 03E-12 |
| C-14 | 2 1714E-05 | 419 74 | 839 48 | 0 00E+00 | 9 11E-03 | 1 82E-02 |
| Cl-36 | 5 5188E-08 | 419 74 | 839 48 | 0 00E+00 | 2 32E-05 | 4 63E-05 |
| Cm-243 | 1 5496E-14 | 419 74 | 839 48 | 0 00E+00 | 6 50E-12 | 1.30E-11 |
| Cm-244 | 5 2375E-16 | 419 74 | 839 48 | 0 00E+00 | 2.20E-13 | 4 40E-13 |
| Co-60 | 2 0947E-03 | 419 74 | 839 48 | 0 00E+00 | 8.79E-01 | 1 76E+00 |
| Cs-134 | 6 2448E-07 | 419 74 | 839 48 | 0 00E+00 | 2 62E-04 | 5 24E-04 |
| Cs-135 | 4 4996E-05 | 419 74 | 839 48 | 0 00E+00 | 1 89E-02 | 3 78E-02 |
| Cs-137 | 1.3775E+00 | 419 74 | 839 48 | 0 00E+00 | 5 78E+02 | 1 16E+03 |
| Eu-154 | 1 8510E-04 | 419 74 | 839 48 | 0 00E+00 | 7.77E-02 | 1 55E-01 |
| Eu-155 | 1 4163E-03 | 419 74 | 839 48 | 0 00E+00 | 5 94E-01 | 1 19E+00 |
| Fe-55 | 1 4179E-05 | 419 74 | 839 48 | 0 00E+00 | 5 95E-03 | 1 19E-02 |
| H-3 | 3 5383E-03 | 419 74 | 839 48 | 0 00E+00 | 1 49E+00 | 2 97E+00 |
| I-129 | 1.1426E-06 | 419 74 | 839 48 | 0 00E+00 | 4 80E-04 | 9 59E-04 |
| Kr-85 | 3 8604E-02 | 419 74 | 839 48 | 0 00E+00 | 1 62E+01 | 3 24E+01 |
| Np-237 | 3 3099E-06 | 419 74 | 839 48 | 0 00E+00 | 1 39E-03 | 2 78E-03 |
| Pa-231 | 1 8953E-07 | 419 74 | 839 48 | 0 00E+00 | 7 96E-05 | 1 59E-04 |
| Pb-210 | 8 9531E-12 | 419 74 | 839 48 | 0 00E+00 | 3 76E-09 | 7 52E-09 |
| Pm-147 | 1 1588E-03 | 419 74 | 839 48 | 0 00E+00 | 4 86E-01 | 9 73E-01 |
| Pu-238 | 1 7146E-04 | 419 74 | 839 48 | 0 00E+00 | 7 20E-02 | 1 44E-01 |
| Pu-239 | 1 9464E-02 | 419 74 | 839 48 | 0 00E+00 | 8 17E+00 | 1 63E+01 |
| Pu-240 | 6 7919E-05 | 419 74 | 839 48 | 0 00E+00 | 2 85E-02 | 5 70E-02 |
| Pu-241 | 4 1774E-06 | 419 74 | 839 48 | 0 00E+00 | 1 75E-03 | 3 51E-03 |
| Pu-242 | 4 3751E-13 | 419 74 | 839 48 | 0 00E+00 | 1 84E-10 | 3 67E-10 |
| Ra-226 | 2 4219E-11 | 419 74 | 839 48 | 0 00E+00 | 1 02E-08 | 2 03E-08 |
| Ra-228 | 2 3572E-11 | 419 74 | 839 48 | 0 00E+00 | 9 89E-09 | 1 98E-08 |
| Ru-106 | 3 0951E-10 | 419 74 | 839 48 | 0 00E+00 | 1 30E-07 | 2 60E-07 |
| Se-79 | 1 6488E-05 | 419 74 | 839 48 | 0 00E+00 | 6 92E-03 | 1 38E-02 |
| Sn-126 | 3 7564E-05 | 419.74 | 839 48 | 0 00E+00 | 1 58E-02 | 3 15E-02 |
| Sr-90 | 1 2052E+00 | 419 74 | 839 48 | 0 00E+00 | 5 06E+02 | 1 01E+03 |
| Tc-99 | 4 4825E-04 | 419 74 | 839 48 | 0 00E+00 | 1 88E-01 | 3 76E-01 |
| Th-229 | 4 6478E-11 | 419 74 | 839 48 | 0 00E+00 | 1 95E-08 | 3 90E-08 |
| Th-230 | 2 2259E-09 | 419 74 | 839 48 | 0 00E+00 | 9 34E-07 | 1 87E-06 |
| Th-232 | 2 3691E-11 | 419 74 | 839 48 | 0 00E+00 | 9 94E-09 | 1.99E-08 |
| Tl-208 | 5 8256E-09 | 419 74 | 839 48 | 0 00E+00 | 2.45E-06 | 4 89E-06 |
| U-232 | 1 5759E-08 | 419 74 | 839 48 | 0 00E+00 | 6 61E-06 | 1.32E-05 |
| U-233 | 1 0110E-08 | 419 74 | 839 48 | 0 00E+00 | 4 24E-06 | 8.49E-06 |
| U-234 | 4 9001E-06 | 419 74 | 839 48 | 0 00E+00 | 2.06E-03 | 4.11E-03 |
| U-235 | -2 3191E-06 | 419 74 | 0 00 | 1 01E-02 | 9 14E-03 | 1.01E-02 |
| U-236 | 1 2633E-05 | 419 74 | 839 48 | 0 00E+00 | 5 30E-03 | 1 06E-02 |
| U-238 | -9 5407E-08 | 419 74 | 0 00 | 4 55E-03 | 4 51E-03 | 4 55E-03 |
| Y-90 | 1 2053E+00 | 419 74 | 839 48 | 0 00E+00 | 5 06E+02 | 1 01E+03 |
| Other Radionuclides | | | | | 5 75E+02 | 1 15E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 555E+13 |
| 0 0250 | 1 154E+13 |
| 0 0375 | 1 015E+13 |
| 0 0575 | 1 075E+13 |
| 0 0850 | 6 503E+12 |
| 0 1250 | 4.212E+12 |
| 0.2250 | 5 582E+12 |
| 0.3750 | 2 432E+12 |
| 0 5750 | 4 297E+13 |
| 0.8500 | 3 968E+11 |
| 1.2500 | 2 632E+11 |
| 1 7500 | 1 024E+10 |
| 2.2500 | 1 806E+06 |
| 2 7500 | 1 741E+05 |
| 3.5000 | 1 660E+02 |
| 5 0000 | 5 707E+01 |
| 7.0000 | 4 951E+00 |
| 11 0000 | 4 617E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6 48E+00 | 1.30E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | FAST | FAST | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 25 69081404 | 10 to 40 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 29 14 | 419 74 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 50 35 | 839 48 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 7 38 | 14 41 |
| Bounding | 14 75 | 16 67 |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FERMI CORE I & 2 (CORE SHIM) | [1]Fuel decay start date | 1972 |
| SNF ID # | 69 | Estimates as of | 2010 |
| Fuel Units & Descr | 280 - ROD | Template | FERMI (Fast Zirc, 10 to 40% U) |
| Heavy Metal Mass | BOL=37 492kg EOL=36 82kg | [2]Template Burnup(MWd) | 58 6725048 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 018774 |
| | | Template Decay Time | 35 years |

| Estimated Canister usage 18"x10' |
|---|
| 0 07 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 592 57 | 1,185 14 | 0 00E+00 | 5 70E-05 | 1 14E-04 |
| Am-241 | 6 5601E-07 | 592.57 | 1,185 14 | 0 00E+00 | 3 89E-04 | 7 77E-04 |
| Am-242m | 0 0000E+00 | 592 57 | 1,185 14 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 592 57 | 1,185 14 | 0 00E+00 | 4 96E-12 | 9 93E-12 |
| C-14 | 2 1714E-05 | 592 57 | 1,185 14 | 0 00E+00 | 1 29E-02 | 2 57E-02 |
| Cl-36 | 5 5188E-08 | 592 57 | 1,185 14 | 0 00E+00 | 3 27E-05 | 6 54E-05 |
| Cm-243 | 1 5496E-14 | 592 57 | 1,185 14 | 0 00E+00 | 9 18E-12 | 1 84E-11 |
| Cm-244 | 5 2375E-16 | 592 57 | 1,185 14 | 0 00E+00 | 3 10E-13 | 6.21E-13 |
| Co-60 | 2 0947E-03 | 592 57 | 1,185 14 | 0 00E+00 | 1 24E+00 | 2 48E+00 |
| Cs-134 | 6 2448E-07 | 592 57 | 1,185 14 | 0 00E+00 | 3 70E-04 | 7.40E-04 |
| Cs-135 | 4 4996E-05 | 592 57 | 1,185 14 | 0 00E+00 | 2 67E-02 | 5 33E-02 |
| Cs-137 | 1.3775E+00 | 592 57 | 1,185 14 | 0 00E+00 | 8 16E+02 | 1 63E+03 |
| Eu-154 | 1 8510E-04 | 592 57 | 1,185 14 | 0 00E+00 | 1.10E-01 | 2 19E-01 |
| Eu-155 | 1 4163E-03 | 592.57 | 1,185 14 | 0 00E+00 | 8.39E-01 | 1 68E+00 |
| Fe-55 | 1 4179E-05 | 592.57 | 1,185 14 | 0 00E+00 | 8 40E-03 | 1 68E-02 |
| H-3 | 3 5383E-03 | 592 57 | 1,185 14 | 0 00E+00 | 2 10E+00 | 4 19E+00 |
| I-129 | 1 1426E-06 | 592 57 | 1,185 14 | 0 00E+00 | 6 77E-04 | 1 35E-03 |
| Kr-85 | 3 8604E-02 | 592 57 | 1,185 14 | 0 00E+00 | 2.29E+01 | 4 58E+01 |
| Np-237 | 3 3099E-06 | 592 57 | 1,185 14 | 0 00E+00 | 1 96E-03 | 3 92E-03 |
| Pa-231 | 1 8953E-07 | 592 57 | 1,185.14 | 0 00E+00 | 1 12E-04 | 2 25E-04 |
| Pb-210 | 8 9531E-12 | 592 57 | 1,185 14 | 0 00E+00 | 5 31E-09 | 1 06E-08 |
| Pm-147 | 1 1588E-03 | 592 57 | 1,185 14 | 0 00E+00 | 6 87E-01 | 1 37E+00 |
| Pu-238 | 1 7146E-04 | 592 57 | 1,185 14 | 0 00E+00 | 1 02E-01 | 2.03E-01 |
| Pu-239 | 1 9464E-02 | 592 57 | 1,185 14 | 0 00E+00 | 1 15E+01 | 2.31E+01 |
| Pu-240 | 6.7919E-05 | 592 57 | 1,185 14 | 0 00E+00 | 4 02E-02 | 8 05E-02 |
| Pu-241 | 4 1774E-06 | 592 57 | 1,185 14 | 0 00E+00 | 2 48E-03 | 4 95E-03 |
| Pu-242 | 4 3751E-13 | 592.57 | 1,185 14 | 0 00E+00 | 2.59E-10 | 5 19E-10 |
| Ra-226 | 2 4219E-11 | 592.57 | 1,185 14 | 0 00E+00 | 1.44E-08 | 2 87E-08 |
| Ra-228 | 2 3572E-11 | 592 57 | 1,185 14 | 0 00E+00 | 1 40E-08 | 2 79E-08 |
| Ru-106 | 3 0951E-10 | 592 57 | 1,185 14 | 0 00E+00 | 1 83E-07 | 3 67E-07 |
| Se-79 | 1 6488E-05 | 592 57 | 1,185 14 | 0 00E+00 | 9 77E-03 | 1 95E-02 |
| Sn-126 | 3 7564E-05 | 592 57 | 1,185 14 | 0 00E+00 | 2 23E-02 | 4 45E-02 |
| Sr-90 | 1 2052E+00 | 592 57 | 1,185 14 | 0 00E+00 | 7 14E+02 | 1 43E+03 |
| Tc-99 | 4 4825E-04 | 592 57 | 1,185.14 | 0 00E+00 | 2 66E-01 | 5 31E-01 |
| Th-229 | 4 6478E-11 | 592 57 | 1,185 14 | 0 00E+00 | 2 75E-08 | 5 51E-08 |
| Th-230 | 2.2259E-09 | 592 57 | 1,185 14 | 0 00E+00 | 1 32E-06 | 2 64E-06 |
| Th-232 | 2.3691E-11 | 592 57 | 1,185 14 | 0 00E+00 | 1 40E-08 | 2 81E-08 |
| Tl-208 | 5 8256E-09 | 592 57 | 1,185 14 | 0 00E+00 | 3 45E-06 | 6 90E-06 |
| U-232 | 1.5759E-08 | 592.57 | 1,185 14 | 0 00E+00 | 9 34E-06 | 1 87E-05 |
| U-233 | 1 0110E-08 | 592.57 | 1,185 14 | 0 00E+00 | 5 99E-06 | 1 20E-05 |
| U-234 | 4 9001E-06 | 592 57 | 1,185 14 | 0 00E+00 | 2 90E-03 | 5 81E-03 |
| U-235 | -2 3191E-06 | 592 57 | 0 00 | 1 10E-02 | 9 61E-03 | 1 10E-02 |
| U-236 | 1 2633E-05 | 592 57 | 1,185 14 | 0 00E+00 | 7 49E-03 | 1 50E-02 |
| U-238 | -9 5407E-08 | 592 57 | 0 00 | 1 09E-02 | 1 08E-02 | 1 09E-02 |
| Y-90 | 1 2053E+00 | 592 57 | 1,185 14 | 0 00E+00 | 7.14E+02 | 1 43E+03 |
| Other Radionuclides | | | | | 8 11E+02 | 1 62E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 842E+13 |
| 0 0250 | 1 629E+13 |
| 0 0375 | 1 433E+13 |
| 0 0575 | 1 518E+13 |
| 0 0850 | 9 181E+12 |
| 0 1250 | 5 946E+12 |
| 0 2250 | 7 880E+12 |
| 0 3750 | 3 434E+12 |
| 0 5750 | 6 066E+13 |
| 0 8500 | 5 602E+11 |
| 1 2500 | 3 716E+11 |
| 1 7500 | 1 446E+10 |
| 2.2500 | 2.549E+06 |
| 2 7500 | 2 458E+05 |
| 3.5000 | 2.580E+02 |
| 5 0000 | 9 077E+01 |
| 7 0000 | 8 165E+00 |
| 11 0000 | 7.869E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 14E+00 | 1 83E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator. | FAST | FAST |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 13 55265123 | 10 to 40 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 59 99 | 592.57 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 103 67 | 1 185 14 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5 06 | 9 88 |
| Bounding | 10 11 | 11 43 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FERMI CORE I & 2 (DECLAD) | [1]Fuel decay start date | 1972 |
| SNF ID #· | 453 | Estimates as of | 2010 |
| Fuel Units & Descr· | 976 - ROD | Template | FERMI (Fast, Zirc, 10 to 40%, U) |
| Heavy Metal Mass | BOL=130 686kg EOL=110 971kg | [2]Template Burnup(MWd): | 58 6725048 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 018774 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x10' 0 25

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 67E-03 | 3 34E-03 |
| Am-241 | 6 5601E-07 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 14E-02 | 2 28E-02 |
| Am-242m | 0 0000E+00 | 17,384 91 | 34,769 81 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 46E-10 | 2 91E-10 |
| C-14 | 2 1714E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 3 77E-01 | 7 55E-01 |
| Cl-36 | 5 5188E-08 | 17,384 91 | 34,769 81 | 0 00E+00 | 9 59E-04 | 1 92E-03 |
| Cm-243 | 1 5496E-14 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 69E-10 | 5 39E-10 |
| Cm-244 | 5 2375E-16 | 17,384 91 | 34,769 81 | 0 00E+00 | 9 11E-12 | 1 82E-11 |
| Co-60 | 2 0947E-03 | 17,384 91 | 34,769 81 | 0 00E+00 | 3 64E+01 | 7 28E+01 |
| Cs-134 | 6 2448E-07 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 09E-02 | 2.17E-02 |
| Cs-135 | 4 4996E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 7 82E-01 | 1 56E+00 |
| Cs-137 | 1 3775E+00 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 39E+04 | 4 79E+04 |
| Eu-154 | 1 8510E-04 | 17,384 91 | 34,769 81 | 0 00E+00 | 3 22E+00 | 6 44E+00 |
| Eu-155 | 1 4163E-03 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 46E+01 | 4 92E+01 |
| Fe-55 | 1 4179E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 46E-01 | 4 93E-01 |
| H-3 | 3 5383E-03 | 17,384 91 | 34,769 81 | 0 00E+00 | 6 15E+01 | 1 23E+02 |
| I-129 | 1 1426E-06 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 99E-02 | 3 97E-02 |
| Kr-85 | 3 8604E-02 | 17,384 91 | 34,769 81 | 0 00E+00 | 6 71E+02 | 1 34E+03 |
| Np-237 | 3 3099E-06 | 17,384 91 | 34,769 81 | 0 00E+00 | 5 75E-02 | 1 15E-01 |
| Pa-231 | 1 8953E-07 | 17,384 91 | 34,769 81 | 0 00E+00 | 3.29E-03 | 6 59E-03 |
| Pb-210 | 8 9531E-12 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 56E-07 | 3 11E-07 |
| Pm-147 | 1 1588E-03 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 01E+01 | 4 03E+01 |
| Pu-238 | 1 7146E-04 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 98E+00 | 5 96E+00 |
| Pu-239 | 1 9464E-02 | 17,384 91 | 34,769 81 | 0 00E+00 | 3 38E+02 | 6 77E+02 |
| Pu-240 | 6 7919E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 18E+00 | 2 36E+00 |
| Pu-241 | 4 1774E-06 | 17,384.91 | 34,769 81 | 0 00E+00 | 7.26E-02 | 1 45E-01 |
| Pu-242 | 4 3751E-13 | 17,384.91 | 34,769 81 | 0 00E+00 | 7 61E-09 | 1 52E-08 |
| Ra-226 | 2 4219E-11 | 17,384 91 | 34,769 81 | 0 00E+00 | 4 21E-07 | 8 42E-07 |
| Ra-228 | 2 3572E-11 | 17,384 91 | 34,769 81 | 0 00E+00 | 4 10E-07 | 8 20E-07 |
| Ru-106 | 3 0951E-10 | 17,384 91 | 34,769 81 | 0 00E+00 | 5 38E-06 | 1 08E-05 |
| Se-79 | 1 6488E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 87E-01 | 5 73E-01 |
| Sn-126 | 3 7564E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 6 53E-01 | 1.31E+00 |
| Sr-90 | 1 2052E+00 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 10E+04 | 4 19E+04 |
| Tc-99 | 4 4825E-04 | 17,384 91 | 34,769 81 | 0 00E+00 | 7 79E+00 | 1 56E+01 |
| Th-229 | 4 6478E-11 | 17,384 91 | 34,769 81 | 0 00E+00 | 8 08E-07 | 1 62E-06 |
| Th-230 | 2.2259E-09 | 17,384 91 | 34,769 81 | 0 00E+00 | 3 87E-05 | 7 74E-05 |
| Th-232 | 2 3691E-11 | 17,384 91 | 34,769 81 | 0 00E+00 | 4 12E-07 | 8 24E-07 |
| Tl-208 | 5 8256E-09 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 01E-04 | 2 03E-04 |
| U-232 | 1 5759E-08 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 74E-04 | 5 48E-04 |
| U-233 | 1 0110E-08 | 17,384 91 | 34,769 81 | 0 00E+00 | 1 76E-04 | 3 52E-04 |
| U-234 | 4 9001E-06 | 17,384 91 | 34,769 81 | 0 00E+00 | 8 52E-02 | 1 70E-01 |
| U-235 | -2 3191E-06 | 17,384 91 | 0 00 | 7 26E-02 | 3 22E-02 | 7.26E-02 |
| U-236 | 1 2633E-05 | 17,384 91 | 34,769 81 | 0 00E+00 | 2 20E-01 | 4 39E-01 |
| U-238 | -9 5407E-08 | 17,384 91 | 0 00 | 3 26E-02 | 3 10E-02 | 3 26E-02 |
| Y-90 | 1 2053E+00 | 17,384 91 | 34,769 81 | 0 00E+00 | 2.10E+04 | 4 19E+04 |
| Other Radionuclides | | | | | 2 38E+04 | 4 76E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.301E+15 |
| 0 0250 | 4 779E+14 |
| 0 0375 | 4.204E+14 |
| 0 0575 | 4 453E+14 |
| 0 0850 | 2 693E+14 |
| 0 1250 | 1 745E+14 |
| 0 2250 | 2 312E+14 |
| 0 3750 | 1 007E+14 |
| 0 5750 | 1 780E+15 |
| 0 8500 | 1 644E+13 |
| 1 2500 | 1 090E+13 |
| 1 7500 | 4 241E+11 |
| 2 2500 | 7 479E+07 |
| 2 7500 | 7 209E+06 |
| 3 5000 | 6 033E+03 |
| 5 0000 | 2 002E+03 |
| 7 0000 | 1 635E+02 |
| 11 0000 | 1 434E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.68E+02 | 5.37E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator· | FAST | FAST |
| Fuel Cladding | NONE | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 25 69081404 | 10 to 40 |

**Basis for Parameter Differences·**

This Template was used for the following reasons

This fuel matches on all parameters except cladding.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 209 10 | 17,384 91 |
| Bounding | 361 35 | 34 769 81 |

**Basis for burnup used in estimate**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 42.57 | 83 14 |
| Bounding | 85 13 | 96.22 |

Estimated EOL HM/Given EOL HM: 1 04

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FERMI CORE I & 2 (SECTIONED) | [1]Fuel decay start date | 1972 |
| SNF ID # | 454 | Estimates as of | 2010 |
| Fuel Units & Descr | 980 - ROD | Template | FERMI (Fast Zirc 10 to 40%, U) |
| Heavy Metal Mass | BOL=131.222kg EOL=125 048kg | [2]Template Burnup(MWd) | 58 6725048 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 018774 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x10' 0 26

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 5,444 25 | 10,888 49 | 0 00E+00 | 5.23E-04 | 1 05E-03 |
| Am-241 | 6 5601E-07 | 5,444 25 | 10,888 49 | 0 00E+00 | 3 57E-03 | 7 14E-03 |
| Am-242m | 0 0000E+00 | 5,444 25 | 10,888 49 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 5,444 25 | 10 888 49 | 0 00E+00 | 4 56E-11 | 9 12E-11 |
| C-14 | 2 1714E-05 | 5,444 25 | 10 888 49 | 0 00E+00 | 1 18E-01 | 2 36E-01 |
| Cl-36 | 5 5188E-08 | 5,444 25 | 10,888 49 | 0 00E+00 | 3 00E-04 | 6 01E-04 |
| Cm-243 | 1 5496E-14 | 5,444 25 | 10,888 49 | 0 00E+00 | 8 44E-11 | 1 69E-10 |
| Cm-244 | 5 2375E-16 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 85E-12 | 5 70E-12 |
| Co-60 | 2 0947E-03 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 14E+01 | 2 28E+01 |
| Cs-134 | 6 2448E-07 | 5,444 25 | 10,888 49 | 0 00E+00 | 3 40E-03 | 6 80E-03 |
| Cs-135 | 4 4996E-05 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 45E-01 | 4 90E-01 |
| Cs-137 | 1.3775E+00 | 5,444.25 | 10,888 49 | 0 00E+00 | 7 50E+03 | 1 50E+04 |
| Eu-154 | 1 8510E-04 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 01E+00 | 2 02E+00 |
| Eu-155 | 1 4163E-03 | 5,444.25 | 10,888 49 | 0 00E+00 | 7 71E+00 | 1 54E+01 |
| Fe-55 | 1 4179E-05 | 5,444 25 | 10,888 49 | 0 00E+00 | 7 72E-02 | 1 54E-01 |
| H-3 | 3 5383E-03 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 93E+01 | 3 85E+01 |
| I-129 | 1 1426E-06 | 5,444.25 | 10,888 49 | 0 00E+00 | 6 22E-03 | 1.24E-02 |
| Kr-85 | 3 8604E-02 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 10E+02 | 4 20E+02 |
| Np-237 | 3 3099E-06 | 5,444.25 | 10,888 49 | 0 00E+00 | 1 80E-02 | 3 60E-02 |
| Pa-231 | 1 8953E-07 | 5 444.25 | 10,888 49 | 0 00E+00 | 1 03E-03 | 2 06E-03 |
| Pb-210 | 8 9531E-12 | 5,444 25 | 10,888 49 | 0 00E+00 | 4 87E-08 | 9 75E-08 |
| Pm-147 | 1 1588E-03 | 5 444 25 | 10,888 49 | 0 00E+00 | 6 31E+00 | 1.26E+01 |
| Pu-238 | 1 7146E-04 | 5,444.25 | 10,888 49 | 0 00E+00 | 9 33E-01 | 1 87E+00 |
| Pu-239 | 1 9464E-02 | 5,444.25 | 10,888 49 | 0 00E+00 | 1 06E+02 | 2.12E+02 |
| Pu-240 | 6 7919E-05 | 5,444.25 | 10,888 49 | 0 00E+00 | 3 70E-01 | 7.40E-01 |
| Pu-241 | 4 1774E-06 | 5 444 25 | 10,888 49 | 0 00E+00 | 2.27E-02 | 4 55E-02 |
| Pu-242 | 4 3751E-13 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 38E-09 | 4 76E-09 |
| Ra-226 | 2 4219E-11 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 32E-07 | 2 64E-07 |
| Ra-228 | 2 3572E-11 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 28E-07 | 2 57E-07 |
| Ru-106 | 3 0951E-10 | 5,444 25 | 10,888 49 | 0 00E+00 | 1 69E-06 | 3 37E-06 |
| Se-79 | 1 6488E-05 | 5,444 25 | 10,888 49 | 0 00E+00 | 8 98E-02 | 1 80E-01 |
| Sn-126 | 3 7564E-05 | 5,444 25 | 10,888 49 | 0 00E+00 | 2.05E-01 | 4 09E-01 |
| Sr-90 | 1.2052E+00 | 5,444 25 | 10,888 49 | 0 00E+00 | 6 56E+03 | 1.31E+04 |
| Tc-99 | 4 4825E-04 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 44E+00 | 4 88E+00 |
| Th-229 | 4 6478E-11 | 5,444 25 | 10,888 49 | 0 00E+00 | 2 53E-07 | 5 06E-07 |
| Th-230 | 2.2259E-09 | 5,444 25 | 10,888 49 | 0 00E+00 | 1.21E-05 | 2 42E-05 |
| Th-232 | 2.3691E-11 | 5,444.25 | 10,888 49 | 0 00E+00 | 1.29E-07 | 2 58E-07 |
| Tl-208 | 5 8256E-09 | 5,444.25 | 10,888 49 | 0 00E+00 | 3 17E-05 | 6 34E-05 |
| U-232 | 1.5759E-08 | 5 444 25 | 10,888 49 | 0 00E+00 | 8 58E-05 | 1 72E-04 |
| U-233 | 1 0110E-08 | 5,444.25 | 10,888 49 | 0 00E+00 | 5 50E-05 | 1 10E-04 |
| U-234 | 4 9001E-06 | 5,444.25 | 10,888 49 | 0 00E+00 | 2 67E-02 | 5 34E-02 |
| U-235 | -2 3191E-06 | 5,444.25 | 0 00 | 7.29E-02 | 6 02E-02 | 7 29E-02 |
| U-236 | 1.2633E-05 | 5,444.25 | 10,888 49 | 0 00E+00 | 6 88E-02 | 1 38E-01 |
| U-238 | -9 5407E-08 | 5 444.25 | 0 00 | 3.28E-02 | 3 23E-02 | 3 28E-02 |
| Y-90 | 1.2053E+00 | 5,444.25 | 10,888 49 | 0 00E+00 | 6 56E+03 | 1 31E+04 |
| Other Radionuclides | | | | | 7 45E+03 | 1 49E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.205E+14 |
| 0 0250 | 1 497E+14 |
| 0 0375 | 1 317E+14 |
| 0 0575 | 1 395E+14 |
| 0 0850 | 8 435E+13 |
| 0 1250 | 5 463E+13 |
| 0.2250 | 7.240E+13 |
| 0 3750 | 3 155E+13 |
| 0.5750 | 5 573E+14 |
| 0 8500 | 5 147E+12 |
| 1.2500 | 3 414E+12 |
| 1 7500 | 1 328E+11 |
| 2.2500 | 2 342E+07 |
| 2 7500 | 2.258E+06 |
| 3 5000 | 2 011E+03 |
| 5 0000 | 6 794E+02 |
| 7 0000 | 5 722E+01 |
| 11 0000 | 5 183E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8 40E+01 | 1 68E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | FAST | FAST | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 25 69081404 | 10 to 40 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 209 96 | 5 444.25 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 362.83 | 10 888 49 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 13.28 | 25 93 |
| Bounding | 26 55 | 30 01 |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | FERMI CORE I & 2 (SODIUM WORTH) | [1]Fuel decay start date | 1972 |
| SNF ID #: | 455 | Estimates as of | 2010 |
| Fuel Units & Descr: | 420 - ROD | Template | FERMI (Fast, Zirc, 10 to 40% U) |
| Heavy Metal Mass | BOL=56 238kg, EOL=55 398kg | [2]Template Burnup(MWd) | 58 6725048 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 018774 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x10' 0 11

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 740 71 | 1,481 43 | 0 00E+00 | 7 12E-05 | 1 42E-04 |
| Am-241 | 6 5601E-07 | 740 71 | 1,481 43 | 0 00E+00 | 4 86E-04 | 9 72E-04 |
| Am-242m | 0 0000E+00 | 740 71 | 1,481 43 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 740 71 | 1,481 43 | 0 00E+00 | 6 20E-12 | 1 24E-11 |
| C-14 | 2 1714E-05 | 740 71 | 1,481 43 | 0 00E+00 | 1 61E-02 | 3 22E-02 |
| Cl-36 | 5 5188E-08 | 740 71 | 1,481 43 | 0 00E+00 | 4 09E-05 | 8 18E-05 |
| Cm-243 | 1 5496E-14 | 740 71 | 1,481 43 | 0 00E+00 | 1 15E-11 | 2 30E-11 |
| Cm-244 | 5 2375E-16 | 740 71 | 1,481 43 | 0 00E+00 | 3 88E-13 | 7.76E-13 |
| Co-60 | 2 0947E-03 | 740 71 | 1,481 43 | 0 00E+00 | 1 55E+00 | 3 10E+00 |
| Cs-134 | 6 2448E-07 | 740 71 | 1,481 43 | 0 00E+00 | 4 63E-04 | 9 25E-04 |
| Cs-135 | 4 4996E-05 | 740 71 | 1,481 43 | 0 00E+00 | 3 33E-02 | 6 67E-02 |
| Cs-137 | 1 3775E+00 | 740 71 | 1,481 43 | 0 00E+00 | 1 02E+03 | 2 04E+03 |
| Eu-154 | 1 8510E-04 | 740 71 | 1,481 43 | 0 00E+00 | 1 37E-01 | 2.74E-01 |
| Eu-155 | 1 4163E-03 | 740 71 | 1,481 43 | 0 00E+00 | 1 05E+00 | 2 10E+00 |
| Fe-55 | 1 4179E-05 | 740 71 | 1,481 43 | 0 00E+00 | 1 05E-02 | 2 10E-02 |
| H-3 | 3 5383E-03 | 740 71 | 1,481 43 | 0 00E+00 | 2 62E+00 | 5 24E+00 |
| I-129 | 1 1426E-06 | 740 71 | 1,481 43 | 0 00E+00 | 8 46E-04 | 1 69E-03 |
| Kr-85 | 3 8604E-02 | 740 71 | 1,481 43 | 0 00E+00 | 2 86E+01 | 5 72E+01 |
| Np-237 | 3 3099E-06 | 740 71 | 1,481 43 | 0 00E+00 | 2 45E-03 | 4 90E-03 |
| Pa-231 | 1 8953E-07 | 740 71 | 1,481 43 | 0 00E+00 | 1 40E-04 | 2 81E-04 |
| Pb-210 | 8 9531E-12 | 740 71 | 1,481 43 | 0 00E+00 | 6 63E-09 | 1.33E-08 |
| Pm-147 | 1 1588E-03 | 740 71 | 1,481 43 | 0 00E+00 | 8 58E-01 | 1 72E+00 |
| Pu-238 | 1 7146E-04 | 740 71 | 1,481 43 | 0 00E+00 | 1 27E-01 | 2 54E-01 |
| Pu-239 | 1 9464E-02 | 740 71 | 1,481 43 | 0 00E+00 | 1 44E+01 | 2 88E+01 |
| Pu-240 | 6 7919E-05 | 740 71 | 1,481 43 | 0 00E+00 | 5 03E-02 | 1 01E-01 |
| Pu-241 | 4 1774E-06 | 740 71 | 1,481 43 | 0 00E+00 | 3 09E-03 | 6.19E-03 |
| Pu-242 | 4 3751E-13 | 740 71 | 1,481 43 | 0 00E+00 | 3 24E-10 | 6 48E-10 |
| Ra-226 | 2 4219E-11 | 740 71 | 1,481 43 | 0 00E+00 | 1 79E-08 | 3 59E-08 |
| Ra-228 | 2 3572E-11 | 740 71 | 1,481 43 | 0 00E+00 | 1 75E-08 | 3 49E-08 |
| Ru-106 | 3 0951E-10 | 740 71 | 1,481 43 | 0 00E+00 | 2 29E-07 | 4 59E-07 |
| Se-79 | 1 6488E-05 | 740 71 | 1,481 43 | 0 00E+00 | 1 22E-02 | 2 44E-02 |
| Sn-126 | 3 7564E-05 | 740 71 | 1,481 43 | 0 00E+00 | 2 78E-02 | 5 56E-02 |
| Sr-90 | 1 2052E+00 | 740 71 | 1,481 43 | 0 00E+00 | 8 93E+02 | 1 79E+03 |
| Tc-99 | 4 4825E-04 | 740 71 | 1,481 43 | 0 00E+00 | 3 32E-01 | 6 64E-01 |
| Th-229 | 4 6478E-11 | 740 71 | 1,481 43 | 0 00E+00 | 3 44E-08 | 6 89E-08 |
| Th-230 | 2 2259E-09 | 740 71 | 1,481 43 | 0 00E+00 | 1 65E-06 | 3 30E-06 |
| Th-232 | 2 3691E-11 | 740 71 | 1,481 43 | 0 00E+00 | 1 75E-08 | 3 51E-08 |
| Tl-208 | 5 8256E-09 | 740 71 | 1,481 43 | 0 00E+00 | 4 32E-06 | 8 63E-06 |
| U-232 | 1 5759E-08 | 740 71 | 1,481 43 | 0 00E+00 | 1 17E-05 | 2 33E-05 |
| U-233 | 1 0110E-08 | 740 71 | 1,481 43 | 0 00E+00 | 7 49E-06 | 1 50E-05 |
| U-234 | 4 9001E-06 | 740 71 | 1,481 43 | 0 00E+00 | 3 63E-03 | 7.26E-03 |
| U-235 | -2 3191E-06 | 740 71 | 0 00 | 3 12E-02 | 2 95E-02 | 3.12E-02 |
| U-236 | 1 2633E-05 | 740 71 | 1,481 43 | 0 00E+00 | 9 36E-03 | 1 87E-02 |
| U-238 | -9 5407E-08 | 740 71 | 0 00 | 1 40E-02 | 1 40E-02 | 1 40E-02 |
| Y-90 | 1 2053E+00 | 740 71 | 1,481 43 | 0 00E+00 | 8 93E+02 | 1 79E+03 |
| Other Radionuclides | | | | | 1 01E+03 | 2 03E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 802E+13 |
| 0 0250 | 2.036E+13 |
| 0 0375 | 1 791E+13 |
| 0 0575 | 1 897E+13 |
| 0 0850 | 1 148E+13 |
| 0 1250 | 7 433E+12 |
| 0.2250 | 9 851E+12 |
| 0 3750 | 4 292E+12 |
| 0 5750 | 7 582E+13 |
| 0 8500 | 7 002E+11 |
| 1.2500 | 4 645E+11 |
| 1 7500 | 1 807E+10 |
| 2.2500 | 3 187E+06 |
| 2 7500 | 3 072E+05 |
| 3.5000 | 3.254E+02 |
| 5.0000 | 1 147E+02 |
| 7 0000 | 1 035E+01 |
| 11 0000 | 9 995E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 14E+01 | 2.29E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 25 69081404 | 10 to 40 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 89 98 | 740 71 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 155 50 | 1 481 43 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 4.21 | 8.23 |
| Bounding | 8 43 | 9 53 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | FERMI CORE I & 2 (STD FUEL SUBASSEMBLY) | [1]Fuel decay start date | 1972 |
| SNF ID # | 456 | Estimates as of | 2010 |
| Fuel Units & Descr | 27160 - ROD | Template | FERMI (Fast Zirc 10 to 40% U) |
| Heavy Metal Mass | BOL=3636 724kg EOL=3566 108kg | [2]Template Burnup(MWd) | 58 6725048 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 018774 |
| | | Template Decay Time | 35 years |

| Estimated Canister usage 18"x10' |
|---|
| 7 07 |

### II. Estimates

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 6110E-08 | 62,269 34 | 124,538 69 | 0 00E+00 | 5 98E-03 | 1 20E-02 |
| Am-241 | 6 5601E-07 | 62,269 34 | 124,538 69 | 0 00E+00 | 4 08E-02 | 8 17E-02 |
| Am-242m | 0 0000E+00 | 62,269 34 | 124,538 69 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 8 3770E-15 | 62,269 34 | 124,538 69 | 0 00E+00 | 5 22E-10 | 1 04E-09 |
| C-14 | 2 1714E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 35E+00 | 2 70E+00 |
| Cl-36 | 5 5188E-08 | 62,269 34 | 124,538 69 | 0 00E+00 | 3 44E-03 | 6 87E-03 |
| Cm-243 | 1 5496E-14 | 62,269 34 | 124 538 69 | 0 00E+00 | 9 65E-10 | 1 93E-09 |
| Cm-244 | 5 2375E-16 | 62,269 34 | 124,538 69 | 0 00E+00 | 3 26E-11 | 6 52E-11 |
| Co-60 | 2 0947E-03 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 30E+02 | 2 61E+02 |
| Cs-134 | 6 2448E-07 | 62,269 34 | 124,538 69 | 0 00E+00 | 3 89E-02 | 7 78E-02 |
| Cs-135 | 4 4996E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 80E+00 | 5 60E+00 |
| Cs-137 | 1 3775E+00 | 62,269 34 | 124,538 69 | 0 00E+00 | 8 58E+04 | 1 72E+05 |
| Eu-154 | 1 8510E-04 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 15E+01 | 2 31E+01 |
| Eu-155 | 1 4163E-03 | 62,269 34 | 124,538 69 | 0 00E+00 | 8 82E+01 | 1 76E+02 |
| Fe-55 | 1 4179E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 8 83E-01 | 1 77E+00 |
| H-3 | 3 5383E-03 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 20E+02 | 4 41E+02 |
| I-129 | 1 1426E-06 | 62,269 34 | 124,538 69 | 0 00E+00 | 7.11E-02 | 1.42E-01 |
| Kr-85 | 3 8604E-02 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 40E+03 | 4 81E+03 |
| Np-237 | 3 3099E-06 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 06E-01 | 4 12E-01 |
| Pa-231 | 1 8953E-07 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 18E-02 | 2 36E-02 |
| Pb-210 | 8 9531E-12 | 62,269 34 | 124,538 69 | 0 00E+00 | 5 58E-07 | 1 12E-06 |
| Pm-147 | 1 1588E-03 | 62,269 34 | 124,538 69 | 0 00E+00 | 7.22E+01 | 1.44E+02 |
| Pu-238 | 1 7146E-04 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 07E+01 | 2 14E+01 |
| Pu-239 | 1 9464E-02 | 62,269 34 | 124,538 69 | 0 00E+00 | 1.21E+03 | 2 42E+03 |
| Pu-240 | 6 7919E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 4.23E+00 | 8 46E+00 |
| Pu-241 | 4 1774E-06 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 60E-01 | 5 20E-01 |
| Pu-242 | 4 3751E-13 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 72E-08 | 5 45E-08 |
| Ra-226 | 2 4219E-11 | 62,269 34 | 124 538 69 | 0 00E+00 | 1 51E-06 | 3 02E-06 |
| Ra-228 | 2 3572E-11 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 47E-06 | 2 94E-06 |
| Ru-106 | 3 0951E-10 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 93E-05 | 3 85E-05 |
| Se-79 | 1 6488E-05 | 62,269 34 | 124 538 69 | 0 00E+00 | 1 03E+00 | 2 05E+00 |
| Sn-126 | 3 7564E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 34E+00 | 4 68E+00 |
| Sr-90 | 1 2052E+00 | 62,269 34 | 124,538 69 | 0 00E+00 | 7 50E+04 | 1 50E+05 |
| Tc-99 | 4 4825E-04 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 79E+01 | 5 58E+01 |
| Th-229 | 4 6478E-11 | 62,269 34 | 124,538 69 | 0 00E+00 | 2 89E-06 | 5 79E-06 |
| Th-230 | 2.2259E-09 | 62,269 34 | 124 538 69 | 0 00E+00 | 1 39E-04 | 2 77E-04 |
| Th-232 | 2.3691E-11 | 62,269 34 | 124,538 69 | 0 00E+00 | 1 48E-06 | 2 95E-06 |
| Tl-208 | 5 8256E-09 | 62,269 34 | 124,538 69 | 0 00E+00 | 3 63E-04 | 7.26E-04 |
| U-232 | 1.5759E-08 | 62,269 34 | 124,538 69 | 0 00E+00 | 9 81E-04 | 1.96E-03 |
| U-233 | 1 0110E-08 | 62,269 34 | 124,538 69 | 0 00E+00 | 6 30E-04 | 1.26E-03 |
| U-234 | 4 9001E-06 | 62,269 34 | 124,538 69 | 0 00E+00 | 3 05E-01 | 6 10E-01 |
| U-235 | -2 3191E-06 | 62,269 34 | 0 00 | 2 02E+00 | 1 87E+00 | 2 02E+00 |
| U-236 | 1.2633E-05 | 62,269 34 | 124,538 69 | 0 00E+00 | 7.87E-01 | 1.57E+00 |
| U-238 | -9 5407E-08 | 62,269 34 | 0 00 | 9 08E-01 | 9 02E-01 | 9 08E-01 |
| Y-90 | 1.2053E+00 | 62,269 34 | 124,538 69 | 0 00E+00 | 7.51E+04 | 1.50E+05 |
| Other Radionuclides | | | | | 8 53E+04 | 1 71E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8.241E+15 |
| 0 0250 | 1 712E+15 |
| 0 0375 | 1 506E+15 |
| 0 0575 | 1 595E+15 |
| 0 0850 | 9 647E+14 |
| 0 1250 | 6 249E+14 |
| 0.2250 | 8 281E+14 |
| 0 3750 | 3 608E+14 |
| 0 5750 | 6 374E+15 |
| 0 8500 | 5 887E+13 |
| 1 2500 | 3 905E+13 |
| 1 7500 | 1 519E+12 |
| 2 2500 | 2 679E+08 |
| 2 7500 | 2 582E+07 |
| 3 5000 | 2.589E+04 |
| 5 0000 | 9 009E+03 |
| 7 0000 | 7 969E+02 |
| 11 0000 | 7 566E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 61E+02 | 1 92E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 25 69081404 | 10 to 40 |

**Basis for Parameter Differences**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 62 269 34 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 5 818 76 | 124 538 69 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5 48 | |
| Bounding | 10 96 | 21 40 |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: FFTF CARBIDE FUEL EXPER | [1]Fuel decay start date | 1993 | |
| SNF ID #: 347 | Estimates as of | 2010 | |
| Fuel Units & Descr: 15 - ELEMENT | Template | FFTF (FAST, SST, 10 to 30% Pu & U) | |
| Heavy Metal Mass: BOL= , EOL=7 356kg | [2]Template Burnup(MWd) | 5011.2 | |
| ROD Storage Site: INEEL | Template BOL Heavy Metal Mass (MT) | 0 0329181 | |
| | Template Decay Time | 15 years | |

Estimated Canister usage 18"x10' = 0 31

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3735E-12 | 525 78 | 652 69 | 0 00E+00 | 7.22E-10 | 8 96E-10 |
| Am-241 | 7 9527E-02 | 525 78 | 652 69 | 1 52E+01 | 5 70E+01 | 6 71E+01 |
| Am-242m | 2 1053E-03 | 525 78 | 652 69 | 0 00E+00 | 1 11E+00 | 1.37E+00 |
| Am-243 | 1 0760E-04 | 525 78 | 652 69 | 0 00E+00 | 5 66E-02 | 7 02E-02 |
| C-14 | 2 6141E-05 | 525 78 | 652.69 | 0 00E+00 | 1 37E-02 | 1 71E-02 |
| Cl-36 | 3 4243E-10 | 525 78 | 652 69 | 0 00E+00 | 1 80E-07 | 2 24E-07 |
| Cm-243 | 6 6092E-04 | 525 78 | 652 69 | 0 00E+00 | 3 47E-01 | 4 31E-01 |
| Cm-244 | 2 9933E-03 | 525 78 | 652 69 | 0 00E+00 | 1 57E+00 | 1 95E+00 |
| Co-60 | 1 5934E-02 | 525 78 | 652 69 | 0 00E+00 | 8.38E+00 | 1 04E+01 |
| Cs-134 | 4 6356E-02 | 525 78 | 652 69 | 0 00E+00 | 2 44E+01 | 3 03E+01 |
| Cs-135 | 4 7693E-05 | 525 78 | 652 69 | 0 00E+00 | 2 51E-02 | 3 11E-02 |
| Cs-137 | 2 1113E+00 | 525 78 | 652 69 | 0 00E+00 | 1.11E+03 | 1 38E+03 |
| Eu-154 | 4 8092E-02 | 525 78 | 652 69 | 0 00E+00 | 2 53E+01 | 3 14E+01 |
| Eu-155 | 6 8447E-02 | 525 78 | 652 69 | 0 00E+00 | 3 60E+01 | 4 47E+01 |
| Fe-55 | 5 8479E-03 | 525 78 | 652 69 | 0 00E+00 | 3 07E+00 | 3 82E+00 |
| H-3 | 8 9300E-03 | 525 78 | 652 69 | 0 00E+00 | 4 70E+00 | 5 83E+00 |
| I-129 | 1 2891E-06 | 525 78 | 652 69 | 0 00E+00 | 6 78E-04 | 8 41E-04 |
| Kr-85 | 7 0941E-02 | 525 78 | 652 69 | 0 00E+00 | 3 73E+01 | 4 63E+01 |
| Np-237 | 2 6541E-06 | 525 78 | 652 69 | 0 00E+00 | 1 40E-03 | 1 73E-03 |
| Pa-231 | 4 8970E-12 | 525 78 | 652 69 | 0 00E+00 | 2 57E-09 | 3 20E-09 |
| Pb-210 | 2 2170E-13 | 525 78 | 652 69 | 0 00E+00 | 1 17E-10 | 1 45E-10 |
| Pm-147 | 2 3617E-01 | 525 78 | 652 69 | 0 00E+00 | 1.24E+02 | 1 54E+02 |
| Pu-238 | 2 8636E-02 | 525 78 | 652 69 | 0 00E+00 | 1 51E+01 | 1 87E+01 |
| Pu-239 | -3.5520E-02 | 525 78 | 0 00 | 1.25E+02 | 1 06E+02 | 1 25E+02 |
| Pu-240 | 2 0790E-02 | 525 78 | 652 69 | 6.34E+01 | 7 43E+01 | 7 70E+01 |
| Pu-241 | -4 8316E-01 | 525 78 | 0 00 | 2 85E+03 | 2 59E+03 | 2 85E+03 |
| Pu-242 | 1 1052E-05 | 525 78 | 652 69 | 1 69E-02 | 2 27E-02 | 2 41E-02 |
| Ra-226 | 5 7471E-13 | 525 78 | 652 69 | 0 00E+00 | 3 02E-10 | 3 75E-10 |
| Ra-228 | 5 4957E-17 | 525 78 | 652 69 | 0 00E+00 | 2 89E-14 | 3 59E-14 |
| Ru-106 | 1 4582E-02 | 525 78 | 652 69 | 0 00E+00 | 7 67E+00 | 9 52E+00 |
| Se-79 | 1 0137E-05 | 525 78 | 652 69 | 0 00E+00 | 5 33E-03 | 6 62E-03 |
| Sn-126 | 4 3922E-05 | 525 78 | 652 69 | 0 00E+00 | 2 31E-02 | 2 87E-02 |
| Sr-90 | 7 6329E-01 | 525 78 | 652 69 | 0 00E+00 | 4 01E+02 | 4 98E+02 |
| Tc-99 | 3 9412E-04 | 525 78 | 652 69 | 0 00E+00 | 2 07E-01 | 2 57E-01 |
| Th-229 | 1 6457E-12 | 525 78 | 652 69 | 0 00E+00 | 8 65E-10 | 1 07E-09 |
| Th-230 | 1 8822E-10 | 525 78 | 652 69 | 0 00E+00 | 9 90E-08 | 1.23E-07 |
| Th-232 | 9 7601E-17 | 525 78 | 652 69 | 0 00E+00 | 5 13E-14 | 6 37E-14 |
| Tl-208 | 5 2722E-07 | 525 78 | 652 69 | 0 00E+00 | 2 77E-04 | 3 44E-04 |
| U-232 | 1 4925E-06 | 525 78 | 652 69 | 0 00E+00 | 7 85E-04 | 9 74E-04 |
| U-233 | 2 1113E-10 | 525 78 | 652 69 | 0 00E+00 | 1 11E-07 | 1 38E-07 |
| U-234 | 1 9528E-06 | 525 78 | 652 69 | 0 00E+00 | 1 03E-03 | 1 27E-03 |
| U-235 | -9 7920E-09 | 525.78 | 0 00 | 2 56E-05 | 2 05E-05 | 2 56E-05 |
| U-236 | 1 1570E-07 | 525.78 | 652 69 | 0 00E+00 | 6 08E-05 | 7 55E-05 |
| U-238 | -1.7914E-07 | 525 78 | 0 00 | 1 86E-03 | 1 77E-03 | 1 86E-03 |
| Y-90 | 7 6329E-01 | 525 78 | 652 69 | 0 00E+00 | 4 01E+02 | 4 98E+02 |
| Other Radionuclides | | | | | 1 14E+03 | 1 41E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3.316E+13 |
| 0 0250 | 7 084E+12 |
| 0 0375 | 8 094E+12 |
| 0 0575 | 6 973E+12 |
| 0 0850 | 4 032E+12 |
| 0 1250 | 3 012E+12 |
| 0 2250 | 3 054E+12 |
| 0 3750 | 1 570E+12 |
| 0 5750 | 5.245E+13 |
| 0 8500 | 1 756E+12 |
| 1.2500 | 1 528E+12 |
| 1 7500 | 2.511E+10 |
| 2.2500 | 8 452E+08 |
| 2 7500 | 8 818E+07 |
| 3 5000 | 9 968E+06 |
| 5 0000 | 3.081E+04 |
| 7 0000 | 3 521E+03 |
| 11 0000 | 4 031E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 71E+01 | 2.04E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 525 78 |
| Bounding | | 652 69 |

**Basis for burnup used in estimate:**

Nominal burnup taken from SFD and converted to MWd using BOL=7 883kg

Bounding burnup taken from SFD and converted to MWd using BOL=7 883kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 44 | |
| Bounding | 0 54 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | FFTF OXIDE EXPERIMENTS | [1]Fuel decay start date | 1993 |
| SNF ID # | 349 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - HEX ARRAY 91 ROD | Template | FFTF (FAST SST 10 to 30% Pu & U) |
| Heavy Metal Mass | BOL= , EOL=0.249kg | [2]Template Burnup(MWd) | 5011 2 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 0329181 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x10' 0 02

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 1.3735E-12 | 33 98 | 62.29 | 0 00E+00 | 4 67E-11 | 8 56E-11 |
| Am-241 | 7.9527E-02 | 33 98 | 62.29 | 5 46E-01 | 3 25E+00 | 5 50E+00 |
| Am-242m | 2 1053E-03 | 33 98 | 62.29 | 0 00E+00 | 7 15E-02 | 1 31E-01 |
| Am-243 | 1 0760E-04 | 33 98 | 62.29 | 0 00E+00 | 3 66E-03 | 6 70E-03 |
| C-14 | 2 6141E-05 | 33 98 | 62.29 | 0 00E+00 | 8 88E-04 | 1 63E-03 |
| Cl-36 | 3 4243E-10 | 33 98 | 62 29 | 0 00E+00 | 1 16E-08 | 2 13E-08 |
| Cm-243 | 6 6092E-04 | 33 98 | 62.29 | 0 00E+00 | 2 25E-02 | 4 12E-02 |
| Cm-244 | 2 9933E-03 | 33 98 | 62.29 | 0 00E+00 | 1 02E-01 | 1 86E-01 |
| Co-60 | 1 5934E-02 | 33 98 | 62 29 | 0 00E+00 | 5 41E-01 | 9 93E-01 |
| Cs-134 | 4 6356E-02 | 33 98 | 62 29 | 0 00E+00 | 1 58E+00 | 2 89E+00 |
| Cs-135 | 4 7693E-05 | 33 98 | 62 29 | 0 00E+00 | 1 62E-03 | 2 97E-03 |
| Cs-137 | 2 1113E+00 | 33 98 | 62 29 | 0 00E+00 | 7 17E+01 | 1 32E+02 |
| Eu-154 | 4 8092E-02 | 33 98 | 62 29 | 0 00E+00 | 1 63E+00 | 3 00E+00 |
| Eu-155 | 6 8447E-02 | 33 98 | 62 29 | 0 00E+00 | 2 33E+00 | 4.26E+00 |
| Fe-55 | 5 8479E-03 | 33 98 | 62 29 | 0 00E+00 | 1 99E-01 | 3 64E-01 |
| H-3 | 8 9300E-03 | 33 98 | 62 29 | 0 00E+00 | 3 03E-01 | 5 56E-01 |
| I-129 | 1 2891E-06 | 33 98 | 62 29 | 0 00E+00 | 4 38E-05 | 8 03E-05 |
| Kr-85 | 7 0941E-02 | 33 98 | 62 29 | 0 00E+00 | 2 41E+00 | 4 42E+00 |
| Np-237 | 2 6541E-06 | 33 98 | 62 29 | 0 00E+00 | 9 02E-05 | 1 65E-04 |
| Pa-231 | 4 8970E-12 | 33 98 | 62 29 | 0 00E+00 | 1 66E-10 | 3 05E-10 |
| Pb-210 | 2 2170E-13 | 33 98 | 62 29 | 0 00E+00 | 7 53E-12 | 1 38E-11 |
| Pm-147 | 2 3617E-01 | 33 98 | 62 29 | 0 00E+00 | 8 02E+00 | 1 47E+01 |
| Pu-238 | 2 8636E-02 | 33 98 | 62 29 | 0 00E+00 | 9 73E-01 | 1 78E+00 |
| Pu-239 | -3 5520E-02 | 33 98 | 0 00 | 4 48E+00 | 3 27E+00 | 4 48E+00 |
| Pu-240 | 2 0790E-02 | 33 98 | 62 29 | 2.28E+00 | 2 98E+00 | 3 57E+00 |
| Pu-241 | -4 8316E-01 | 33 98 | 0 00 | 1.02E+02 | 8 58E+01 | 1 02E+02 |
| Pu-242 | 1.1052E-05 | 33 98 | 62 29 | 6 07E-04 | 9 83E-04 | 1 30E-03 |
| Ra-226 | 5 7471E-13 | 33 98 | 62 29 | 0 00E+00 | 1 95E-11 | 3 58E-11 |
| Ra-228 | 5 4957E-17 | 33 98 | 62 29 | 0 00E+00 | 1 87E-15 | 3 42E-15 |
| Ru-106 | 1 4582E-02 | 33 98 | 62.29 | 0 00E+00 | 4 95E-01 | 9 08E-01 |
| Se-79 | 1 0137E-05 | 33 98 | 62.29 | 0 00E+00 | 3 44E-04 | 6 31E-04 |
| Sn-126 | 4.3922E-05 | 33 98 | 62.29 | 0 00E+00 | 1 49E-03 | 2 74E-03 |
| Sr-90 | 7 6329E-01 | 33 98 | 62.29 | 0 00E+00 | 2 59E+01 | 4 75E+01 |
| Tc-99 | 3 9412E-04 | 33 98 | 62.29 | 0 00E+00 | 1.34E-02 | 2 45E-02 |
| Th-229 | 1 6457E-12 | 33 98 | 62.29 | 0 00E+00 | 5 59E-11 | 1 03E-10 |
| Th-230 | 1.8822E-10 | 33 98 | 62.29 | 0 00E+00 | 6 40E-09 | 1 17E-08 |
| Th-232 | 9 7601E-17 | 33 98 | 62.29 | 0 00E+00 | 3.32E-15 | 6 08E-15 |
| Tl-208 | 5.2722E-07 | 33 98 | 62.29 | 0 00E+00 | 1 79E-05 | 3.28E-05 |
| U-232 | 1.4925E-06 | 33 98 | 62.29 | 0 00E+00 | 5 07E-05 | 9.30E-05 |
| U-233 | 2 1113E-10 | 33 98 | 62.29 | 0 00E+00 | 7 17E-09 | 1.32E-08 |
| U-234 | 1 9528E-06 | 33 98 | 62.29 | 0 00E+00 | 6 64E-05 | 1.22E-04 |
| U-235 | -9 7920E-09 | 33 98 | 0 00 | 9 20E-07 | 5 87E-07 | 9.20E-07 |
| U-236 | 1 1570E-07 | 33 98 | 62.29 | 0 00E+00 | 3 93E-06 | 7.21E-06 |
| U-238 | -1 7914E-07 | 33 98 | 0 00 | 6 70E-05 | 6 09E-05 | 6 70E-05 |
| Y-90 | 7 6329E-01 | 33 98 | 62 29 | 0 00E+00 | 2 59E+01 | 4.75E+01 |
| Other Radionuclides | | | | | 7.36E+01 | 1.35E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 115E+12 |
| 0 0250 | 6 752E+11 |
| 0 0375 | 7 724E+11 |
| 0 0575 | 6 529E+11 |
| 0 0850 | 3 848E+11 |
| 0 1250 | 2 874E+11 |
| 0.2250 | 2 914E+11 |
| 0 3750 | 1 498E+11 |
| 0.5750 | 5 006E+12 |
| 0 8500 | 1 675E+11 |
| 1.2500 | 1 459E+11 |
| 1 7500 | 2 396E+09 |
| 2.2500 | 8 066E+07 |
| 2 7500 | 8 413E+06 |
| 3 5000 | 9 492E+05 |
| 5 0000 | 2 044E+03 |
| 7 0000 | 2 341E+02 |
| 11 0000 | 2 681E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9 19E-01 | 1.56E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator* | FAST | FAST |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | Pu and U | Pu and U |
| BOL Enrichment % | | 10 to 30 |

**Basis for Parameter Differences***

This Template was used for the following reasons

This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 33 98 |
| Bounding | | 62.29 |

**Basis for burnup used in estimate***

Nominal burnup taken from SFD and converted to MWd using BOL=0.283kg

Bounding burnup taken from SFD and converted to MWd using BOL=0.283kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 79 | |
| Bounding | 1 45 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name: | FSVR | [1]Fuel decay start date: | 1989 |
| SNF ID # | 86 | Estimates as of. | 2010 |
| Fuel Units & Descr | 1464 - CARBON COATED PART | Template | FSV (Graphite, Graphite 60 to 100%, Th & U) |
| Heavy Metal Mass | BOL=15366 583kg EOL=14725 937kg | [2]Template Burnup(MWd): | 1270 275 |
| ROD Storage Site | FSV | Template BOL Heavy Metal Mass (MT): | 0 012702752 |
| | | Template Decay Time | 20 years |

Estimated Canister usage
18"x15'
292 80

### II. Estimates

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8411E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 72E+00 | 2 05E+00 |
| Am-241 | 2 5254E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 53E+03 | 1 82E+03 |
| Am-242m | 2 5664E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 55E+00 | 1 85E+00 |
| Am-243 | 4 6132E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 80E+01 | 3 33E+01 |
| C-14 | 2 3168E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 40E+01 | 1 67E+01 |
| Cl-36 | 1 0667E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 46E-01 | 7 70E-01 |
| Cm-243 | 3 6520E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 21E+01 | 2 64E+01 |
| Cm-244 | 1 1446E-02 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 94E+03 | 8 27E+03 |
| Co-60 | 3 2379E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 96E+03 | 2 34E+03 |
| Cs-134 | 5 8964E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 3 57E+03 | 4 26E+03 |
| Cs-135 | 2 4711E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 50E+01 | 1 78E+01 |
| Cs-137 | 1 8775E+00 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 14E+06 | 1 36E+06 |
| Eu-154 | 5 2619E-02 | 605,875 77 | 722,229 41 | 0 00E+00 | 3 19E+04 | 3 80E+04 |
| Eu-155 | 8 4785E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 5 14E+03 | 6 12E+03 |
| Fe-55 | 2 4381E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 48E+00 | 1 76E+00 |
| H-3 | 9 0768E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 5 50E+03 | 6 56E+03 |
| I-129 | 1 0092E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 11E-01 | 7.29E-01 |
| Kr-85 | 1 0423E-01 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 32E+04 | 7 53E+04 |
| Np-237 | 1 2517E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 7 58E+00 | 9 04E+00 |
| Pa-231 | 4 7391E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 87E+00 | 3 42E+00 |
| Pb-210 | 7 3244E-10 | 605,875 77 | 722,229 41 | 0 00E+00 | 4 44E-04 | 5.29E-04 |
| Pm-147 | 7 9747E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 4 83E+03 | 5 76E+03 |
| Pu-238 | 1 8295E-01 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 11E+05 | 1 32E+05 |
| Pu-239 | 1 3580E-04 | 605,875 77 | 722,229 41 | 0 00E+00 | 8 23E+01 | 9 81E+01 |
| Pu-240 | 2 5601E-04 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 55E+02 | 1 85E+02 |
| Pu-241 | 3 9810E-02 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 41E+04 | 2 88E+04 |
| Pu-242 | 3 8866E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 35E+00 | 2 81E+00 |
| Ra-226 | 1 1163E-09 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 76E-04 | 8 06E-04 |
| Ra-228 | 8 9587E-07 | 605,875 77 | 722,229 41 | 0 00E+00 | 5 43E-01 | 6 47E-01 |
| Ru-106 | 1 0628E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 6 44E-01 | 7 68E-01 |
| Se-79 | 2 1082E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 28E+01 | 1 52E+01 |
| Sn-126 | 2 2200E-05 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 35E+01 | 1 60E+01 |
| Sr-90 | 1 8098E+00 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 10E+06 | 1 31E+06 |
| Tc-99 | 3 3331E-04 | 605,875 77 | 722,229 41 | 0 00E+00 | 2 02E+02 | 2 41E+02 |
| Th-229 | 5 7665E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 3 49E+00 | 4 16E+00 |
| Th-230 | 1 2493E-07 | 605,875 77 | 722,229 41 | 0 00E+00 | 7 57E-02 | 9 02E-02 |
| Th-232 | -6.9673E-08 | 605,875 77 | 0 00 | 1.52E+00 | 1 48E+00 | 1 52E+00 |
| Tl-208 | 6 8796E-04 | 605,875 77 | 722,229 41 | 0 00E+00 | 4 17E+02 | 4 97E+02 |
| U-232 | 1 8618E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 13E+03 | 1 34E+03 |
| U-233 | 2 0602E-03 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 25E+03 | 1 49E+03 |
| U-234 | 2 7805E-04 | 605,875 77 | 722,229 41 | 0 00E+00 | 1 68E+02 | 2.01E+02 |
| U-235 | -1.7343E-06 | 605,875 77 | 0 00 | 3 04E+00 | 1 99E+00 | 3 04E+00 |
| U-236 | 8 6281E-06 | 605,875 77 | 722,229 41 | 0 00E+00 | 5 23E+00 | 6.23E+00 |
| U-238 | -5 6065E-09 | 605,875 77 | 0 00 | 3 02E-02 | 2 68E-02 | 3 02E-02 |
| Y-90 | 1 8098E+00 | 605,875.77 | 722,229 41 | 0 00E+00 | 1 10E+06 | 1.31E+06 |
| Other Radionuclides | | | | | 1 09E+06 | 1.30E+06 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.252E+16 |
| 0 0250 | 1 491E+16 |
| 0 0375 | 1 316E+16 |
| 0.0575 | 1 398E+16 |
| 0 0850 | 8 474E+15 |
| 0 1250 | 6 033E+15 |
| 0.2250 | 7 354E+15 |
| 0.3750 | 3 172E+15 |
| 0 5750 | 5 090E+16 |
| 0 8500 | 1 328E+15 |
| 1.2500 | 1 094E+15 |
| 1 7500 | 3 707E+13 |
| 2.2500 | 2 677E+09 |
| 2 7500 | 1 745E+13 |
| 3 5000 | 1 242E+08 |
| 5 0000 | 5 268E+07 |
| 7 0000 | 6 062E+06 |
| 11 0000 | 6 955E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 76E+04 | 2.10E+04 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 93 15 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 605 875 77 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 722,229 41 | 1,211,751 53 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.39 | |
| Bounding | 0 47 | 1 68 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name FSVR
SNF ID # 85
Fuel Units & Descr. 744 - CARBON COATED PART
Heavy Metal Mass BOL=8780 018kg EOL=8626 159kg
ROD Storage Site INEEL

[1]Fuel decay start date 1980
Estimates as of 2010
Template FSV (Graphite Graphite 60 to 100% Th & U)
[2]Template Burnup(MWd) 1270.275
Template BOL Heavy Metal Mass (MT) 0 012702752
Template Decay Time 25 years

Estimated Canister usage
18"x15'
148 80

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 3583E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 89E-01 | 1 39E+00 |
| Am-241 | 2 8805E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 19E+02 | 1.19E+03 |
| Am-242m | 2.5089E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 65E-01 | 1 04E+00 |
| Am-243 | 4 6116E-05 | 145,508 60 | 412,660 86 | 0 00E+00 | 6 71E+00 | 1.90E+01 |
| C-14 | 2.3152E-05 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 37E+00 | 9 55E+00 |
| Cl-36 | 1 0667E-06 | 145 508 60 | 412,660 86 | 0 00E+00 | 1.55E-01 | 4 40E-01 |
| Cm-243 | 3 2339E-05 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 71E+00 | 1.33E+01 |
| Cm-244 | 9 4546E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 1.38E+03 | 3 90E+03 |
| Co-60 | 1 6776E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 2.44E+02 | 6 92E+02 |
| Cs-134 | 1 0974E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 1.60E+02 | 4 53E+02 |
| Cs-135 | 2 4711E-06 | 145,508 60 | 412 660 86 | 0 00E+00 | 3 60E+00 | 1 02E+01 |
| Cs-137 | 1 6729E+00 | 145,508 60 | 412,660 86 | 0 00E+00 | 2 43E+05 | 6 90E+05 |
| Eu-154 | 3 5166E-02 | 145,508 60 | 412,660 86 | 0 00E+00 | 5 12E+03 | 1 45E+04 |
| Eu-155 | 4.2148E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 6 13E+02 | 1 74E+03 |
| Fe-55 | 6 4301E-07 | 145,508 60 | 412,660 86 | 0 00E+00 | 9 36E-02 | 2 65E-01 |
| H-3 | 6 8528E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 9 97E+02 | 2 83E+03 |
| I-129 | 1 0092E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 1 47E-01 | 4.16E-01 |
| Kr-85 | 7.5440E-02 | 145,508 60 | 412 660 86 | 0 00E+00 | 1 10E+04 | 3 11E+04 |
| Np-237 | 1 2525E-05 | 145,508 60 | 412 660 86 | 0 00E+00 | 1 82E+00 | 5 17E+00 |
| Pa-231 | 4 7383E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 6 89E-01 | 1.96E+00 |
| Pb-210 | 9 1476E-10 | 145,508 60 | 412,660 86 | 0 00E+00 | 1.33E-04 | 3 77E-04 |
| Pm-147 | 2 1271E-03 | 145,508 60 | 412 660 86 | 0 00E+00 | 3 10E+02 | 8 78E+02 |
| Pu-238 | 1 7587E-01 | 145,508 60 | 412,660 86 | 0 00E+00 | 2 56E+04 | 7.26E+04 |
| Pu-239 | 1 3580E-04 | 145,508 60 | 412,660 86 | 0 00E+00 | 1.98E+01 | 5 60E+01 |
| Pu-240 | 2 6404E-04 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 84E+01 | 1 09E+02 |
| Pu-241 | 3 1300E-02 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 55E+03 | 1 29E+04 |
| Pu-242 | 3 8866E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 5 66E-01 | 1 60E+00 |
| Ra-226 | 1 7059E-09 | 145,508 60 | 412,660 86 | 0 00E+00 | 2 48E-04 | 7 04E-04 |
| Ra-228 | 9 1083E-07 | 145,508 60 | 412,660 86 | 0 00E+00 | 1 33E-01 | 3 76E-01 |
| Ru-106 | 3 4126E-08 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 97E-03 | 1 41E-02 |
| Se-79 | 2 1082E-05 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 07E+00 | 8 70E+00 |
| Sn-126 | 2.2200E-05 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 23E+00 | 9 16E+00 |
| Sr-90 | 1 6067E+00 | 145,508 60 | 412,660 86 | 0 00E+00 | 2 34E+05 | 6 63E+05 |
| Tc-99 | 3 3331E-04 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 85E+01 | 1.38E+02 |
| Th-229 | 7 7062E-06 | 145,508 60 | 412,660 86 | 0 00E+00 | 1 12E+00 | 3 18E+00 |
| Th-230 | 1 5020E-07 | 145,508 60 | 412,660 86 | 0 00E+00 | 2 19E-02 | 6 20E-02 |
| Th-232 | -6 9673E-08 | 145,508 60 | 0 00 | 8 68E-01 | 8 58E-01 | 8 68E-01 |
| Tl-208 | 6 5584E-04 | 145,508 60 | 412,660 86 | 0 00E+00 | 9 54E+01 | 2 71E+02 |
| U-232 | 1 7744E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 2.58E+02 | 7 32E+02 |
| U-233 | 2 0602E-03 | 145,508 60 | 412,660 86 | 0 00E+00 | 3 00E+02 | 8 50E+02 |
| U-234 | 2 8285E-04 | 145,508 60 | 412,660 86 | 0 00E+00 | 4 12E+01 | 1 17E+02 |
| U-235 | -1 7343E-06 | 145,508 60 | 0 00 | 1.74E+00 | 1 48E+00 | 1 74E+00 |
| U-236 | 8 6281E-06 | 145,508 60 | 412,660 86 | 0.00E+00 | 1 26E+00 | 3 56E+00 |
| U-238 | -5 6065E-09 | 145 508 60 | 0 00 | 1 73E-02 | 1 65E-02 | 1.73E-02 |
| Y-90 | 1.6067E+00 | 145 508 60 | 412,660 86 | 0 00E+00 | 2 34E+05 | 6 63E+05 |
| Other Radionuclides | | | | | 2 33E+05 | 6 61E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 674E+16 |
| 0 0250 | 7.543E+15 |
| 0 0375 | 6 621E+15 |
| 0 0575 | 7 074E+15 |
| 0 0850 | 4.278E+15 |
| 0 1250 | 2 978E+15 |
| 0.2250 | 3 714E+15 |
| 0.3750 | 1 603E+15 |
| 0.5750 | 2.581E+16 |
| 0 8500 | 5 340E+14 |
| 1.2500 | 4 217E+14 |
| 1 7500 | 1 608E+13 |
| 2.2500 | 1 117E+09 |
| 2 7500 | 9 503E+12 |
| 3 5000 | 5 886E+07 |
| 5 0000 | 2 511E+07 |
| 7 0000 | 2.889E+06 |
| 11 0000 | 3.314E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 80E+03 | 1 08E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE | |
| Fuel Cladding | GRAPHITE | GRAPHITE | |
| BOL HM Constituents | Th and U | Th and U | |
| BOL Enrichment % | 93 13638737 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 145,508 60 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 412 660 86 | 291 017.20 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 17 | |
| Bounding | 0 47 | 0 71 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | GA HTGR FUEL | [1]Fuel decay start date | 1996 |
| SNF ID # | 89 | Estimates as of | 2010 |
| Fuel Units & Descr | 2 - CANISTER OF SCRAP | Template | FSV (Graphite, Graphite, 60 to 100%, Th & U) |
| Heavy Metal Mass | BOL=2 162kg, EOL=2 081kg | [2]Template Burnup(MWd). | 1270.275 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 012702752 |
| | | Template Decay Time | 10 years |

Estimated Canister usage HIC: 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 1295E-06 | 76 23 | 152 45 | 0 00E+00 | 1 62E-04 | 3.25E-04 |
| Am-241 | 1.9169E-03 | 76 23 | 152 45 | 0 00E+00 | 1 46E-01 | 2 92E-01 |
| Am-242m | 2 6860E-06 | 76 23 | 152 45 | 0 00E+00 | 2 05E-04 | 4 09E-04 |
| Am-243 | 4 6179E-05 | 76 23 | 152 45 | 0 00E+00 | 3 52E-03 | 7 04E-03 |
| C-14 | 2.3192E-05 | 76 23 | 152 45 | 0 00E+00 | 1 77E-03 | 3 54E-03 |
| Cl-36 | 1 0667E-06 | 76 23 | 152 45 | 0 00E+00 | 8 13E-05 | 1 63E-04 |
| Cm-243 | 4 6573E-05 | 76 23 | 152 45 | 0 00E+00 | 3 55E-03 | 7 10E-03 |
| Cm-244 | 1 6784E-02 | 76 23 | 152 45 | 0 00E+00 | 1.28E+00 | 2 56E+00 |
| Co-60 | 1 2060E-02 | 76 23 | 152 45 | 0 00E+00 | 9 19E-01 | 1 84E+00 |
| Cs-134 | 1 7004E-01 | 76 23 | 152 45 | 0 00E+00 | 1.30E+01 | 2 59E+01 |
| Cs-135 | 2 4711E-05 | 76 23 | 152 45 | 0 00E+00 | 1 88E-03 | 3 77E-03 |
| Cs-137 | 2 3656E+00 | 76 23 | 152 45 | 0 00E+00 | 1 80E+02 | 3 61E+02 |
| Eu-154 | 1 1785E-01 | 76 23 | 152 45 | 0 00E+00 | 8 98E+00 | 1 80E+01 |
| Eu-155 | 3 4292E-02 | 76 23 | 152 45 | 0 00E+00 | 2 61E+00 | 5.23E+00 |
| Fe-55 | 3 5071E-05 | 76 23 | 152 45 | 0 00E+00 | 2 67E-03 | 5 35E-03 |
| H-3 | 1 5902E-02 | 76 23 | 152 45 | 0 00E+00 | 1 21E+00 | 2 42E+00 |
| I-129 | 1 0092E-06 | 76 23 | 152 45 | 0 00E+00 | 7 69E-05 | 1 54E-04 |
| Kr-85 | 1 9901E-01 | 76 23 | 152 45 | 0 00E+00 | 1 52E+01 | 3 03E+01 |
| Np-237 | 1 2509E-05 | 76 23 | 152.45 | 0 00E+00 | 9 54E-04 | 1 91E-03 |
| Pa-231 | 4 7399E-06 | 76 23 | 152 45 | 0 00E+00 | 3 61E-04 | 7 23E-04 |
| Pb-210 | 7 0481E-10 | 76 23 | 152 45 | 0 00E+00 | 5 37E-08 | 1 07E-07 |
| Pm-147 | 1 1194E-01 | 76 23 | 152.45 | 0 00E+00 | 8 53E+00 | 1.71E+01 |
| Pu-238 | 1 9799E-01 | 76.23 | 152.45 | 0 00E+00 | 1 51E+01 | 3 02E+01 |
| Pu-239 | 1 3580E-04 | 76.23 | 152 45 | 0 00E+00 | 1 04E-02 | 2 07E-02 |
| Pu-240 | 2 4404E-04 | 76.23 | 152 45 | 0 00E+00 | 1 86E-02 | 3 72E-02 |
| Pu-241 | 6 4427E-02 | 76.23 | 152 45 | 0 00E+00 | 4 91E+00 | 9 82E+00 |
| Pu-242 | 3 8866E-06 | 76.23 | 152 45 | 0 00E+00 | 2 96E-04 | 5 93E-04 |
| Ra-226 | 6 3223E-10 | 76.23 | 152 45 | 0 00E+00 | 4 82E-08 | 9 64E-08 |
| Ra-228 | 8 5178E-07 | 76.23 | 152 45 | 0 00E+00 | 6 49E-05 | 1 30E-04 |
| Ru-106 | 1 0305E-03 | 76.23 | 152 45 | 0 00E+00 | 7 85E-02 | 1 57E-01 |
| Se-79 | 2 1082E-05 | 76.23 | 152 45 | 0 00E+00 | 1 61E-03 | 3.21E-03 |
| Sn-126 | 2 2200E-05 | 76.23 | 152 45 | 0 00E+00 | 1 69E-03 | 3 38E-03 |
| Sr-90 | 2 2964E+00 | 76 23 | 152 45 | 0 00E+00 | 1 75E+02 | 3 50E+02 |
| Tc-99 | 3 3331E-04 | 76 23 | 152 45 | 0 00E+00 | 2 54E-02 | 5 08E-02 |
| Th-229 | 3 8252E-06 | 76 23 | 152 45 | 0 00E+00 | 2 92E-04 | 5 83E-04 |
| Th-230 | 1 0014E-07 | 76 23 | 152 45 | 0 00E+00 | 7 63E-06 | 1 53E-05 |
| Th-232 | -6 9673E-08 | 76 23 | 0 00 | 2 14E-04 | 2 09E-04 | 2 14E-04 |
| Tl-208 | 7 4724E-04 | 76 23 | 152 45 | 0 00E+00 | 5 70E-02 | 1 14E-01 |
| U-232 | 2.0499E-03 | 76 23 | 152 45 | 0 00E+00 | 1 56E-01 | 3 13E-01 |
| U-233 | 2 0610E-03 | 76 23 | 152 45 | 0 00E+00 | 1 57E-01 | 3 14E-01 |
| U-234 | 2.7293E-04 | 76 23 | 152 45 | 0 00E+00 | 2.08E-02 | 4 16E-02 |
| U-235 | -1 7343E-06 | 76 23 | 0 00 | 4 28E-04 | 2 95E-04 | 4.28E-04 |
| U-236 | 8 6281E-06 | 76 23 | 152 45 | 0 00E+00 | 6 58E-04 | 1 32E-03 |
| U-238 | -5 6065E-09 | 76 23 | 0 00 | 4 25E-06 | 3 83E-06 | 4 25E-06 |
| Y-90 | 2 2964E+00 | 76 23 | 152 45 | 0 00E+00 | 1 75E+02 | 3 50E+02 |
| Other Radionuclides | | | | | 1 74E+02 | 3 48E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 962E+13 |
| 0.0250 | 4 081E+12 |
| 0 0375 | 3 657E+12 |
| 0 0575 | 3 794E+12 |
| 0 0850 | 2 327E+12 |
| 0 1250 | 1 765E+12 |
| 0.2250 | 2 004E+12 |
| 0 3750 | 8 817E+11 |
| 0 5750 | 1 477E+13 |
| 0 8500 | 1 301E+12 |
| 1.2500 | 5 885E+11 |
| 1 7500 | 1 445E+10 |
| 2.2500 | 7 140E+07 |
| 2 7500 | 4 001E+09 |
| 3 5000 | 2 009E+05 |
| 5 0000 | 1 605E+04 |
| 7 0000 | 1 848E+03 |
| 11 0000 | 2 121E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 90E+00 | 5 79E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 92 189 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 76.23 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 152 45 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 35 | |
| Bounding | 0 71 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | GA RERTR | [1]Fuel decay start date | 2035 |
| SNF ID # | 90 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - CANISTER OF SCRAP | Template | TRIGA-SS (LW/U Zrx SST 10 to 20%, U) |
| Heavy Metal Mass | BOL=3 851kg EOL=3 071kg | [2]Template Burnup(MWd) | 6 65 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000195 |
| | | Template Decay Time | 5 years |

| Estimated Canister usage HIC |
|---|
| 0 50 |

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 744 21 | 1,488 42 | 0 00E+00 | 6 34E-07 | 1.27E-06 |
| Am-241 | 1 8331E-03 | 744 21 | 1,488 42 | 0 00E+00 | 1.36E+00 | 2.73E+00 |
| Am-242m | 1 4129E-06 | 744.21 | 1,488 42 | 0 00E+00 | 1 05E-03 | 2 10E-03 |
| Am-243 | 1 4774E-07 | 744.21 | 1,488 42 | 0 00E+00 | 1 10E-04 | 2 20E-04 |
| C-14 | 1 2871E-04 | 744 21 | 1,488 42 | 0 00E+00 | 9 58E-02 | 1 92E-01 |
| Cl-36 | 2 8120E-06 | 744 21 | 1,488 42 | 0 00E+00 | 2 09E-03 | 4 19E-03 |
| Cm-243 | 1 7940E-07 | 744 21 | 1,488 42 | 0 00E+00 | 1 34E-04 | 2 67E-04 |
| Cm-244 | 1 6962E-06 | 744 21 | 1,488 42 | 0 00E+00 | 1 26E-03 | 2 52E-03 |
| Co-60 | 1 2839E+00 | 744 21 | 1,488 42 | 0 00E+00 | 9 56E+02 | 1 91E+03 |
| Cs-134 | 9 0541E-02 | 744 21 | 1,488 42 | 0 00E+00 | 6 74E+01 | 1 35E+02 |
| Cs-135 | 3 2195E-05 | 744 21 | 1,488 42 | 0 00E+00 | 2 40E-02 | 4 79E-02 |
| Cs-137 | 2 7564E+00 | 744 21 | 1,488 42 | 0 00E+00 | 2 05E+03 | 4 10E+03 |
| Eu-154 | 1 5368E-02 | 744 21 | 1,488 42 | 0 00E+00 | 1 14E+01 | 2 29E+01 |
| Eu-155 | 2 9293E-02 | 744 21 | 1,488 42 | 0 00E+00 | 2 18E+01 | 4 36E+01 |
| Fe-55 | 7.7158E-01 | 744 21 | 1,488 42 | 0 00E+00 | 5 74E+02 | 1 15E+03 |
| H-3 | 1.1111E-02 | 744 21 | 1,488 42 | 0 00E+00 | 8 27E+00 | 1 65E+01 |
| I-129 | 7.3684E-07 | 744 21 | 1,488 42 | 0 00E+00 | 5 48E-04 | 1 10E-03 |
| Kr-85 | 2.5263E-01 | 744 21 | 1,488 42 | 0 00E+00 | 1 88E+02 | 3 76E+02 |
| Np-237 | 1.2427E-06 | 744 21 | 1,488 42 | 0 00E+00 | 9 25E-04 | 1 85E-03 |
| Pa-231 | 3 8511E-09 | 744.21 | 1,488 42 | 0 00E+00 | 2 87E-06 | 5 73E-06 |
| Pb-210 | 7 3880E-15 | 744 21 | 1,488 42 | 0 00E+00 | 5 50E-12 | 1.10E-11 |
| Pm-147 | 2 1023E+00 | 744 21 | 1,488 42 | 0 00E+00 | 1 56E+03 | 3 13E+03 |
| Pu-238 | 1 0383E-03 | 744 21 | 1,488 42 | 0 00E+00 | 7.73E-01 | 1 55E+00 |
| Pu-239 | 5 5293E-03 | 744 21 | 1,488 42 | 0 00E+00 | 4 11E+00 | 8 23E+00 |
| Pu-240 | 2 1278E-03 | 744.21 | 1,488 42 | 0.00E+00 | 1 58E+00 | 3 17E+00 |
| Pu-241 | 1 0195E-01 | 744.21 | 1,488 42 | 0.00E+00 | 7 59E+01 | 1 52E+02 |
| Pu-242 | 2 3128E-07 | 744.21 | 1,488 42 | 0 00E+00 | 1.72E-04 | 3 44E-04 |
| Ra-226 | 5 2782E-14 | 744.21 | 1,488 42 | 0 00E+00 | 3 93E-11 | 7.86E-11 |
| Ra-228 | 1 9338E-10 | 744.21 | 1,488 42 | 0 00E+00 | 1 44E-07 | 2 88E-07 |
| Ru-106 | 9 1684E-02 | 744 21 | 1,488 42 | 0 00E+00 | 6 82E+01 | 1.36E+02 |
| Se-79 | 1 3018E-05 | 744 21 | 1,488 42 | 0 00E+00 | 9 69E-03 | 1 94E-02 |
| Sn-126 | 1 2167E-05 | 744 21 | 1,488 42 | 0 00E+00 | 9 05E-03 | 1 81E-02 |
| Sr-90 | 2 6045E+00 | 744 21 | 1,488 42 | 0 00E+00 | 1.94E+03 | 3 88E+03 |
| Tc-99 | 4 4241E-04 | 744 21 | 1,488 42 | 0 00E+00 | 3.29E-01 | 6 58E-01 |
| Th-229 | 1 3713E-10 | 744 21 | 1,488 42 | 0 00E+00 | 1 02E-07 | 2 04E-07 |
| Th-230 | 1 8090E-11 | 744 21 | 1,488 42 | 0 00E+00 | 1 35E-08 | 2 69E-08 |
| Th-232 | 2 5278E-10 | 744 21 | 1,488 42 | 0 00E+00 | 1 88E-07 | 3 76E-07 |
| Tl-208 | 1 6947E-08 | 744 21 | 1,488 42 | 0 00E+00 | 1 26E-05 | 2 52E-05 |
| U-232 | 4 8737E-08 | 744 21 | 1,488 42 | 0 00E+00 | 3 63E-05 | 7.25E-05 |
| U-233 | 1.2203E-07 | 744 21 | 1,488 42 | 0 00E+00 | 9 08E-05 | 1 82E-04 |
| U-234 | 1.5925E-07 | 744.21 | 1 488 42 | 0 00E+00 | 1 19E-04 | 2 37E-04 |
| U-235 | -2 6194E-06 | 744.21 | 0 00 | 1 65E-03 | 0 00E+00 | 1 65E-03 |
| U-236 | 1.2693E-05 | 744 21 | 1,488 42 | 0 00E+00 | 9 45E-03 | 1 89E-02 |
| U-238 | -3 6331E-08 | 744.21 | 0 00 | 1 04E-03 | 1 01E-03 | 1 04E-03 |
| Y-90 | 2.6060E+00 | 744.21 | 1,488 42 | 0 00E+00 | 1 94E+03 | 3 88E+03 |
| Other Radionuclides | | | | | 2 68E+03 | 5 37E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 406E+14 |
| 0 0250 | 5.293E+13 |
| 0 0375 | 4 508E+13 |
| 0 0575 | 4 627E+13 |
| 0 0850 | 2 867E+13 |
| 0 1250 | 2 082E+13 |
| 0.2250 | 2 432E+13 |
| 0 3750 | 1.234E+13 |
| 0 5750 | 1 641E+14 |
| 0 8500 | 7 041E+12 |
| 1.2500 | 1 430E+14 |
| 1 7500 | 9 531E+10 |
| 2.2500 | 1 536E+11 |
| 2 7500 | 1 219E+09 |
| 3.5000 | 1 419E+08 |
| 5 0000 | 7 824E+02 |
| 7 0000 | 8 856E+01 |
| 11 0000 | 1 009E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.33E+01 | 8 66E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | INCOLOY | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 787 | 10 to 20 1 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches on all parameters except cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 744 21 |
| Bounding | | 1 488 42 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5 67 | |
| Bounding | 11 33 | |

Estimated EOL HM/Given EOL HM: 1 05

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name GCRE CAN (1B-8T 1&2)
SNF ID # 94
Fuel Units & Descr 1 - CANISTER OF SCRAP
Heavy Metal Mass BOL=0 908kg EOL=0 908kg
ROD Storage Site INEEL

[1]Fuel decay start date 1961
Estimates as of 2010
Template. Pathfinder (Light Water, SST 60 to 100% U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT) 0 00012882
Template Decay Time 35 years

Estimated Canister usage: 18"x10' 0 08

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 17.15 | 34 31 | 0 00E+00 | 4 00E-07 | 8 01E-07 |
| Am-241 | 1 1135E-04 | 17.15 | 34 31 | 0 00E+00 | 1 91E-03 | 3 82E-03 |
| Am-242m | 8 5075E-09 | 17.15 | 34 31 | 0 00E+00 | 1 46E-07 | 2 92E-07 |
| Am-243 | 9 8519E-10 | 17 15 | 34 31 | 0 00E+00 | 1 69E-08 | 3 38E-08 |
| C-14 | 2 3012E-04 | 17.15 | 34 31 | 0 00E+00 | 3 95E-03 | 7 90E-03 |
| Cl-36 | 1 2261E-06 | 17.15 | 34 31 | 0 00E+00 | 2 10E-05 | 4 21E-05 |
| Cm-243 | 2 4875E-10 | 17 15 | 34 31 | 0 00E+00 | 4 27E-09 | 8 53E-09 |
| Cm-244 | 2 3178E-09 | 17 15 | 34 31 | 0 00E+00 | 3 98E-08 | 7 95E-08 |
| Co-60 | 7 0849E-02 | 17 15 | 34 31 | 0 00E+00 | 1 22E+00 | 2 43E+00 |
| Cs-134 | 3 0266E-06 | 17 15 | 34 31 | 0 00E+00 | 5 19E-05 | 1 04E-04 |
| Cs-135 | 3 0316E-05 | 17 15 | 34 31 | 0 00E+00 | 5 20E-04 | 1 04E-03 |
| Cs-137 | 1 4511E+00 | 17 15 | 34 31 | 0 00E+00 | 2 49E+01 | 4 98E+01 |
| Eu-154 | 6 6955E-04 | 17 15 | 34 31 | 0 00E+00 | 1 15E-02 | 2 30E-02 |
| Eu-155 | 6 9850E-04 | 17 15 | 34 31 | 0 00E+00 | 1 20E-02 | 2 40E-02 |
| Fe-55 | 1 2318E-03 | 17 15 | 34 31 | 0 00E+00 | 2.11E-02 | 4 23E-02 |
| H-3 | 2 5141E-03 | 17 15 | 34 31 | 0 00E+00 | 4 31E-02 | 8 63E-02 |
| I-129 | 7 3195E-07 | 17 15 | 34 31 | 0 00E+00 | 1 26E-05 | 2 51E-05 |
| Kr-85 | 4 1281E-02 | 17 15 | 34 31 | 0 00E+00 | 7 08E-01 | 1 42E+00 |
| Np-237 | 1 1489E-06 | 17 15 | 34 31 | 0 00E+00 | 1 97E-05 | 3 94E-05 |
| Pa-231 | 4 5241E-08 | 17 15 | 34.31 | 0 00E+00 | 7 76E-07 | 1 55E-06 |
| Pb-210 | 6 4476E-13 | 17 15 | 34 31 | 0 00E+00 | 1 11E-11 | 2 21E-11 |
| Pm-147 | 1 1651E-03 | 17 15 | 34.31 | 0 00E+00 | 2 00E-02 | 4 00E-02 |
| Pu-238 | 2 9517E-04 | 17 15 | 34 31 | 0 00E+00 | 5 06E-03 | 1 01E-02 |
| Pu-239 | 6 6772E-04 | 17 15 | 34.31 | 0 00E+00 | 1 15E-02 | 2 29E-02 |
| Pu-240 | 8 6839E-05 | 17 15 | 34.31 | 0 00E+00 | 1 49E-03 | 2 98E-03 |
| Pu-241 | 7 1514E-04 | 17 15 | 34.31 | 0 00E+00 | 1 23E-02 | 2 45E-02 |
| Pu-242 | 1 9717E-09 | 17 15 | 34.31 | 0 00E+00 | 3 38E-08 | 6 76E-08 |
| Ra-226 | 1 7654E-12 | 17 15 | 34.31 | 0 00E+00 | 3 03E-11 | 6 06E-11 |
| Ra-228 | 8 2928E-12 | 17 15 | 34.31 | 0 00E+00 | 1 42E-10 | 2 85E-10 |
| Ru-106 | 1 8419E-10 | 17 15 | 34.31 | 0 00E+00 | 3 16E-09 | 6 32E-09 |
| Se-79 | 1 3223E-05 | 17 15 | 34.31 | 0 00E+00 | 2 27E-04 | 4 54E-04 |
| Sn-126 | 1 1493E-05 | 17 15 | 34.31 | 0 00E+00 | 1 97E-04 | 3 94E-04 |
| Sr-90 | 1 3649E+00 | 17 15 | 34.31 | 0 00E+00 | 2 34E+01 | 4 68E+01 |
| Tc-99 | 4 6656E-04 | 17 15 | 34.31 | 0 00E+00 | 8 00E-03 | 1 60E-02 |
| Th-229 | 1 4547E-11 | 17 15 | 34.31 | 0 00E+00 | 2 50E-10 | 4 99E-10 |
| Th-230 | 1 6617E-10 | 17 15 | 34.31 | 0 00E+00 | 2 85E-09 | 5 70E-09 |
| Th-232 | 8 3361E-12 | 17 15 | 34.31 | 0 00E+00 | 1 43E-10 | 2 86E-10 |
| Tl-208 | 2 1664E-08 | 17 15 | 34.31 | 0 00E+00 | 3 72E-07 | 7 43E-07 |
| U-232 | 5 8669E-08 | 17 15 | 34.31 | 0 00E+00 | 1 01E-06 | 2 01E-06 |
| U-233 | 3 1847E-09 | 17 15 | 34.31 | 0 00E+00 | 5 46E-08 | 1 09E-07 |
| U-234 | 3 8769E-07 | 17 15 | 34 31 | 0 00E+00 | 6 65E-06 | 1 33E-05 |
| U-235 | -2 7761E-06 | 17 15 | 0 00 | 1 83E-03 | 1.78E-03 | 1 83E-03 |
| U-236 | 1 6190E-05 | 17 15 | 34 31 | 0 00E+00 | 2.78E-04 | 5 55E-04 |
| U-238 | -2 8547E-09 | 17 15 | 0 00 | 2 05E-05 | 2 05E-05 | 2 05E-05 |
| Y-90 | 1 3652E+00 | 17 15 | 34 31 | 0 00E+00 | 2 34E+01 | 4 68E+01 |
| Other Radionuclides | | | | | 2 83E+01 | 5 66E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.561E+12 |
| 0 0250 | 5 322E+11 |
| 0 0375 | 4 603E+11 |
| 0 0575 | 4 961E+11 |
| 0 0850 | 2 998E+11 |
| 0 1250 | 1 946E+11 |
| 0.2250 | 2.581E+11 |
| 0 3750 | 1 126E+11 |
| 0.5750 | 1 854E+12 |
| 0.8500 | 1.877E+10 |
| 1.2500 | 1 865E+11 |
| 1 7500 | 4.841E+08 |
| 2.2500 | 1 005E+06 |
| 2 7500 | 2 905E+04 |
| 3 5000 | 2.206E+00 |
| 5 0000 | 9 088E-01 |
| 7 0000 | 1 005E-01 |
| 11 0000 | 1 129E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 00E-01 | 5 99E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 282 | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 17 15 |
| Bounding | | 34 31 |

**Basis for burnup used in estimate.**
Nominal burnup assumed to be 2% of BOL heavy metal mass.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 40 | |
| Bounding | 0 81 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name: GCRE PELLETS (1B 7T-1) | [1]Fuel decay start date | 1961 | Estimated Canister usage |
| SNF ID #: 95 | Estimates as of | 2010 | 18"x10' |
| Fuel Units & Descr: 1 - CANISTER OF SCRAP | Template | Pathfinder (Light Water SST 60 to 100% U) | 0 08 |
| Heavy Metal Mass: BOL=0 074kg EOL=0 074kg | [2]Template Burnup(MWd) | 6 01 | |
| ROD Storage Site: INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 | |
| | Template Decay Time | 35 years | |

### II. Estimates

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 2 3344E-08 | 1 40 | 2 79 | 0 00E+00 | 3 26E-08 | 6 52E-08 |
| Am-241 | 1 1135E-04 | 1 40 | 2 79 | 0 00E+00 | 1 55E-04 | 3 11E-04 |
| Am-242m | 8 5075E-09 | 1 40 | 2 79 | 0 00E+00 | 1 19E-08 | 2 38E-08 |
| Am-243 | 9 8519E-10 | 1 40 | 2 79 | 0 00E+00 | 1 38E-09 | 2 75E-09 |
| C-14 | 2 3012E-04 | 1 40 | 2 79 | 0 00E+00 | 3 21E-04 | 6 43E-04 |
| Cl-36 | 1 2261E-06 | 1 40 | 2 79 | 0 00E+00 | 1 71E-06 | 3 42E-06 |
| Cm-243 | 2 4875E-10 | 1 40 | 2 79 | 0 00E+00 | 3 47E-10 | 6 95E-10 |
| Cm-244 | 2 3178E-09 | 1 40 | 2 79 | 0 00E+00 | 3 24E-09 | 6 47E-09 |
| Co-60 | 7 0849E-02 | 1 40 | 2 79 | 0 00E+00 | 9 89E-02 | 1 98E-01 |
| Cs-134 | 3 0266E-06 | 1 40 | 2 79 | 0 00E+00 | 4 23E-06 | 8 45E-06 |
| Cs-135 | 3 0316E-05 | 1 40 | 2 79 | 0 00E+00 | 4 23E-05 | 8 47E-05 |
| Cs-137 | 1 4511E+00 | 1 40 | 2 79 | 0 00E+00 | 2 03E+00 | 4 05E+00 |
| Eu-154 | 6 6955E-04 | 1 40 | 2 79 | 0 00E+00 | 9 35E-04 | 1 87E-03 |
| Eu-155 | 6 9850E-04 | 1 40 | 2 79 | 0 00E+00 | 9 75E-04 | 1 95E-03 |
| Fe-55 | 1 2318E-03 | 1 40 | 2 79 | 0 00E+00 | 1 72E-03 | 3 44E-03 |
| H-3 | 2 5141E-03 | 1 40 | 2 79 | 0 00E+00 | 3 51E-03 | 7 02E-03 |
| I-129 | 7 3195E-07 | 1 40 | 2 79 | 0 00E+00 | 1 02E-06 | 2 04E-06 |
| Kr-85 | 4 1281E-02 | 1 40 | 2 79 | 0 00E+00 | 5 76E-02 | 1 15E-01 |
| Np-237 | 1 1489E-06 | 1 40 | 2 79 | 0 00E+00 | 1 60E-06 | 3 21E-06 |
| Pa-231 | 4 5241E-08 | 1 40 | 2 79 | 0 00E+00 | 6 32E-08 | 1 26E-07 |
| Pb-210 | 6 4476E-13 | 1 40 | 2 79 | 0 00E+00 | 9 00E-13 | 1 80E-12 |
| Pm-147 | 1 1651E-03 | 1 40 | 2 79 | 0 00E+00 | 1 63E-03 | 3 25E-03 |
| Pu-238 | 2 9517E-04 | 1 40 | 2 79 | 0 00E+00 | 4 12E-04 | 8 24E-04 |
| Pu-239 | 6 6772E-04 | 1 40 | 2 79 | 0 00E+00 | 9 32E-04 | 1 86E-03 |
| Pu-240 | 8 6839E-05 | 1 40 | 2 79 | 0 00E+00 | 1 21E-04 | 2 42E-04 |
| Pu-241 | 7 1514E-04 | 1 40 | 2 79 | 0 00E+00 | 9 98E-04 | 2 00E-03 |
| Pu-242 | 1 9717E-09 | 1 40 | 2 79 | 0 00E+00 | 2 75E-09 | 5 51E-09 |
| Ra-226 | 1 7654E-12 | 1 40 | 2 79 | 0 00E+00 | 2 46E-12 | 4 93E-12 |
| Ra-228 | 8 2928E-12 | 1 40 | 2 79 | 0 00E+00 | 1 16E-11 | 2 32E-11 |
| Ru-106 | 1 8419E-10 | 1 40 | 2 79 | 0 00E+00 | 2 57E-10 | 5 14E-10 |
| Se-79 | 1 3223E-05 | 1 40 | 2 79 | 0 00E+00 | 1 85E-05 | 3 69E-05 |
| Sn-126 | 1 1493E-05 | 1 40 | 2 79 | 0 00E+00 | 1 60E-05 | 3 21E-05 |
| Sr-90 | 1 3649E+00 | 1 40 | 2 79 | 0 00E+00 | 1.91E+00 | 3 81E+00 |
| Tc-99 | 4 6656E-04 | 1 40 | 2 79 | 0 00E+00 | 6 51E-04 | 1 30E-03 |
| Th-229 | 1 4547E-11 | 1 40 | 2 79 | 0 00E+00 | 2 03E-11 | 4 06E-11 |
| Th-230 | 1 6617E-10 | 1 40 | 2 79 | 0 00E+00 | 2 32E-10 | 4 64E-10 |
| Th-232 | 8 3361E-12 | 1 40 | 2 79 | 0 00E+00 | 1 16E-11 | 2 33E-11 |
| Tl-208 | 2 1664E-08 | 1 40 | 2 79 | 0 00E+00 | 3 02E-08 | 6 05E-08 |
| U-232 | 5 8669E-08 | 1 40 | 2 79 | 0 00E+00 | 8 19E-08 | 1 64E-07 |
| U-233 | 3 1847E-09 | 1 40 | 2 79 | 0 00E+00 | 4 45E-09 | 8 89E-09 |
| U-234 | 3 8769E-07 | 1 40 | 2 79 | 0 00E+00 | 5 41E-07 | 1 08E-06 |
| U-235 | -2 7761E-06 | 1 40 | 0 00 | 1 49E-04 | 1 45E-04 | 1 49E-04 |
| U-236 | 1 6190E-05 | 1 40 | 2 79 | 0 00E+00 | 2 26E-05 | 4 52E-05 |
| U-238 | -2 8547E-09 | 1 40 | 0 00 | 1 71E-06 | 1 71E-06 | 1 71E-06 |
| Y-90 | 1 3652E+00 | 1 40 | 2 79 | 0 00E+00 | 1.91E+00 | 3 81E+00 |
| Other Radionuclides | | | | | 2.30E+00 | 4 61E+00 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 084E+11 |
| 0 0250 | 4 331E+10 |
| 0 0375 | 3 746E+10 |
| 0 0575 | 4 038E+10 |
| 0 0850 | 2 440E+10 |
| 0 1250 | 1 584E+10 |
| 0 2250 | 2 100E+10 |
| 0 3750 | 9 160E+09 |
| 0 5750 | 1 509E+11 |
| 0 8500 | 1.527E+09 |
| 1 2500 | 1 518E+10 |
| 1 7500 | 3 940E+07 |
| 2 2500 | 8 180E+04 |
| 2 7500 | 2 364E+03 |
| 3 5000 | 1 798E-01 |
| 5 0000 | 7 406E-02 |
| 7 0000 | 8 190E-03 |
| 11 0000 | 9 199E-04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 44E-02 | 4.88E-02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 1 | 60 to 100 |

**Basis for Parameter Differences**

This Template was used for the following reasons

This fuel matches on all parameters except cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1 40 |
| Bounding | | 2 79 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 40 | |
| Bounding | 0 81 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown core removal storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: GETR FILTERS
SNF ID #: 98
Fuel Units & Descr: 70 - FILTERS
Heavy Metal Mass BOL=4 543kg EOL=4 417kg
ROD Storage Site INEEL

[1]Fuel decay start date 1977
Estimates as of 2010
Template Pathfinder (Light Water, SST 60 to 100% U)
[2]Template Burnup(MWd) 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time 25 years

Estimated Canister usage
HIC
1 56

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3562E-08 | 119 03 | 238 05 | 0 00E+00 | 1 61E-06 | 3 23E-06 |
| Am-241 | 1 0168E-04 | 119 03 | 238 05 | 0 00E+00 | 1 21E-02 | 2 42E-02 |
| Am-242m | 8 9052E-09 | 119 03 | 238 05 | 0 00E+00 | 1 06E-06 | 2 12E-06 |
| Am-243 | 9 8602E-10 | 119 03 | 238 05 | 0 00E+00 | 1 17E-07 | 2 35E-07 |
| C-14 | 2 3045E-04 | 119 03 | 238 05 | 0 00E+00 | 2 74E-02 | 5 49E-02 |
| Cl-36 | 1.2261E-06 | 119 03 | 238 05 | 0 00E+00 | 1 46E-04 | 2 92E-04 |
| Cm-243 | 3 1730E-10 | 119 03 | 238 05 | 0 00E+00 | 3 78E-08 | 7 55E-08 |
| Cm-244 | 3 3977E-09 | 119 03 | 238 05 | 0 00E+00 | 4 04E-07 | 8 09E-07 |
| Co-60 | 2 6373E-01 | 119 03 | 238 05 | 0 00E+00 | 3 14E+01 | 6 28E+01 |
| Cs-134 | 8 7072E-05 | 119 03 | 238 05 | 0 00E+00 | 1 04E-02 | 2 07E-02 |
| Cs-135 | 3 0316E-05 | 119 03 | 238 05 | 0 00E+00 | 3 61E-03 | 7 22E-03 |
| Cs-137 | 1 8286E+00 | 119 03 | 238 05 | 0 00E+00 | 2 18E+02 | 4 35E+02 |
| Eu-154 | 1 4982E-03 | 119 03 | 238 05 | 0 00E+00 | 1 78E-01 | 3 57E-01 |
| Eu-155 | 2 8236E-03 | 119 03 | 238 05 | 0 00E+00 | 3 36E-01 | 6 72E-01 |
| Fe-55 | 1 7687E-02 | 119 03 | 238 05 | 0 00E+00 | 2.11E+00 | 4 21E+00 |
| H-3 | 4 4043E-03 | 119 03 | 238 05 | 0 00E+00 | 5 24E-01 | 1 05E+00 |
| I-129 | 7 3195E-07 | 119 03 | 238 05 | 0 00E+00 | 8 71E-05 | 1 74E-04 |
| Kr-85 | 7 8769E-02 | 119 03 | 238 05 | 0 00E+00 | 9 38E+00 | 1 88E+01 |
| Np-237 | 1 1484E-06 | 119 03 | 238 05 | 0 00E+00 | 1 37E-04 | 2.73E-04 |
| Pa-231 | 3 2396E-08 | 119 03 | 238 05 | 0 00E+00 | 3 86E-06 | 7.71E-06 |
| Pb-210 | 2 4409E-13 | 119 03 | 238 05 | 0 00E+00 | 2 91E-11 | 5 81E-11 |
| Pm-147 | 1 6331E-02 | 119 03 | 238 05 | 0 00E+00 | 1 94E+00 | 3 89E+00 |
| Pu-238 | 3 1947E-04 | 119 03 | 238 05 | 0 00E+00 | 3 80E-02 | 7 60E-02 |
| Pu-239 | 6 6789E-04 | 119 03 | 238 05 | 0 00E+00 | 7 95E-02 | 1.59E-01 |
| Pu-240 | 8 6922E-05 | 119 03 | 238 05 | 0 00E+00 | 1 03E-02 | 2 07E-02 |
| Pu-241 | 1 1567E-03 | 119 03 | 238 05 | 0 00E+00 | 1 38E-01 | 2 75E-01 |
| Pu-242 | 1 9717E-09 | 119 03 | 238 05 | 0 00E+00 | 2 35E-07 | 4 69E-07 |
| Ra-226 | 8 6190E-13 | 119 03 | 238 05 | 0 00E+00 | 1 03E-10 | 2 05E-10 |
| Ra-228 | 8 1498E-12 | 119 03 | 238 05 | 0 00E+00 | 9 70E-10 | 1.94E-09 |
| Ru-106 | 1 7770E-07 | 119 03 | 238 05 | 0 00E+00 | 2 12E-05 | 4.23E-05 |
| Se-79 | 1 3225E-05 | 119 03 | 238 05 | 0 00E+00 | 1 57E-03 | 3.15E-03 |
| Sn-126 | 1 1493E-05 | 119 03 | 238 05 | 0 00E+00 | 1 37E-03 | 2 74E-03 |
| Sr-90 | 1 7321E+00 | 119 03 | 238 05 | 0 00E+00 | 2 06E+02 | 4.12E+02 |
| Tc-99 | 4 6656E-04 | 119.03 | 238 05 | 0 00E+00 | 5 55E-02 | 1.11E-01 |
| Th-229 | 1 0110E-11 | 119 03 | 238 05 | 0 00E+00 | 1 20E-09 | 2 41E-09 |
| Th-230 | 1 1466E-10 | 119 03 | 238 05 | 0 00E+00 | 1 36E-08 | 2 73E-08 |
| Th-232 | 8 3245E-12 | 119 03 | 238 05 | 0 00E+00 | 9 91E-10 | 1 98E-09 |
| Tl-208 | 2 3860E-08 | 119 03 | 238 05 | 0 00E+00 | 2 84E-06 | 5 68E-06 |
| U-232 | 6 4576E-08 | 119 03 | 238 05 | 0 00E+00 | 7 69E-06 | 1 54E-05 |
| U-233 | 3 1082E-09 | 119 03 | 238 05 | 0 00E+00 | 3 70E-07 | 7 40E-07 |
| U-234 | 3 7587E-07 | 119 03 | 238 05 | 0 00E+00 | 4 47E-05 | 8 95E-05 |
| U-235 | -2.7761E-06 | 119 03 | 0 00 | 9 14E-03 | 8 81E-03 | 9 14E-03 |
| U-236 | 1 6190E-05 | 119 03 | 238 05 | 0 00E+00 | 1 93E-03 | 3 85E-03 |
| U-238 | -2 8547E-09 | 119 03 | 0 00 | 1 05E-04 | 1 04E-04 | 1 05E-04 |
| Y-90 | 1 7321E+00 | 119 03 | 238 05 | 0 00E+00 | 2 06E+02 | 4 12E+02 |
| Other Radionuclides | | | | | 2 42E+02 | 4 83E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.265E+13 |
| 0 0250 | 4 706E+12 |
| 0 0375 | 4 062E+12 |
| 0 0575 | 4 382E+12 |
| 0 0850 | 2 650E+12 |
| 0 1250 | 1 722E+12 |
| 0.2250 | 2.274E+12 |
| 0.3750 | 9 927E+11 |
| 0 5750 | 1 621E+13 |
| 0 8500 | 1 690E+11 |
| 1.2500 | 4 708E+12 |
| 1 7500 | 4 354E+09 |
| 2.2500 | 2.508E+07 |
| 2 7500 | 2 760E+05 |
| 3.5000 | 5 907E+01 |
| 5 0000 | 6.232E+00 |
| 7 0000 | 6 887E-01 |
| 11 0000 | 7 733E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.95E+00 | 5 91E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 14635987 | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except cladding (SST is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 119 03 |
| Bounding | | 238 05 |

**Basis for burnup used in estimate:**
Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 56 | |
| Bounding | 1 12 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

# Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name H B ROBINSON (ASSEMBLY)
SNF ID # 383
Fuel Units & Descr: 1 - ASSEMBLY
Heavy Metal Mass: BOL=236.248kg EOL=229 168kg
ROD Storage Site INEEL

[1]Fuel decay start date 1974
Estimates as of 2010
Template PWR (Light Water, Zirc 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 35 years

Estimated Canister usage
18"x15'
1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 6,732 94 | 13,465 87 | 0 00E+00 | 5 91E-06 | 1 18E-05 |
| Am-241 | 1 4352E-01 | 6,732 94 | 13,465 87 | 0 00E+00 | 9 66E+02 | 1 93E+03 |
| Am-242m | 2 8698E-04 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 93E+00 | 3 86E+00 |
| Am-243 | 6 2565E-04 | 6,732 94 | 13,465 87 | 0 00E+00 | 4 21E+00 | 8 42E+00 |
| C-14 | 4 7901E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 3 23E-01 | 6 45E-01 |
| Cl-36 | 8 0297E-07 | 6 732 94 | 13,465 87 | 0 00E+00 | 5 41E-03 | 1 08E-02 |
| Cm-243 | 2 5081E-04 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 69E+00 | 3 38E+00 |
| Cm-244 | 4 9015E-02 | 6,732 94 | 13,465 87 | 0 00E+00 | 3 30E+02 | 6 60E+02 |
| Co-60 | 2 5581E-03 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 72E+01 | 3 44E+01 |
| Cs-134 | 4 0536E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 2.73E-01 | 5 46E-01 |
| Cs-135 | 1 4433E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 9 72E-02 | 1.94E-01 |
| Cs-137 | 1 3979E+00 | 6,732.94 | 13,465 87 | 0 00E+00 | 9 41E+03 | 1.88E+04 |
| Eu-154 | 2 0203E-02 | 6,732 94 | 13,465 87 | 0 00E+00 | 1.36E+02 | 2.72E+02 |
| Eu-155 | 1 7684E-03 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 19E+01 | 2.38E+01 |
| Fe-55 | 4 3136E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 2 90E-01 | 5 81E-01 |
| H-3 | 2 0769E-02 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 40E+02 | 2 80E+02 |
| I-129 | 9 8288E-07 | 6 732 94 | 13,465 87 | 0 00E+00 | 6 62E-03 | 1 32E-02 |
| Kr-85 | 2 8214E-02 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 90E+02 | 3 80E+02 |
| Np-237 | 1.1218E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 7 55E-02 | 1 51E-01 |
| Pa-231 | 1.3036E-09 | 6,732 94 | 13,465 87 | 0 00E+00 | 8 78E-06 | 1 76E-05 |
| Pb-210 | 8.5078E-11 | 6,732 94 | 13,465 87 | 0 00E+00 | 5 73E-07 | 1 15E-06 |
| Pm-147 | 3 6531E-04 | 6,732 94 | 13 465 87 | 0 00E+00 | 2 46E+00 | 4 92E+00 |
| Pu-238 | 7 4564E-02 | 6,732 94 | 13,465 87 | 0 00E+00 | 5 02E+02 | 1 00E+03 |
| Pu-239 | 1 1623E-02 | 6,732.94 | 13,465 87 | 0 00E+00 | 7 83E+01 | 1.57E+02 |
| Pu-240 | 1 5132E-02 | 6,732.94 | 13,465 87 | 0 00E+00 | 1 02E+02 | 2 04E+02 |
| Pu-241 | 9 0036E-01 | 6,732 94 | 13,465 87 | 0 00E+00 | 6 06E+03 | 1.21E+04 |
| Pu-242 | 6 4260E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 4 33E-01 | 8 65E-01 |
| Ra-226 | 2 2804E-10 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 54E-06 | 3 07E-06 |
| Ra-228 | 5 2713E-12 | 6,732 94 | 13,465 87 | 0 00E+00 | 3 55E-08 | 7 10E-08 |
| Ru-106 | 6 1160E-10 | 6,732 94 | 13,465 87 | 0 00E+00 | 4 12E-06 | 8 24E-06 |
| Se-79 | 1.2377E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 8 33E-02 | 1 67E-01 |
| Sn-126 | 2.5210E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 70E-01 | 3 39E-01 |
| Sr-90 | 9 1667E-01 | 6,732 94 | 13,465 87 | 0 00E+00 | 6 17E+03 | 1 23E+04 |
| Tc-99 | 3 9357E-04 | 6,732 94 | 13,465 87 | 0 00E+00 | 2 65E+00 | 5 30E+00 |
| Th-229 | 1.2057E-10 | 6,732 94 | 13,465 87 | 0 00E+00 | 8 12E-07 | 1.62E-06 |
| Th-230 | 2 1043E-08 | 6,732 94 | 13,465 87 | 0 00E+00 | 1.42E-04 | 2.83E-04 |
| Th-232 | 5.2972E-12 | 6,732.94 | 13,465 87 | 0 00E+00 | 3 57E-08 | 7.13E-08 |
| Tl-208 | 1 7474E-07 | 6,732 94 | 13,465 87 | 0 00E+00 | 1.18E-03 | 2.35E-03 |
| U-232 | 4 7368E-07 | 6,732 94 | 13,465 87 | 0 00E+00 | 3 19E-03 | 6 38E-03 |
| U-233 | 2 5097E-08 | 6,732 94 | 13,465 87 | 0 00E+00 | 1 69E-04 | 3 38E-04 |
| U-234 | 5 0000E-05 | 6,732 94 | 13,465 87 | 0 00E+00 | 3 37E-01 | 6 73E-01 |
| U-235 | -1 4489E-06 | 6 732 94 | 0 00 | 1 48E-02 | 5 05E-03 | 1 48E-02 |
| U-236 | 7 5824E-06 | 6,732 94 | 13,465 87 | 0 00E+00 | 5 11E-02 | 1 02E-01 |
| U-238 | -2 6129E-07 | 6,732 94 | 0 00 | 7 71E-02 | 7 53E-02 | 7 71E-02 |
| Y-90 | 9 1699E-01 | 6,732 94 | 13,465 87 | 0 00E+00 | 6 17E+03 | 1 23E+04 |
| Other Radionuclides | | | | | 9 04E+03 | 1 81E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.245E+14 |
| 0 0250 | 1 461E+14 |
| 0 0375 | 1.393E+14 |
| 0 0575 | 1 610E+14 |
| 0 0850 | 8 107E+13 |
| 0 1250 | 5 626E+13 |
| 0.2250 | 6 952E+13 |
| 0.3750 | 2 989E+13 |
| 0 5750 | 6 953E+14 |
| 0 8500 | 9 619E+12 |
| 1.2500 | 9 448E+12 |
| 1 7500 | 2 829E+11 |
| 2.2500 | 4 556E+07 |
| 2 7500 | 9 334E+07 |
| 3 5000 | 9 611E+06 |
| 5 0000 | 4 109E+06 |
| 7 0000 | 4 736E+05 |
| 11 0000 | 5 440E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.55E+02 | 3 10E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2.900129144 | 0 to 5 |

Basis for Parameter Differences

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 6 617 31 | 6 732.94 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 13 465.87 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 81 | 1 02 |
| Bounding | 1 63 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. H B ROBINSON RODS
SNF ID # 864
Fuel Units & Descr 12 - CANISTER OF SCRAP
Heavy Metal Mass BOL=25 088kg EOL=20 86kg
ROD Storage Site INEEL

[1]Fuel decay start date 1974
Estimates as of: 2010
Template: PWR (Light Water Zirc, 0 to 5%, U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage.
HIC
12 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 53E-06 | 7 06E-06 |
| Am-241 | 1 4352E-01 | 4,021 39 | 8,042.78 | 0 00E+00 | 5 77E+02 | 1 15E+03 |
| Am-242m | 2 8698E-04 | 4,021 39 | 8 042 78 | 0 00E+00 | 1 15E+00 | 2 31E+00 |
| Am-243 | 6 2565E-04 | 4,021 39 | 8,042 78 | 0 00E+00 | 2 52E+00 | 5 03E+00 |
| C-14 | 4 7901E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 93E-01 | 3 85E-01 |
| Cl-36 | 8 0297E-07 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 23E-03 | 6 46E-03 |
| Cm-243 | 2 5081E-04 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 01E+00 | 2 02E+00 |
| Cm-244 | 4 9015E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 97E+02 | 3 94E+02 |
| Co-60 | 2 5581E-03 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 03E+01 | 2 06E+01 |
| Cs-134 | 4 0536E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 63E-01 | 3.26E-01 |
| Cs-135 | 1 4433E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 5 80E-02 | 1.16E-01 |
| Cs-137 | 1 3979E+00 | 4,021 39 | 8,042.78 | 0 00E+00 | 5 62E+03 | 1 12E+04 |
| Eu-154 | 2 0203E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 8 12E+01 | 1 62E+02 |
| Eu-155 | 1 7684E-03 | 4,021 39 | 8,042.78 | 0 00E+00 | 7 11E+00 | 1 42E+01 |
| Fe-55 | 4 3136E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 73E-01 | 3 47E-01 |
| H-3 | 2 0769E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 8 35E+01 | 1 67E+02 |
| I-129 | 9 8288E-07 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 95E-03 | 7 91E-03 |
| Kr-85 | 2 8214E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 13E+02 | 2 27E+02 |
| Np-237 | 1 1218E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 4 51E-02 | 9 02E-02 |
| Pa-231 | 1 3036E-09 | 4,021 39 | 8,042.78 | 0 00E+00 | 5 24E-06 | 1 05E-05 |
| Pb-210 | 8 5078E-11 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 42E-07 | 6 84E-07 |
| Pm-147 | 3 6531E-04 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 47E+00 | 2 94E+00 |
| Pu-238 | 7 4564E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 00E+02 | 6 00E+02 |
| Pu-239 | 1 1623E-02 | 4 021 39 | 8,042.78 | 0 00E+00 | 4 67E+01 | 9 35E+01 |
| Pu-240 | 1 5132E-02 | 4,021 39 | 8,042.78 | 0 00E+00 | 6 09E+01 | 1.22E+02 |
| Pu-241 | 9 0036E-01 | 4,021 39 | 8,042 78 | 0 00E+00 | 3 62E+03 | 7 24E+03 |
| Pu-242 | 6 4260E-05 | 4 021 39 | 8,042.78 | 0 00E+00 | 2 58E-01 | 5.17E-01 |
| Ra-226 | 2 2804E-10 | 4,021 39 | 8,042 78 | 0 00E+00 | 9 17E-07 | 1 83E-06 |
| Ra-228 | 5 2713E-12 | 4,021 39 | 8,042.78 | 0 00E+00 | 2 12E-08 | 4.24E-08 |
| Ru-106 | 6 1160E-10 | 4,021 39 | 8,042.78 | 0 00E+00 | 2 46E-06 | 4 92E-06 |
| Se-79 | 1 2377E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 4 98E-02 | 9 95E-02 |
| Sn-126 | 2 5210E-05 | 4,021 39 | 8,042 78 | 0 00E+00 | 1 01E-01 | 2 03E-01 |
| Sr-90 | 9 1667E-01 | 4,021 39 | 8,042 78 | 0 00E+00 | 3 69E+03 | 7 37E+03 |
| Tc-99 | 3 9357E-04 | 4 021 39 | 8,042 78 | 0 00E+00 | 1 58E+00 | 3 17E+00 |
| Th-229 | 1 2057E-10 | 4,021 39 | 8,042.78 | 0 00E+00 | 4 85E-07 | 9 70E-07 |
| Th-230 | 2 1043E-08 | 4 021 39 | 8,042 78 | 0 00E+00 | 8 46E-05 | 1 69E-04 |
| Th-232 | 5 2972E-12 | 4,021 39 | 8,042.78 | 0 00E+00 | 2 13E-08 | 4.26E-08 |
| Tl-208 | 1 7474E-07 | 4,021 39 | 8,042.78 | 0 00E+00 | 7 03E-04 | 1 41E-03 |
| U-232 | 4 7368E-07 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 90E-03 | 3 81E-03 |
| U-233 | 2 5097E-08 | 4,021 39 | 8,042.78 | 0 00E+00 | 1 01E-04 | 2 02E-04 |
| U-234 | 5 0000E-05 | 4,021 39 | 8,042.78 | 0 00E+00 | 2 01E-01 | 4 02E-01 |
| U-235 | -1.4489E-06 | 4,021 39 | 0 00 | 1 57E-03 | 0 00E+00 | 1.57E-03 |
| U-236 | 7 5824E-06 | 4,021 39 | 8,042.78 | 0 00E+00 | 3 05E-02 | 6.10E-02 |
| U-238 | -2 6129E-07 | 4,021 39 | 0 00 | 8 19E-03 | 7 14E-03 | 8.19E-03 |
| Y-90 | 9 1699E-01 | 4,021 39 | 8,042 78 | 0 00E+00 | 3 69E+03 | 7 38E+03 |
| Other Radionuclides | | | | | 5 40E+03 | 1 08E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 327E+14 |
| 0 0250 | 8 726E+13 |
| 0 0375 | 8 323E+13 |
| 0 0575 | 9 617E+13 |
| 0 0850 | 4 842E+13 |
| 0 1250 | 3 360E+13 |
| 0.2250 | 4 152E+13 |
| 0 3750 | 1 785E+13 |
| 0 5750 | 4 153E+14 |
| 0 8500 | 5 745E+12 |
| 1 2500 | 5 643E+12 |
| 1 7500 | 1 690E+11 |
| 2.2500 | 2 721E+07 |
| 2 7500 | 5 575E+07 |
| 3 5000 | 5 740E+06 |
| 5 0000 | 2 454E+06 |
| 7 0000 | 2.829E+05 |
| 11 0000 | 3.249E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.25E+01 | 1 85E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 9 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 702 48 | 4 021 39 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 8 042 78 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 4 58 | 5 72 |
| Bounding | 9 16 | |

Estimated EOL HM/Given EOL HM: 1 10

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | HFBR | [1]Fuel decay start date | 1977 |
| SNF ID # | 102 | Estimates as of | 2010 |
| Fuel Units & Descr | 220 - 18 CURVED PLATES | Template | HFBR (Heavy Water, Alum , 40 to 100% U) |
| Heavy Metal Mass | BOL=82.72kg EOL=58 102kg | [2]Template Burnup(MWd) | 164 6 |
| ROD Storage Site | SRS | Template BOL Heavy Metal Mass (MT) | 0 000377 |
| | | Template Decay Time | 25 years |

Estimated Canister usage 18"x10'
6 11

### II. Estimates

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 5 4520E-10 | 22,675.71 | 45,351 43 | 0 00E+00 | 1.24E-05 | 2 47E-05 |
| Am-241 | 9.2284E-03 | 22,675 71 | 45,351 43 | 0 00E+00 | 2 09E+02 | 4 19E+02 |
| Am-242m | 1.3390E-06 | 22,675.71 | 45,351 43 | 0 00E+00 | 3 04E-02 | 6 07E-02 |
| Am-243 | 3.7084E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 8 41E-01 | 1 68E+00 |
| C-14 | 2 6452E-08 | 22,675 71 | 45,351 43 | 0 00E+00 | 6 00E-04 | 1.20E-03 |
| Cl-36 | 4 4441E-31 | 22,675 71 | 45,351 43 | 0 00E+00 | 1 01E-26 | 2 02E-26 |
| Cm-243 | 5 0498E-06 | 22,675 71 | 45,351 43 | 0.00E+00 | 1 15E-01 | 2.29E-01 |
| Cm-244 | 3 8451E-03 | 22,675 71 | 45,351 43 | 0.00E+00 | 8 72E+01 | 1 74E+02 |
| Co-60 | 2 5225E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 5 72E-01 | 1 14E+00 |
| Cs-134 | 1 9830E-03 | 22,675 71 | 45,351 43 | 0 00E+00 | 4 50E+01 | 8 99E+01 |
| Cs-135 | 4.2564E-06 | 22,675 71 | 45,351 43 | 0 00E+00 | 9 65E-02 | 1.93E-01 |
| Cs-137 | 1 8141E+00 | 22,675 71 | 45,351 43 | 0 00E+00 | 4 11E+04 | 8.23E+04 |
| Eu-154 | 3 4733E-02 | 22,675 71 | 45,351.43 | 0 00E+00 | 7 88E+02 | 1.58E+03 |
| Eu-155 | 7 1081E-03 | 22,675 71 | 45,351.43 | 0 00E+00 | 1 61E+02 | 3.22E+02 |
| Fe-55 | 3 5790E-04 | 22,675 71 | 45,351.43 | 0 00E+00 | 8 12E+00 | 1.62E+01 |
| H-3 | 3 4945E-03 | 22,675 71 | 45,351.43 | 0 00E+00 | 7 92E+01 | 1.58E+02 |
| I-129 | 6 6403E-07 | 22,675 71 | 45,351.43 | 0 00E+00 | 1.51E-02 | 3 01E-02 |
| Kr-85 | 7 8250E-02 | 22,675 71 | 45,351 43 | 0 00E+00 | 1.77E+03 | 3.55E+03 |
| Np-237 | 3 1567E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 7 16E-01 | 1.43E+00 |
| Pa-231 | 1.3372E-09 | 22,675.71 | 45,351 43 | 0 00E+00 | 3 03E-05 | 6 06E-05 |
| Pb-210 | 3.0644E-11 | 22,675.71 | 45,351 43 | 0 00E+00 | 6 95E-07 | 1 39E-06 |
| Pm-147 | 6.5188E-03 | 22,675.71 | 45,351 43 | 0 00E+00 | 1.48E+02 | 2 96E+02 |
| Pu-238 | 1.4769E-01 | 22,675 71 | 45,351 43 | 0 00E+00 | 3 35E+03 | 6 70E+03 |
| Pu-239 | 6.9502E-04 | 22,675 71 | 45,351 43 | 0 00E+00 | 1.58E+01 | 3 15E+01 |
| Pu-240 | 3 7928E-04 | 22,675 71 | 45,351 43 | 0 00E+00 | 8 60E+00 | 1 72E+01 |
| Pu-241 | 1 0565E-01 | 22,675 71 | 45,351 43 | 0 00E+00 | 2 40E+03 | 4 79E+03 |
| Pu-242 | 3 0911E-06 | 22,675 71 | 45,351 43 | 0 00E+00 | 7 01E-02 | 1 40E-01 |
| Ra-226 | 1 1081E-10 | 22,675 71 | 45,351 43 | 0 00E+00 | 2 51E-06 | 5 03E-06 |
| Ra-228 | 2 1185E-14 | 22,675 71 | 45,351 43 | 0.00E+00 | 4 80E-10 | 9 61E-10 |
| Ru-106 | 2.3621E-07 | 22,675 71 | 45,351 43 | 0.00E+00 | 5 36E-03 | 1.07E-02 |
| Se-79 | 1 2339E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 2 80E-01 | 5.60E-01 |
| Sn-126 | 1 0194E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 2.31E-01 | 4 62E-01 |
| Sr-90 | 1 6932E+00 | 22,675 71 | 45,351 43 | 0 00E+00 | 3 84E+04 | 7.68E+04 |
| Tc-99 | 3 8056E-04 | 22,675 71 | 45,351.43 | 0 00E+00 | 8 63E+00 | 1.73E+01 |
| Th-229 | 9 1252E-12 | 22,675 71 | 45,351.43 | 0 00E+00 | 2 07E-07 | 4 14E-07 |
| Th-230 | 1 5407E-08 | 22,675 71 | 45,351.43 | 0 00E+00 | 3 49E-04 | 6 99E-04 |
| Th-232 | 2 8937E-14 | 22,675 71 | 45,351.43 | 0 00E+00 | 6.56E-10 | 1.31E-09 |
| Tl-208 | 4 7272E-08 | 22,675.71 | 45,351 43 | 0 00E+00 | 1.07E-03 | 2 14E-03 |
| U-232 | 1.2855E-07 | 22,675 71 | 45,351.43 | 0 00E+00 | 2.92E-03 | 5 83E-03 |
| U-233 | 5.1470E-09 | 22,675.71 | 45,351 43 | 0 00E+00 | 1 17E-04 | 2 33E-04 |
| U-234 | 5 6069E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 1.27E+00 | 2 54E+00 |
| U-235 | -2 8661E-06 | 22,675 71 | 0 00 | 1 66E-01 | 1 01E-01 | 1 66E-01 |
| U-236 | 1.6701E-05 | 22,675 71 | 45,351 43 | 0 00E+00 | 3 79E-01 | 7.57E-01 |
| U-238 | -9 4194E-09 | 22,675 71 | 0 00 | 1 92E-03 | 1 71E-03 | 1 92E-03 |
| Y-90 | 1.6932E+00 | 22,675 71 | 45,351 43 | 0 00E+00 | 3 84E+04 | 7 68E+04 |
| Other Radionuclides | | | | | 3 94E+04 | 7 87E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4.252E+15 |
| 0 0250 | 8 751E+14 |
| 0 0375 | 7 727E+14 |
| 0 0575 | 8.241E+14 |
| 0 0850 | 4 960E+14 |
| 0 1250 | 3 442E+14 |
| 0.2250 | 4.281E+14 |
| 0.3750 | 1.854E+14 |
| 0 5750 | 3 073E+15 |
| 0 8500 | 6 053E+13 |
| 1.2500 | 4 085E+13 |
| 1 7500 | 1 691E+12 |
| 2.2500 | 9 114E+07 |
| 2 7500 | 7.835E+07 |
| 3.5000 | 2 690E+06 |
| 5 0000 | 1 140E+06 |
| 7 0000 | 1 308E+05 |
| 11 0000 | 1 498E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.88E+02 | 1 18E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | HEAVY WATER | HEAVY WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 08510638 | 40 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 22,675 71 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 45,351 43 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 63 | |
| Bounding | 1.26 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. HFBR
SNF ID #. 961
Fuel Units & Descr: 20 - 18 CURVED PLATES
Heavy Metal Mass: BOL=7 52kg; EOL=5.282kg
ROD Storage Site: SRS

[1]Fuel decay start date. 1977
Estimates as of: 2010
Template: HFBR (Heavy Water, Alum., 40 to 100%, U)
[2]Template Burnup(MWd): 164 6
Template BOL Heavy Metal Mass (MT): 0 000377
Template Decay Time 25 years

Estimated Canister usage 18"x10'
0 56

**II. Estimates**

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 5 4520E-10 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 12E-06 | 2 25E-06 |
| Am-241 | 9 2284E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 90E+01 | 3 80E+01 |
| Am-242m | 1 3390E-06 | 2,061 43 | 4,122 86 | 0 00E+00 | 2 76E-03 | 5 52E-03 |
| Am-243 | 3 7084E-05 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 64E-02 | 1 53E-01 |
| C-14 | 2 6452E-08 | 2,061 43 | 4,122 86 | 0 00E+00 | 5 45E-05 | 1 09E-04 |
| Cl-36 | 4 4441E-31 | 2,061 43 | 4,122 86 | 0 00E+00 | 9.16E-28 | 1 83E-27 |
| Cm-243 | 5 0498E-06 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 04E-02 | 2 08E-02 |
| Cm-244 | 3 8451E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 93E+00 | 1 59E+01 |
| Co-60 | 2 5225E-05 | 2,061 43 | 4,122 86 | 0 00E+00 | 5.20E-02 | 1 04E-01 |
| Cs-134 | 1 9830E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 4 09E+00 | 8 18E+00 |
| Cs-135 | 4 2564E-06 | 2,061.43 | 4,122 86 | 0 00E+00 | 8.77E-03 | 1 75E-02 |
| Cs-137 | 1 8141E+00 | 2,061 43 | 4,122 86 | 0 00E+00 | 3 74E+03 | 7 48E+03 |
| Eu-154 | 3 4733E-02 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 16E+01 | 1 43E+02 |
| Eu-155 | 7 1081E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 47E+01 | 2 93E+01 |
| Fe-55 | 3 5790E-04 | 2,061 43 | 4,122 86 | 0 00E+00 | 7.38E-01 | 1 48E+00 |
| H-3 | 3 4945E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 20E+00 | 1 44E+01 |
| I-129 | 6 6403E-07 | 2,061 43 | 4,122 86 | 0 00E+00 | 1.37E-03 | 2 74E-03 |
| Kr-85 | 7 8250E-02 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 61E+02 | 3 23E+02 |
| Np-237 | 3 1567E-05 | 2,061 43 | 4,122 86 | 0 00E+00 | 6.51E-02 | 1 30E-01 |
| Pa-231 | 1 3372E-09 | 2,061.43 | 4,122 86 | 0 00E+00 | 2.76E-06 | 5 51E-06 |
| Pb-210 | 3 0644E-11 | 2,061.43 | 4,122 86 | 0 00E+00 | 6.32E-08 | 1 26E-07 |
| Pm-147 | 6 5188E-03 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 34E+01 | 2 69E+01 |
| Pu-238 | 1 4769E-01 | 2,061 43 | 4,122 86 | 0 00E+00 | 3 04E+02 | 6 09E+02 |
| Pu-239 | 6.9502E-04 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 43E+00 | 2 87E+00 |
| Pu-240 | 3.7928E-04 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 82E-01 | 1 56E+00 |
| Pu-241 | 1 0565E-01 | 2,061.43 | 4,122 86 | 0 00E+00 | 2.18E+02 | 4 36E+02 |
| Pu-242 | 3 0911E-06 | 2,061 43 | 4,122 86 | 0 00E+00 | 6.37E-03 | 1 27E-02 |
| Ra-226 | 1 1081E-10 | 2,061 43 | 4,122 86 | 0 00E+00 | 2.28E-07 | 4 57E-07 |
| Ra-228 | 2.1185E-14 | 2,061 43 | 4,122 86 | 0.00E+00 | 4.37E-11 | 8 73E-11 |
| Ru-106 | 2 3621E-07 | 2,061 43 | 4,122 86 | 0 00E+00 | 4 87E-04 | 9 74E-04 |
| Se-79 | 1.2339E-05 | 2,061 43 | 4,122 86 | 0 00E+00 | 2.54E-02 | 5 09E-02 |
| Sn-126 | 1 0194E-05 | 2,061 43 | 4,122 86 | 0 00E+00 | 2.10E-02 | 4 20E-02 |
| Sr-90 | 1 6932E+00 | 2,061 43 | 4,122 86 | 0 00E+00 | 3 49E+03 | 6 98E+03 |
| Tc-99 | 3 8056E-04 | 2,061 43 | 4,122 86 | 0 00E+00 | 7 84E-01 | 1 57E+00 |
| Th-229 | 9 1252E-12 | 2,061 43 | 4,122 86 | 0 00E+00 | 1.88E-08 | 3 76E-08 |
| Th-230 | 1 5407E-08 | 2,061 43 | 4,122 86 | 0 00E+00 | 3.18E-05 | 6 35E-05 |
| Th-232 | 2 8937E-14 | 2,061 43 | 4,122 86 | 0 00E+00 | 5 97E-11 | 1 19E-10 |
| Tl-208 | 4 7272E-08 | 2,061 43 | 4,122 86 | 0 00E+00 | 9.74E-05 | 1 95E-04 |
| U-232 | 1.2855E-07 | 2,061.43 | 4,122 86 | 0 00E+00 | 2 65E-04 | 5 30E-04 |
| U-233 | 5 1470E-09 | 2,061 43 | 4,122 86 | 0 00E+00 | 1 06E-05 | 2 12E-05 |
| U-234 | 5 6069E-05 | 2,061.43 | 4,122 86 | 0 00E+00 | 1.16E-01 | 2 31E-01 |
| U-235 | -2 8661E-06 | 2,061 43 | 0 00 | 1 51E-02 | 9.22E-03 | 1 51E-02 |
| U-236 | 1 6701E-05 | 2,061.43 | 4,122 86 | 0 00E+00 | 3.44E-02 | 6 89E-02 |
| U-238 | -9 4194E-09 | 2,061 43 | 0 00 | 1 75E-04 | 1.55E-04 | 1 75E-04 |
| Y-90 | 1 6932E+00 | 2,061 43 | 4,122 86 | 0 00E+00 | 3 49E+03 | 6 98E+03 |
| Other Radionuclides | | | | | 3 58E+03 | 7 16E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 865E+14 |
| 0 0250 | 7 955E+13 |
| 0 0375 | 7 024E+13 |
| 0 0575 | 7 492E+13 |
| 0 0850 | 4 509E+13 |
| 0 1250 | 3.129E+13 |
| 0.2250 | 3.892E+13 |
| 0 3750 | 1 685E+13 |
| 0 5750 | 2.794E+14 |
| 0 8500 | 5.503E+12 |
| 1 2500 | 3 714E+12 |
| 1 7500 | 1.537E+11 |
| 2.2500 | 8.285E+06 |
| 2.7500 | 7 123E+06 |
| 3.5000 | 2 445E+05 |
| 5 0000 | 1.037E+05 |
| 7 0000 | 1 189E+04 |
| 11 0000 | 1.362E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.35E+01 | 1.07E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | HEAVY WATER | HEAVY WATER | |
| Fuel Cladding | ALUM | ALUM | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93 08510638 | 40 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 2,061 43 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 4 122.86 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 63 | |
| Bounding | 1.26 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | HFEF FISSION CHAMBERS (U METAL) | [1]Fuel decay start date | 1994 |
| SNF ID # | 894 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - UNKNOWN | Template | TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U) |
| Heavy Metal Mass | BOL= ; EOL=24.345kg | [2]Template Burnup(MWd) | 6 65 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000195 |
| | | Template Decay Time | 15 years |

Estimated Canister usage 18"x10' : 0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9744E-09 | 23,240 11 | 23,240 11 | 0 00E+00 | 4 59E-05 | 4 59E-05 |
| Am-241 | 2 8150E-03 | 23,240 11 | 23,240 11 | 0 00E+00 | 6 54E+01 | 6 54E+01 |
| Am-242m | 1.3501E-06 | 23,240 11 | 23,240 11 | 0 00E+00 | 3 14E-02 | 3 14E-02 |
| Am-243 | 1 4761E-07 | 23,240 11 | 23,240 11 | 0 00E+00 | 3 43E-03 | 3 43E-03 |
| C-14 | 1.2854E-04 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 99E+00 | 2 99E+00 |
| Cl-36 | 2 8120E-06 | 23,240 11 | 23,240 11 | 0 00E+00 | 6 54E-02 | 6 54E-02 |
| Cm-243 | 1.4075E-07 | 23 240 11 | 23,240 11 | 0 00E+00 | 3.27E-03 | 3 27E-03 |
| Cm-244 | 1.1570E-06 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 69E-02 | 2 69E-02 |
| Co-60 | 3.4481E-01 | 23,240 11 | 23,240 11 | 0 00E+00 | 8 01E+03 | 8 01E+03 |
| Cs-134 | 3.1474E-03 | 23,240 11 | 23,240 11 | 0 00E+00 | 7.31E+01 | 7 31E+01 |
| Cs-135 | 3.2195E-05 | 23,240 11 | 23,240 11 | 0 00E+00 | 7.48E-01 | 7 48E-01 |
| Cs-137 | 2.1880E+00 | 23,240 11 | 23,240 11 | 0.00E+00 | 5 08E+04 | 5 08E+04 |
| Eu-154 | 6 8647E-03 | 23,240 11 | 23,240 11 | 0 00E+00 | 1 60E+02 | 1 60E+02 |
| Eu-155 | 7.2481E-03 | 23,240 11 | 23,240 11 | 0.00E+00 | 1 68E+02 | 1 68E+02 |
| Fe-55 | 5.3744E-02 | 23,240 11 | 23,240 11 | 0 00E+00 | 1.25E+03 | 1.25E+03 |
| H-3 | 6 3414E-03 | 23,240 11 | 23,240 11 | 0.00E+00 | 1 47E+02 | 1 47E+02 |
| I-129 | 7.3684E-07 | 23,240 11 | 23,240 11 | 0.00E+00 | 1.71E-02 | 1 71E-02 |
| Kr-85 | 1.3236E-01 | 23,240 11 | 23,240 11 | 0 00E+00 | 3 08E+03 | 3 08E+03 |
| Np-237 | 1.2504E-06 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 91E-02 | 2 91E-02 |
| Pa-231 | 5 9774E-09 | 23,240 11 | 23,240 11 | 0 00E+00 | 1.39E-04 | 1.39E-04 |
| Pb-210 | 3 3534E-14 | 23,240.11 | 23,240 11 | 0 00E+00 | 7.79E-10 | 7 79E-10 |
| Pm-147 | 1 5002E-01 | 23,240.11 | 23,240 11 | 0 00E+00 | 3 49E+03 | 3 49E+03 |
| Pu-238 | 9 5970E-04 | 23,240.11 | 23,240.11 | 0 00E+00 | 2.23E+01 | 2 23E+01 |
| Pu-239 | 5 5278E-03 | 23,240.11 | 23,240.11 | 0 00E+00 | 1.28E+02 | 1.28E+02 |
| Pu-240 | 2 1248E-03 | 23,240 11 | 23,240.11 | 0 00E+00 | 4 94E+01 | 4 94E+01 |
| Pu-241 | 6 3023E-02 | 23,240 11 | 23,240.11 | 0 00E+00 | 1 46E+03 | 1 46E+03 |
| Pu-242 | 2 3128E-07 | 23,240 11 | 23,240 11 | 0 00E+00 | 5.37E-03 | 5.37E-03 |
| Ra-226 | 1 6346E-13 | 23,240 11 | 23,240.11 | 0 00E+00 | 3 80E-09 | 3 80E-09 |
| Ra-228 | 2 3173E-10 | 23,240 11 | 23,240 11 | 0 00E+00 | 5.39E-06 | 5 39E-06 |
| Ru-106 | 9 5038E-05 | 23,240 11 | 23,240 11 | 0 00E+00 | 2.21E+00 | 2 21E+00 |
| Se-79 | 1 3017E-05 | 23,240 11 | 23,240.11 | 0 00E+00 | 3 03E-01 | 3 03E-01 |
| Sn-126 | 1 2165E-05 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 83E-01 | 2.83E-01 |
| Sr-90 | 2 0541E+00 | 23,240 11 | 23,240 11 | 0 00E+00 | 4.77E+04 | 4 77E+04 |
| Tc-99 | 4 4241E-04 | 23,240 11 | 23,240 11 | 0 00E+00 | 1.03E+01 | 1 03E+01 |
| Th-229 | 2 5218E-10 | 23,240 11 | 23,240 11 | 0 00E+00 | 5 86E-06 | 5.86E-06 |
| Th-230 | 3 3654E-11 | 23,240 11 | 23,240 11 | 0 00E+00 | 7 82E-07 | 7.82E-07 |
| Th-232 | 2.5278E-10 | 23,240 11 | 23,240 11 | 0 00E+00 | 5 87E-06 | 5.87E-06 |
| Tl-208 | 1 6511E-08 | 23,240 11 | 23,240 11 | 0 00E+00 | 3 84E-04 | 3 84E-04 |
| U-232 | 4 4722E-08 | 23,240 11 | 23,240 11 | 0 00E+00 | 1 04E-03 | 1.04E-03 |
| U-233 | 1.2209E-07 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 84E-03 | 2 84E-03 |
| U-234 | 1 8662E-07 | 23,240 11 | 23,240 11 | 0 00E+00 | 4.34E-03 | 4.34E-03 |
| U-235 | -2 6194E-06 | 23,240 11 | 0 00 | 2 10E-02 | 0 00E+00 | 2.10E-02 |
| U-236 | 1.2693E-05 | 23,240 11 | 23,240 11 | 0 00E+00 | 2 95E-01 | 2 95E-01 |
| U-238 | -3 6331E-08 | 23,240 11 | 0 00 | 1 31E-02 | 1.22E-02 | 1.31E-02 |
| Y-90 | 2 0541E+00 | 23,240 11 | 23,240 11 | 0 00E+00 | 4 77E+04 | 4.77E+04 |
| Other Radionuclides | | | | | 5 03E+04 | 5 03E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 636E+15 |
| 0 0250 | 5.510E+14 |
| 0 0375 | 4 757E+14 |
| 0 0575 | 5 104E+14 |
| 0 0850 | 3.087E+14 |
| 0 1250 | 2 022E+14 |
| 0.2250 | 2.643E+14 |
| 0 3750 | 1 172E+14 |
| 0 5750 | 1.901E+15 |
| 0 8500 | 2.405E+13 |
| 1.2500 | 6.028E+14 |
| 1 7500 | 5 743E+11 |
| 2.2500 | 3.625E+09 |
| 2 7500 | 4 108E+07 |
| 3 5000 | 2.325E+06 |
| 5 0000 | 1.213E+04 |
| 7 0000 | 1.370E+03 |
| 11 0000 | 1.559E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.09E+02 | 7.09E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | UNKNOWN | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 10 to 20 1 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 23,240 11 |
| Bounding | | 23,240 11 |

**Basis for burnup used in estimate**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.00 | |
| Bounding | 14 00 | |

Estimated EOL HM/Given EOL HM: 1 78

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name. HTGR (PEACH BOTTOM SCRAP)
SNF ID #: 935
Fuel Units & Descr: 21 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=18 722kg, EOL=16.34kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1967
Estimates as of: 2010
Template: FSV (Graphite, Graphite, 60 to 100% Th & U)
[2]Template Burnup(MWd): 1270.275
Template BOL Heavy Metal Mass (MT): 0 012702752
Template Decay Time: 35 years

Estimated Canister usage 18"x15': 1 62

### II. Estimates

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 8818E-06 | 2,252 15 | 4,504 30 | 0 00E+00 | 8 74E-03 | 1 75E-02 |
| Am-241 | 3 1387E-03 | 2,252 15 | 4,504 30 | 0 00E+00 | 7 07E+00 | 1 41E+01 |
| Am-242m | 2 3971E-06 | 2,252 15 | 4,504 30 | 0 00E+00 | 5 40E-03 | 1 08E-02 |
| Am-243 | 4 6069E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 1 04E-01 | 2 08E-01 |
| C-14 | 2 3121E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 5 21E-02 | 1 04E-01 |
| Cl-36 | 1 0667E-06 | 2,252 15 | 4,504 30 | 0 00E+00 | 2 40E-03 | 4 80E-03 |
| Cm-243 | 2 5357E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 5 71E-02 | 1 14E-01 |
| Cm-244 | 6 4458E-03 | 2,252 15 | 4,504 30 | 0 00E+00 | 1 45E+01 | 2 90E+01 |
| Co-60 | 4 5014E-04 | 2,252.15 | 4,504 30 | 0 00E+00 | 1 01E+00 | 2 03E+00 |
| Cs-134 | 3 8086E-05 | 2,252.15 | 4,504 30 | 0 00E+00 | 8 58E-02 | 1 72E-01 |
| Cs-135 | 2 4711E-05 | 2,252.15 | 4,504 30 | 0 00E+00 | 5 57E-02 | 1 11E-01 |
| Cs-137 | 1.3273E+00 | 2,252.15 | 4,504 30 | 0 00E+00 | 2 99E+03 | 5 98E+03 |
| Eu-154 | 1 5705E-02 | 2,252.15 | 4,504 30 | 0 00E+00 | 3 54E+01 | 7 07E+01 |
| Eu-155 | 1 0415E-03 | 2,252.15 | 4,504 30 | 0 00E+00 | 2 35E+00 | 4 69E+00 |
| Fe-55 | 4 4707E-08 | 2,252.15 | 4,504 30 | 0 00E+00 | 1 01E-04 | 2 01E-04 |
| H-3 | 3 9094E-03 | 2,252 15 | 4,504 30 | 0 00E+00 | 8 80E+00 | 1 76E+01 |
| I-129 | 1 0092E-06 | 2,252.15 | 4,504 30 | 0 00E+00 | 2.27E-03 | 4.55E-03 |
| Kr-85 | 3 9519E-02 | 2,252 15 | 4,504 30 | 0 00E+00 | 8 90E+01 | 1 78E+02 |
| Np-237 | 1.2541E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 2 82E-02 | 5 65E-02 |
| Pa-231 | 4.7376E-06 | 2,252 15 | 4,504 30 | 0 00E+00 | 1 07E-02 | 2.13E-02 |
| Pb-210 | 1.4194E-09 | 2,252.15 | 4,504 30 | 0 00E+00 | 3.20E-06 | 6 39E-06 |
| Pm-147 | 1.5146E-04 | 2,252 15 | 4,504 30 | 0 00E+00 | 3.41E-01 | 6 82E-01 |
| Pu-238 | 1.6248E-01 | 2,252 15 | 4,504 30 | 0 00E+00 | 3 66E+02 | 7.32E+02 |
| Pu-239 | 1.3580E-04 | 2,252 15 | 4,504 30 | 0 00E+00 | 3 06E-01 | 6 12E-01 |
| Pu-240 | 2.7136E-04 | 2,252 15 | 4,504 30 | 0 00E+00 | 6.11E-01 | 1.22E+00 |
| Pu-241 | 1 9342E-02 | 2,252 15 | 4,504 30 | 0 00E+00 | 4 36E+01 | 8.71E+01 |
| Pu-242 | 3 8866E-06 | 2,252 15 | 4,504 30 | 0 00E+00 | 8.75E-03 | 1 75E-02 |
| Ra-226 | 2.7923E-09 | 2,252 15 | 4,504 30 | 0 00E+00 | 6.29E-06 | 1.26E-05 |
| Ra-228 | 9 1791E-07 | 2,252 15 | 4,504 30 | 0 00E+00 | 2.07E-03 | 4 13E-03 |
| Ru-106 | 3 5205E-11 | 2,252 15 | 4,504 30 | 0 00E+00 | 7.93E-08 | 1 59E-07 |
| Se-79 | 2.1082E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 4 75E-02 | 9 50E-02 |
| Sn-126 | 2.2192E-05 | 2,252 15 | 4,504 30 | 0 00E+00 | 5 00E-02 | 1 00E-01 |
| Sr-90 | 1.2667E+00 | 2,252 15 | 4,504.30 | 0 00E+00 | 2.85E+03 | 5 71E+03 |
| Tc-99 | 3 3331E-04 | 2,252 15 | 4,504 30 | 0 00E+00 | 7.51E-01 | 1 50E+00 |
| Th-229 | 1 0612E-05 | 2,252 15 | 4,504.30 | 0 00E+00 | 2 39E-02 | 4 78E-02 |
| Th-230 | 1 8878E-07 | 2,252 15 | 4,504.30 | 0 00E+00 | 4.25E-04 | 8 50E-04 |
| Th-232 | -6 9673E-08 | 2,252 15 | 0 00 | 1 85E-03 | 1 69E-03 | 1 85E-03 |
| Tl-208 | 5 9530E-04 | 2,252 15 | 4,504.30 | 0 00E+00 | 1.34E+00 | 2 68E+00 |
| U-232 | 1 6115E-03 | 2,252 15 | 4,504.30 | 0 00E+00 | 3 63E+00 | 7 26E+00 |
| U-233 | 2 0602E-03 | 2,252 15 | 4,504.30 | 0 00E+00 | 4 64E+00 | 9 28E+00 |
| U-234 | 2 8939E-04 | 2,252 15 | 4,504.30 | 0 00E+00 | 6 52E-01 | 1 30E+00 |
| U-235 | -1 7343E-06 | 2,252 15 | 0 00 | 3.70E-03 | 0 00E+00 | 3.70E-03 |
| U-236 | 8 6281E-06 | 2,252 15 | 4,504.30 | 0 00E+00 | 1 94E-02 | 3 89E-02 |
| U-238 | -5 6065E-09 | 2,252 15 | 0 00 | 3.68E-05 | 2 42E-05 | 3 68E-05 |
| Y-90 | 1 2667E+00 | 2,252 15 | 4,504 30 | 0 00E+00 | 2.85E+03 | 5 71E+03 |
| Other Radionuclides | | | | | 2 87E+03 | 5 74E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 161E+14 |
| 0 0250 | 6 475E+13 |
| 0 0375 | 5 643E+13 |
| 0 0575 | 6 070E+13 |
| 0 0850 | 3 665E+13 |
| 0 1250 | 2.472E+13 |
| 0.2250 | 3 179E+13 |
| 0.3750 | 1 375E+13 |
| 0 5750 | 2.231E+14 |
| 0 8500 | 3 525E+12 |
| 1.2500 | 2.273E+12 |
| 1 7500 | 1 079E+11 |
| 2.2500 | 7 952E+06 |
| 2.7500 | 9 415E+10 |
| 3 5000 | 4 497E+05 |
| 5 0000 | 1 918E+05 |
| 7 0000 | 2.204E+04 |
| 11 0000 | 2.527E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 80E+01 | 9.59E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 80.231 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 1,239 49 | 2,252.15 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 1,361.22 | 4 504 30 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.20 | 1 82 |
| Bounding | 2.41 | 3.31 |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name KEMA
SNF ID # 861
Fuel Units & Descr 14 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=243 783kg EOL=243 755kg
ROD Storage Site INEEL

[1]Fuel decay start date 1979
Estimates as of 2010
Template LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd) 10269 14
Template BOL Heavy Metal Mass (MT) 0 45991251
Template Decay Time 25 years

Estimated Canister usage 18"x10' 1 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 27.25 | 54 50 | 0 00E+00 | 2.27E-03 | 4.55E-03 |
| Am-241 | 2 2387E-04 | 27.25 | 54 50 | 0 00E+00 | 6 10E-03 | 1.22E-02 |
| Am-242m | 1.5512E-06 | 27.25 | 54 50 | 0 00E+00 | 4.23E-05 | 8 45E-05 |
| Am-243 | 3 1181E-07 | 27.25 | 54.50 | 0 00E+00 | 8 50E-06 | 1 70E-05 |
| C-14 | 9 2539E-05 | 27.25 | 54.50 | 0 00E+00 | 2.52E-03 | 5 04E-03 |
| Cl-36 | 1.8103E-06 | 27 25 | 54.50 | 0 00E+00 | 4.93E-05 | 9 87E-05 |
| Cm-243 | 3.9020E-07 | 27 25 | 54 50 | 0 00E+00 | 1 06E-05 | 2 13E-05 |
| Cm-244 | 2.0742E-05 | 27 25 | 54 50 | 0 00E+00 | 5 65E-04 | 1 13E-03 |
| Co-60 | 3.2554E-03 | 27 25 | 54.50 | 0 00E+00 | 8 87E-02 | 1 77E-01 |
| Cs-134 | 7.3823E-04 | 27.25 | 54 50 | 0 00E+00 | 2 01E-02 | 4 02E-02 |
| Cs-135 | 2 8639E-05 | 27.25 | 54 50 | 0 00E+00 | 7 80E-04 | 1.56E-03 |
| Cs-137 | 1 8609E+00 | 27.25 | 54 50 | 0 00E+00 | 5 07E+01 | 1 01E+02 |
| Eu-154 | 1 9262E-02 | 27.25 | 54 50 | 0 00E+00 | 5 25E-01 | 1 05E+00 |
| Eu-155 | 2 6721E-03 | 27.25 | 54 50 | 0 00E+00 | 7 28E-02 | 1.46E-01 |
| Fe-55 | 3 3099E-05 | 27.25 | 54 50 | 0 00E+00 | 9 02E-04 | 1.80E-03 |
| H-3 | 3 7296E-03 | 27.25 | 54.50 | 0 00E+00 | 1 02E-01 | 2 03E-01 |
| I-129 | 1.5853E-06 | 27.25 | 54.50 | 0 00E+00 | 4.32E-05 | 8 64E-05 |
| Kr-85 | 1.1958E-01 | 27.25 | 54.50 | 0 00E+00 | 3 26E+00 | 6.52E+00 |
| Np-237 | 1.2513E-07 | 27 25 | 54.50 | 0 00E+00 | 3 41E-06 | 6 82E-06 |
| Pa-231 | 1.2017E-04 | 27.25 | 54.50 | 0.00E+00 | 3.27E-03 | 6 55E-03 |
| Pb-210 | 1.1939E-08 | 27.25 | 54.50 | 0 00E+00 | 3.25E-07 | 6 51E-07 |
| Pm-147 | 3 6819E-03 | 27.25 | 54 50 | 0 00E+00 | 1.00E-01 | 2 01E-01 |
| Pu-238 | 4 5953E-04 | 27.25 | 54 50 | 0 00E+00 | 1.25E-02 | 2 50E-02 |
| Pu-239 | 2 7529E-05 | 27.25 | 54 50 | 0 00E+00 | 7.50E-04 | 1.50E-03 |
| Pu-240 | 1 6184E-05 | 27.25 | 54 50 | 0 00E+00 | 4 41E-04 | 8 82E-04 |
| Pu-241 | 2 3780E-03 | 27.25 | 54 50 | 0 00E+00 | 6 48E-02 | 1.30E-01 |
| Pu-242 | 4 0821E-08 | 27.25 | 54.50 | 0 00E+00 | 1 11E-06 | 2.22E-06 |
| Ra-226 | 1 4471E-08 | 27.25 | 54 50 | 0 00E+00 | 3 94E-07 | 7.89E-07 |
| Ra-228 | 4 5651E-06 | 27.25 | 54.50 | 0 00E+00 | 1 24E-04 | 2.49E-04 |
| Ru-106 | 3 8971E-08 | 27.25 | 54.50 | 0 00E+00 | 1 06E-06 | 2 12E-06 |
| Se-79 | 3.5417E-05 | 27.25 | 54.50 | 0 00E+00 | 9 65E-04 | 1 93E-03 |
| Sn-126 | 3 9848E-05 | 27.25 | 54.50 | 0 00E+00 | 1 09E-03 | 2 17E-03 |
| Sr-90 | 1.8940E+00 | 27.25 | 54.50 | 0 00E+00 | 5 16E+01 | 1 03E+02 |
| Tc-99 | 3.2534E-04 | 27.25 | 54.50 | 0 00E+00 | 8 87E-03 | 1 77E-02 |
| Th-229 | 4 6839E-05 | 27.25 | 54 50 | 0.00E+00 | 1.28E-03 | 2 55E-03 |
| Th-230 | 1 0322E-06 | 27.25 | 54 50 | 0 00E+00 | 2 81E-05 | 5 63E-05 |
| Th-232 | -9 0328E-08 | 27.25 | 0 00 | 2 57E-02 | 2.57E-02 | 2.57E-02 |
| Tl-208 | 1 5386E-02 | 27.25 | 54 50 | 0 00E+00 | 4 19E-01 | 8.38E-01 |
| U-232 | 4 1639E-02 | 27.25 | 54 50 | 0 00E+00 | 1.13E+00 | 2.27E+00 |
| U-233 | -3.3244E-03 | 27.25 | 0 00 | 8 66E+01 | 8 65E+01 | 8 66E+01 |
| U-234 | 8 1769E-04 | 27.25 | 54.50 | 0 00E+00 | 2.23E-02 | 4 46E-02 |
| U-235 | 5 7813E-08 | 27.25 | 54.50 | 1 77E-05 | 1 93E-05 | 2 09E-05 |
| U-236 | 1.3273E-07 | 27.25 | 54 50 | 0 00E+00 | 3 62E-06 | 7.23E-06 |
| U-238 | -3 1121E-10 | 27 25 | 0 00 | 1.13E-05 | 1 13E-05 | 1 13E-05 |
| Y-90 | 1.8940E+00 | 27 25 | 54 50 | 0 00E+00 | 5 16E+01 | 1 03E+02 |
| Other Radionuclides | | | | | 5 61E+01 | 1 12E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 963E+12 |
| 0 0250 | 1 178E+12 |
| 0 0375 | 1 011E+12 |
| 0 0575 | 1 100E+12 |
| 0 0850 | 6.989E+11 |
| 0 1250 | 4.479E+11 |
| 0.2250 | 6.241E+11 |
| 0 3750 | 2.533E+11 |
| 0.5750 | 3 828E+12 |
| 0 8500 | 7.575E+10 |
| 1.2500 | 4 791E+10 |
| 1 7500 | 4 568E+09 |
| 2.2500 | 1 854E+05 |
| 2 7500 | 2.944E+10 |
| 3 5000 | 6 749E+02 |
| 5 0000 | 2.032E+02 |
| 7 0000 | 1.358E+01 |
| 11 0000 | 9 047E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.40E+00 | 4.28E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 89 895 | 60 to 100 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except cladding

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 27.25 |
| Bounding | | 54.50 |

**Basis for burnup used in estimate**

Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 01 | |
| Bounding | 0 01 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: LOFT CENTER FUEL MODULE (A1,A2,A3 F1)
SNF ID #: 127
Fuel Units & Descr: 4 - 15 X 15 ROD ARRAY
Heavy Metal Mass: BOL=814 001kg, EOL=813.286kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1975
Estimates as of: 2010
Template: PWR (Light Water Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT) 0 00176911
Template Decay Time 35 years

Estimated Canister usage: 18"x10" 4 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 803 42 | 1,108 67 | 0 00E+00 | 7 05E-07 | 9 73E-07 |
| Am-241 | 1 4352E-01 | 803 42 | 1,108 67 | 0 00E+00 | 1.15E+02 | 1 59E+02 |
| Am-242m | 2 8698E-04 | 803 42 | 1,108 67 | 0 00E+00 | 2 31E-01 | 3 18E-01 |
| Am-243 | 6 2565E-04 | 803 42 | 1,108 67 | 0 00E+00 | 5 03E-01 | 6 94E-01 |
| C-14 | 4 7901E-05 | 803 42 | 1,108 67 | 0 00E+00 | 3 85E-02 | 5 31E-02 |
| Cl-36 | 8 0297E-07 | 803 42 | 1,108 67 | 0 00E+00 | 6 45E-04 | 8 90E-04 |
| Cm-243 | 2 5081E-04 | 803 42 | 1,108 67 | 0 00E+00 | 2 02E-01 | 2 78E-01 |
| Cm-244 | 4 9015E-02 | 803 42 | 1,108 67 | 0 00E+00 | 3 94E+01 | 5 43E+01 |
| Co-60 | 2 5581E-03 | 803 42 | 1,108 67 | 0 00E+00 | 2 06E+00 | 2 84E+00 |
| Cs-134 | 4 0536E-05 | 803 42 | 1,108 67 | 0 00E+00 | 3 26E-02 | 4 49E-02 |
| Cs-135 | 1 4433E-05 | 803 42 | 1,108 67 | 0 00E+00 | 1 16E-02 | 1 60E-02 |
| Cs-137 | 1 3979E+00 | 803 42 | 1,108 67 | 0 00E+00 | 1.12E+03 | 1 55E+03 |
| Eu-154 | 2 0203E-02 | 803 42 | 1,108 67 | 0 00E+00 | 1.62E+01 | 2 24E+01 |
| Eu-155 | 1 7684E-03 | 803 42 | 1,108 67 | 0 00E+00 | 1.42E+00 | 1 96E+00 |
| Fe-55 | 4 3136E-05 | 803 42 | 1,108 67 | 0 00E+00 | 3 47E-02 | 4 78E-02 |
| H-3 | 2 0769E-02 | 803 42 | 1,108 67 | 0 00E+00 | 1.67E+01 | 2 30E+01 |
| I-129 | 9 8288E-07 | 803 42 | 1,108 67 | 0 00E+00 | 7 90E-04 | 1 09E-03 |
| Kr-85 | 2 8214E-02 | 803 42 | 1,108 67 | 0 00E+00 | 2.27E+01 | 3 13E+01 |
| Np-237 | 1 1218E-05 | 803 42 | 1,108 67 | 0 00E+00 | 9 01E-03 | 1 24E-02 |
| Pa-231 | 1 3036E-09 | 803 42 | 1,108 67 | 0 00E+00 | 1 05E-06 | 1 45E-06 |
| Pb-210 | 8 5078E-11 | 803 42 | 1,108 67 | 0 00E+00 | 6 84E-08 | 9 43E-08 |
| Pm-147 | 3 6531E-04 | 803 42 | 1,108 67 | 0 00E+00 | 2 93E-01 | 4 05E-01 |
| Pu-238 | 7 4564E-02 | 803 42 | 1,108 67 | 0 00E+00 | 5 99E+01 | 8.27E+01 |
| Pu-239 | 1 1623E-02 | 803 42 | 1,108 67 | 0 00E+00 | 9.34E+00 | 1.29E+01 |
| Pu-240 | 1 5132E-02 | 803 42 | 1,108 67 | 0 00E+00 | 1.22E+01 | 1 68E+01 |
| Pu-241 | 9 0036E-01 | 803 42 | 1,108 67 | 0 00E+00 | 7.23E+02 | 9 98E+02 |
| Pu-242 | 6 4260E-05 | 803 42 | 1,108 67 | 0 00E+00 | 5 16E-02 | 7 12E-02 |
| Ra-226 | 2 2804E-10 | 803 42 | 1,108 67 | 0 00E+00 | 1.83E-07 | 2 53E-07 |
| Ra-228 | 5.2713E-12 | 803 42 | 1,108 67 | 0 00E+00 | 4.24E-09 | 5 84E-09 |
| Ru-106 | 6 1160E-10 | 803 42 | 1,108 67 | 0 00E+00 | 4 91E-07 | 6 78E-07 |
| Se-79 | 1 2377E-05 | 803 42 | 1,108 67 | 0 00E+00 | 9 94E-03 | 1 37E-02 |
| Sn-126 | 2 5210E-05 | 803 42 | 1,108 67 | 0.00E+00 | 2.03E-02 | 2.79E-02 |
| Sr-90 | 9 1667E-01 | 803 42 | 1,108 67 | 0 00E+00 | 7.36E+02 | 1.02E+03 |
| Tc-99 | 3 9357E-04 | 803 42 | 1,108 67 | 0.00E+00 | 3.16E-01 | 4.36E-01 |
| Th-229 | 1 2057E-10 | 803 42 | 1,108 67 | 0 00E+00 | 9 69E-08 | 1.34E-07 |
| Th-230 | 2 1043E-08 | 803 42 | 1,108 67 | 0 00E+00 | 1.69E-05 | 2 33E-05 |
| Th-232 | 5 2972E-12 | 803 42 | 1,108 67 | 0.00E+00 | 4.26E-09 | 5 87E-09 |
| Tl-208 | 1 7474E-07 | 803 42 | 1,108 67 | 0.00E+00 | 1.40E-04 | 1 94E-04 |
| U-232 | 4 7368E-07 | 803 42 | 1,108 67 | 0.00E+00 | 3 81E-04 | 5.25E-04 |
| U-233 | 2 5097E-08 | 803 42 | 1,108 67 | 0 00E+00 | 2.02E-05 | 2.78E-05 |
| U-234 | 5 0000E-05 | 803 42 | 1,108 67 | 0.00E+00 | 4 02E-02 | 5 54E-02 |
| U-235 | -1.4489E-06 | 803 42 | 0 00 | 7.12E-02 | 7.00E-02 | 7.12E-02 |
| U-236 | 7 5824E-06 | 803 42 | 1,108 67 | 0.00E+00 | 6 09E-03 | 8 41E-03 |
| U-238 | -2.6129E-07 | 803 42 | 0 00 | 2.63E-01 | 2.62E-01 | 2 63E-01 |
| Y-90 | 9 1699E-01 | 803 42 | 1,108 67 | 0 00E+00 | 7.37E+02 | 1.02E+03 |
| Other Radionuclides | | | | | 1 08E+03 | 1.49E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 966E+13 |
| 0 0250 | 1.203E+13 |
| 0 0375 | 1 147E+13 |
| 0 0575 | 1 326E+13 |
| 0 0850 | 6 675E+12 |
| 0 1250 | 4 632E+12 |
| 0 2250 | 5 725E+12 |
| 0 3750 | 2 461E+12 |
| 0 5750 | 5.724E+13 |
| 0 8500 | 7 919E+11 |
| 1.2500 | 7 779E+11 |
| 1 7500 | 2.329E+10 |
| 2.2500 | 3.754E+06 |
| 2.7500 | 7 686E+06 |
| 3.5000 | 7 927E+05 |
| 5 0000 | 3.389E+05 |
| 7 0000 | 3.906E+04 |
| 11 0000 | 4 486E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.85E+01 | 2.55E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 4 046614577 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 803 42 | 679.36 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 1 108.67 | 1,358 72 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 03 | 0.85 |
| Bounding | 0 04 | 1.23 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | LOFT CENTER FUEL MODULE (FP-1) | [1]Fuel decay start date | 1975 |
| SNF ID # | 1061 | Estimates as of | 2010 |
| Fuel Units & Descr. | 1 - 15 X 15 ROD ARRAY | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=203.5kg EOL=203.322kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x10' 0 50

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 200 85 | 277.17 | 0 00E+00 | 1 76E-07 | 2 43E-07 |
| Am-241 | 1.4352E-01 | 200 85 | 277.17 | 0 00E+00 | 2.88E+01 | 3 98E+01 |
| Am-242m | 2.8698E-04 | 200 85 | 277 17 | 0 00E+00 | 5 76E-02 | 7 95E-02 |
| Am-243 | 6.2565E-04 | 200 85 | 277 17 | 0 00E+00 | 1.26E-01 | 1 73E-01 |
| C-14 | 4.7901E-05 | 200 85 | 277 17 | 0 00E+00 | 9 62E-03 | 1 33E-02 |
| Cl-36 | 8 0297E-07 | 200 85 | 277 17 | 0 00E+00 | 1 61E-04 | 2 23E-04 |
| Cm-243 | 2.5081E-04 | 200 85 | 277 17 | 0 00E+00 | 5 04E-02 | 6 95E-02 |
| Cm-244 | 4 9015E-02 | 200 85 | 277 17 | 0 00E+00 | 9 84E+00 | 1 36E+01 |
| Co-60 | 2 5581E-03 | 200 85 | 277 17 | 0 00E+00 | 5 14E-01 | 7 09E-01 |
| Cs-134 | 4 0536E-05 | 200 85 | 277 17 | 0 00E+00 | 8 14E-03 | 1 12E-02 |
| Cs-135 | 1 4433E-05 | 200 85 | 277 17 | 0 00E+00 | 2 90E-03 | 4 00E-03 |
| Cs-137 | 1.3979E+00 | 200 85 | 277 17 | 0 00E+00 | 2 81E+02 | 3 87E+02 |
| Eu-154 | 2 0203E-02 | 200 85 | 277 17 | 0 00E+00 | 4 06E+00 | 5 60E+00 |
| Eu-155 | 1 7684E-03 | 200 85 | 277 17 | 0 00E+00 | 3 55E-01 | 4 90E-01 |
| Fe-55 | 4 3136E-05 | 200 85 | 277 17 | 0 00E+00 | 8 66E-03 | 1.20E-02 |
| H-3 | 2 0769E-02 | 200 85 | 277 17 | 0 00E+00 | 4 17E+00 | 5 76E+00 |
| I-129 | 9 8288E-07 | 200 85 | 277 17 | 0 00E+00 | 1 97E-04 | 2 72E-04 |
| Kr-85 | 2 8214E-02 | 200 85 | 277 17 | 0 00E+00 | 5 67E+00 | 7 82E+00 |
| Np-237 | 1 1218E-05 | 200 85 | 277 17 | 0 00E+00 | 2 25E-03 | 3 11E-03 |
| Pa-231 | 1 3036E-09 | 200 85 | 277 17 | 0 00E+00 | 2 62E-07 | 3 61E-07 |
| Pb-210 | 8 5078E-11 | 200 85 | 277 17 | 0 00E+00 | 1 71E-08 | 2.36E-08 |
| Pm-147 | 3 6531E-04 | 200 85 | 277 17 | 0 00E+00 | 7 34E-02 | 1 01E-01 |
| Pu-238 | 7 4564E-02 | 200 85 | 277 17 | 0 00E+00 | 1 50E+01 | 2 07E+01 |
| Pu-239 | 1 1623E-02 | 200 85 | 277 17 | 0 00E+00 | 2 33E+00 | 3 22E+00 |
| Pu-240 | 1 5132E-02 | 200 85 | 277 17 | 0 00E+00 | 3 04E+00 | 4 19E+00 |
| Pu-241 | 9 0036E-01 | 200 85 | 277 17 | 0 00E+00 | 1 81E+02 | 2.50E+02 |
| Pu-242 | 6 4260E-05 | 200 85 | 277 17 | 0 00E+00 | 1.29E-02 | 1.78E-02 |
| Ra-226 | 2 2804E-10 | 200 85 | 277 17 | 0 00E+00 | 4 58E-08 | 6.32E-08 |
| Ra-228 | 5 2713E-12 | 200 85 | 277 17 | 0 00E+00 | 1 06E-09 | 1.46E-09 |
| Ru-106 | 6 1160E-10 | 200 85 | 277.17 | 0 00E+00 | 1.23E-07 | 1.70E-07 |
| Se-79 | 1 2377E-05 | 200 85 | 277.17 | 0 00E+00 | 2 49E-03 | 3 43E-03 |
| Sn-126 | 2 5210E-05 | 200 85 | 277.17 | 0.00E+00 | 5 06E-03 | 6 99E-03 |
| Sr-90 | 9 1667E-01 | 200 85 | 277.17 | 0 00E+00 | 1 84E+02 | 2.54E+02 |
| Tc-99 | 3 9357E-04 | 200 85 | 277.17 | 0.00E+00 | 7.91E-02 | 1 09E-01 |
| Th-229 | 1.2057E-10 | 200.85 | 277.17 | 0 00E+00 | 2.42E-08 | 3 34E-08 |
| Th-230 | 2 1043E-08 | 200 85 | 277.17 | 0 00E+00 | 4.23E-06 | 5 83E-06 |
| Th-232 | 5.2972E-12 | 200 85 | 277.17 | 0 00E+00 | 1 06E-09 | 1 47E-09 |
| Tl-208 | 1.7474E-07 | 200 85 | 277.17 | 0 00E+00 | 3 51E-05 | 4 84E-05 |
| U-232 | 4.7368E-07 | 200 85 | 277.17 | 0 00E+00 | 9 51E-05 | 1 31E-04 |
| U-233 | 2 5097E-08 | 200 85 | 277.17 | 0 00E+00 | 5 04E-06 | 6 96E-06 |
| U-234 | 5 0000E-05 | 200 85 | 277 17 | 0 00E+00 | 1 00E-02 | 1 39E-02 |
| U-235 | -1.4489E-06 | 200 85 | 0 00 | 1 78E-02 | 1 75E-02 | 1 78E-02 |
| U-236 | 7.5824E-06 | 200 85 | 277 17 | 0 00E+00 | 1.52E-03 | 2 10E-03 |
| U-238 | -2 6129E-07 | 200 85 | 0 00 | 6 56E-02 | 6 56E-02 | 6 56E-02 |
| Y-90 | 9.1699E-01 | 200 85 | 277.17 | 0 00E+00 | 1.84E+02 | 2 54E+02 |
| Other Radionuclides | | | | | 2 70E+02 | 3 72E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.491E+13 |
| 0 0250 | 3.007E+12 |
| 0 0375 | 2.868E+12 |
| 0 0575 | 3.314E+12 |
| 0 0850 | 1.669E+12 |
| 0 1250 | 1 158E+12 |
| 0.2250 | 1.431E+12 |
| 0 3750 | 6 153E+11 |
| 0 5750 | 1.431E+13 |
| 0 8500 | 1.980E+11 |
| 1.2500 | 1.945E+11 |
| 1 7500 | 5.824E+09 |
| 2.2500 | 9.384E+05 |
| 2 7500 | 1.922E+06 |
| 3 5000 | 1.982E+05 |
| 5 0000 | 8.473E+04 |
| 7 0000 | 9 766E+03 |
| 11 0000 | 1 122E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 62E+00 | 6.38E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 4 047 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 200 85 | 169.84 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 277 17 | 339 68 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 03 | 0 85 | 1 00 |
| Bounding | 0 04 | 1.23 | |

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| **Fuel Name:** | LOFT CENTER FUEL MODULE FP-2 REMAINS | **[1]Fuel decay start date:** | 1975 |
| **SNF ID #:** | 923 | **Estimates as of:** | 2010 |
| **Fuel Units & Descr:** | 10 - CANISTER OF SCRAP | **Template:** | PWR (Light Water, Zirc, 0 to 5% U) |
| **Heavy Metal Mass.** | BOL=99 951kg, EOL=99 899kg | **[2]Template Burnup(MWd):** | 61 92 |
| **ROD Storage Site** | INEEL | **Template BOL Heavy Metal Mass (MT):** | 0 00176911 |
| | | **Template Decay Time:** | 35 years |

| Estimated Canister usage 18"x10' |
|---|
| 1 00 |

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8.7758E-10 | 49 45 | 98 90 | 0 00E+00 | 4 34E-08 | 8 68E-08 |
| Am-241 | 1 4352E-01 | 49 45 | 98 90 | 0 00E+00 | 7 10E+00 | 1 42E+01 |
| Am-242m | 2 8698E-04 | 49 45 | 98 90 | 0 00E+00 | 1 42E-02 | 2.84E-02 |
| Am-243 | 6.2565E-04 | 49 45 | 98 90 | 0 00E+00 | 3 09E-02 | 6.19E-02 |
| C-14 | 4 7901E-05 | 49 45 | 98 90 | 0 00E+00 | 2 37E-03 | 4.74E-03 |
| Cl-36 | 8 0297E-07 | 49 45 | 98 90 | 0 00E+00 | 3 97E-05 | 7.94E-05 |
| Cm-243 | 2 5081E-04 | 49 45 | 98 90 | 0 00E+00 | 1.24E-02 | 2 48E-02 |
| Cm-244 | 4 9015E-02 | 49 45 | 98 90 | 0 00E+00 | 2 42E+00 | 4 85E+00 |
| Co-60 | 2 5581E-03 | 49 45 | 98 90 | 0 00E+00 | 1 26E-01 | 2.53E-01 |
| Cs-134 | 4 0536E-05 | 49 45 | 98 90 | 0 00E+00 | 2 00E-03 | 4 01E-03 |
| Cs-135 | 1 4433E-05 | 49 45 | 98 90 | 0 00E+00 | 7 14E-04 | 1 43E-03 |
| Cs-137 | 1 3979E+00 | 49 45 | 98 90 | 0 00E+00 | 6 91E+01 | 1 38E+02 |
| Eu-154 | 2 0203E-02 | 49 45 | 98 90 | 0 00E+00 | 9 99E-01 | 2 00E+00 |
| Eu-155 | 1 7684E-03 | 49 45 | 98 90 | 0 00E+00 | 8.74E-02 | 1 75E-01 |
| Fe-55 | 4 3136E-05 | 49 45 | 98 90 | 0 00E+00 | 2 13E-03 | 4.27E-03 |
| H-3 | 2 0769E-02 | 49 45 | 98 90 | 0 00E+00 | 1 03E+00 | 2 05E+00 |
| I-129 | 9 8288E-07 | 49 45 | 98.90 | 0 00E+00 | 4 86E-05 | 9 72E-05 |
| Kr-85 | 2 8214E-02 | 49 45 | 98 90 | 0 00E+00 | 1 40E+00 | 2.79E+00 |
| Np-237 | 1 1218E-05 | 49 45 | 98.90 | 0 00E+00 | 5.55E-04 | 1 11E-03 |
| Pa-231 | 1 3036E-09 | 49 45 | 98.90 | 0 00E+00 | 6.45E-08 | 1 29E-07 |
| Pb-210 | 8 5078E-11 | 49 45 | 98 90 | 0 00E+00 | 4.21E-09 | 8 41E-09 |
| Pm-147 | 3 6531E-04 | 49 45 | 98 90 | 0 00E+00 | 1 81E-02 | 3 61E-02 |
| Pu-238 | 7 4564E-02 | 49 45 | 98.90 | 0 00E+00 | 3 69E+00 | 7 37E+00 |
| Pu-239 | 1 1623E-02 | 49 45 | 98.90 | 0 00E+00 | 5.75E-01 | 1 15E+00 |
| Pu-240 | 1 5132E-02 | 49 45 | 98.90 | 0 00E+00 | 7.48E-01 | 1 50E+00 |
| Pu-241 | 9 0036E-01 | 49 45 | 98.90 | 0 00E+00 | 4 45E+01 | 8 90E+01 |
| Pu-242 | 6.4260E-05 | 49 45 | 98.90 | 0 00E+00 | 3.18E-03 | 6 36E-03 |
| Ra-226 | 2 2804E-10 | 49 45 | 98.90 | 0 00E+00 | 1.13E-08 | 2 26E-08 |
| Ra-228 | 5 2713E-12 | 49 45 | 98 90 | 0 00E+00 | 2 61E-10 | 5 21E-10 |
| Ru-106 | 6.1160E-10 | 49 45 | 98.90 | 0 00E+00 | 3 02E-08 | 6 05E-08 |
| Se-79 | 1.2377E-05 | 49 45 | 98.90 | 0 00E+00 | 6.12E-04 | 1 22E-03 |
| Sn-126 | 2 5210E-05 | 49 45 | 98.90 | 0 00E+00 | 1.25E-03 | 2 49E-03 |
| Sr-90 | 9 1667E-01 | 49 45 | 98.90 | 0 00E+00 | 4 53E+01 | 9 07E+01 |
| Tc-99 | 3.9357E-04 | 49 45 | 98 90 | 0 00E+00 | 1.95E-02 | 3 89E-02 |
| Th-229 | 1.2057E-10 | 49 45 | 98.90 | 0 00E+00 | 5 96E-09 | 1 19E-08 |
| Th-230 | 2.1043E-08 | 49 45 | 98.90 | 0 00E+00 | 1 04E-06 | 2 08E-06 |
| Th-232 | 5.2972E-12 | 49 45 | 98 90 | 0 00E+00 | 2 62E-10 | 5 24E-10 |
| Tl-208 | 1.7474E-07 | 49 45 | 98 90 | 0 00E+00 | 8 64E-06 | 1 73E-05 |
| U-232 | 4 7368E-07 | 49 45 | 98 90 | 0 00E+00 | 2.34E-05 | 4 68E-05 |
| U-233 | 2.5097E-08 | 49 45 | 98 90 | 0 00E+00 | 1.24E-06 | 2 48E-06 |
| U-234 | 5 0000E-05 | 49 45 | 98 90 | 0 00E+00 | 2 47E-03 | 4 94E-03 |
| U-235 | -1 4489E-06 | 49 45 | 0.00 | 2.10E-02 | 2.10E-02 | 2.10E-02 |
| U-236 | 7.5824E-06 | 49 45 | 98 90 | 0.00E+00 | 3 75E-04 | 7 50E-04 |
| U-238 | -2 6129E-07 | 49 45 | 0 00 | 3.03E-02 | 3 03E-02 | 3 03E-02 |
| Y-90 | 9 1699E-01 | 49 45 | 98.90 | 0.00E+00 | 4 53E+01 | 9 07E+01 |
| Other Radionuclides | | | | | 6 64E+01 | 1 33E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 5 322E+12 |
| 0 0250 | 1 073E+12 |
| 0 0375 | 1 023E+12 |
| 0 0575 | 1 183E+12 |
| 0 0850 | 5.955E+11 |
| 0 1250 | 4 133E+11 |
| 0.2250 | 5 110E+11 |
| 0 3750 | 2 196E+11 |
| 0 5750 | 5 106E+12 |
| 0 8500 | 7 064E+10 |
| 1.2500 | 6.939E+10 |
| 1 7500 | 2 078E+09 |
| 2 2500 | 3.349E+05 |
| 2.7500 | 6.857E+05 |
| 3 5000 | 7 075E+04 |
| 5 0000 | 3 025E+04 |
| 7 0000 | 3 486E+03 |
| 11 0000 | 4 004E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 14E+00 | 2.28E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 9 74 | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches PWR Template on all but one parameter (enrichment) making PWR a reasonable match.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 47 48 | 49 45 |
| Bounding | | 98 90 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.01 | 1 04 |
| Bounding | 0.03 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | LOFT CORNER FUEL MODULE | [1]Fuel decay start date | 1975 |
| SNF ID # | 128 | Estimates as of: | 2010 |
| Fuel Units & Descr: | 4 - 11 X 11 ROD ARRAY | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=279 864kg EOL=279 053kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage: 18"x10' 2 00

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 780.26 | 1,560 52 | 0 00E+00 | 6 85E-07 | 1.37E-06 |
| Am-241 | 1 4352E-01 | 780.26 | 1,560 52 | 0 00E+00 | 1 12E+02 | 2.24E+02 |
| Am-242m | 2.8698E-04 | 780.26 | 1,560 52 | 0 00E+00 | 2 24E-01 | 4 48E-01 |
| Am-243 | 6.2565E-04 | 780 26 | 1,560 52 | 0 00E+00 | 4 88E-01 | 9 76E-01 |
| C-14 | 4 7901E-05 | 780 26 | 1,560 52 | 0 00E+00 | 3 74E-02 | 7 47E-02 |
| Cl-36 | 8 0297E-07 | 780 26 | 1,560 52 | 0 00E+00 | 6 27E-04 | 1 25E-03 |
| Cm-243 | 2 5081E-04 | 780 26 | 1,560 52 | 0 00E+00 | 1 96E-01 | 3 91E-01 |
| Cm-244 | 4 9015E-02 | 780 26 | 1,560.52 | 0 00E+00 | 3 82E+01 | 7 65E+01 |
| Co-60 | 2 5581E-03 | 780 26 | 1,560.52 | 0 00E+00 | 2 00E+00 | 3 99E+00 |
| Cs-134 | 4 0536E-05 | 780 26 | 1,560.52 | 0 00E+00 | 3 16E-02 | 6 33E-02 |
| Cs-135 | 1 4433E-05 | 780 26 | 1,560 52 | 0 00E+00 | 1.13E-02 | 2 25E-02 |
| Cs-137 | 1.3979E+00 | 780.26 | 1,560 52 | 0 00E+00 | 1 09E+03 | 2 18E+03 |
| Eu-154 | 2 0203E-02 | 780.26 | 1,560 52 | 0 00E+00 | 1 58E+01 | 3 15E+01 |
| Eu-155 | 1 7684E-03 | 780.26 | 1,560 52 | 0 00E+00 | 1 38E+00 | 2 76E+00 |
| Fe-55 | 4 3136E-05 | 780.26 | 1,560 52 | 0 00E+00 | 3.37E-02 | 6 73E-02 |
| H-3 | 2 0769E-02 | 780.26 | 1,560 52 | 0 00E+00 | 1 62E+01 | 3.24E+01 |
| I-129 | 9 8288E-07 | 780.26 | 1,560 52 | 0 00E+00 | 7.67E-04 | 1.53E-03 |
| Kr-85 | 2 8214E-02 | 780.26 | 1,560 52 | 0 00E+00 | 2.20E+01 | 4 40E+01 |
| Np-237 | 1 1218E-05 | 780.26 | 1,560 52 | 0 00E+00 | 8 75E-03 | 1.75E-02 |
| Pa-231 | 1.3036E-09 | 780.26 | 1,560 52 | 0 00E+00 | 1 02E-06 | 2 03E-06 |
| Pb-210 | 8 5078E-11 | 780.26 | 1,560 52 | 0 00E+00 | 6 64E-08 | 1.33E-07 |
| Pm-147 | 3 6531E-04 | 780.26 | 1,560 52 | 0 00E+00 | 2 85E-01 | 5 70E-01 |
| Pu-238 | 7 4564E-02 | 780 26 | 1,560 52 | 0 00E+00 | 5 82E+01 | 1 16E+02 |
| Pu-239 | 1.1623E-02 | 780 26 | 1,560 52 | 0 00E+00 | 9 07E+00 | 1 81E+01 |
| Pu-240 | 1.5132E-02 | 780 26 | 1,560 52 | 0 00E+00 | 1 18E+01 | 2.36E+01 |
| Pu-241 | 9 0036E-01 | 780 26 | 1,560 52 | 0 00E+00 | 7 03E+02 | 1 41E+03 |
| Pu-242 | 6 4260E-05 | 780 26 | 1,560 52 | 0 00E+00 | 5 01E-02 | 1 00E-01 |
| Ra-226 | 2.2804E-10 | 780 26 | 1,560 52 | 0 00E+00 | 1 78E-07 | 3 56E-07 |
| Ra-228 | 5.2713E-12 | 780 26 | 1,560 52 | 0 00E+00 | 4 11E-09 | 8 23E-09 |
| Ru-106 | 6 1160E-10 | 780 26 | 1,560 52 | 0 00E+00 | 4 77E-07 | 9 54E-07 |
| Se-79 | 1.2377E-05 | 780 26 | 1,560.52 | 0 00E+00 | 9 66E-03 | 1 93E-02 |
| Sn-126 | 2 5210E-05 | 780 26 | 1,560.52 | 0 00E+00 | 1 97E-02 | 3 93E-02 |
| Sr-90 | 9 1667E-01 | 780 26 | 1,560.52 | 0 00E+00 | 7 15E+02 | 1 43E+03 |
| Tc-99 | 3 9357E-04 | 780.26 | 1,560.52 | 0 00E+00 | 3 07E-01 | 6 14E-01 |
| Th-229 | 1.2057E-10 | 780.26 | 1,560 52 | 0 00E+00 | 9 41E-08 | 1 88E-07 |
| Th-230 | 2 1043E-08 | 780.26 | 1,560 52 | 0 00E+00 | 1 64E-05 | 3.28E-05 |
| Th-232 | 5 2972E-12 | 780.26 | 1,560 52 | 0 00E+00 | 4.13E-09 | 8.27E-09 |
| Tl-208 | 1 7474E-07 | 780.26 | 1,560 52 | 0 00E+00 | 1.36E-04 | 2.73E-04 |
| U-232 | 4 7368E-07 | 780.26 | 1,560 52 | 0 00E+00 | 3 70E-04 | 7.39E-04 |
| U-233 | 2 5097E-08 | 780.26 | 1,560 52 | 0 00E+00 | 1.96E-05 | 3 92E-05 |
| U-234 | 5 0000E-05 | 780.26 | 1,560 52 | 0 00E+00 | 3.90E-02 | 7.80E-02 |
| U-235 | -1.4489E-06 | 780.26 | 0 00 | 2 42E-02 | 2.31E-02 | 2 42E-02 |
| U-236 | 7.5824E-06 | 780.26 | 1,560 52 | 0 00E+00 | 5.92E-03 | 1 18E-02 |
| U-238 | -2.6129E-07 | 780.26 | 0 00 | 9 03E-02 | 9 01E-02 | 9 03E-02 |
| Y-90 | 9 1699E-01 | 780.26 | 1,560 52 | 0 00E+00 | 7.15E+02 | 1.43E+03 |
| Other Radionuclides | | | | | 1 05E+03 | 2 09E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0.0150 | 8.397E+13 |
| 0 0250 | 1 693E+13 |
| 0 0375 | 1 615E+13 |
| 0 0575 | 1.866E+13 |
| 0 0850 | 9 395E+12 |
| 0 1250 | 6 520E+12 |
| 0.2250 | 8 057E+12 |
| 0.3750 | 3 464E+12 |
| 0.5750 | 8 057E+13 |
| 0 8500 | 1 115E+12 |
| 1.2500 | 1 095E+12 |
| 1 7500 | 3.279E+10 |
| 2.2500 | 5 281E+06 |
| 2 7500 | 1 082E+07 |
| 3 5000 | 1 114E+06 |
| 5 0000 | 4 764E+05 |
| 7 0000 | 5 491E+04 |
| 11 0000 | 6.306E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.80E+01 | 3.59E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment %. | 4 000514536 | 0 to 5 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 780.26 | 771 41 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 1,560 52 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 08 | 0 99 |
| Bounding | 0 16 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: LOFT FUEL RODS
SNF ID #: 924
Fuel Units & Descr: 2 - ROD
Heavy Metal Mass: BOL= , EOL=1 895kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1975
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage

| 18"x10' |
|---|
| 0 67 |

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 11.83 | 23 65 | 0 00E+00 | 1.04E-08 | 2 08E-08 |
| Am-241 | 1 4352E-01 | 11.83 | 23 65 | 0 00E+00 | 1 70E+00 | 3 39E+00 |
| Am-242m | 2 8698E-04 | 11.83 | 23 65 | 0 00E+00 | 3.39E-03 | 6.79E-03 |
| Am-243 | 6 2565E-04 | 11.83 | 23 65 | 0 00E+00 | 7.40E-03 | 1 48E-02 |
| C-14 | 4 7901E-05 | 11.83 | 23 65 | 0 00E+00 | 5 66E-04 | 1.13E-03 |
| Cl-36 | 8 0297E-07 | 11.83 | 23 65 | 0 00E+00 | 9.50E-06 | 1.90E-05 |
| Cm-243 | 2 5081E-04 | 11.83 | 23 65 | 0 00E+00 | 2 97E-03 | 5 93E-03 |
| Cm-244 | 4 9015E-02 | 11 83 | 23 65 | 0 00E+00 | 5 80E-01 | 1 16E+00 |
| Co-60 | 2 5581E-03 | 11 83 | 23 65 | 0 00E+00 | 3 03E-02 | 6 05E-02 |
| Cs-134 | 4 0536E-05 | 11 83 | 23 65 | 0 00E+00 | 4 79E-04 | 9 59E-04 |
| Cs-135 | 1 4433E-05 | 11 83 | 23 65 | 0 00E+00 | 1.71E-04 | 3 41E-04 |
| Cs-137 | 1 3979E+00 | 11 83 | 23 65 | 0 00E+00 | 1 65E+01 | 3.31E+01 |
| Eu-154 | 2 0203E-02 | 11 83 | 23 65 | 0 00E+00 | 2 39E-01 | 4 78E-01 |
| Eu-155 | 1 7684E-03 | 11 83 | 23 65 | 0 00E+00 | 2 09E-02 | 4 18E-02 |
| Fe-55 | 4 3136E-05 | 11 83 | 23 65 | 0.00E+00 | 5 10E-04 | 1 02E-03 |
| H-3 | 2 0769E-02 | 11 83 | 23 65 | 0 00E+00 | 2 46E-01 | 4 91E-01 |
| I-129 | 9 8288E-07 | 11 83 | 23 65 | 0 00E+00 | 1 16E-05 | 2.32E-05 |
| Kr-85 | 2 8214E-02 | 11 83 | 23 65 | 0 00E+00 | 3 34E-01 | 6 67E-01 |
| Np-237 | 1 1218E-05 | 11 83 | 23 65 | 0 00E+00 | 1.33E-04 | 2 65E-04 |
| Pa-231 | 1 3036E-09 | 11 83 | 23 65 | 0 00E+00 | 1 54E-08 | 3 08E-08 |
| Pb-210 | 8 5078E-11 | 11 83 | 23 65 | 0 00E+00 | 1 01E-09 | 2 01E-09 |
| Pm-147 | 3 6531E-04 | 11 83 | 23 65 | 0 00E+00 | 4 32E-03 | 8 64E-03 |
| Pu-238 | 7 4564E-02 | 11 83 | 23 65 | 0 00E+00 | 8 82E-01 | 1 76E+00 |
| Pu-239 | 1 1623E-02 | 11 83 | 23 65 | 0 00E+00 | 1 37E-01 | 2 75E-01 |
| Pu-240 | 1 5132E-02 | 11 83 | 23 65 | 0 00E+00 | 1 79E-01 | 3 58E-01 |
| Pu-241 | 9 0036E-01 | 11 83 | 23 65 | 0 00E+00 | 1 06E+01 | 2.13E+01 |
| Pu-242 | 6 4260E-05 | 11 83 | 23 65 | 0 00E+00 | 7 60E-04 | 1 52E-03 |
| Ra-226 | 2.2804E-10 | 11 83 | 23.65 | 0 00E+00 | 2 70E-09 | 5 39E-09 |
| Ra-228 | 5.2713E-12 | 11 83 | 23 65 | 0 00E+00 | 6 23E-11 | 1 25E-10 |
| Ru-106 | 6 1160E-10 | 11 83 | 23 65 | 0 00E+00 | 7 23E-09 | 1 45E-08 |
| Se-79 | 1 2377E-05 | 11 83 | 23 65 | 0 00E+00 | 1 46E-04 | 2 93E-04 |
| Sn-126 | 2.5210E-05 | 11 83 | 23 65 | 0 00E+00 | 2 98E-04 | 5 96E-04 |
| Sr-90 | 9 1667E-01 | 11 83 | 23 65 | 0 00E+00 | 1 08E+01 | 2 17E+01 |
| Tc-99 | 3 9357E-04 | 11 83 | 23 65 | 0 00E+00 | 4 65E-03 | 9 31E-03 |
| Th-229 | 1.2057E-10 | 11 83 | 23 65 | 0 00E+00 | 1 43E-09 | 2 85E-09 |
| Th-230 | 2.1043E-08 | 11 83 | 23.65 | 0 00E+00 | 2 49E-07 | 4 98E-07 |
| Th-232 | 5.2972E-12 | 11 83 | 23.65 | 0 00E+00 | 6 26E-11 | 1 25E-10 |
| Tl-208 | 1.7474E-07 | 11 83 | 23.65 | 0 00E+00 | 2 07E-06 | 4 13E-06 |
| U-232 | 4.7368E-07 | 11 83 | 23.65 | 0 00E+00 | 5 60E-06 | 1 12E-05 |
| U-233 | 2.5097E-08 | 11 83 | 23 65 | 0 00E+00 | 2 97E-07 | 5 94E-07 |
| U-234 | 5 0000E-05 | 11 83 | 23 65 | 0 00E+00 | 5 91E-04 | 1 18E-03 |
| U-235 | -1 4489E-06 | 11 83 | 0 00 | 1 32E-04 | 1.15E-04 | 1 32E-04 |
| U-236 | 7.5824E-06 | 11 83 | 23 65 | 0 00E+00 | 8 97E-05 | 1 79E-04 |
| U-238 | -2 6129E-07 | 11 83 | 0 00 | 6.20E-04 | 6 17E-04 | 6.20E-04 |
| Y-90 | 9.1699E-01 | 11 83 | 23 65 | 0 00E+00 | 1 08E+01 | 2 17E+01 |
| Other Radionuclides | | | | | 1 59E+01 | 3 17E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1.273E+12 |
| 0 0250 | 2.566E+11 |
| 0 0375 | 2 448E+11 |
| 0 0575 | 2 828E+11 |
| 0 0850 | 1 424E+11 |
| 0 1250 | 9 882E+10 |
| 0 2250 | 1.221E+11 |
| 0 3750 | 5 251E+10 |
| 0 5750 | 1.221E+12 |
| 0 8500 | 1 689E+10 |
| 1 2500 | 1 660E+10 |
| 1 7500 | 4 970E+08 |
| 2.2500 | 8 003E+04 |
| 2.7500 | 1 640E+05 |
| 3.5000 | 1 688E+04 |
| 5 0000 | 7.219E+03 |
| 7 0000 | 8 320E+02 |
| 11 0000 | 9 556E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.72E-01 | 5.44E-01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 0 to 5 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 11 83 |
| Bounding | | 23 65 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=1.907kg
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.18 | |
| Bounding | 0.35 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | LOFT SQUARE FUEL MODULE | [1]Fuel decay start date | 1975 |
| SNF ID # | 129 | Estimates as of: | 2010 |
| Fuel Units & Descr | 4 - 15 X 15 ROD ARRAY | Template: | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=815 6kg EOL=813 026kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00176911 |
| | | Template Decay Time: | 35 years |

Estimated Canister usage: 18"x10' 4 00

**II. Estimates**

| Radionuclide | m: CI/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (CI) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 2,447.37 | 4,894 74 | 0 00E+00 | 2.15E-06 | 4.30E-06 |
| Am-241 | 1 4352E-01 | 2,447 37 | 4,894 74 | 0 00E+00 | 3 51E+02 | 7.03E+02 |
| Am-242m | 2 8698E-04 | 2,447.37 | 4,894 74 | 0.00E+00 | 7.02E-01 | 1.40E+00 |
| Am-243 | 6.2565E-04 | 2,447.37 | 4,894 74 | 0.00E+00 | 1.53E+00 | 3.06E+00 |
| C-14 | 4 7901E-05 | 2,447.37 | 4,894 74 | 0 00E+00 | 1.17E-01 | 2.34E-01 |
| Cl-36 | 8 0297E-07 | 2,447.37 | 4,894 74 | 0 00E+00 | 1.97E-03 | 3 93E-03 |
| Cm-243 | 2.5081E-04 | 2,447.37 | 4,894 74 | 0.00E+00 | 6.14E-01 | 1.23E+00 |
| Cm-244 | 4 9015E-02 | 2,447.37 | 4,894 74 | 0 00E+00 | 1.20E+02 | 2.40E+02 |
| Co-60 | 2.5581E-03 | 2,447.37 | 4,894 74 | 0 00E+00 | 6.26E+00 | 1.25E+01 |
| Cs-134 | 4.0536E-05 | 2,447.37 | 4,894 74 | 0 00E+00 | 9.92E-02 | 1 98E-01 |
| Cs-135 | 1.4433E-05 | 2,447.37 | 4,894 74 | 0 00E+00 | 3.53E-02 | 7 06E-02 |
| Cs-137 | 1.3979E+00 | 2,447.37 | 4,894 74 | 0 00E+00 | 3 42E+03 | 6 84E+03 |
| Eu-154 | 2 0203E-02 | 2,447.37 | 4,894 74 | 0 00E+00 | 4 94E+01 | 9 89E+01 |
| Eu-155 | 1.7684E-03 | 2,447.37 | 4,894 74 | 0 00E+00 | 4 33E+00 | 8 66E+00 |
| Fe-55 | 4.3136E-05 | 2,447.37 | 4,894 74 | 0 00E+00 | 1.06E-01 | 2 11E-01 |
| H-3 | 2 0769E-02 | 2,447.37 | 4,894 74 | 0 00E+00 | 5 08E+01 | 1 02E+02 |
| I-129 | 9 8288E-07 | 2,447.37 | 4,894 74 | 0 00E+00 | 2.41E-03 | 4 81E-03 |
| Kr-85 | 2 8214E-02 | 2,447.37 | 4,894 74 | 0 00E+00 | 6.90E+01 | 1.38E+02 |
| Np-237 | 1 1218E-05 | 2,447.37 | 4,894 74 | 0 00E+00 | 2 75E-02 | 5 49E-02 |
| Pa-231 | 1.3036E-09 | 2,447.37 | 4,894 74 | 0 00E+00 | 3 19E-06 | 6 38E-06 |
| Pb-210 | 8 5078E-11 | 2,447.37 | 4,894 74 | 0 00E+00 | 2 08E-07 | 4 16E-07 |
| Pm-147 | 3 6531E-04 | 2,447.37 | 4,894 74 | 0 00E+00 | 8 94E-01 | 1 79E+00 |
| Pu-238 | 7 4564E-02 | 2,447.37 | 4,894 74 | 0 00E+00 | 1.82E+02 | 3 65E+02 |
| Pu-239 | 1 1623E-02 | 2,447.37 | 4,894.74 | 0 00E+00 | 2.84E+01 | 5 69E+01 |
| Pu-240 | 1.5132E-02 | 2,447.37 | 4,894.74 | 0 00E+00 | 3.70E+01 | 7 41E+01 |
| Pu-241 | 9 0036E-01 | 2,447.37 | 4,894.74 | 0 00E+00 | 2.20E+03 | 4 41E+03 |
| Pu-242 | 6 4260E-05 | 2,447.37 | 4,894.74 | 0 00E+00 | 1 57E-01 | 3 15E-01 |
| Ra-226 | 2.2804E-10 | 2,447.37 | 4,894.74 | 0 00E+00 | 5 58E-07 | 1 12E-06 |
| Ra-228 | 5 2713E-12 | 2,447.37 | 4,894.74 | 0 00E+00 | 1 29E-08 | 2 58E-08 |
| Ru-106 | 6 1160E-10 | 2,447.37 | 4,894.74 | 0 00E+00 | 1 50E-06 | 2 99E-06 |
| Se-79 | 1.2377E-05 | 2,447.37 | 4,894.74 | 0 00E+00 | 3 03E-02 | 6 06E-02 |
| Sn-126 | 2 5210E-05 | 2,447.37 | 4,894.74 | 0 00E+00 | 6 17E-02 | 1.23E-01 |
| Sr-90 | 9 1667E-01 | 2,447.37 | 4,894 74 | 0 00E+00 | 2.24E+03 | 4 49E+03 |
| Tc-99 | 3 9357E-04 | 2,447.37 | 4,894 74 | 0 00E+00 | 9 63E-01 | 1 93E+00 |
| Th-229 | 1 2057E-10 | 2,447 37 | 4,894.74 | 0 00E+00 | 2 95E-07 | 5 90E-07 |
| Th-230 | 2 1043E-08 | 2,447 37 | 4,894 74 | 0 00E+00 | 5 15E-05 | 1.03E-04 |
| Th-232 | 5 2972E-12 | 2,447 37 | 4,894 74 | 0 00E+00 | 1 30E-08 | 2.59E-08 |
| Tl-208 | 1 7474E-07 | 2,447 37 | 4,894 74 | 0 00E+00 | 4 28E-04 | 8.55E-04 |
| U-232 | 4 7368E-07 | 2,447 37 | 4,894 74 | 0 00E+00 | 1 16E-03 | 2.32E-03 |
| U-233 | 2 5097E-08 | 2,447 37 | 4,894 74 | 0 00E+00 | 6 14E-05 | 1.23E-04 |
| U-234 | 5 0000E-05 | 2,447 37 | 4,894 74 | 0 00E+00 | 1.22E-01 | 2.45E-01 |
| U-235 | -1.4489E-06 | 2,447 37 | 0 00 | 7 05E-02 | 6 70E-02 | 7.05E-02 |
| U-236 | 7 5824E-06 | 2,447 37 | 4,894 74 | 0 00E+00 | 1 86E-02 | 3 71E-02 |
| U-238 | -2.6129E-07 | 2,447 37 | 0 00 | 2 63E-01 | 2 63E-01 | 2 63E-01 |
| Y-90 | 9 1699E-01 | 2,447 37 | 4,894 74 | 0 00E+00 | 2 24E+03 | 4 49E+03 |
| Other Radionuclides | | | | | 3 29E+03 | 6.57E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.634E+14 |
| 0 0250 | 5.311E+13 |
| 0 0375 | 5.065E+13 |
| 0 0575 | 5.853E+13 |
| 0 0850 | 2.947E+13 |
| 0 1250 | 2.045E+13 |
| 0.2250 | 2.527E+13 |
| 0.3750 | 1.087E+13 |
| 0.5750 | 2.527E+14 |
| 0.8500 | 3 496E+12 |
| 1.2500 | 3 434E+12 |
| 1 7500 | 1.028E+11 |
| 2.2500 | 1.656E+07 |
| 2 7500 | 3.393E+07 |
| 3.5000 | 3 495E+06 |
| 5 0000 | 1.494E+06 |
| 7 0000 | 1 722E+05 |
| 11 0000 | 1.978E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.63E+01 | 1 13E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 4 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 2,418.25 | 2,447.37 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 4 894 74 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 09 | 1 01 | 1.00 |
| Bounding | 0 17 | - | |

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: LOOSE FUEL ROD STORAGE BASKET (LFRSB)
SNF ID #: 126
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass: BOL= , EOL=311 112kg
ROD Storage Site INEEL

[1]Fuel decay start date. 1983
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT). 0 00012882
Template Decay Time: 25 years

Estimated Canister usage: 18"x15' — 1 00

**II. Estimates**

| Radionuclide | m: Cv/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3562E-08 | 293,891.20 | 293,891.20 | 0 00E+00 | 3 99E-03 | 3 99E-03 |
| Am-241 | 1 0168E-04 | 293,891.20 | 293,891.20 | 0 00E+00 | 2 99E+01 | 2 99E+01 |
| Am-242m | 8 9052E-09 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.62E-03 | 2 62E-03 |
| Am-243 | 9 8602E-10 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.90E-04 | 2 90E-04 |
| C-14 | 2.3045E-04 | 293,891.20 | 293,891.20 | 0 00E+00 | 6 77E+01 | 6 77E+01 |
| Cl-36 | 1.2261E-06 | 293,891.20 | 293,891.20 | 0 00E+00 | 3 60E-01 | 3 60E-01 |
| Cm-243 | 3 1730E-10 | 293,891.20 | 293,891.20 | 0 00E+00 | 9 33E-05 | 9.33E-05 |
| Cm-244 | 3.3977E-09 | 293,891.20 | 293,891.20 | 0 00E+00 | 9 99E-04 | 9 99E-04 |
| Co-60 | 2 6373E-01 | 293,891.20 | 293,891.20 | 0 00E+00 | 7 75E+04 | 7 75E+04 |
| Cs-134 | 8 7072E-05 | 293,891.20 | 293 891.20 | 0 00E+00 | 2 56E+01 | 2 56E+01 |
| Cs-135 | 3 0316E-05 | 293,891.20 | 293,891.20 | 0 00E+00 | 8 91E+00 | 8 91E+00 |
| Cs-137 | 1 8286E+00 | 293,891.20 | 293,891.20 | 0 00E+00 | 5 37E+05 | 5 37E+05 |
| Eu-154 | 1 4982E-03 | 293,891.20 | 293,891.20 | 0 00E+00 | 4 40E+02 | 4 40E+02 |
| Eu-155 | 2 8236E-03 | 293,891.20 | 293,891.20 | 0 00E+00 | 8 30E+02 | 8 30E+02 |
| Fe-55 | 1 7687E-02 | 293,891.20 | 293,891.20 | 0 00E+00 | 5.20E+03 | 5.20E+03 |
| H-3 | 4 4043E-03 | 293,891.20 | 293,891.20 | 0 00E+00 | 1 29E+03 | 1.29E+03 |
| I-129 | 7 3195E-07 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.15E-01 | 2.15E-01 |
| Kr-85 | 7 8769E-02 | 293,891.20 | 293,891.20 | 0 00E+00 | 2 31E+04 | 2.31E+04 |
| Np-237 | 1 1484E-06 | 293,891.20 | 293,891.20 | 0 00E+00 | 3 38E-01 | 3.38E-01 |
| Pa-231 | 3 2396E-08 | 293,891.20 | 293,891.20 | 0 00E+00 | 9 52E-03 | 9.52E-03 |
| Pb-210 | 2 4409E-13 | 293,891.20 | 293,891.20 | 0 00E+00 | 7.17E-08 | 7.17E-08 |
| Pm-147 | 1 6331E-02 | 293,891.20 | 293,891.20 | 0 00E+00 | 4 80E+03 | 4 80E+03 |
| Pu-238 | 3 1947E-04 | 293,891.20 | 293,891.20 | 0 00E+00 | 9 39E+01 | 9 39E+01 |
| Pu-239 | 6 6789E-04 | 293,891.20 | 293,891.20 | 0 00E+00 | 1 96E+02 | 1 96E+02 |
| Pu-240 | 8 6922E-05 | 293,891.20 | 293,891.20 | 0 00E+00 | 2 55E+01 | 2 55E+01 |
| Pu-241 | 1 1567E-03 | 293,891.20 | 293,891.20 | 0 00E+00 | 3 40E+02 | 3 40E+02 |
| Pu-242 | 1 9717E-09 | 293,891.20 | 293 891.20 | 0 00E+00 | 5.79E-04 | 5.79E-04 |
| Ra-226 | 8 6190E-13 | 293,891.20 | 293,891.20 | 0 00E+00 | 2 53E-07 | 2.53E-07 |
| Ra-228 | 8 1498E-12 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.40E-06 | 2.40E-06 |
| Ru-106 | 1 7770E-07 | 293,891.20 | 293,891.20 | 0 00E+00 | 5 22E-02 | 5.22E-02 |
| Se-79 | 1 3225E-05 | 293,891.20 | 293,891.20 | 0 00E+00 | 3 89E+00 | 3 89E+00 |
| Sn-126 | 1 1493E-05 | 293,891.20 | 293,891.20 | 0 00E+00 | 3.38E+00 | 3 38E+00 |
| Sr-90 | 1 7321E+00 | 293,891.20 | 293,891.20 | 0 00E+00 | 5 09E+05 | 5 09E+05 |
| Tc-99 | 4 6656E-04 | 293,891.20 | 293,891.20 | 0 00E+00 | 1 37E+02 | 1 37E+02 |
| Th-229 | 1 0110E-11 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.97E-06 | 2.97E-06 |
| Th-230 | 1 1466E-10 | 293,891.20 | 293,891.20 | 0 00E+00 | 3.37E-05 | 3.37E-05 |
| Th-232 | 8 3245E-12 | 293,891.20 | 293,891.20 | 0 00E+00 | 2.45E-06 | 2 45E-06 |
| Tl-208 | 2 3860E-08 | 293,891.20 | 293,891.20 | 0 00E+00 | 7.01E-03 | 7.01E-03 |
| U-232 | 6 4576E-08 | 293,891.20 | 293,891.20 | 0 00E+00 | 1.90E-02 | 1.90E-02 |
| U-233 | 3 1082E-09 | 293,891.20 | 293,891.20 | 0 00E+00 | 9.13E-04 | 9.13E-04 |
| U-234 | 3 7587E-07 | 293,891.20 | 293,891.20 | 0 00E+00 | 1.10E-01 | 1.10E-01 |
| U-235 | -2 7761E-06 | 293,891.20 | 0 00 | 1.26E+00 | 4.41E-01 | 1.26E+00 |
| U-236 | 1 6190E-05 | 293,891.20 | 293,891.20 | 0 00E+00 | 4 76E+00 | 4 76E+00 |
| U-238 | -2 8547E-09 | 293,891.20 | 0 00 | 1 36E-02 | 1.27E-02 | 1.36E-02 |
| Y-90 | 1 7321E+00 | 293,891.20 | 293,891.20 | 0 00E+00 | 5 09E+05 | 5 09E+05 |
| Other Radionuclides | | | | | 5 96E+05 | 5 96E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 796E+16 |
| 0 0250 | 5 810E+15 |
| 0 0375 | 5 015E+15 |
| 0 0575 | 5 410E+15 |
| 0 0850 | 3.272E+15 |
| 0 1250 | 2.126E+15 |
| 0.2250 | 2 807E+15 |
| 0 3750 | 1.225E+15 |
| 0.5750 | 2 001E+16 |
| 0 8500 | 2 087E+14 |
| 1.2500 | 5 812E+15 |
| 1 7500 | 5 375E+12 |
| 2.2500 | 3 096E+10 |
| 2.7500 | 3 407E+08 |
| 3 5000 | 7 197E+04 |
| 5 0000 | 7 292E+03 |
| 7 0000 | 8 051E+02 |
| 11 0000 | 9 033E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.29E+03 | 7.29E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | UNKNOWN | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 293 891.20 |
| Bounding | | 293 891.20 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup.
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: LWR SNF SCRAP (ZR/SST)
SNF ID #: 940
Fuel Units & Descr: 9 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=161.862kg, EOL=154.224kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1983
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage: 18"x10" 0 69

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 7,263 66 | 14,527.32 | 0 00E+00 | 4 82E-06 | 9 64E-06 |
| Am-241 | 1 3144E-01 | 7,263 66 | 14,527.32 | 0 00E+00 | 9 55E+02 | 1 91E+03 |
| Am-242m | 3 0039E-04 | 7,263 66 | 14,527.32 | 0 00E+00 | 2 18E+00 | 4 36E+00 |
| Am-243 | 6 2629E-04 | 7,263 66 | 14,527.32 | 0 00E+00 | 4 55E+00 | 9 10E+00 |
| C-14 | 4 7965E-05 | 7,263 66 | 14,527.32 | 0 00E+00 | 3 48E-01 | 6 97E-01 |
| Cl-36 | 8 0297E-07 | 7,263 66 | 14,527.32 | 0 00E+00 | 5 83E-03 | 1 17E-02 |
| Cm-243 | 3 1993E-04 | 7,263 66 | 14,527.32 | 0 00E+00 | 2.32E+00 | 4 65E+00 |
| Cm-244 | 7.1851E-02 | 7,263 66 | 14,527.32 | 0 00E+00 | 5.22E+02 | 1 04E+03 |
| Co-60 | 9 5220E-03 | 7,263 66 | 14,527.32 | 0 00E+00 | 6 92E+01 | 1 38E+02 |
| Cs-134 | 1 1662E-03 | 7,263 66 | 14,527.32 | 0 00E+00 | 8 47E+00 | 1 69E+01 |
| Cs-135 | 1 4433E-05 | 7,263 66 | 14,527.32 | 0 00E+00 | 1 05E-01 | 2 10E-01 |
| Cs-137 | 1.7603E+00 | 7,263 66 | 14,527 32 | 0 00E+00 | 1.28E+04 | 2 56E+04 |
| Eu-154 | 4 5203E-02 | 7,263 66 | 14,527 32 | 0 00E+00 | 3 28E+02 | 6 57E+02 |
| Eu-155 | 7.1479E-03 | 7,263 66 | 14,527 32 | 0 00E+00 | 5 19E+01 | 1 04E+02 |
| Fe-55 | 6.1919E-04 | 7,263 66 | 14,527 32 | 0 00E+00 | 4 50E+00 | 9 00E+00 |
| H-3 | 3 6386E-02 | 7,263 66 | 14,527 32 | 0 00E+00 | 2 64E+02 | 5.29E+02 |
| I-129 | 9 8288E-07 | 7,263 66 | 14,527 32 | 0 00E+00 | 7.14E-03 | 1 43E-02 |
| Kr-85 | 5.3844E-02 | 7,263 66 | 14,527 32 | 0 00E+00 | 3 91E+02 | 7.82E+02 |
| Np-237 | 1.0546E-05 | 7,263 66 | 14,527 32 | 0 00E+00 | 7 66E-02 | 1.53E-01 |
| Pa-231 | 1.1370E-09 | 7,263.66 | 14,527.32 | 0 00E+00 | 8.26E-06 | 1.65E-05 |
| Pb-210 | 3.3624E-11 | 7,263 66 | 14,527 32 | 0 00E+00 | 2 44E-07 | 4 88E-07 |
| Pm-147 | 5 1211E-03 | 7,263 66 | 14,527 32 | 0 00E+00 | 3 72E+01 | 7.44E+01 |
| Pu-238 | 8 0669E-02 | 7,263.66 | 14,527.32 | 0 00E+00 | 5 86E+02 | 1 17E+03 |
| Pu-239 | 1 1626E-02 | 7,263.66 | 14,527 32 | 0 00E+00 | 8 44E+01 | 1 69E+02 |
| Pu-240 | 1.5097E-02 | 7,263 66 | 14,527 32 | 0 00E+00 | 1 10E+02 | 2.19E+02 |
| Pu-241 | 1 4567E+00 | 7,263 66 | 14,527.32 | 0 00E+00 | 1 06E+04 | 2.12E+04 |
| Pu-242 | 6 4260E-05 | 7,263 66 | 14,527.32 | 0.00E+00 | 4 67E-01 | 9 34E-01 |
| Ra-226 | 1 1392E-10 | 7,263 66 | 14,527.32 | 0.00E+00 | 8.27E-07 | 1 65E-06 |
| Ra-228 | 5 1841E-12 | 7,263 66 | 14,527.32 | 0.00E+00 | 3.77E-08 | 7.53E-08 |
| Ru-106 | 5 9012E-07 | 7,263 66 | 14,527.32 | 0 00E+00 | 4.29E-03 | 8 57E-03 |
| Se-79 | 1 2379E-05 | 7,263 66 | 14,527.32 | 0 00E+00 | 8.99E-02 | 1 80E-01 |
| Sn-126 | 2 5210E-05 | 7,263 66 | 14,527.32 | 0.00E+00 | 1.83E-01 | 3 66E-01 |
| Sr-90 | 1 1630E+00 | 7,263 66 | 14,527.32 | 0 00E+00 | 8 45E+03 | 1 69E+04 |
| Tc-99 | 3 9357E-04 | 7,263 66 | 14,527.32 | 0 00E+00 | 2 86E+00 | 5 72E+00 |
| Th-229 | 8 5691E-11 | 7,263 66 | 14,527.32 | 0 00E+00 | 6.22E-07 | 1.24E-06 |
| Th-230 | 1 4493E-08 | 7,263 66 | 14,527.32 | 0 00E+00 | 1 05E-04 | 2 11E-04 |
| Th-232 | 5 2923E-12 | 7,263 66 | 14,527.32 | 0 00E+00 | 3 84E-08 | 7 69E-08 |
| Tl-208 | 1 9202E-07 | 7,263 66 | 14,527.32 | 0 00E+00 | 1.39E-03 | 2 79E-03 |
| U-232 | 5 2083E-07 | 7,263 66 | 14,527.32 | 0 00E+00 | 3 78E-03 | 7.57E-03 |
| U-233 | 2 4386E-08 | 7,263 66 | 14,527.32 | 0 00E+00 | 1.77E-04 | 3 54E-04 |
| U-234 | 4 7012E-05 | 7,263 66 | 14,527.32 | 0 00E+00 | 3 41E-01 | 6 83E-01 |
| U-235 | -1 4492E-06 | 7,263 66 | 0 00 | 1 37E-02 | 3 20E-03 | 1.37E-02 |
| U-236 | 7 5759E-06 | 7,263 66 | 14,527.32 | 0 00E+00 | 5 50E-02 | 1 10E-01 |
| U-238 | -2.6129E-07 | 7,263 66 | 0.00 | 5 23E-02 | 5 04E-02 | 5 23E-02 |
| Y-90 | 1.1631E+00 | 7,263 66 | 14,527.32 | 0 00E+00 | 8 45E+03 | 1 69E+04 |
| Other Radionuclides | | | | | 1.23E+04 | 2 45E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 879E+14 |
| 0 0250 | 2.001E+14 |
| 0 0375 | 1.936E+14 |
| 0 0575 | 2 112E+14 |
| 0 0850 | 1 119E+14 |
| 0 1250 | 8 177E+13 |
| 0.2250 | 9 609E+13 |
| 0.3750 | 4 123E+13 |
| 0 5750 | 9 474E+14 |
| 0.8500 | 1.870E+13 |
| 1.2500 | 2.526E+13 |
| 1 7500 | 5.535E+11 |
| 2.2500 | 1 022E+08 |
| 2.7500 | 1 149E+08 |
| 3.5000 | 1 506E+07 |
| 5.0000 | 6 434E+06 |
| 7.0000 | 7.418E+05 |
| 11.0000 | 8 521E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.99E+02 | 3.98E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC OR SST | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 3.923 | 0 to 5 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except possibly cladding

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 7,263 66 |
| Bounding | | 14,527.32 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.28 | |
| Bounding | 2.56 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: MISCELLANEOUS RSWF FUEL
SNF ID #: 366
Fuel Units & Descr: 1 - UNKNOWN
Heavy Metal Mass: BOL= ; EOL=4161.515kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1994
Estimates as of: 2010
Template: FFTF (FAST, SST, 10 to 30%, Pu & U)
[2]Template Burnup(MWd): 5011.2
Template BOL Heavy Metal Mass (MT): 0.0329181
Template Decay Time: 15 years

Estimated Canister usage: 18"x10'
2.00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3735E-12 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.72E-08 | 3.98E-08 |
| Am-241 | 7.9527E-02 | 12,522.18 | 28,967.98 | 8.05E+03 | 9.04E+03 | 1.04E+04 |
| Am-242m | 2.1053E-03 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.64E+01 | 6.10E+01 |
| Am-243 | 1.0760E-04 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.35E+00 | 3.12E+00 |
| C-14 | 2.6141E-05 | 12,522.18 | 28,967.98 | 0.00E+00 | 3.27E-01 | 7.57E-01 |
| Cl-36 | 3.4243E-10 | 12,522.18 | 28,967.98 | 0.00E+00 | 4.29E-06 | 9.92E-06 |
| Cm-243 | 6.6092E-04 | 12,522.18 | 28,967.98 | 0.00E+00 | 8.28E+00 | 1.91E+01 |
| Cm-244 | 2.9933E-03 | 12,522.18 | 28,967.98 | 0.00E+00 | 3.75E+01 | 8.67E+01 |
| Co-60 | 1.5934E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.00E+02 | 4.62E+02 |
| Cs-134 | 4.6356E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 5.80E+02 | 1.34E+03 |
| Cs-135 | 4.7693E-05 | 12,522.18 | 28,967.98 | 0.00E+00 | 5.97E-01 | 1.38E+00 |
| Cs-137 | 2.1113E+00 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.64E+04 | 6.12E+04 |
| Eu-154 | 4.8092E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 6.02E+02 | 1.39E+03 |
| Eu-155 | 6.8447E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 8.57E+02 | 1.98E+03 |
| Fe-55 | 5.8479E-03 | 12,522.18 | 28,967.98 | 0.00E+00 | 7.32E+01 | 1.69E+02 |
| H-3 | 8.9300E-03 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.12E+02 | 2.59E+02 |
| I-129 | 1.2891E-06 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.61E-02 | 3.73E-02 |
| Kr-85 | 7.0941E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 8.88E+02 | 2.06E+03 |
| Np-237 | 2.6541E-06 | 12,522.18 | 28,967.98 | 0.00E+00 | 3.32E-02 | 7.69E-02 |
| Pa-231 | 4.8970E-12 | 12,522.18 | 28,967.98 | 0.00E+00 | 6.13E-08 | 1.42E-07 |
| Pb-210 | 2.2170E-13 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.78E-09 | 6.42E-09 |
| Pm-147 | 2.3617E-01 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.96E+03 | 6.84E+03 |
| Pu-238 | 2.8636E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 3.59E+02 | 8.30E+02 |
| Pu-239 | -3.5520E-02 | 12,522.18 | 0.00 | 6.61E+04 | 6.56E+04 | 6.61E+04 |
| Pu-240 | 2.0790E-02 | 12,522.18 | 28,967.98 | 3.36E+04 | 3.38E+04 | 3.42E+04 |
| Pu-241 | -4.8316E-01 | 12,522.18 | 0.00 | 1.51E+06 | 1.50E+06 | 1.51E+06 |
| Pu-242 | 1.1052E-05 | 12,522.18 | 28,967.98 | 8.95E+00 | 9.09E+00 | 9.27E+00 |
| Ra-226 | 5.7471E-13 | 12,522.18 | 28,967.98 | 0.00E+00 | 7.20E-09 | 1.66E-08 |
| Ra-228 | 5.4957E-17 | 12,522.18 | 28,967.98 | 0.00E+00 | 6.88E-13 | 1.59E-12 |
| Ru-106 | 1.4582E-02 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.83E+02 | 4.22E+02 |
| Se-79 | 1.0137E-05 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.27E-01 | 2.94E-01 |
| Sn-126 | 4.3922E-05 | 12,522.18 | 28,967.98 | 0.00E+00 | 5.50E-01 | 1.27E+00 |
| Sr-90 | 7.6329E-01 | 12,522.18 | 28,967.98 | 0.00E+00 | 9.56E+03 | 2.21E+04 |
| Tc-99 | 3.9412E-04 | 12,522.18 | 28,967.98 | 0.00E+00 | 4.94E+00 | 1.14E+01 |
| Th-229 | 1.6457E-12 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.06E-08 | 4.77E-08 |
| Th-230 | 1.8822E-10 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.36E-06 | 5.45E-06 |
| Th-232 | 9.7601E-17 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.22E-12 | 2.83E-12 |
| Tl-208 | 5.2722E-07 | 12,522.18 | 28,967.98 | 0.00E+00 | 6.60E-03 | 1.53E-02 |
| U-232 | 1.4925E-06 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.87E-02 | 4.32E-02 |
| U-233 | 2.1113E-10 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.64E-06 | 6.12E-06 |
| U-234 | 1.9528E-06 | 12,522.18 | 28,967.98 | 0.00E+00 | 2.45E-02 | 5.66E-02 |
| U-235 | -9.7920E-09 | 12,522.18 | 0.00 | 1.36E-02 | 1.34E-02 | 1.36E-02 |
| U-236 | 1.1570E-07 | 12,522.18 | 28,967.98 | 0.00E+00 | 1.45E-03 | 3.35E-03 |
| U-238 | -1.7914E-07 | 12,522.18 | 0.00 | 9.87E-01 | 9.85E-01 | 9.87E-01 |
| Y-90 | 7.6329E-01 | 12,522.18 | 28,967.98 | 0.00E+00 | 9.56E+03 | 2.21E+04 |
| Other Radionuclides | | | | | 2.71E+04 | 6.28E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0.0150 | 1.869E+15 |
| 0.0250 | 3.213E+14 |
| 0.0375 | 3.599E+14 |
| 0.0575 | 4.118E+14 |
| 0.0850 | 1.791E+14 |
| 0.1250 | 1.340E+14 |
| 0.2250 | 1.356E+14 |
| 0.3750 | 6.983E+13 |
| 0.5750 | 2.328E+15 |
| 0.8500 | 7.792E+13 |
| 1.2500 | 6.784E+13 |
| 1.7500 | 1.114E+12 |
| 2.2500 | 3.755E+10 |
| 2.7500 | 3.933E+09 |
| 3.5000 | 4.596E+08 |
| 5.0000 | 8.673E+06 |
| 7.0000 | 9.878E+05 |
| 11.0000 | 1.129E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.65E+03 | 4.02E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | FAST | FAST |
| Fuel Cladding: | SST | SST |
| BOL HM Constituents: | UNKNOWN | Pu and U |
| BOL Enrichment %: | | 10 to 30 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown) and BOL heavy metal (it is mostly U with a little Pu).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 12,522.18 |
| Bounding: | | 28,967.98 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=4174.061kg
Bounding burnup taken from SFD and converted to MWd using BOL=4174.061kg

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal: | 0.02 | |
| Bounding: | 0.05 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name MISCELLANEOUS TREAT FUEL (MOX)
SNF ID #. 369
Fuel Units & Descr 1 - UNKNOWN
Heavy Metal Mass BOL= , EOL=0 12kg
ROD Storage Site INEEL

[1]Fuel decay start date 1994
Estimates as of 2010
Template (Worst Case)
[2]Template Burnup(MWd) 62.5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 15 years

Estimated Canister usage 18"x10' 0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 4157E-06 | 114 14 | 114 14 | 0 00E+00 | 1 62E-04 | 1 62E-04 |
| Am-241 | 6 2608E+00 | 114 14 | 114 14 | 0 00E+00 | 7 15E+02 | 7 15E+02 |
| Am-242m | 1 8448E-02 | 114 14 | 114 14 | 0 00E+00 | 2 11E+00 | 2 11E+00 |
| Am-243 | 1 6352E-02 | 114 14 | 114 14 | 0 00E+00 | 1 87E+00 | 1 87E+00 |
| C-14 | 1.2112E-01 | 114 14 | 114 14 | 0 00E+00 | 1.38E+01 | 1 38E+01 |
| Cl-36 | 2.2860E-03 | 114 14 | 114 14 | 0 00E+00 | 2 61E-01 | 2 61E-01 |
| Cm-243 | 1.4088E-03 | 114.14 | 114 14 | 0 00E+00 | 1 61E-01 | 1 61E-01 |
| Cm-244 | 3 6224E-01 | 114.14 | 114 14 | 0 00E+00 | 4 13E+01 | 4 13E+01 |
| Co-60 | 3 8998E+02 | 114 14 | 114 14 | 0 00E+00 | 4 45E+04 | 4 45E+04 |
| Cs-134 | 2 8276E-01 | 114 14 | 114 14 | 0 00E+00 | 3 23E+01 | 3.23E+01 |
| Cs-135 | 4 3976E-04 | 114 14 | 114.14 | 0 00E+00 | 5 02E-02 | 5.02E-02 |
| Cs-137 | 3 3405E+01 | 114 14 | 114.14 | 0.00E+00 | 3 81E+03 | 3 81E+03 |
| Eu-154 | 6 2585E+00 | 114 14 | 114 14 | 0 00E+00 | 7.14E+02 | 7.14E+02 |
| Eu-155 | 1 1271E+00 | 114 14 | 114 14 | 0 00E+00 | 1.29E+02 | 1.29E+02 |
| Fe-55 | 6 0624E+01 | 114 14 | 114 14 | 0 00E+00 | 6 92E+03 | 6.92E+03 |
| H-3 | 7 4678E-01 | 114 14 | 114 14 | 0 00E+00 | 8.52E+01 | 8 52E+01 |
| I-129 | 1 0618E-05 | 114 14 | 114 14 | 0 00E+00 | 1.21E-03 | 1.21E-03 |
| Kr-85 | 2 1802E+00 | 114 14 | 114 14 | 0 00E+00 | 2 49E+02 | 2 49E+02 |
| Np-237 | 1.5626E-04 | 114 14 | 114 14 | 0 00E+00 | 1 78E-02 | 1 78E-02 |
| Pa-231 | 2 8608E-06 | 114 14 | 114 14 | 0 00E+00 | 3 27E-04 | 3 27E-04 |
| Pb-210 | 2 0448E-09 | 114 14 | 114 14 | 0 00E+00 | 2 33E-07 | 2.33E-07 |
| Pm-147 | 3 3212E+00 | 114 14 | 114 14 | 0 00E+00 | 3 79E+02 | 3 79E+02 |
| Pu-238 | -3 5400E-01 | 114.14 | 0 00 | 3 09E+01 | 0 00E+00 | 3 09E+01 |
| Pu-239 | -4 8280E-02 | 114.14 | 0 00 | 3 74E+00 | 0 00E+00 | 3 74E+00 |
| Pu-240 | -3 0095E-01 | 114.14 | 0 00 | 4 77E+00 | 0 00E+00 | 4 77E+00 |
| Pu-241 | -2 5280E+01 | 114 14 | 0 00 | 1.23E+03 | 0 00E+00 | 1.23E+03 |
| Pu-242 | -1 1381E-04 | 114 14 | 0 00 | 2.06E-02 | 7 66E-03 | 2.06E-02 |
| Ra-226 | 1 0977E-08 | 114 14 | 114 14 | 0 00E+00 | 1.25E-06 | 1.25E-06 |
| Ra-228 | 5 4624E-07 | 114 14 | 114 14 | 0 00E+00 | 6.23E-05 | 6.23E-05 |
| Ru-106 | 3 7939E-03 | 114 14 | 114 14 | 0 00E+00 | 4.33E-01 | 4.33E-01 |
| Se-79 | 1 9186E-04 | 114 14 | 114 14 | 0 00E+00 | 2 19E-02 | 2 19E-02 |
| Sn-126 | 1 6673E-04 | 114 14 | 114 14 | 0 00E+00 | 1 90E-02 | 1 90E-02 |
| Sr-90 | 3 1860E+01 | 114 14 | 114 14 | 0 00E+00 | 3 64E+03 | 3 64E+03 |
| Tc-99 | 6 7678E-03 | 114 14 | 114 14 | 0 00E+00 | 7.72E-01 | 7 72E-01 |
| Th-229 | 7.2928E-07 | 114 14 | 114 14 | 0 00E+00 | 8 32E-05 | 8 32E-05 |
| Th-230 | 2 4191E-06 | 114 14 | 114 14 | 0 00E+00 | 2 76E-04 | 2 76E-04 |
| Th-232 | 6 0208E-07 | 114 14 | 114 14 | 0 00E+00 | 6 87E-05 | 6 87E-05 |
| Tl-208 | 1 0599E-04 | 114 14 | 114 14 | 0 00E+00 | 1.21E-02 | 1.21E-02 |
| U-232 | 2.8743E-04 | 114.14 | 114 14 | 0 00E+00 | 3.28E-02 | 3.28E-02 |
| U-233 | 3 6128E-04 | 114.14 | 114 14 | 0 00E+00 | 4 12E-02 | 4.12E-02 |
| U-234 | 1.2788E-02 | 114 14 | 114 14 | 0 00E+00 | 1 46E+00 | 1 46E+00 |
| U-235 | 5.7486E-04 | 114 14 | 114.14 | 1 03E-04 | 6 57E-02 | 6.57E-02 |
| U-236 | 2.3485E-04 | 114 14 | 114 14 | 0 00E+00 | 2 68E-02 | 2.68E-02 |
| U-238 | 1 1581E-04 | 114 14 | 114.14 | 1.29E-05 | 1.32E-02 | 1.32E-02 |
| Y-90 | 3 1860E+01 | 114 14 | 114 14 | 0 00E+00 | 3 64E+03 | 3 64E+03 |
| Other Radionuclides | | | | | 9.17E+03 | 9 17E+03 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 2.995E+14 |
| 0 0250 | 5.846E+13 |
| 0 0375 | 5.221E+13 |
| 0 0575 | 6 027E+13 |
| 0 0850 | 2.903E+13 |
| 0 1250 | 2.823E+13 |
| 0.2250 | 2.283E+13 |
| 0.3750 | 9.530E+12 |
| 0.5750 | 1 464E+14 |
| 0.8500 | 1.526E+13 |
| 1.2500 | 3.308E+15 |
| 1 7500 | 4.548E+11 |
| 2.2500 | 1 755E+10 |
| 2 7500 | 4 829E+08 |
| 3 5000 | 1 045E+06 |
| 5 0000 | 2 536E+05 |
| 7 0000 | 2 918E+04 |
| 11 0000 | 3 348E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.74E+02 | 7.75E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | (Worst Case) |
| Fuel Cladding | UNKNOWN | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences**

This fuel didn't closely match any existing templates therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 114 14 |
| Bounding | | 114 14 |

**Basis for burnup used in estimate**

Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14 21 | |
| Bounding | 14 21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: MISCELLANEOUS TREAT FUEL (U-METAL)
SNF ID #: 905
Fuel Units & Descr. 1 - UNKNOWN
Heavy Metal Mass: BOL= , EOL=0 12kg
ROD Storage Site. INEEL

[1]Fuel decay start date: 1994
Estimates as of 2010
Template N-Reactor (Graphite, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 69600
Template BOL Heavy Metal Mass (MT). 11 6
Template Decay Time 15 years

Estimated Canister usage: 18"x10' 0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 0 0000E+00 | 126 70 | 126 70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-241 | 7 2313E-02 | 126 70 | 126 70 | 0 00E+00 | 9.16E+00 | 9 16E+00 |
| Am-242m | 6 2011E-05 | 126 70 | 126 70 | 0 00E+00 | 7 86E-03 | 7 86E-03 |
| Am-243 | 4 6336E-05 | 126 70 | 126 70 | 0 00E+00 | 5 87E-03 | 5 87E-03 |
| C-14 | 9 2170E-05 | 126 70 | 126 70 | 0 00E+00 | 1 17E-02 | 1 17E-02 |
| Cl-36 | 0 0000E+00 | 126 70 | 126 70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 0 0000E+00 | 126 70 | 126 70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 7 4511E-04 | 126 70 | 126 70 | 0 00E+00 | 9 44E-02 | 9 44E-02 |
| Co-60 | 3 4842E-04 | 126 70 | 126 70 | 0 00E+00 | 4 41E-02 | 4 41E-02 |
| Cs-134 | 1 0795E-03 | 126 70 | 126 70 | 0 00E+00 | 1 37E-01 | 1 37E-01 |
| Cs-135 | 1 0066E-05 | 126 70 | 126 70 | 0 00E+00 | 1.28E-03 | 1.28E-03 |
| Cs-137 | 1 6092E+00 | 126 70 | 126 70 | 0 00E+00 | 2.04E+02 | 2.04E+02 |
| Eu-154 | 1 8822E-02 | 126 70 | 126 70 | 0 00E+00 | 2.38E+00 | 2.38E+00 |
| Eu-155 | 1 7672E-03 | 126 70 | 126 70 | 0 00E+00 | 2 24E-01 | 2 24E-01 |
| Fe-55 | 9 0172E-05 | 126 70 | 126 70 | 0 00E+00 | 1 14E-02 | 1 14E-02 |
| H-3 | 4 3506E-03 | 126 70 | 126 70 | 0 00E+00 | 5 51E-01 | 5 51E-01 |
| I-129 | 8 6006E-07 | 126 70 | 126 70 | 0 00E+00 | 1 09E-04 | 1 09E-04 |
| Kr-85 | 6 1652E-02 | 126 70 | 126 70 | 0 00E+00 | 7 81E+00 | 7.81E+00 |
| Np-237 | 7 7672E-06 | 126 70 | 126 70 | 0 00E+00 | 9 84E-04 | 9 84E-04 |
| Pa-231 | 0 0000E+00 | 126 70 | 126 70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pb-210 | 0 0000E+00 | 126 70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pm-147 | 1 8175E-02 | 126 70 | 126 70 | 0 00E+00 | 2.30E+00 | 2.30E+00 |
| Pu-238 | 2 2170E-02 | 126 70 | 126.70 | 0.00E+00 | 2 81E+00 | 2.81E+00 |
| Pu-239 | 2 8836E-02 | 126 70 | 126 70 | 0 00E+00 | 3 65E+00 | 3 65E+00 |
| Pu-240 | 2 2830E-02 | 126 70 | 126.70 | 0 00E+00 | 2 89E+00 | 2 89E+00 |
| Pu-241 | 1 1362E+00 | 126.70 | 126.70 | 0 00E+00 | 1 44E+02 | 1 44E+02 |
| Pu-242 | 1 4526E-05 | 126 70 | 126.70 | 0 00E+00 | 1 84E-03 | 1 84E-03 |
| Ra-226 | 0 0000E+00 | 126 70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-228 | 0 0000E+00 | 126 70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ru-106 | 4 2672E-06 | 126.70 | 126.70 | 0 00E+00 | 5 41E-04 | 5 41E-04 |
| Se-79 | 1 0901E-05 | 126.70 | 126.70 | 0 00E+00 | 1.38E-03 | 1 38E-03 |
| Sn-126 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 1 1546E+00 | 126 70 | 126.70 | 0 00E+00 | 1 46E+02 | 1 46E+02 |
| Tc-99 | 3 6494E-04 | 126.70 | 126.70 | 0 00E+00 | 4 62E-02 | 4 62E-02 |
| Th-229 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-230 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-232 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Tl-208 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-232 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 0 0000E+00 | 126.70 | 126.70 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-234 | 6 3994E-05 | 126.70 | 126 70 | 0 00E+00 | 8.11E-03 | 8 11E-03 |
| U-235 | -1.2944E-06 | 126.70 | 0 00 | 4 92E-06 | 0 00E+00 | 4 92E-06 |
| U-236 | 1.1932E-05 | 126.70 | 126.70 | 0 00E+00 | 1 51E-03 | 1.51E-03 |
| U-238 | -3 0619E-07 | 126.70 | 0 00 | 7 99E-05 | 4 11E-05 | 7 99E-05 |
| Y-90 | 1.1550E+00 | 126.70 | 126 70 | 0 00E+00 | 1 46E+02 | 1 46E+02 |
| Other Radionuclides | | | | | 1 95E+02 | 1 95E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 8 322E+12 |
| 0 0250 | 1 708E+12 |
| 0 0375 | 1 593E+12 |
| 0 0575 | 1 710E+12 |
| 0 0850 | 9.536E+11 |
| 0 1250 | 6 513E+11 |
| 0 2250 | 8 195E+11 |
| 0 3750 | 3 536E+11 |
| 0 5750 | 7 554E+12 |
| 0 8500 | 1 036E+11 |
| 1 2500 | 6 918E+10 |
| 1 7500 | 2 863E+09 |
| 2 2500 | 2 188E+05 |
| 2.7500 | 7 870E+03 |
| 3 5000 | 3 692E+03 |
| 5 0000 | 1 326E+03 |
| 7 0000 | 1 510E+02 |
| 11 0000 | 1 724E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.61E+00 | 2.61E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | UNKNOWN | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 0 to 5 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except cladding (unknown) and enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 126 70 |
| Bounding | | 126 70 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup.
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 87 91 | |
| Bounding | 87 91 | |

Estimated EOL HM/Given EOL HM: 1 84

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name MTR CANAL SCRAP
SNF ID #. 1062
Fuel Units & Descr. 105 - CANISTER OF SCRAP
Heavy Metal Mass BOL= ; EOL=265.975kg
ROD Storage Site INEEL

[1]Fuel decay start date 1979
Estimates as of. 2010
Template PWR (Light Water, Zirc, 0 to 5% U)
[2]Template Burnup(MWd) 61 92
Template BOL Heavy Metal Mass (MT) 0.00176911
Template Decay Time 25 years

Estimated Canister usage HIC: 105 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_a$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6.6376E-10 | 266.26 | 532.51 | 0 00E+00 | 1 77E-07 | 3 53E-07 |
| Am-241 | 1.3144E-01 | 266.26 | 532 51 | 0 00E+00 | 3 50E+01 | 7 00E+01 |
| Am-242m | 3.0039E-04 | 266.26 | 532.51 | 0 00E+00 | 8 00E-02 | 1 60E-01 |
| Am-243 | 6.2629E-04 | 266.26 | 532.51 | 0 00E+00 | 1 67E-01 | 3 34E-01 |
| C-14 | 4.7965E-05 | 266.26 | 532.51 | 0 00E+00 | 1 28E-02 | 2 55E-02 |
| Cl-36 | 8.0297E-07 | 266.26 | 532.51 | 0 00E+00 | 2 14E-04 | 4 28E-04 |
| Cm-243 | 3.1993E-04 | 266.26 | 532.51 | 0 00E+00 | 8 52E-02 | 1 70E-01 |
| Cm-244 | 7.1851E-02 | 266.26 | 532.51 | 0 00E+00 | 1 91E+01 | 3 83E+01 |
| Co-60 | 9 5220E-03 | 266.26 | 532.51 | 0 00E+00 | 2 54E+00 | 5 07E+00 |
| Cs-134 | 1 1662E-03 | 266 26 | 532.51 | 0 00E+00 | 3 11E-01 | 6 21E-01 |
| Cs-135 | 1.4433E-05 | 266.26 | 532.51 | 0 00E+00 | 3 84E-03 | 7 69E-03 |
| Cs-137 | 1 7603E+00 | 266 26 | 532.51 | 0 00E+00 | 4 69E+02 | 9 37E+02 |
| Eu-154 | 4 5203E-02 | 266.26 | 532.51 | 0 00E+00 | 1 20E+01 | 2 41E+01 |
| Eu-155 | 7.1479E-03 | 266 26 | 532.51 | 0 00E+00 | 1 90E+00 | 3 81E+00 |
| Fe-55 | 6 1919E-04 | 266 26 | 532.51 | 0 00E+00 | 1 65E-01 | 3 30E-01 |
| H-3 | 3 6386E-02 | 266 26 | 532 51 | 0 00E+00 | 9 69E+00 | 1 94E+01 |
| I-129 | 9 8288E-07 | 266 26 | 532.51 | 0 00E+00 | 2 62E-04 | 5 23E-04 |
| Kr-85 | 5 3844E-02 | 266 26 | 532 51 | 0 00E+00 | 1 43E+01 | 2 87E+01 |
| Np-237 | 1 0546E-05 | 266 26 | 532 51 | 0 00E+00 | 2 81E-03 | 5 62E-03 |
| Pa-231 | 1 1370E-09 | 266 26 | 532 51 | 0 00E+00 | 3 03E-07 | 6 05E-07 |
| Pb-210 | 3 3624E-11 | 266 26 | 532.51 | 0 00E+00 | 8 95E-09 | 1 79E-08 |
| Pm-147 | 5 1211E-03 | 266 26 | 532.51 | 0 00E+00 | 1 36E+00 | 2 73E+00 |
| Pu-238 | 8 0669E-02 | 266 26 | 532 51 | 0 00E+00 | 2 15E+01 | 4 30E+01 |
| Pu-239 | 1 1626E-02 | 266 26 | 532 51 | 0 00E+00 | 3 10E+00 | 6 19E+00 |
| Pu-240 | 1 5097E-02 | 266 26 | 532 51 | 0 00E+00 | 4 02E+00 | 8 04E+00 |
| Pu-241 | 1 4567E+00 | 266 26 | 532 51 | 0 00E+00 | 3 88E+02 | 7.76E+02 |
| Pu-242 | 6 4260E-05 | 266 26 | 532 51 | 0 00E+00 | 1 71E-02 | 3 42E-02 |
| Ra-226 | 1 1392E-10 | 266 26 | 532 51 | 0 00E+00 | 3 03E-08 | 6 07E-08 |
| Ra-228 | 5 1841E-12 | 266 26 | 532 51 | 0 00E+00 | 1.38E-09 | 2.76E-09 |
| Ru-106 | 5 9012E-07 | 266 26 | 532 51 | 0 00E+00 | 1 57E-04 | 3.14E-04 |
| Se-79 | 1.2379E-05 | 266 26 | 532 51 | 0 00E+00 | 3 30E-03 | 6 59E-03 |
| Sn-126 | 2 5210E-05 | 266.26 | 532 51 | 0 00E+00 | 6 71E-03 | 1.34E-02 |
| Sr-90 | 1 1630E+00 | 266 26 | 532 51 | 0 00E+00 | 3 10E+02 | 6 19E+02 |
| Tc-99 | 3 9357E-04 | 266.26 | 532 51 | 0 00E+00 | 1 05E-01 | 2.10E-01 |
| Th-229 | 8 5691E-11 | 266.26 | 532 51 | 0 00E+00 | 2.28E-08 | 4.56E-08 |
| Th-230 | 1 4493E-08 | 266.26 | 532 51 | 0 00E+00 | 3 86E-06 | 7.72E-06 |
| Th-232 | 5.2923E-12 | 266.26 | 532 51 | 0 00E+00 | 1 41E-09 | 2.82E-09 |
| Tl-208 | 1 9202E-07 | 266.26 | 532 51 | 0 00E+00 | 5 11E-05 | 1.02E-04 |
| U-232 | 5 2083E-07 | 266.26 | 532 51 | 0 00E+00 | 1.39E-04 | 2.77E-04 |
| U-233 | 2 4386E-08 | 266.26 | 532 51 | 0 00E+00 | 6 49E-06 | 1.30E-05 |
| U-234 | 4 7012E-05 | 266.26 | 532 51 | 0 00E+00 | 1.25E-02 | 2 50E-02 |
| U-235 | -1.4492E-06 | 266.26 | 0 00 | 1 84E-02 | 1.80E-02 | 1 84E-02 |
| U-236 | 7 5759E-06 | 266.26 | 532 51 | 0 00E+00 | 2.02E-03 | 4 03E-03 |
| U-238 | -2 6129E-07 | 266.26 | 0 00 | 8 66E-02 | 8.65E-02 | 8 66E-02 |
| Y-90 | 1 1631E+00 | 266.26 | 532 51 | 0 00E+00 | 3 10E+02 | 6 19E+02 |
| Other Radionuclides | | | | | 4 50E+02 | 9 00E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 621E+13 |
| 0 0250 | 7.334E+12 |
| 0 0375 | 7 098E+12 |
| 0 0575 | 7 744E+12 |
| 0 0850 | 4 103E+12 |
| 0 1250 | 2.997E+12 |
| 0.2250 | 3 523E+12 |
| 0 3750 | 1.511E+12 |
| 0 5750 | 3 473E+13 |
| 0 8500 | 6 855E+11 |
| 1.2500 | 9.259E+11 |
| 1 7500 | 2 029E+10 |
| 2.2500 | 3 748E+06 |
| 2 7500 | 4.212E+06 |
| 3 5000 | 5.523E+05 |
| 5.0000 | 2.361E+05 |
| 7 0000 | 2 721E+04 |
| 11.0000 | 3 126E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.30E+00 | 1.46E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 0 to 5 |

**Basis for Parameter Differences:**
This Template was used for the following reasons.
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 266.26 |
| Bounding | | 532.51 |

**Basis for burnup used in estimate:**
Nominal burnup taken from SFD and converted to MWd using BOL=266.255kg
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 03 | |
| Bounding | 0 06 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: MURR (UALX) COLUMBIA
SNF ID #: 142
Fuel Units & Descr: 32 - 24 CURVED PLATES
Heavy Metal Mass: BOL=25.12kg; EOL=21 725kg
ROD Storage Site SRS

[1]Fuel decay start date: 1985
Estimates as of: 2010
Template: ATR (Light Water, Alum., 60 to 100% U)
[2]Template Burnup(MWd): 367.2
Template BOL Heavy Metal Mass (MT): 0 00116689
Template Decay Time: 25 years

Estimated Canister usage 18"x10'
1.33

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 1465E-09 | 4,521 60 | 9,043 20 | 0 00E+00 | 5.18E-06 | 1 04E-05 |
| Am-241 | 2 3056E-03 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 04E+01 | 2 08E+01 |
| Am-242m | 4 1476E-07 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 88E-03 | 3 75E-03 |
| Am-243 | 1 4894E-06 | 4,521 60 | 9,043.20 | 0 00E+00 | 6.73E-03 | 1 35E-02 |
| C-14 | 5 7108E-09 | 4,521 60 | 9,043.20 | 0 00E+00 | 2 58E-05 | 5 16E-05 |
| Cl-36 | 1.3124E-32 | 4,521 60 | 9,043 20 | 0 00E+00 | 5 93E-29 | 1 19E-28 |
| Cm-243 | 1 4562E-07 | 4,521 60 | 9,043.20 | 0 00E+00 | 6 58E-04 | 1 32E-03 |
| Cm-244 | 2 4221E-05 | 4,521 60 | 9,043.20 | 0 00E+00 | 1.10E-01 | 2 19E-01 |
| Co-60 | 2 7560E-06 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 25E-02 | 2 49E-02 |
| Cs-134 | 5 8851E-04 | 4,521 60 | 9,043 20 | 0 00E+00 | 2 66E+00 | 5 32E+00 |
| Cs-135 | 3.4477E-06 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 56E-02 | 3 12E-02 |
| Cs-137 | 1 8099E+00 | 4,521 60 | 9,043 20 | 0 00E+00 | 8.18E+03 | 1 64E+04 |
| Eu-154 | 1 6386E-02 | 4,521 60 | 9,043.20 | 0 00E+00 | 7 41E+01 | 1 48E+02 |
| Eu-155 | 2.3957E-03 | 4,521 60 | 9,043.20 | 0 00E+00 | 1 08E+01 | 2 17E+01 |
| Fe-55 | 3.2707E-05 | 4,521 60 | 9,043.20 | 0 00E+00 | 1 48E-01 | 2 96E-01 |
| H-3 | 3 4504E-03 | 4,521 60 | 9,043 20 | 0 00E+00 | 1.56E+01 | 3 12E+01 |
| I-129 | 7.5300E-07 | 4,521 60 | 9,043.20 | 0 00E+00 | 3 40E-03 | 6 81E-03 |
| Kr-85 | 7.8540E-02 | 4,521 60 | 9,043.20 | 0 00E+00 | 3.55E+02 | 7 10E+02 |
| Np-237 | 9 5615E-06 | 4,521 60 | 9,043 20 | 0 00E+00 | 4.32E-02 | 8 65E-02 |
| Pa-231 | 2.7968E-09 | 4,521 60 | 9,043.20 | 0 00E+00 | 1.26E-05 | 2.53E-05 |
| Pb-210 | 1.2612E-10 | 4,521 60 | 9,043.20 | 0 00E+00 | 5 70E-07 | 1 14E-06 |
| Pm-147 | 1.2952E-02 | 4,521 60 | 9,043.20 | 0 00E+00 | 5 86E+01 | 1 17E+02 |
| Pu-238 | 1.7549E-02 | 4,521 60 | 9,043.20 | 0 00E+00 | 7 93E+01 | 1 59E+02 |
| Pu-239 | 4.2810E-04 | 4,521 60 | 9,043.20 | 0 00E+00 | 1 94E+00 | 3 87E+00 |
| Pu-240 | 2 4357E-04 | 4,521 60 | 9,043.20 | 0 00E+00 | 1.10E+00 | 2 20E+00 |
| Pu-241 | 2.6277E-02 | 4,521 60 | 9,043.20 | 0 00E+00 | 1.19E+02 | 2 38E+02 |
| Pu-242 | 3 6329E-07 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 64E-03 | 3.29E-03 |
| Ra-226 | 4 4444E-10 | 4,521 60 | 9,043 20 | 0 00E+00 | 2 01E-06 | 4 02E-06 |
| Ra-228 | 1.9714E-14 | 4,521 60 | 9,043.20 | 0 00E+00 | 8 91E-11 | 1 78E-10 |
| Ru-106 | 2.0477E-07 | 4,521 60 | 9,043.20 | 0 00E+00 | 9.26E-04 | 1 85E-03 |
| Se-79 | 1.2933E-05 | 4,521 60 | 9,043 20 | 0 00E+00 | 5 85E-02 | 1 17E-01 |
| Sn-126 | 1.1574E-05 | 4,521 60 | 9,043 20 | 0 00E+00 | 5.23E-02 | 1 05E-01 |
| Sr-90 | 1.7092E+00 | 4,521 60 | 9,043.20 | 0 00E+00 | 7.73E+03 | 1 55E+04 |
| Tc-99 | 4.2239E-04 | 4,521 60 | 9,043 20 | 0 00E+00 | 1 91E+00 | 3 82E+00 |
| Th-229 | 7.7260E-12 | 4,521 60 | 9,043.20 | 0 00E+00 | 3 49E-08 | 6.99E-08 |
| Th-230 | 5.8497E-08 | 4,521 60 | 9,043.20 | 0 00E+00 | 2 64E-04 | 5.29E-04 |
| Th-232 | 2.6906E-14 | 4,521 60 | 9,043 20 | 0 00E+00 | 1.22E-10 | 2.43E-10 |
| Tl-208 | 4 4336E-08 | 4,521 60 | 9,043 20 | 0 00E+00 | 2 00E-04 | 4 01E-04 |
| U-232 | 1.2037E-07 | 4,521 60 | 9,043 20 | 0 00E+00 | 5 44E-04 | 1.09E-03 |
| U-233 | 3 0011E-09 | 4,521 60 | 9,043 20 | 0 00E+00 | 1.36E-05 | 2.71E-05 |
| U-234 | 1.8497E-04 | 4,521 60 | 9,043 20 | 0 00E+00 | 8.36E-01 | 1 67E+00 |
| U-235 | -2 7235E-06 | 4,521 60 | 0 00 | 5 08E-02 | 3 84E-02 | 5 08E-02 |
| U-236 | 1.5493E-05 | 4,521 60 | 9,043 20 | 0 00E+00 | 7 01E-02 | 1 40E-01 |
| U-238 | -4 2851E-09 | 4,521 60 | 0 00 | 5 49E-04 | 5.29E-04 | 5 49E-04 |
| Y-90 | 1.7094E+00 | 4,521 60 | 9,043 20 | 0 00E+00 | 7.73E+03 | 1.55E+04 |
| Other Radionuclides | | | | | 7.79E+03 | 1.56E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 8 462E+14 |
| 0 0250 | 1 758E+14 |
| 0 0375 | 1.531E+14 |
| 0 0575 | 1 644E+14 |
| 0 0850 | 9 920E+13 |
| 0 1250 | 6 644E+13 |
| 0.2250 | 8.564E+13 |
| 0 3750 | 3 723E+13 |
| 0 5750 | 6 104E+14 |
| 0 8500 | 8 796E+12 |
| 1.2500 | 4.891E+12 |
| 1 7500 | 2 417E+11 |
| 2.2500 | 1 722E+07 |
| 2 7500 | 1 410E+07 |
| 3 5000 | 1 064E+04 |
| 5 0000 | 3.580E+03 |
| 7 0000 | 3 940E+02 |
| 11 0000 | 4 407E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.56E+01 | 1.91E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 5 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 4 521 60 | 3,215 32 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 9,043 20 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 57 | 0 71 |
| Bounding | 1 14 | |

Estimated EOL HM/Given EOL HM: 0 95

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name MURR (UALX) COLUMBIA
SNF ID # 962
Fuel Units & Descr. 24 - 24 CURVED PLATES
Heavy Metal Mass BOL=18 84kg EOL=16.294kg
ROD Storage Site SRS

[1]Fuel decay start date 1985
Estimates as of 2010
Template ATR (Light Water, Alum , 60 to 100% U)
[2]Template Burnup(MWd) 367.2
Template BOL Heavy Metal Mass (MT): 0 00116689
Template Decay Time: 25 years

Estimated Canister usage 18"x10'
1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 1465E-09 | 3,391.20 | 6,782 40 | 0 00E+00 | 3 89E-06 | 7 78E-06 |
| Am-241 | 2 3056E-03 | 3,391.20 | 6,782 40 | 0 00E+00 | 7 82E+00 | 1 56E+01 |
| Am-242m | 4 1476E-07 | 3,391.20 | 6,782 40 | 0 00E+00 | 1.41E-03 | 2 81E-03 |
| Am-243 | 1 4894E-06 | 3,391.20 | 6,782 40 | 0 00E+00 | 5 05E-03 | 1 01E-02 |
| C-14 | 5 7108E-09 | 3,391.20 | 6,782 40 | 0 00E+00 | 1.94E-05 | 3 87E-05 |
| Cl-36 | 1.3124E-32 | 3,391.20 | 6,782 40 | 0 00E+00 | 4 45E-29 | 8 90E-29 |
| Cm-243 | 1 4562E-07 | 3,391.20 | 6,782 40 | 0 00E+00 | 4.94E-04 | 9 88E-04 |
| Cm-244 | 2 4221E-05 | 3,391.20 | 6,782 40 | 0 00E+00 | 8.21E-02 | 1 64E-01 |
| Co-60 | 2.7560E-06 | 3,391.20 | 6,782 40 | 0 00E+00 | 9 35E-03 | 1.87E-02 |
| Cs-134 | 5 8851E-04 | 3,391.20 | 6,782 40 | 0 00E+00 | 2 00E+00 | 3 99E+00 |
| Cs-135 | 3 4477E-06 | 3,391.20 | 6,782 40 | 0 00E+00 | 1 17E-02 | 2.34E-02 |
| Cs-137 | 1.8099E+00 | 3,391 20 | 6,782 40 | 0 00E+00 | 6 14E+03 | 1.23E+04 |
| Eu-154 | 1 6386E-02 | 3,391 20 | 6,782 40 | 0 00E+00 | 5.56E+01 | 1.11E+02 |
| Eu-155 | 2.3957E-03 | 3,391 20 | 6,782 40 | 0 00E+00 | 8.12E+00 | 1 62E+01 |
| Fe-55 | 3.2707E-05 | 3,391 20 | 6,782.40 | 0 00E+00 | 1.11E-01 | 2.22E-01 |
| H-3 | 3 4504E-03 | 3,391 20 | 6,782 40 | 0 00E+00 | 1.17E+01 | 2.34E+01 |
| I-129 | 7.5300E-07 | 3,391 20 | 6,782.40 | 0 00E+00 | 2 55E-03 | 5 11E-03 |
| Kr-85 | 7 8540E-02 | 3,391 20 | 6,782.40 | 0 00E+00 | 2 66E+02 | 5.33E+02 |
| Np-237 | 9 5615E-06 | 3,391 20 | 6,782 40 | 0 00E+00 | 3 24E-02 | 6 49E-02 |
| Pa-231 | 2 7968E-09 | 3,391.20 | 6,782 40 | 0 00E+00 | 9 48E-06 | 1 90E-05 |
| Pb-210 | 1.2612E-10 | 3,391.20 | 6,782 40 | 0 00E+00 | 4 28E-07 | 8 55E-07 |
| Pm-147 | 1.2952E-02 | 3,391.20 | 6,782 40 | 0 00E+00 | 4 39E+01 | 8 78E+01 |
| Pu-238 | 1 7549E-02 | 3,391.20 | 6,782 40 | 0 00E+00 | 5 95E+01 | 1 19E+02 |
| Pu-239 | 4 2810E-04 | 3,391.20 | 6,782 40 | 0 00E+00 | 1 45E+00 | 2 90E+00 |
| Pu-240 | 2 4357E-04 | 3,391.20 | 6,782.40 | 0 00E+00 | 8 26E-01 | 1 65E+00 |
| Pu-241 | 2 6277E-02 | 3,391.20 | 6,782 40 | 0 00E+00 | 8 91E+01 | 1 78E+02 |
| Pu-242 | 3 6329E-07 | 3,391.20 | 6,782 40 | 0 00E+00 | 1.23E-03 | 2 46E-03 |
| Ra-226 | 4 4444E-10 | 3,391.20 | 6,782 40 | 0 00E+00 | 1 51E-06 | 3 01E-06 |
| Ra-228 | 1 9714E-14 | 3,391.20 | 6,782 40 | 0 00E+00 | 6 69E-11 | 1 34E-10 |
| Ru-106 | 2 0477E-07 | 3,391.20 | 6,782 40 | 0 00E+00 | 6 94E-04 | 1 39E-03 |
| Se-79 | 1 2933E-05 | 3,391.20 | 6,782 40 | 0 00E+00 | 4 39E-02 | 8 77E-02 |
| Sn-126 | 1 1574E-05 | 3,391.20 | 6,782 40 | 0 00E+00 | 3 93E-02 | 7 85E-02 |
| Sr-90 | 1 7092E+00 | 3,391.20 | 6,782 40 | 0 00E+00 | 5 80E+03 | 1 16E+04 |
| Tc-99 | 4 2239E-04 | 3,391.20 | 6,782 40 | 0 00E+00 | 1 43E+00 | 2 86E+00 |
| Th-229 | 7 7260E-12 | 3,391.20 | 6,782 40 | 0 00E+00 | 2 62E-08 | 5.24E-08 |
| Th-230 | 5 8497E-08 | 3,391.20 | 6,782 40 | 0 00E+00 | 1 98E-04 | 3.97E-04 |
| Th-232 | 2 6906E-14 | 3,391.20 | 6,782 40 | 0 00E+00 | 9 12E-11 | 1 82E-10 |
| Tl-208 | 4 4336E-08 | 3,391.20 | 6,782 40 | 0 00E+00 | 1.50E-04 | 3 01E-04 |
| U-232 | 1.2037E-07 | 3,391.20 | 6,782 40 | 0 00E+00 | 4 08E-04 | 8.16E-04 |
| U-233 | 3 0011E-09 | 3,391.20 | 6,782 40 | 0 00E+00 | 1.02E-05 | 2.04E-05 |
| U-234 | 1 8497E-04 | 3,391.20 | 6,782 40 | 0 00E+00 | 6.27E-01 | 1.25E+00 |
| U-235 | -2 7235E-06 | 3,391.20 | 0 00 | 3 81E-02 | 2.88E-02 | 3 81E-02 |
| U-236 | 1.5493E-05 | 3,391.20 | 6,782 40 | 0 00E+00 | 5.25E-02 | 1.05E-01 |
| U-238 | -4.2851E-09 | 3,391.20 | 0.00 | 4 12E-04 | 3.97E-04 | 4 12E-04 |
| Y-90 | 1.7094E+00 | 3,391.20 | 6,782 40 | 0 00E+00 | 5 80E+03 | 1.16E+04 |
| Other Radionuclides | | | | | 5 84E+03 | 1.17E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 347E+14 |
| 0.0250 | 1 318E+14 |
| 0 0375 | 1 148E+14 |
| 0 0575 | 1.233E+14 |
| 0 0850 | 7 440E+13 |
| 0 1250 | 4 983E+13 |
| 0.2250 | 6 423E+13 |
| 0.3750 | 2.792E+13 |
| 0 5750 | 4 578E+14 |
| 0.8500 | 6 597E+12 |
| 1.2500 | 3 668E+12 |
| 1 7500 | 1 812E+11 |
| 2.2500 | 1.292E+07 |
| 2.7500 | 1 058E+07 |
| 3.5000 | 7.983E+03 |
| 5 0000 | 2.685E+03 |
| 7.0000 | 2.955E+02 |
| 11 0000 | 3.305E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7 17E+01 | 1 43E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 5 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 3,391.20 | 2,411 49 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 6 782.40 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 57 | 0 71 |
| Bounding | 1 14 | |

Estimated EOL HM/Given EOL HM: 0 95

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: OCONEE
SNF ID #: 156
Fuel Units & Descr: 14 - ROD
Heavy Metal Mass: BOL=39.2kg; EOL=31 983kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1986
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 20 years

Estimated Canister usage.
18"x10'
0 78

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 5 0630E-10 | 6,863 03 | 13,726 05 | 0 00E+00 | 3 47E-06 | 6 95E-06 |
| Am-241 | 1 1489E-01 | 6,863 03 | 13,726 05 | 0 00E+00 | 7 88E+02 | 1 58E+03 |
| Am-242m | 3 0733E-04 | 6,863 03 | 13,726 05 | 0 00E+00 | 2 11E+00 | 4 22E+00 |
| Am-243 | 6 2661E-04 | 6,863 03 | 13,726 05 | 0 00E+00 | 4 30E+00 | 8 60E+00 |
| C-14 | 4 7997E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 3.29E-01 | 6 59E-01 |
| Cl-36 | 8 0313E-07 | 6,863 03 | 13,726 05 | 0 00E+00 | 5 51E-03 | 1 10E-02 |
| Cm-243 | 3 6127E-04 | 6,863 03 | 13,726 05 | 0 00E+00 | 2 48E+00 | 4 96E+00 |
| Cm-244 | 8 6999E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 5 97E+02 | 1 19E+03 |
| Co-60 | 1 8379E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 1 26E+02 | 2 52E+02 |
| Cs-134 | 6 2548E-03 | 6,863 03 | 13,726 05 | 0 00E+00 | 4 29E+01 | 8 59E+01 |
| Cs-135 | 1 4433E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 9 91E-02 | 1 98E-01 |
| Cs-137 | 1 9767E+00 | 6,863 03 | 13,726 05 | 0 00E+00 | 1 36E+04 | 2 71E+04 |
| Eu-154 | 6.7603E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 4 64E+02 | 9 28E+02 |
| Eu-155 | 1 4373E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 9 86E+01 | 1 97E+02 |
| Fe-55 | 2 3466E-03 | 6,863 03 | 13,726 05 | 0 00E+00 | 1 61E+01 | 3 22E+01 |
| H-3 | 4 8143E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 3 30E+02 | 6 61E+02 |
| I-129 | 9 8288E-07 | 6,863 03 | 13,726 05 | 0 00E+00 | 6 75E-03 | 1 35E-02 |
| Kr-85 | 7 4386E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 5 11E+02 | 1 02E+03 |
| Np-237 | 1 0145E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 6 96E-02 | 1.39E-01 |
| Pa-231 | 1.0258E-09 | 6,863 03 | 13,726 05 | 0 00E+00 | 7.04E-06 | 1.41E-05 |
| Pb-210 | 1 4163E-11 | 6,863 03 | 13,726 05 | 0 00E+00 | 9.72E-08 | 1 94E-07 |
| Pm-147 | 1 9170E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 1 32E+02 | 2 63E+02 |
| Pu-238 | 8.3915E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 5 76E+02 | 1 15E+03 |
| Pu-239 | 1.1628E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 7 98E+01 | 1 60E+02 |
| Pu-240 | 1 5050E-02 | 6,863 03 | 13,726 05 | 0 00E+00 | 1 03E+02 | 2 07E+02 |
| Pu-241 | 1 8524E+00 | 6,863 03 | 13,726 05 | 0 00E+00 | 1.27E+04 | 2 54E+04 |
| Pu-242 | 6 4260E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 4 41E-01 | 8 82E-01 |
| Ra-226 | 6.0562E-11 | 6,863 03 | 13,726 05 | 0 00E+00 | 4.16E-07 | 8.31E-07 |
| Ra-228 | 4 9919E-12 | 6,863 03 | 13,726 05 | 0 00E+00 | 3.43E-08 | 6 85E-08 |
| Ru-106 | 1 8330E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 1.26E-01 | 2.52E-01 |
| Se-79 | 1.2379E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 8.50E-02 | 1.70E-01 |
| Sn-126 | 2.5210E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 1.73E-01 | 3 46E-01 |
| Sr-90 | 1.3098E+00 | 6,863 03 | 13,726 05 | 0 00E+00 | 8 99E+03 | 1 80E+04 |
| Tc-99 | 3 9357E-04 | 6,863 03 | 13,726 05 | 0 00E+00 | 2.70E+00 | 5 40E+00 |
| Th-229 | 6.2968E-11 | 6,863 03 | 13,726 05 | 0 00E+00 | 4.32E-07 | 8 64E-07 |
| Th-230 | 1.0362E-08 | 6,863 03 | 13,726 05 | 0 00E+00 | 7.11E-05 | 1 42E-04 |
| Th-232 | 5.2891E-12 | 6,863 03 | 13,726 05 | 0 00E+00 | 3 63E-08 | 7.26E-08 |
| Tl-208 | 1.9977E-07 | 6,863 03 | 13,726 05 | 0 00E+00 | 1.37E-03 | 2.74E-03 |
| U-232 | 5 4490E-07 | 6,863 03 | 13,726 05 | 0 00E+00 | 3.74E-03 | 7 48E-03 |
| U-233 | 2.3934E-08 | 6,863 03 | 13,726 05 | 0 00E+00 | 1.64E-04 | 3.29E-04 |
| U-234 | 4 4816E-05 | 6,863 03 | 13,726 05 | 0 00E+00 | 3 08E-01 | 6 15E-01 |
| U-235 | -1 4492E-06 | 6 863 03 | 0 00 | 1 75E-03 | 0 00E+00 | 1.75E-03 |
| U-236 | 7.5711E-06 | 6,863 03 | 13,726 05 | 0 00E+00 | 5.20E-02 | 1 04E-01 |
| U-238 | -2 6129E-07 | 6,863 03 | 0 00 | 1 29E-02 | 1.11E-02 | 1.29E-02 |
| Y-90 | 1.3101E+00 | 6,863 03 | 13,726 05 | 0 00E+00 | 8 99E+03 | 1 80E+04 |
| Other Radionuclides | | | | | 1.30E+04 | 2.60E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 051E+15 |
| 0 0250 | 2.138E+14 |
| 0 0375 | 2 090E+14 |
| 0 0575 | 2.195E+14 |
| 0 0850 | 1.203E+14 |
| 0 1250 | 9 109E+13 |
| 0.2250 | 1 031E+14 |
| 0 3750 | 4 444E+13 |
| 0 5750 | 1 009E+15 |
| 0 8500 | 2 615E+13 |
| 1.2500 | 3 927E+13 |
| 1 7500 | 7 230E+11 |
| 2.2500 | 1 676E+08 |
| 2 7500 | 1 176E+08 |
| 3 5000 | 1 741E+07 |
| 5 0000 | 7.333E+06 |
| 7 0000 | 8 455E+05 |
| 11 0000 | 9 713E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.06E+02 | 4.11E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 0625 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 1,326.33 | 6 863.03 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 1 960 00 | 13,726 05 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5 00 | 5.17 |
| Bounding | 10 00 | 7 00 |

Estimated EOL HM/Given EOL HM: 1 12

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | ORR | [1]Fuel decay start date | 1985 |
| SNF ID # | 461 | Estimates as of | 2010 |
| Fuel Units & Descr | 17 - 19 CURVED PLATES | Template | ATR (Light Water, Alum , 60 to 100%, U) |
| Heavy Metal Mass | BOL=4 981kg, EOL=3.252kg | [2]Template Burnup(MWd) | 367.2 |
| ROD Storage Site | SRS | Template BOL Heavy Metal Mass (MT) | 0 00116689 |
| | | Template Decay Time | 25 years |

Estimated Canister usage
18"x10'
0 47

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 1465E-09 | 1,637.30 | 3,274 60 | 0 00E+00 | 1 88E-06 | 3 75E-06 |
| Am-241 | 2 3056E-03 | 1,637.30 | 3,274 60 | 0 00E+00 | 3 77E+00 | 7 55E+00 |
| Am-242m | 4 1476E-07 | 1,637.30 | 3,274 60 | 0 00E+00 | 6 79E-04 | 1.36E-03 |
| Am-243 | 1 4894E-06 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 44E-03 | 4 88E-03 |
| C-14 | 5 7108E-09 | 1,637.30 | 3,274 60 | 0 00E+00 | 9 35E-06 | 1 87E-05 |
| Cl-36 | 1.3124E-32 | 1,637.30 | 3,274 60 | 0 00E+00 | 2.15E-29 | 4 30E-29 |
| Cm-243 | 1 4562E-07 | 1,637 30 | 3,274 60 | 0 00E+00 | 2.38E-04 | 4.77E-04 |
| Cm-244 | 2 4221E-05 | 1,637 30 | 3,274 60 | 0 00E+00 | 3 97E-02 | 7.93E-02 |
| Co-60 | 2.7560E-06 | 1,637 30 | 3,274 60 | 0 00E+00 | 4.51E-03 | 9 02E-03 |
| Cs-134 | 5.8851E-04 | 1,637 30 | 3,274 60 | 0 00E+00 | 9 64E-01 | 1.93E+00 |
| Cs-135 | 3 4477E-06 | 1,637.30 | 3,274 60 | 0 00E+00 | 5 64E-03 | 1 13E-02 |
| Cs-137 | 1 8099E+00 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 96E+03 | 5 93E+03 |
| Eu-154 | 1 6386E-02 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 68E+01 | 5 37E+01 |
| Eu-155 | 2 3957E-03 | 1,637.30 | 3,274 60 | 0 00E+00 | 3 92E+00 | 7 84E+00 |
| Fe-55 | 3 2707E-05 | 1,637.30 | 3,274 60 | 0 00E+00 | 5 36E-02 | 1 07E-01 |
| H-3 | 3 4504E-03 | 1,637.30 | 3,274 60 | 0 00E+00 | 5 65E+00 | 1 13E+01 |
| I-129 | 7 5300E-07 | 1,637 30 | 3,274 60 | 0 00E+00 | 1 23E-03 | 2 47E-03 |
| Kr-85 | 7 8540E-02 | 1,637 30 | 3,274 60 | 0 00E+00 | 1 29E+02 | 2 57E+02 |
| Np-237 | 9 5615E-06 | 1,637 30 | 3,274 60 | 0 00E+00 | 1 57E-02 | 3 13E-02 |
| Pa-231 | 2 7968E-09 | 1,637 30 | 3,274 60 | 0 00E+00 | 4 58E-06 | 9 16E-06 |
| Pb-210 | 1.2612E-10 | 1,637 30 | 3,274 60 | 0 00E+00 | 2 06E-07 | 4 13E-07 |
| Pm-147 | 1.2952E-02 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 12E+01 | 4.24E+01 |
| Pu-238 | 1.7549E-02 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 87E+01 | 5 75E+01 |
| Pu-239 | 4.2810E-04 | 1,637.30 | 3,274 60 | 0 00E+00 | 7.01E-01 | 1.40E+00 |
| Pu-240 | 2 4357E-04 | 1,637.30 | 3,274 60 | 0 00E+00 | 3 99E-01 | 7 98E-01 |
| Pu-241 | 2 6277E-02 | 1,637.30 | 3,274 60 | 0 00E+00 | 4.30E+01 | 8 60E+01 |
| Pu-242 | 3 6329E-07 | 1,637.30 | 3,274 60 | 0 00E+00 | 5 95E-04 | 1 19E-03 |
| Ra-226 | 4 4444E-10 | 1,637.30 | 3,274 60 | 0 00E+00 | 7.28E-07 | 1 46E-06 |
| Ra-228 | 1 9714E-14 | 1,637.30 | 3,274 60 | 0 00E+00 | 3 23E-11 | 6 46E-11 |
| Ru-106 | 2 0477E-07 | 1,637.30 | 3,274 60 | 0 00E+00 | 3 35E-04 | 6 71E-04 |
| Se-79 | 1 2933E-05 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 12E-02 | 4 24E-02 |
| Sn-126 | 1 1574E-05 | 1,637 30 | 3,274 60 | 0 00E+00 | 1 90E-02 | 3 79E-02 |
| Sr-90 | 1 7092E+00 | 1,637 30 | 3,274 60 | 0 00E+00 | 2 80E+03 | 5 60E+03 |
| Tc-99 | 4.2239E-04 | 1,637 30 | 3,274 60 | 0 00E+00 | 6 92E-01 | 1.38E+00 |
| Th-229 | 7 7260E-12 | 1,637 30 | 3,274 60 | 0 00E+00 | 1.26E-08 | 2.53E-08 |
| Th-230 | 5 8497E-08 | 1,637.30 | 3,274 60 | 0 00E+00 | 9 58E-05 | 1 92E-04 |
| Th-232 | 2 6906E-14 | 1,637.30 | 3,274 60 | 0 00E+00 | 4 41E-11 | 8 81E-11 |
| Tl-208 | 4 4336E-08 | 1,637.30 | 3,274 60 | 0 00E+00 | 7.26E-05 | 1 45E-04 |
| U-232 | 1.2037E-07 | 1,637.30 | 3,274 60 | 0 00E+00 | 1 97E-04 | 3 94E-04 |
| U-233 | 3 0011E-09 | 1,637.30 | 3,274 60 | 0 00E+00 | 4 91E-06 | 9 83E-06 |
| U-234 | 1 8497E-04 | 1,637.30 | 3,274.60 | 0.00E+00 | 3 03E-01 | 6 06E-01 |
| U-235 | -2.7235E-06 | 1,637.30 | 0 00 | 1 00E-02 | 5 57E-03 | 1 00E-02 |
| U-236 | 1.5493E-05 | 1,637.30 | 3,274 60 | 0 00E+00 | 2 54E-02 | 5 07E-02 |
| U-238 | -4.2851E-09 | 1,637.30 | 0 00 | 1 14E-04 | 1 07E-04 | 1 14E-04 |
| Y-90 | 1 7094E+00 | 1,637 30 | 3,274 60 | 0 00E+00 | 2 80E+03 | 5 60E+03 |
| Other Radionuclides | | | | | 2 82E+03 | 5 64E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 064E+14 |
| 0 0250 | 6.366E+13 |
| 0 0375 | 5.544E+13 |
| 0 0575 | 5.953E+13 |
| 0 0850 | 3.592E+13 |
| 0 1250 | 2.406E+13 |
| 0.2250 | 3 101E+13 |
| 0.3750 | 1.348E+13 |
| 0 5750 | 2.210E+14 |
| 0 8500 | 3 185E+12 |
| 1.2500 | 1 771E+12 |
| 1 7500 | 8 750E+10 |
| 2.2500 | 6 237E+06 |
| 2.7500 | 5 107E+06 |
| 3.5000 | 3.854E+03 |
| 5 0000 | 1.296E+03 |
| 7.0000 | 1 426E+02 |
| 11.0000 | 1.595E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.46E+01 | 6.93E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 19412969 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 0 47 | 1,637 30 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 3,274 60 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 04 | 3 460 10 |
| Bounding | 2.09 | |

Estimated EOL HM/Given EOL HM: 1 03

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PATHFINDER (SUPERHEATER)
SNF ID #: 166
Fuel Units & Descr: 411 - ROD
Heavy Metal Mass: BOL=54 54kg; EOL=52.608kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1967
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time: 35 years

Estimated Canister usage: 18"x10" 3 57

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 1,824.78 | 3,649 55 | 0 00E+00 | 4 26E-05 | 8 52E-05 |
| Am-241 | 1 1135E-04 | 1,824.78 | 3,649 55 | 0 00E+00 | 2 03E-01 | 4 06E-01 |
| Am-242m | 8 5075E-09 | 1,824.78 | 3,649 55 | 0 00E+00 | 1 55E-05 | 3 10E-05 |
| Am-243 | 9 8519E-10 | 1,824.78 | 3,649 55 | 0 00E+00 | 1 80E-06 | 3 60E-06 |
| C-14 | 2 3012E-04 | 1,824.78 | 3,649 55 | 0 00E+00 | 4 20E-01 | 8 40E-01 |
| Cl-36 | 1 2261E-06 | 1,824.78 | 3,649 55 | 0 00E+00 | 2 24E-03 | 4 47E-03 |
| Cm-243 | 2 4875E-10 | 1,824.78 | 3,649 55 | 0 00E+00 | 4 54E-07 | 9 08E-07 |
| Cm-244 | 2 3178E-09 | 1,824.78 | 3,649 55 | 0 00E+00 | 4 23E-06 | 8 46E-06 |
| Co-60 | 7 0849E-02 | 1,824.78 | 3,649 55 | 0 00E+00 | 1 29E+02 | 2 59E+02 |
| Cs-134 | 3 0266E-06 | 1,824 78 | 3,649 55 | 0 00E+00 | 5 52E-03 | 1 10E-02 |
| Cs-135 | 3 0316E-05 | 1,824 78 | 3,649 55 | 0 00E+00 | 5 53E-02 | 1 11E-01 |
| Cs-137 | 1 4511E+00 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 65E+03 | 5 30E+03 |
| Eu-154 | 6 6955E-04 | 1,824 78 | 3,649 55 | 0 00E+00 | 1.22E+00 | 2 44E+00 |
| Eu-155 | 6 9850E-04 | 1,824 78 | 3,649.55 | 0 00E+00 | 1.27E+00 | 2.55E+00 |
| Fe-55 | 1 2318E-03 | 1,824 78 | 3,649.55 | 0 00E+00 | 2.25E+00 | 4 50E+00 |
| H-3 | 2 5141E-03 | 1,824 78 | 3 649.55 | 0 00E+00 | 4.59E+00 | 9 18E+00 |
| I-129 | 7 3195E-07 | 1,824 78 | 3,649.55 | 0 00E+00 | 1 34E-03 | 2 67E-03 |
| Kr-85 | 4 1281E-02 | 1,824 78 | 3,649.55 | 0 00E+00 | 7 53E+01 | 1 51E+02 |
| Np-237 | 1 1489E-06 | 1,824 78 | 3,649 55 | 0 00E+00 | 2.10E-03 | 4 19E-03 |
| Pa-231 | 4 5241E-08 | 1,824 78 | 3,649 55 | 0 00E+00 | 8.26E-05 | 1 65E-04 |
| Pb-210 | 6 4476E-13 | 1,824 78 | 3,649 55 | 0 00E+00 | 1.18E-09 | 2 35E-09 |
| Pm-147 | 1 1651E-03 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 13E+00 | 4.25E+00 |
| Pu-238 | 2 9517E-04 | 1,824 78 | 3,649 55 | 0 00E+00 | 5.39E-01 | 1.08E+00 |
| Pu-239 | 6 6772E-04 | 1,824 78 | 3,649 55 | 0 00E+00 | 1 22E+00 | 2 44E+00 |
| Pu-240 | 8 6839E-05 | 1,824 78 | 3,649 55 | 0 00E+00 | 1.58E-01 | 3 17E-01 |
| Pu-241 | 7.1514E-04 | 1,824 78 | 3,649 55 | 0 00E+00 | 1 30E+00 | 2 61E+00 |
| Pu-242 | 1 9717E-09 | 1,824 78 | 3,649 55 | 0 00E+00 | 3 60E-06 | 7.20E-06 |
| Ra-226 | 1 7654E-12 | 1,824 78 | 3,649 55 | 0 00E+00 | 3 22E-09 | 6 44E-09 |
| Ra-228 | 8.2928E-12 | 1,824 78 | 3,649 55 | 0 00E+00 | 1 51E-08 | 3.03E-08 |
| Ru-106 | 1 8419E-10 | 1,824 78 | 3,649 55 | 0 00E+00 | 3 36E-07 | 6.72E-07 |
| Se-79 | 1.3223E-05 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 41E-02 | 4.83E-02 |
| Sn-126 | 1.1493E-05 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 10E-02 | 4.19E-02 |
| Sr-90 | 1 3649E+00 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 49E+03 | 4 98E+03 |
| Tc-99 | 4 6656E-04 | 1,824 78 | 3,649 55 | 0 00E+00 | 8 51E-01 | 1 70E+00 |
| Th-229 | 1.4547E-11 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 65E-08 | 5.31E-08 |
| Th-230 | 1 6617E-10 | 1,824 78 | 3,649 55 | 0 00E+00 | 3 03E-07 | 6 06E-07 |
| Th-232 | 8.3361E-12 | 1,824 78 | 3,649 55 | 0.00E+00 | 1 52E-08 | 3 04E-08 |
| Tl-208 | 2.1664E-08 | 1,824 78 | 3,649 55 | 0 00E+00 | 3 95E-05 | 7 91E-05 |
| U-232 | 5 8669E-08 | 1,824 78 | 3,649 55 | 0 00E+00 | 1 07E-04 | 2.14E-04 |
| U-233 | 3.1847E-09 | 1,824 78 | 3 649 55 | 0 00E+00 | 5 81E-06 | 1 16E-05 |
| U-234 | 3 8769E-07 | 1,824 78 | 3,649 55 | 0 00E+00 | 7 07E-04 | 1 41E-03 |
| U-235 | -2.7761E-06 | 1,824 78 | 0 00 | 1 10E-01 | 1 05E-01 | 1.10E-01 |
| U-236 | 1 6190E-05 | 1,824 78 | 3,649 55 | 0 00E+00 | 2 95E-02 | 5 91E-02 |
| U-238 | -2 8547E-09 | 1,824.78 | 0 00 | 1 26E-03 | 1 25E-03 | 1 26E-03 |
| Y-90 | 1 3652E+00 | 1,824.78 | 3,649 55 | 0 00E+00 | 2 49E+03 | 4 98E+03 |
| Other Radionuclides | | | | | 3 01E+03 | 6 02E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 2.724E+14 |
| 0 0250 | 5 661E+13 |
| 0 0375 | 4 896E+13 |
| 0 0575 | 5.277E+13 |
| 0.0850 | 3 189E+13 |
| 0 1250 | 2.070E+13 |
| 0.2250 | 2.745E+13 |
| 0.3750 | 1 197E+13 |
| 0.5750 | 1 972E+14 |
| 0.8500 | 1 996E+12 |
| 1.2500 | 1 984E+13 |
| 1 7500 | 5 149E+10 |
| 2.2500 | 1 069E+08 |
| 2.7500 | 3 090E+06 |
| 3.5000 | 2.269E+02 |
| 5 0000 | 9 340E+01 |
| 7 0000 | 1 032E+01 |
| 11 0000 | 1 159E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 19E+01 | 6.37E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences* |
|---|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding: | SST | SST | |
| BOL HM Constituents: | U | U | |
| BOL Enrichment %: | 93 14242653 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 1 824 78 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 3,649 55 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 72 | | 1 00 |
| Bounding | 1 43 | | |

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | PATHFINDER (SUPERHEATER) | [1]Fuel decay start date | 1967 |
| SNF ID # | 814 | Estimates as of: | 2010 |
| Fuel Units & Descr | 6 - ROD | Template | Pathfinder (Light Water, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=0 796kg EOL=0 796kg | [2]Template Burnup(MWd) | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 |
| | | Template Decay Time | 35 years |

| Estimated Canister usage 18"x10' |
|---|
| 0 05 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2.3344E-08 | 15 04 | 30 09 | 0 00E+00 | 3 51E-07 | 7 02E-07 |
| Am-241 | 1 1135E-04 | 15 04 | 30 09 | 0 00E+00 | 1 67E-03 | 3 35E-03 |
| Am-242m | 8 5075E-09 | 15 04 | 30 09 | 0 00E+00 | 1 28E-07 | 2 56E-07 |
| Am-243 | 9 8519E-10 | 15 04 | 30 09 | 0 00E+00 | 1 48E-08 | 2 96E-08 |
| C-14 | 2 3012E-04 | 15 04 | 30 09 | 0.00E+00 | 3 46E-03 | 6 92E-03 |
| Cl-36 | 1 2261E-06 | 15 04 | 30 09 | 0 00E+00 | 1 84E-05 | 3 69E-05 |
| Cm-243 | 2 4875E-10 | 15 04 | 30 09 | 0 00E+00 | 3 74E-09 | 7.48E-09 |
| Cm-244 | 2 3178E-09 | 15 04 | 30.09 | 0 00E+00 | 3 49E-08 | 6 97E-08 |
| Co-60 | 7 0849E-02 | 15 04 | 30 09 | 0 00E+00 | 1 07E+00 | 2 13E+00 |
| Cs-134 | 3 0266E-06 | 15 04 | 30 09 | 0 00E+00 | 4 55E-05 | 9.11E-05 |
| Cs-135 | 3 0316E-05 | 15 04 | 30 09 | 0 00E+00 | 4 56E-04 | 9 12E-04 |
| Cs-137 | 1 4511E+00 | 15 04 | 30 09 | 0 00E+00 | 2 18E+01 | 4 37E+01 |
| Eu-154 | 6 6955E-04 | 15 04 | 30 09 | 0 00E+00 | 1.01E-02 | 2 01E-02 |
| Eu-155 | 6.9850E-04 | 15 04 | 30 09 | 0 00E+00 | 1.05E-02 | 2 10E-02 |
| Fe-55 | 1.2318E-03 | 15 04 | 30 09 | 0 00E+00 | 1 85E-02 | 3 71E-02 |
| H-3 | 2 5141E-03 | 15 04 | 30 09 | 0 00E+00 | 3 78E-02 | 7.56E-02 |
| I-129 | 7.3195E-07 | 15 04 | 30 09 | 0 00E+00 | 1 10E-05 | 2.20E-05 |
| Kr-85 | 4 1281E-02 | 15 04 | 30 09 | 0 00E+00 | 6 21E-01 | 1.24E+00 |
| Np-237 | 1 1489E-06 | 15 04 | 30 09 | 0 00E+00 | 1 73E-05 | 3 46E-05 |
| Pa-231 | 4 5241E-08 | 15 04 | 30 09 | 0.00E+00 | 6 81E-07 | 1 36E-06 |
| Pb-210 | 6 4476E-13 | 15 04 | 30 09 | 0 00E+00 | 9 70E-12 | 1 94E-11 |
| Pm-147 | 1 1651E-03 | 15 04 | 30 09 | 0.00E+00 | 1 75E-02 | 3 51E-02 |
| Pu-238 | 2 9517E-04 | 15 04 | 30 09 | 0 00E+00 | 4 44E-03 | 8 88E-03 |
| Pu-239 | 6 6772E-04 | 15 04 | 30.09 | 0 00E+00 | 1 00E-02 | 2 01E-02 |
| Pu-240 | 8 6839E-05 | 15 04 | 30.09 | 0 00E+00 | 1 31E-03 | 2 61E-03 |
| Pu-241 | 7.1514E-04 | 15 04 | 30 09 | 0 00E+00 | 1 08E-02 | 2 15E-02 |
| Pu-242 | 1.9717E-09 | 15.04 | 30 09 | 0 00E+00 | 2 97E-08 | 5 93E-08 |
| Ra-226 | 1.7654E-12 | 15 04 | 30 09 | 0 00E+00 | 2 66E-11 | 5 31E-11 |
| Ra-228 | 8.2928E-12 | 15 04 | 30 09 | 0 00E+00 | 1.25E-10 | 2 49E-10 |
| Ru-106 | 1.8419E-10 | 15 04 | 30 09 | 0 00E+00 | 2.77E-09 | 5.54E-09 |
| Se-79 | 1.3223E-05 | 15 04 | 30 09 | 0 00E+00 | 1.99E-04 | 3 98E-04 |
| Sn-126 | 1 1493E-05 | 15 04 | 30 09 | 0 00E+00 | 1.73E-04 | 3 46E-04 |
| Sr-90 | 1.3649E+00 | 15 04 | 30 09 | 0 00E+00 | 2 05E+01 | 4 11E+01 |
| Tc-99 | 4 6656E-04 | 15 04 | 30 09 | 0 00E+00 | 7.02E-03 | 1.40E-02 |
| Th-229 | 1 4547E-11 | 15 04 | 30 09 | 0 00E+00 | 2 19E-10 | 4 38E-10 |
| Th-230 | 1 6617E-10 | 15 04 | 30 09 | 0 00E+00 | 2.50E-09 | 5 00E-09 |
| Th-232 | 8 3361E-12 | 15 04 | 30 09 | 0 00E+00 | 1.25E-10 | 2 51E-10 |
| Tl-208 | 2.1664E-08 | 15 04 | 30 09 | 0.00E+00 | 3.26E-07 | 6 52E-07 |
| U-232 | 5 8669E-08 | 15 04 | 30.09 | 0 00E+00 | 8 83E-07 | 1 77E-06 |
| U-233 | 3 1847E-09 | 15 04 | 30 09 | 0 00E+00 | 4 79E-08 | 9 58E-08 |
| U-234 | 3 8769E-07 | 15.04 | 30 09 | 0 00E+00 | 5 83E-06 | 1 17E-05 |
| U-235 | -2 7761E-06 | 15.04 | 0.00 | 1 60E-03 | 1 56E-03 | 1 60E-03 |
| U-236 | 1.6190E-05 | 15 04 | 30 09 | 0 00E+00 | 2 44E-04 | 4 87E-04 |
| U-238 | -2 8547E-09 | 15 04 | 0.00 | 1 84E-05 | 1 83E-05 | 1 84E-05 |
| Y-90 | 1.3652E+00 | 15 04 | 30 09 | 0 00E+00 | 2 05E+01 | 4 11E+01 |
| Other Radionuclides | | | | | 2 48E+01 | 4 97E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.246E+12 |
| 0 0250 | 4 666E+11 |
| 0 0375 | 4 036E+11 |
| 0 0575 | 4.351E+11 |
| 0 0850 | 2.629E+11 |
| 0 1250 | 1 707E+11 |
| 0.2250 | 2.263E+11 |
| 0 3750 | 9.869E+10 |
| 0 5750 | 1.626E+12 |
| 0 8500 | 1.646E+10 |
| 1.2500 | 1 636E+11 |
| 1 7500 | 4.245E+08 |
| 2.2500 | 8 813E+05 |
| 2 7500 | 2.547E+04 |
| 3.5000 | 1 936E+00 |
| 5 0000 | 7.977E-01 |
| 7 0000 | 8.821E-02 |
| 11 0000 | 9 907E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.63E-01 | 5.25E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 14242815 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 15 04 |
| Bounding | | 30 09 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 40 | |
| Bounding | 0.81 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name. PBF DRIVER CORE | [1]Fuel decay start date: | 1985 | Estimated Canister usage: 18"x15" |
| SNF ID #. 167 | Estimates as of: | 2010 | 8 98 |
| Fuel Units & Descr: 2425 - ROD | Template: | Pathfinder (Light Water, SST 60 to 100%, U) | |
| Heavy Metal Mass· BOL=571 815kg; EOL=561 63kg | [2]Template Burnup(MWd). | 6 01 | |
| ROD Storage Site INEEL | Template BOL Heavy Metal Mass (MT): | 0 00012882 | |
| | Template Decay Time: | 25 years | |

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3562E-08 | 9,621.24 | 19,242.47 | 0 00E+00 | 1 30E-04 | 2 61E-04 |
| Am-241 | 1 0168E-04 | 9,621 24 | 19,242.47 | 0 00E+00 | 9 78E-01 | 1 96E+00 |
| Am-242m | 8 9052E-09 | 9,621 24 | 19,242.47 | 0 00E+00 | 8 57E-05 | 1 71E-04 |
| Am-243 | 9 8602E-10 | 9,621.24 | 19,242.47 | 0 00E+00 | 9 49E-06 | 1 90E-05 |
| C-14 | 2 3045E-04 | 9,621.24 | 19,242 47 | 0 00E+00 | 2.22E+00 | 4 43E+00 |
| Cl-36 | 1 2261E-06 | 9,621 24 | 19,242.47 | 0 00E+00 | 1 18E-02 | 2 36E-02 |
| Cm-243 | 3 1730E-10 | 9,621 24 | 19,242.47 | 0 00E+00 | 3 05E-06 | 6 11E-06 |
| Cm-244 | 3 3977E-09 | 9,621 24 | 19,242 47 | 0 00E+00 | 3 27E-05 | 6 54E-05 |
| Co-60 | 2 6373E-01 | 9,621 24 | 19,242 47 | 0 00E+00 | 2 54E+03 | 5 07E+03 |
| Cs-134 | 8 7072E-05 | 9,621 24 | 19,242 47 | 0 00E+00 | 8 38E-01 | 1 68E+00 |
| Cs-135 | 3 0316E-05 | 9,621 24 | 19,242 47 | 0 00E+00 | 2 92E-01 | 5 83E-01 |
| Cs-137 | 1 8286E+00 | 9,621 24 | 19,242 47 | 0 00E+00 | 1.76E+04 | 3 52E+04 |
| Eu-154 | 1 4982E-03 | 9,621 24 | 19,242 47 | 0 00E+00 | 1 44E+01 | 2 88E+01 |
| Eu-155 | 2 8236E-03 | 9,621 24 | 19,242 47 | 0 00E+00 | 2.72E+01 | 5 43E+01 |
| Fe-55 | 1 7687E-02 | 9,621 24 | 19,242 47 | 0 00E+00 | 1.70E+02 | 3 40E+02 |
| H-3 | 4 4043E-03 | 9,621 24 | 19,242 47 | 0 00E+00 | 4.24E+01 | 8 48E+01 |
| I-129 | 7.3195E-07 | 9,621 24 | 19,242 47 | 0 00E+00 | 7 04E-03 | 1 41E-02 |
| Kr-85 | 7 8769E-02 | 9,621 24 | 19,242 47 | 0 00E+00 | 7.58E+02 | 1 52E+03 |
| Np-237 | 1 1484E-06 | 9,621 24 | 19,242 47 | 0 00E+00 | 1.10E-02 | 2 21E-02 |
| Pa-231 | 3.2396E-08 | 9,621 24 | 19,242 47 | 0 00E+00 | 3.12E-04 | 6 23E-04 |
| Pb-210 | 2 4409E-13 | 9,621.24 | 19,242 47 | 0 00E+00 | 2.35E-09 | 4 70E-09 |
| Pm-147 | 1 6331E-02 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 57E+02 | 3 14E+02 |
| Pu-238 | 3.1947E-04 | 9,621.24 | 19,242 47 | 0 00E+00 | 3 07E+00 | 6 15E+00 |
| Pu-239 | 6.6789E-04 | 9,621.24 | 19,242 47 | 0 00E+00 | 6 43E+00 | 1.29E+01 |
| Pu-240 | 8 6922E-05 | 9,621.24 | 19,242 47 | 0 00E+00 | 8 36E-01 | 1.67E+00 |
| Pu-241 | 1 1567E-03 | 9,621.24 | 19,242 47 | 0 00E+00 | 1.11E+01 | 2.23E+01 |
| Pu-242 | 1 9717E-09 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 90E-05 | 3 79E-05 |
| Ra-226 | 8 6190E-13 | 9,621.24 | 19,242 47 | 0 00E+00 | 8 29E-09 | 1 66E-08 |
| Ra-228 | 8.1498E-12 | 9,621.24 | 19,242 47 | 0 00E+00 | 7 84E-08 | 1.57E-07 |
| Ru-106 | 1 7770E-07 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 71E-03 | 3.42E-03 |
| Se-79 | 1 3225E-05 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 27E-01 | 2.54E-01 |
| Sn-126 | 1 1493E-05 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 11E-01 | 2.21E-01 |
| Sr-90 | 1 7321E+00 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 67E+04 | 3.33E+04 |
| Tc-99 | 4 6656E-04 | 9,621.24 | 19,242 47 | 0 00E+00 | 4 49E+00 | 8 98E+00 |
| Th-229 | 1 0110E-11 | 9,621.24 | 19,242.47 | 0 00E+00 | 9 73E-08 | 1.95E-07 |
| Th-230 | 1 1466E-10 | 9,621.24 | 19,242 47 | 0 00E+00 | 1 10E-06 | 2.21E-06 |
| Th-232 | 8 3245E-12 | 9,621.24 | 19,242.47 | 0 00E+00 | 8 01E-08 | 1 60E-07 |
| Tl-208 | 2 3860E-08 | 9,621.24 | 19,242.47 | 0 00E+00 | 2 30E-04 | 4.59E-04 |
| U-232 | 6 4576E-08 | 9,621.24 | 19,242.47 | 0 00E+00 | 6 21E-04 | 1.24E-03 |
| U-233 | 3 1082E-09 | 9,621 24 | 19,242.47 | 0 00E+00 | 2 99E-05 | 5 98E-05 |
| U-234 | 3 7587E-07 | 9,621 24 | 19,242 47 | 0 00E+00 | 3 62E-03 | 7.23E-03 |
| U-235 | -2.7761E-06 | 9,621.24 | 0 00 | 2.28E-01 | 2 02E-01 | 2.28E-01 |
| U-236 | 1 6190E-05 | 9,621 24 | 19,242 47 | 0.00E+00 | 1 56E-01 | 3.12E-01 |
| U-238 | -2 8547E-09 | 9,621 24 | 0 00 | 1.57E-01 | 1 57E-01 | 1 57E-01 |
| Y-90 | 1 7321E+00 | 9,621 24 | 19,242 47 | 0 00E+00 | 1.67E+04 | 3 33E+04 |
| Other Radionuclides | | | | | 1.95E+04 | 3 90E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 831E+15 |
| 0 0250 | 3.804E+14 |
| 0 0375 | 3.283E+14 |
| 0 0575 | 3 542E+14 |
| 0 0850 | 2.142E+14 |
| 0 1250 | 1 392E+14 |
| 0.2250 | 1 838E+14 |
| 0 3750 | 8 024E+13 |
| 0 5750 | 1 310E+15 |
| 0 8500 | 1 366E+13 |
| 1.2500 | 3 806E+14 |
| 1 7500 | 3 519E+11 |
| 2.2500 | 2 027E+09 |
| 2 7500 | 2.231E+07 |
| 3.5000 | 5 547E+03 |
| 5 0000 | 8 362E+02 |
| 7 0000 | 9 402E+01 |
| 11 0000 | 1 066E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.39E+02 | 4 77E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator· | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 18 49024597 | 60 to 100 |

**Basis for Parameter Differences·**

This Template was used for the following reasons:

This fuel matches Pathfinder Template on all but one parameter (enrichment) making Pathfinder a reasonable match.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal. | 297.34 | 9 621.24 |
| Bounding· | 623.28 | 19,242.47 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.36 | 32.36 |
| Bounding | 0 72 | 30 87 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | PEACH BOTTOM (ASSEMBLY) | [1]Fuel decay start date | 1976 |
| SNF ID # | 385 | Estimates as of | 2010 |
| Fuel Units & Descr. | 2 - 7 X 7 ROD ARRAY | Template | PWR (Light Water, Zirc, 0 to 5% U) |
| Heavy Metal Mass | BOL=288 335kg EOL=285.305kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage 18"x15' 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.91E-06 | 3 83E-06 |
| Am-241 | 1 3144E-01 | 2,881.39 | 5,762 77 | 0 00E+00 | 3.79E+02 | 7.57E+02 |
| Am-242m | 3 0039E-04 | 2,881.39 | 5,762 77 | 0 00E+00 | 8 66E-01 | 1 73E+00 |
| Am-243 | 6 2629E-04 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.80E+00 | 3 61E+00 |
| C-14 | 4 7965E-05 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.38E-01 | 2.76E-01 |
| Cl-36 | 8 0297E-07 | 2,881.39 | 5,762 77 | 0 00E+00 | 2 31E-03 | 4 63E-03 |
| Cm-243 | 3 1993E-04 | 2,881.39 | 5,762 77 | 0 00E+00 | 9 22E-01 | 1.84E+00 |
| Cm-244 | 7.1851E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 2 07E+02 | 4.14E+02 |
| Co-60 | 9 5220E-03 | 2,881.39 | 5,762.77 | 0 00E+00 | 2 74E+01 | 5.49E+01 |
| Cs-134 | 1 1662E-03 | 2,881.39 | 5,762.77 | 0 00E+00 | 3 36E+00 | 6.72E+00 |
| Cs-135 | 1 4433E-05 | 2,881 39 | 5,762.77 | 0 00E+00 | 4 16E-02 | 8 32E-02 |
| Cs-137 | 1 7603E+00 | 2,881 39 | 5,762 77 | 0 00E+00 | 5 07E+03 | 1 01E+04 |
| Eu-154 | 4 5203E-02 | 2,881 39 | 5,762 77 | 0 00E+00 | 1 30E+02 | 2 60E+02 |
| Eu-155 | 7 1479E-03 | 2,881 39 | 5,762 77 | 0 00E+00 | 2 06E+01 | 4 12E+01 |
| Fe-55 | 6 1919E-04 | 2,881 39 | 5,762 77 | 0 00E+00 | 1 78E+00 | 3 57E+00 |
| H-3 | 3 6386E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 1 05E+02 | 2 10E+02 |
| I-129 | 9 8288E-07 | 2,881.39 | 5,762 77 | 0 00E+00 | 2 83E-03 | 5 66E-03 |
| Kr-85 | 5 3844E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.55E+02 | 3 10E+02 |
| Np-237 | 1 0546E-05 | 2,881 39 | 5,762 77 | 0.00E+00 | 3 04E-02 | 6 08E-02 |
| Pa-231 | 1 1370E-09 | 2,881.39 | 5,762 77 | 0 00E+00 | 3.28E-06 | 6 55E-06 |
| Pb-210 | 3 3624E-11 | 2,881.39 | 5,762 77 | 0 00E+00 | 9 69E-08 | 1.94E-07 |
| Pm-147 | 5 1211E-03 | 2,881.39 | 5,762 77 | 0 00E+00 | 1 48E+01 | 2 95E+01 |
| Pu-238 | 8 0669E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 2.32E+02 | 4 65E+02 |
| Pu-239 | 1 1626E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 3.35E+01 | 6 70E+01 |
| Pu-240 | 1.5097E-02 | 2,881.39 | 5,762 77 | 0 00E+00 | 4.35E+01 | 8 70E+01 |
| Pu-241 | 1 4567E+00 | 2,881.39 | 5,762 77 | 0 00E+00 | 4.20E+03 | 8.39E+03 |
| Pu-242 | 6 4260E-05 | 2,881.39 | 5,762 77 | 0 00E+00 | 1 85E-01 | 3 70E-01 |
| Ra-226 | 1.1392E-10 | 2,881.39 | 5,762 77 | 0 00E+00 | 3 28E-07 | 6 57E-07 |
| Ra-228 | 5.1841E-12 | 2,881.39 | 5,762 77 | 0 00E+00 | 1 49E-08 | 2 99E-08 |
| Ru-106 | 5 9012E-07 | 2,881.39 | 5,762.77 | 0 00E+00 | 1 70E-03 | 3 40E-03 |
| Se-79 | 1.2379E-05 | 2,881 39 | 5,762.77 | 0 00E+00 | 3 57E-02 | 7 13E-02 |
| Sn-126 | 2 5210E-05 | 2,881 39 | 5,762.77 | 0 00E+00 | 7 26E-02 | 1 45E-01 |
| Sr-90 | 1 1630E+00 | 2,881 39 | 5,762.77 | 0 00E+00 | 3 35E+03 | 6 70E+03 |
| Tc-99 | 3 9357E-04 | 2,881 39 | 5,762 77 | 0 00E+00 | 1 13E+00 | 2.27E+00 |
| Th-229 | 8 5691E-11 | 2,881 39 | 5,762 77 | 0 00E+00 | 2 47E-07 | 4 94E-07 |
| Th-230 | 1 4493E-08 | 2,881.39 | 5,762 77 | 0 00E+00 | 4.18E-05 | 8.35E-05 |
| Th-232 | 5 2923E-12 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.52E-08 | 3 05E-08 |
| Tl-208 | 1 9202E-07 | 2,881.39 | 5,762 77 | 0 00E+00 | 5.53E-04 | 1.11E-03 |
| U-232 | 5 2083E-07 | 2,881.39 | 5,762 77 | 0 00E+00 | 1.50E-03 | 3 00E-03 |
| U-233 | 2 4386E-08 | 2,881.39 | 5,762 77 | 0 00E+00 | 7.03E-05 | 1.41E-04 |
| U-234 | 4 7012E-05 | 2,881.39 | 5,762 77 | 0.00E+00 | 1.35E-01 | 2.71E-01 |
| U-235 | -1.4492E-06 | 2,881.39 | 0 00 | 1.51E-02 | 1.10E-02 | 1.51E-02 |
| U-236 | 7 5759E-06 | 2,881.39 | 5,762 77 | 0 00E+00 | 2.18E-02 | 4.37E-02 |
| U-238 | -2 6129E-07 | 2,881.39 | 0 00 | 9 46E-02 | 9 38E-02 | 9 46E-02 |
| Y-90 | 1.1631E+00 | 2,881.39 | 5,762 77 | 0 00E+00 | 3.35E+03 | 6.70E+03 |
| Other Radionuclides | | | | | 4 87E+03 | 9.74E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 919E+14 |
| 0 0250 | 7 937E+13 |
| 0 0375 | 7 681E+13 |
| 0 0575 | 8.380E+13 |
| 0 0850 | 4 440E+13 |
| 0 1250 | 3.244E+13 |
| 0.2250 | 3 812E+13 |
| 0.3750 | 1 636E+13 |
| 0 5750 | 3 758E+14 |
| 0 8500 | 7.418E+12 |
| 1.2500 | 1.002E+13 |
| 1.7500 | 2.195E+11 |
| 2.2500 | 4 055E+07 |
| 2.7500 | 4.558E+07 |
| 3.5000 | 5.973E+06 |
| 5.0000 | 2.553E+06 |
| 7.0000 | 2.943E+05 |
| 11.0000 | 3.380E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.90E+01 | 1.58E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 2 429812544 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 2,476 80 | 2,881.39 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 2 479 97 | 5 762 77 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 29 | 1 16 |
| Bounding | 0 57 | 2.32 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PEACH BOTTOM RODS
SNF ID # 386
Fuel Units & Descr: 20 - ROD
Heavy Metal Mass: BOL=79kg, EOL=71 12kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1976
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage
HIC: 0 57

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 97E-06 | 9.95E-06 |
| Am-241 | 1 3144E-01 | 7,493 51 | 14,987 01 | 0 00E+00 | 9 85E+02 | 1 97E+03 |
| Am-242m | 3 0039E-04 | 7,493 51 | 14,987 01 | 0 00E+00 | 2 25E+00 | 4 50E+00 |
| Am-243 | 6 2629E-04 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 69E+00 | 9 39E+00 |
| C-14 | 4 7965E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 59E-01 | 7.19E-01 |
| Cl-36 | 8 0297E-07 | 7,493 51 | 14,987 01 | 0 00E+00 | 6 02E-03 | 1.20E-02 |
| Cm-243 | 3 1993E-04 | 7,493 51 | 14,987 01 | 0 00E+00 | 2 40E+00 | 4 79E+00 |
| Cm-244 | 7 1851E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 5 38E+02 | 1 08E+03 |
| Co-60 | 9 5220E-03 | 7,493.51 | 14,987 01 | 0 00E+00 | 7 14E+01 | 1 43E+02 |
| Cs-134 | 1 1662E-03 | 7,493 51 | 14,987 01 | 0 00E+00 | 8 74E+00 | 1 75E+01 |
| Cs-135 | 1 4433E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 08E-01 | 2 16E-01 |
| Cs-137 | 1 7603E+00 | 7,493.51 | 14,987 01 | 0 00E+00 | 1 32E+04 | 2 64E+04 |
| Eu-154 | 4 5203E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 39E+02 | 6 77E+02 |
| Eu-155 | 7 1479E-03 | 7,493 51 | 14,987 01 | 0 00E+00 | 5 36E+01 | 1 07E+02 |
| Fe-55 | 6 1919E-04 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 64E+00 | 9 28E+00 |
| H-3 | 3 6386E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 2 73E+02 | 5 45E+02 |
| I-129 | 9 8288E-07 | 7,493 51 | 14,987 01 | 0 00E+00 | 7 37E-03 | 1 47E-02 |
| Kr-85 | 5 3844E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 03E+02 | 8 07E+02 |
| Np-237 | 1 0546E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 7 90E-02 | 1 58E-01 |
| Pa-231 | 1 1370E-09 | 7,493 51 | 14,987 01 | 0 00E+00 | 8 52E-06 | 1 70E-05 |
| Pb-210 | 3 3624E-11 | 7,493 51 | 14,987 01 | 0 00E+00 | 2 52E-07 | 5 04E-07 |
| Pm-147 | 5 1211E-03 | 7,493 51 | 14,987 01 | 0.00E+00 | 3 84E+01 | 7 68E+01 |
| Pu-238 | 8 0669E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 6 04E+02 | 1 21E+03 |
| Pu-239 | 1 1626E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 8 71E+01 | 1 74E+02 |
| Pu-240 | 1 5097E-02 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 13E+02 | 2 26E+02 |
| Pu-241 | 1 4567E+00 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 09E+04 | 2.18E+04 |
| Pu-242 | 6 4260E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 82E-01 | 9 63E-01 |
| Ra-226 | 1 1392E-10 | 7,493 51 | 14,987 01 | 0 00E+00 | 8 54E-07 | 1 71E-06 |
| Ra-228 | 5 1841E-12 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 88E-08 | 7 77E-08 |
| Ru-106 | 5 9012E-07 | 7,493 51 | 14,987 01 | 0 00E+00 | 4 42E-03 | 8 84E-03 |
| Se-79 | 1.2379E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 9 28E-02 | 1 86E-01 |
| Sn-126 | 2 5210E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 89E-01 | 3 78E-01 |
| Sr-90 | 1.1630E+00 | 7,493 51 | 14,987 01 | 0 00E+00 | 8 71E+03 | 1 74E+04 |
| Tc-99 | 3.9357E-04 | 7,493 51 | 14,987 01 | 0 00E+00 | 2 95E+00 | 5 90E+00 |
| Th-229 | 8 5691E-11 | 7,493 51 | 14,987 01 | 0 00E+00 | 6 42E-07 | 1 28E-06 |
| Th-230 | 1 4493E-08 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 09E-04 | 2 17E-04 |
| Th-232 | 5.2923E-12 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 97E-08 | 7 93E-08 |
| Tl-208 | 1 9202E-07 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 44E-03 | 2 88E-03 |
| U-232 | 5.2083E-07 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 90E-03 | 7 81E-03 |
| U-233 | 2 4386E-08 | 7,493 51 | 14,987 01 | 0 00E+00 | 1 83E-04 | 3 65E-04 |
| U-234 | 4 7012E-05 | 7,493 51 | 14,987 01 | 0 00E+00 | 3 52E-01 | 7 05E-01 |
| U-235 | -1 4492E-06 | 7,493 51 | 0 00 | 4 15E-03 | 0 00E+00 | 4 15E-03 |
| U-236 | 7.5759E-06 | 7,493 51 | 14,987 01 | 0 00E+00 | 5 68E-02 | 1.14E-01 |
| U-238 | -2 6129E-07 | 7,493 51 | 0 00 | 2 59E-02 | 2 39E-02 | 2 59E-02 |
| Y-90 | 1.1631E+00 | 7,493 51 | 14,987.01 | 0 00E+00 | 8 72E+03 | 1.74E+04 |
| Other Radionuclides | | | | | 1.27E+04 | 2.53E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 019E+15 |
| 0 0250 | 2 064E+14 |
| 0 0375 | 1 998E+14 |
| 0 0575 | 2 179E+14 |
| 0 0850 | 1 155E+14 |
| 0 1250 | 8 436E+13 |
| 0 2250 | 9 913E+13 |
| 0.3750 | 4 254E+13 |
| 0 5750 | 9 774E+14 |
| 0 8500 | 1 929E+13 |
| 1.2500 | 2 606E+13 |
| 1 7500 | 5 710E+11 |
| 2.2500 | 1 055E+08 |
| 2.7500 | 1 185E+08 |
| 3 5000 | 1 553E+07 |
| 5 0000 | 6 638E+06 |
| 7 0000 | 7 653E+05 |
| 11 0000 | 8 790E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2 05E+02 | 4 11E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2 43 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 809 75 | 7,493.51 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 943.26 | 14,987 01 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 2.71 | 9.25 |
| Bounding | 5 42 | 15 89 |

Estimated EOL HM/Given EOL HM: 1 05

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PEACH BOTTOM UNIT I CORE I
SNF ID #: 169
Fuel Units & Descr: 2 - SCRAP
Heavy Metal Mass: BOL=3 746kg, EOL=3 56kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1969
Estimates as of: 2010
Template: FSV (Graphite Graphite, 60 to 100%, Th & U)
[2]Template Burnup(MWd): 1270.275
Template BOL Heavy Metal Mass (MT): 0 012702752
Template Decay Time: 35 years

Estimated Canister usage: 18"x15' — 0 15

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 8818E-06 | 176 28 | 352 57 | 0 00E+00 | 6 84E-04 | 1 37E-03 |
| Am-241 | 3 1387E-03 | 176 28 | 352 57 | 0 00E+00 | 5 53E-01 | 1 11E+00 |
| Am-242m | 2.3971E-06 | 176 28 | 352 57 | 0 00E+00 | 4.23E-04 | 8 45E-04 |
| Am-243 | 4 6069E-05 | 176 28 | 352 57 | 0 00E+00 | 8 12E-03 | 1 62E-02 |
| C-14 | 2.3121E-05 | 176 28 | 352 57 | 0 00E+00 | 4 08E-03 | 8 15E-03 |
| Cl-36 | 1 0667E-06 | 176 28 | 352 57 | 0 00E+00 | 1.88E-04 | 3 76E-04 |
| Cm-243 | 2.5357E-05 | 176.28 | 352 57 | 0 00E+00 | 4 47E-03 | 8 94E-03 |
| Cm-244 | 6 4458E-03 | 176.28 | 352 57 | 0 00E+00 | 1.14E+00 | 2 27E+00 |
| Co-60 | 4 5014E-04 | 176.28 | 352.57 | 0 00E+00 | 7 94E-02 | 1.59E-01 |
| Cs-134 | 3 8086E-05 | 176.28 | 352.57 | 0 00E+00 | 6 71E-03 | 1.34E-02 |
| Cs-135 | 2 4711E-05 | 176.28 | 352.57 | 0 00E+00 | 4 36E-03 | 8 71E-03 |
| Cs-137 | 1 3273E+00 | 176 28 | 352.57 | 0 00E+00 | 2 34E+02 | 4 68E+02 |
| Eu-154 | 1 5705E-02 | 176 28 | 352 57 | 0 00E+00 | 2 77E+00 | 5.54E+00 |
| Eu-155 | 1 0415E-03 | 176 28 | 352 57 | 0 00E+00 | 1 84E-01 | 3 67E-01 |
| Fe-55 | 4 4707E-08 | 176 28 | 352 57 | 0 00E+00 | 7 88E-06 | 1 58E-05 |
| H-3 | 3 9094E-03 | 176 28 | 352 57 | 0 00E+00 | 6 89E-01 | 1.38E+00 |
| I-129 | 1.0092E-06 | 176 28 | 352 57 | 0 00E+00 | 1 78E-04 | 3 56E-04 |
| Kr-85 | 3 9519E-02 | 176 28 | 352 57 | 0 00E+00 | 6 97E+00 | 1.39E+01 |
| Np-237 | 1.2541E-05 | 176.28 | 352 57 | 0 00E+00 | 2.21E-03 | 4 42E-03 |
| Pa-231 | 4 7376E-06 | 176.28 | 352.57 | 0 00E+00 | 8.35E-04 | 1 67E-03 |
| Pb-210 | 1 4194E-09 | 176.28 | 352 57 | 0 00E+00 | 2.50E-07 | 5 00E-07 |
| Pm-147 | 1 5146E-04 | 176.28 | 352.57 | 0.00E+00 | 2 67E-02 | 5.34E-02 |
| Pu-238 | 1 6248E-01 | 176.28 | 352.57 | 0 00E+00 | 2.86E+01 | 5 73E+01 |
| Pu-239 | 1 3580E-04 | 176 28 | 352.57 | 0 00E+00 | 2.39E-02 | 4.79E-02 |
| Pu-240 | 2 7136E-04 | 176 28 | 352.57 | 0 00E+00 | 4 78E-02 | 9.57E-02 |
| Pu-241 | 1 9342E-02 | 176 28 | 352 57 | 0 00E+00 | 3 41E+00 | 6.82E+00 |
| Pu-242 | 3 8866E-06 | 176 28 | 352 57 | 0 00E+00 | 6 85E-04 | 1.37E-03 |
| Ra-226 | 2.7923E-09 | 176 28 | 352 57 | 0 00E+00 | 4 92E-07 | 9 84E-07 |
| Ra-228 | 9 1791E-07 | 176 28 | 352 57 | 0 00E+00 | 1 62E-04 | 3.24E-04 |
| Ru-106 | 3 5205E-11 | 176 28 | 352 57 | 0 00E+00 | 6 21E-09 | 1.24E-08 |
| Se-79 | 2 1082E-05 | 176.28 | 352 57 | 0 00E+00 | 3 72E-03 | 7 43E-03 |
| Sn-126 | 2.2192E-05 | 176.28 | 352 57 | 0 00E+00 | 3 91E-03 | 7 82E-03 |
| Sr-90 | 1.2667E+00 | 176.28 | 352.57 | 0 00E+00 | 2 23E+02 | 4 47E+02 |
| Tc-99 | 3 3331E-04 | 176.28 | 352.57 | 0 00E+00 | 5 88E-02 | 1.18E-01 |
| Th-229 | 1 0612E-05 | 176.28 | 352.57 | 0 00E+00 | 1.87E-03 | 3 74E-03 |
| Th-230 | 1 8878E-07 | 176.28 | 352.57 | 0.00E+00 | 3.33E-05 | 6 66E-05 |
| Th-232 | -6.9673E-08 | 176.28 | 0 00 | 3 71E-04 | 3 58E-04 | 3.71E-04 |
| Tl-208 | 5 9530E-04 | 176 28 | 352.57 | 0 00E+00 | 1 05E-01 | 2.10E-01 |
| U-232 | 1 6115E-03 | 176 28 | 352 57 | 0 00E+00 | 2 84E-01 | 5 68E-01 |
| U-233 | 2 0602E-03 | 176 28 | 352 57 | 0 00E+00 | 3 63E-01 | 7.26E-01 |
| U-234 | 2 8939E-04 | 176 28 | 352 57 | 0 00E+00 | 5 10E-02 | 1 02E-01 |
| U-235 | -1 7343E-06 | 176.28 | 0 00 | 7 41E-04 | 4 35E-04 | 7.41E-04 |
| U-236 | 8 6281E-06 | 176.28 | 352 57 | 0 00E+00 | 1.52E-03 | 3 04E-03 |
| U-238 | -5 6065E-09 | 176.28 | 0 00 | 7.37E-06 | 6 39E-06 | 7.37E-06 |
| Y-90 | 1.2667E+00 | 176.28 | 352 57 | 0 00E+00 | 2 23E+02 | 4 47E+02 |
| Other Radionuclides | | | | | 2 25E+02 | 4 49E+02 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 2 474E+13 |
| 0 0250 | 5 068E+12 |
| 0 0375 | 4 417E+12 |
| 0 0575 | 4 751E+12 |
| 0 0850 | 2.869E+12 |
| 0 1250 | 1 935E+12 |
| 0.2250 | 2 489E+12 |
| 0.3750 | 1 076E+12 |
| 0.5750 | 1 746E+13 |
| 0.8500 | 2.759E+11 |
| 1.2500 | 1 779E+11 |
| 1 7500 | 8 449E+09 |
| 2.2500 | 6.224E+05 |
| 2 7500 | 7.370E+09 |
| 3 5000 | 3.520E+04 |
| 5 0000 | 1.501E+04 |
| 7 0000 | 1 725E+03 |
| 11 0000 | 1.978E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 75E+00 | 7.51E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 93.333 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 176.28 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 115.37 | 352.57 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 47 | |
| Bounding | 0 94 | 3.06 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PEACH BOTTOM UNIT I CORE I
SNF ID #: 170
Fuel Units & Descr: 814 - CONCENTRIC TUBES
Heavy Metal Mass: BOL=1707 365kg; EOL=1660 153kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1969
Estimates as of: 2010
Template: FSV (Graphite, Graphite, 60 to 100%, Th & U)
[2]Template Burnup(MWd): 1270.275
Template BOL Heavy Metal Mass (MT): 0 012702752
Template Decay Time: 35 years

Estimated Canister usage
18"x15'
62 62

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 8818E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.73E-01 | 2.04E-01 |
| Am-241 | 3 1387E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 40E+02 | 1 65E+02 |
| Am-242m | 2 3971E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.07E-01 | 1.26E-01 |
| Am-243 | 4 6069E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 2 06E+00 | 2 42E+00 |
| C-14 | 2 3121E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 03E+00 | 1.22E+00 |
| Cl-36 | 1 0667E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 4.76E-02 | 5 61E-02 |
| Cm-243 | 2 5357E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 13E+00 | 1.33E+00 |
| Cm-244 | 6 4458E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 2 88E+02 | 3.39E+02 |
| Co-60 | 4 5014E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 2 01E+01 | 2 37E+01 |
| Cs-134 | 3 8086E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 70E+00 | 2 00E+00 |
| Cs-135 | 2 4711E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 10E+00 | 1 30E+00 |
| Cs-137 | 1 3273E+00 | 44,649 60 | 52,578 31 | 0 00E+00 | 5 93E+04 | 6 98E+04 |
| Eu-154 | 1 5705E-02 | 44,649 60 | 52,578 31 | 0 00E+00 | 7 01E+02 | 8.26E+02 |
| Eu-155 | 1 0415E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 4 65E+01 | 5 48E+01 |
| Fe-55 | 4 4707E-08 | 44,649 60 | 52,578 31 | 0 00E+00 | 2.00E-03 | 2.35E-03 |
| H-3 | 3 9094E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 75E+02 | 2.06E+02 |
| I-129 | 1 0092E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 4.51E-02 | 5.31E-02 |
| Kr-85 | 3 9519E-02 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 76E+03 | 2 08E+03 |
| Np-237 | 1 2541E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 5 60E-01 | 6 59E-01 |
| Pa-231 | 4 7376E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 2.12E-01 | 2 49E-01 |
| Pb-210 | 1 4194E-09 | 44,649 60 | 52,578 31 | 0 00E+00 | 6.34E-05 | 7 46E-05 |
| Pm-147 | 1 5146E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 6.76E+00 | 7.96E+00 |
| Pu-238 | 1 6248E-01 | 44,649 60 | 52,578 31 | 0 00E+00 | 7.25E+03 | 8.54E+03 |
| Pu-239 | 1 3580E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 6 06E+00 | 7.14E+00 |
| Pu-240 | 2 7136E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.21E+01 | 1 43E+01 |
| Pu-241 | 1 9342E-02 | 44,649 60 | 52,578 31 | 0 00E+00 | 8 64E+02 | 1 02E+03 |
| Pu-242 | 3 8866E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.74E-01 | 2 04E-01 |
| Ra-226 | 2 7923E-09 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.25E-04 | 1.47E-04 |
| Ra-228 | 9 1791E-07 | 44,649 60 | 52,578 31 | 0 00E+00 | 4.10E-02 | 4 83E-02 |
| Ru-106 | 3 5205E-11 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.57E-06 | 1.85E-06 |
| Se-79 | 2 1082E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 9 41E-01 | 1.11E+00 |
| Sn-126 | 2 2192E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 9 91E-01 | 1.17E+00 |
| Sr-90 | 1 2667E+00 | 44,649 60 | 52,578 31 | 0 00E+00 | 5 66E+04 | 6 66E+04 |
| Tc-99 | 3 3331E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 1 49E+01 | 1 75E+01 |
| Th-229 | 1 0612E-05 | 44,649 60 | 52,578 31 | 0 00E+00 | 4.74E-01 | 5.58E-01 |
| Th-230 | 1 8878E-07 | 44,649 60 | 52,578 31 | 0 00E+00 | 8.43E-03 | 9 93E-03 |
| Th-232 | -6 9673E-08 | 44,649 60 | 0 00 | 1 69E-01 | 1 66E-01 | 1 69E-01 |
| Tl-208 | 5 9530E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 2 66E+01 | 3.13E+01 |
| U-232 | 1 6115E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 7.20E+01 | 8.47E+01 |
| U-233 | 2 0602E-03 | 44,649 60 | 52,578 31 | 0 00E+00 | 9.20E+01 | 1.08E+02 |
| U-234 | 2 8939E-04 | 44,649 60 | 52,578 31 | 0 00E+00 | 1.29E+01 | 1.52E+01 |
| U-235 | -1.7343E-06 | 44,649 60 | 0 00 | 3 38E-01 | 2 60E-01 | 3.38E-01 |
| U-236 | 8 6281E-06 | 44,649 60 | 52,578 31 | 0 00E+00 | 3.85E-01 | 4 54E-01 |
| U-238 | -5 6065E-09 | 44,649 60 | 0 00 | 3.36E-03 | 3.11E-03 | 3.36E-03 |
| Y-90 | 1 2667E+00 | 44,649 60 | 52,578 31 | 0 00E+00 | 5 66E+04 | 6 66E+04 |
| Other Radionuclides | | | | | 5 69E+04 | 6.70E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 690E+15 |
| 0 0250 | 7 558E+14 |
| 0 0375 | 6 587E+14 |
| 0 0575 | 7 086E+14 |
| 0 0850 | 4 278E+14 |
| 0 1250 | 2.886E+14 |
| 0.2250 | 3.711E+14 |
| 0.3750 | 1 605E+14 |
| 0 5750 | 2 604E+15 |
| 0 8500 | 4 115E+13 |
| 1.2500 | 2.653E+13 |
| 1 7500 | 1.260E+12 |
| 2.2500 | 9.283E+07 |
| 2 7500 | 1 099E+12 |
| 3.5000 | 5.249E+06 |
| 5 0000 | 2.238E+06 |
| 7 0000 | 2.572E+05 |
| 11 0000 | 2.950E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.51E+02 | 1.12E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 93 1525882 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 44 649 60 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 52,578.31 | 89,299.20 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.26 | |
| Bounding | 0.31 | 1 70 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | PEACH BOTTOM UNIT I CORE II | [1]Fuel decay start date | 1973 |
| SNF ID # | 171 | Estimates as of | 2010 |
| Fuel Units & Descr | 787 - CONCENTRIC TUBES | Template | FSV (Graphite, Graphite, 60 to 100%, Th & U) |
| Heavy Metal Mass | BOL=1389 055kg, EOL=1289 657kg | [2]Template Burnup(MWd) | 1270.275 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 012702752 |
| | | Template Decay Time | 35 years |

Estimated Canister usage: 18"x15' — 60 54

**II. Estimates**

| Radionuclide | m: CI/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (CI) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3.8818E-06 | 94,003.34 | 101,007 91 | 0 00E+00 | 3 65E-01 | 3 92E-01 |
| Am-241 | 3 1387E-03 | 94,003.34 | 101,007 91 | 0 00E+00 | 2 95E+02 | 3 17E+02 |
| Am-242m | 2.3971E-06 | 94,003.34 | 101,007 91 | 0 00E+00 | 2 25E-01 | 2 42E-01 |
| Am-243 | 4 6069E-05 | 94,003 34 | 101,007 91 | 0 00E+00 | 4 33E+00 | 4 65E+00 |
| C-14 | 2 3121E-05 | 94,003 34 | 101,007 91 | 0 00E+00 | 2 17E+00 | 2 34E+00 |
| Cl-36 | 1 0667E-06 | 94,003 34 | 101,007 91 | 0 00E+00 | 1 00E-01 | 1 08E-01 |
| Cm-243 | 2 5357E-05 | 94,003 34 | 101,007 91 | 0 00E+00 | 2 38E+00 | 2 56E+00 |
| Cm-244 | 6 4458E-03 | 94,003 34 | 101,007 91 | 0 00E+00 | 6 06E+02 | 6 51E+02 |
| Co-60 | 4 5014E-04 | 94,003 34 | 101,007.91 | 0 00E+00 | 4 23E+01 | 4 55E+01 |
| Cs-134 | 3 8086E-05 | 94,003 34 | 101,007.91 | 0 00E+00 | 3 58E+00 | 3 85E+00 |
| Cs-135 | 2 4711E-05 | 94,003 34 | 101,007.91 | 0 00E+00 | 2 32E+00 | 2 50E+00 |
| Cs-137 | 1 3273E+00 | 94,003 34 | 101,007.91 | 0 00E+00 | 1.25E+05 | 1 34E+05 |
| Eu-154 | 1 5705E-02 | 94,003 34 | 101,007.91 | 0 00E+00 | 1 48E+03 | 1 59E+03 |
| Eu-155 | 1 0415E-03 | 94,003 34 | 101,007.91 | 0.00E+00 | 9 79E+01 | 1 05E+02 |
| Fe-55 | 4 4707E-08 | 94,003 34 | 101,007.91 | 0.00E+00 | 4.20E-03 | 4.52E-03 |
| H-3 | 3 9094E-03 | 94,003 34 | 101,007 91 | 0 00E+00 | 3 67E+02 | 3 95E+02 |
| I-129 | 1 0092E-06 | 94,003 34 | 101,007 91 | 0 00E+00 | 9 49E-02 | 1.02E-01 |
| Kr-85 | 3 9519E-02 | 94,003 34 | 101,007 91 | 0 00E+00 | 3 71E+03 | 3 99E+03 |
| Np-237 | 1.2541E-05 | 94,003.34 | 101,007 91 | 0 00E+00 | 1.18E+00 | 1.27E+00 |
| Pa-231 | 4 7376E-06 | 94,003.34 | 101,007 91 | 0 00E+00 | 4 45E-01 | 4 79E-01 |
| Pb-210 | 1 4194E-09 | 94,003.34 | 101,007 91 | 0 00E+00 | 1.33E-04 | 1 43E-04 |
| Pm-147 | 1.5146E-04 | 94,003.34 | 101,007 91 | 0 00E+00 | 1.42E+01 | 1.53E+01 |
| Pu-238 | 1.6248E-01 | 94,003.34 | 101,007 91 | 0 00E+00 | 1.53E+04 | 1 64E+04 |
| Pu-239 | 1.3580E-04 | 94,003.34 | 101,007 91 | 0 00E+00 | 1.28E+01 | 1.37E+01 |
| Pu-240 | 2.7136E-04 | 94,003 34 | 101,007 91 | 0 00E+00 | 2 55E+01 | 2 74E+01 |
| Pu-241 | 1 9342E-02 | 94,003 34 | 101,007 91 | 0 00E+00 | 1 82E+03 | 1 95E+03 |
| Pu-242 | 3 8866E-06 | 94,003 34 | 101,007 91 | 0 00E+00 | 3 65E-01 | 3 93E-01 |
| Ra-226 | 2 7923E-09 | 94,003 34 | 101,007 91 | 0 00E+00 | 2 62E-04 | 2 82E-04 |
| Ra-228 | 9 1791E-07 | 94,003 34 | 101,007 91 | 0 00E+00 | 8 63E-02 | 9 27E-02 |
| Ru-106 | 3 5205E-11 | 94,003 34 | 101,007 91 | 0 00E+00 | 3.31E-06 | 3 56E-06 |
| Se-79 | 2 1082E-05 | 94,003 34 | 101,007 91 | 0 00E+00 | 1 98E+00 | 2 13E+00 |
| Sn-126 | 2 2192E-05 | 94,003 34 | 101,007 91 | 0 00E+00 | 2 09E+00 | 2 24E+00 |
| Sr-90 | 1.2667E+00 | 94,003 34 | 101,007.91 | 0 00E+00 | 1 19E+05 | 1 28E+05 |
| Tc-99 | 3 3331E-04 | 94,003 34 | 101,007.91 | 0 00E+00 | 3 13E+01 | 3 37E+01 |
| Th-229 | 1 0612E-05 | 94,003 34 | 101,007.91 | 0 00E+00 | 9 98E-01 | 1 07E+00 |
| Th-230 | 1 8878E-07 | 94,003.34 | 101,007.91 | 0.00E+00 | 1.77E-02 | 1.91E-02 |
| Th-232 | -6.9673E-08 | 94,003.34 | 0 00 | 1.37E-01 | 1.31E-01 | 1.37E-01 |
| Tl-208 | 5 9530E-04 | 94,003.34 | 101,007.91 | 0 00E+00 | 5 60E+01 | 6 01E+01 |
| U-232 | 1 6115E-03 | 94,003 34 | 101,007 91 | 0 00E+00 | 1.51E+02 | 1.63E+02 |
| U-233 | 2 0602E-03 | 94,003 34 | 101,007 91 | 0 00E+00 | 1.94E+02 | 2.08E+02 |
| U-234 | 2 8939E-04 | 94,003.34 | 101,007 91 | 0 00E+00 | 2.72E+01 | 2.92E+01 |
| U-235 | -1 7343E-06 | 94,003.34 | 0 00 | 2 75E-01 | 1.12E-01 | 2.75E-01 |
| U-236 | 8 6281E-06 | 94,003.34 | 101,007 91 | 0 00E+00 | 8 11E-01 | 8 72E-01 |
| U-238 | -5 6065E-09 | 94,003.34 | 0 00 | 2 73E-03 | 2.21E-03 | 2 73E-03 |
| Y-90 | 1.2667E+00 | 94,003.34 | 101,007 91 | 0 00E+00 | 1 19E+05 | 1.28E+05 |
| Other Radionuclides | | | | | 1.20E+05 | 1.29E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 088E+15 |
| 0 0250 | 1 452E+15 |
| 0 0375 | 1.265E+15 |
| 0 0575 | 1.361E+15 |
| 0 0850 | 8.218E+14 |
| 0 1250 | 5.544E+14 |
| 0.2250 | 7 129E+14 |
| 0.3750 | 3 082E+14 |
| 0.5750 | 5 003E+15 |
| 0.8500 | 7.905E+13 |
| 1.2500 | 5.096E+13 |
| 1 7500 | 2.420E+12 |
| 2.2500 | 1 783E+08 |
| 2 7500 | 2 111E+12 |
| 3 5000 | 1.008E+07 |
| 5 0000 | 4.300E+06 |
| 7 0000 | 4.942E+05 |
| 11 0000 | 5 667E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.00E+03 | 2.15E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 93 15000286 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 94,003.34 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 101 007.91 | 188 006.68 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 68 | |
| Bounding | 0 73 | 1.86 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: PEACH BOTTOM UNIT I CORE II (INTACT)
SNF ID #: 206
Fuel Units & Descr: 9 - CONCENTRIC TUBES
Heavy Metal Mass BOL=11 925kg; EOL=11 977kg
ROD Storage Site. INEEL

[1]Fuel decay start date: 1974
Estimates as of: 2010
Template: FSV (Graphite, Graphite, 60 to 100%, Th & U)
[2]Template Burnup(MWd): 1270.275
Template BOL Heavy Metal Mass (MT): 0 012702752
Template Decay Time: 35 years

Estimated Canister usage:

| 18"x15' |
|---|
| 0 69 |

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 8818E-06 | 674 97 | 867 05 | 0 00E+00 | 2 62E-03 | 3 37E-03 |
| Am-241 | 3.1387E-03 | 674 97 | 867 05 | 0 00E+00 | 2.12E+00 | 2.72E+00 |
| Am-242m | 2.3971E-06 | 674 97 | 867 05 | 0 00E+00 | 1 62E-03 | 2 08E-03 |
| Am-243 | 4 6069E-05 | 674 97 | 867.05 | 0 00E+00 | 3 11E-02 | 3 99E-02 |
| C-14 | 2.3121E-05 | 674 97 | 867 05 | 0 00E+00 | 1 56E-02 | 2 00E-02 |
| Cl-36 | 1 0667E-06 | 674 97 | 867 05 | 0 00E+00 | 7 20E-04 | 9 25E-04 |
| Cm-243 | 2.5357E-05 | 674 97 | 867.05 | 0 00E+00 | 1 71E-02 | 2 20E-02 |
| Cm-244 | 6 4458E-03 | 674 97 | 867.05 | 0 00E+00 | 4.35E+00 | 5 59E+00 |
| Co-60 | 4.5014E-04 | 674 97 | 867.05 | 0 00E+00 | 3 04E-01 | 3 90E-01 |
| Cs-134 | 3 8086E-05 | 674 97 | 867.05 | 0 00E+00 | 2 57E-02 | 3 30E-02 |
| Cs-135 | 2 4711E-05 | 674 97 | 867.05 | 0 00E+00 | 1 67E-02 | 2.14E-02 |
| Cs-137 | 1 3273E+00 | 674 97 | 867.05 | 0 00E+00 | 8 96E+02 | 1 15E+03 |
| Eu-154 | 1 5705E-02 | 674 97 | 867 05 | 0 00E+00 | 1 06E+01 | 1 36E+01 |
| Eu-155 | 1 0415E-03 | 674 97 | 867 05 | 0 00E+00 | 7 03E-01 | 9 03E-01 |
| Fe-55 | 4 4707E-08 | 674 97 | 867.05 | 0 00E+00 | 3 02E-05 | 3 88E-05 |
| H-3 | 3 9094E-03 | 674 97 | 867.05 | 0 00E+00 | 2 64E+00 | 3 39E+00 |
| I-129 | 1 0092E-06 | 674 97 | 867 05 | 0 00E+00 | 6 81E-04 | 8 75E-04 |
| Kr-85 | 3 9519E-02 | 674 97 | 867 05 | 0 00E+00 | 2 67E+01 | 3 43E+01 |
| Np-237 | 1 2541E-05 | 674 97 | 867 05 | 0 00E+00 | 8 46E-03 | 1 09E-02 |
| Pa-231 | 4 7376E-06 | 674 97 | 867 05 | 0.00E+00 | 3 20E-03 | 4 11E-03 |
| Pb-210 | 1 4194E-09 | 674 97 | 867 05 | 0 00E+00 | 9 58E-07 | 1.23E-06 |
| Pm-147 | 1 5146E-04 | 674 97 | 867 05 | 0 00E+00 | 1 02E-01 | 1.31E-01 |
| Pu-238 | 1 6248E-01 | 674 97 | 867 05 | 0 00E+00 | 1 10E+02 | 1 41E+02 |
| Pu-239 | 1 3580E-04 | 674 97 | 867 05 | 0 00E+00 | 9 17E-02 | 1 18E-01 |
| Pu-240 | 2 7136E-04 | 674 97 | 867 05 | 0 00E+00 | 1 83E-01 | 2 35E-01 |
| Pu-241 | 1 9342E-02 | 674 97 | 867 05 | 0 00E+00 | 1 31E+01 | 1 68E+01 |
| Pu-242 | 3 8866E-06 | 674 97 | 867 05 | 0 00E+00 | 2 62E-03 | 3 37E-03 |
| Ra-226 | 2 7923E-09 | 674 97 | 867 05 | 0 00E+00 | 1 88E-06 | 2 42E-06 |
| Ra-228 | 9 1791E-07 | 674 97 | 867 05 | 0 00E+00 | 6.20E-04 | 7.96E-04 |
| Ru-106 | 3 5205E-11 | 674 97 | 867 05 | 0 00E+00 | 2.38E-08 | 3 05E-08 |
| Se-79 | 2 1082E-05 | 674 97 | 867 05 | 0 00E+00 | 1 42E-02 | 1.83E-02 |
| Sn-126 | 2 2192E-05 | 674 97 | 867 05 | 0 00E+00 | 1.50E-02 | 1.92E-02 |
| Sr-90 | 1 2667E+00 | 674 97 | 867 05 | 0 00E+00 | 8 55E+02 | 1 10E+03 |
| Tc-99 | 3 3331E-04 | 674 97 | 867 05 | 0 00E+00 | 2.25E-01 | 2 89E-01 |
| Th-229 | 1 0612E-05 | 674 97 | 867 05 | 0 00E+00 | 7.16E-03 | 9.20E-03 |
| Th-230 | 1 8878E-07 | 674 97 | 867 05 | 0 00E+00 | 1.27E-04 | 1 64E-04 |
| Th-232 | -6.9673E-08 | 674 97 | 0 00 | 1 18E-03 | 1 13E-03 | 1.18E-03 |
| Tl-208 | 5 9530E-04 | 674 97 | 867 05 | 0 00E+00 | 4 02E-01 | 5.16E-01 |
| U-232 | 1 6115E-03 | 674 97 | 867 05 | 0 00E+00 | 1 09E+00 | 1 40E+00 |
| U-233 | 2 0602E-03 | 674.97 | 867 05 | 0 00E+00 | 1 39E+00 | 1 79E+00 |
| U-234 | 2 8939E-04 | 674 97 | 867 05 | 0 00E+00 | 1.95E-01 | 2.51E-01 |
| U-235 | -1.7343E-06 | 674.97 | 0 00 | 2.36E-03 | 1.19E-03 | 2.36E-03 |
| U-236 | 8 6281E-06 | 674.97 | 867 05 | 0 00E+00 | 5 82E-03 | 7.48E-03 |
| U-238 | -5 6065E-09 | 674.97 | 0 00 | 2 35E-05 | 1.97E-05 | 2.35E-05 |
| Y-90 | 1.2667E+00 | 674.97 | 867 05 | 0 00E+00 | 8 55E+02 | 1.10E+03 |
| Other Radionuclides | | | | | 8 60E+02 | 1.10E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 6 084E+13 |
| 0 0250 | 1.246E+13 |
| 0 0375 | 1 086E+13 |
| 0 0575 | 1 169E+13 |
| 0 0850 | 7 055E+12 |
| 0 1250 | 4 759E+12 |
| 0.2250 | 6 120E+12 |
| 0 3750 | 2 646E+12 |
| 0 5750 | 4.295E+13 |
| 0 8500 | 6 786E+11 |
| 1 2500 | 4 375E+11 |
| 1 7500 | 2.078E+10 |
| 2.2500 | 1 531E+06 |
| 2.7500 | 1 812E+10 |
| 3 5000 | 8 657E+04 |
| 5 0000 | 3 691E+04 |
| 7 0000 | 4.242E+03 |
| 11 0000 | 4 864E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.44E+01 | 1.85E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | GRAPHITE | GRAPHITE |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 93 152 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 674 97 | -49.37 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 867.05 | -98 73 | Bounding burnup taken directly from SFD (converted to MWd). |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.57 | -0 07 |
| Bounding | 0 73 | -0 11 |

Estimated EOL HM/Given EOL HM: 0.94

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: PNL MIXED MATERIAL EXP DCC-1
SNF ID # 430
Fuel Units & Descr 1 - EXPERIMENT CAPSULE
Heavy Metal Mass BOL= , EOL=23 628kg
ROD Storage Site INEEL

[1]Fuel decay start date 1983
Estimates as of 2010
Template Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd) 6 01
Template BOL Heavy Metal Mass (MT) 0.00012882
Template Decay Time 25 years

Estimated Canister usage
18"x15'
0 07

### II. Estimates

| Radionuclide | m: CI/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (CI) | $y_n$: Nominal Fuel Inventories(CI) | $y_b$: Bounding Fuel Inventories(CI) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3562E-08 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 03E-04 | 3 03E-04 |
| Am-241 | 1 0168E-04 | 22,320 13 | 22,320 13 | 0 00E+00 | 2.27E+00 | 2 27E+00 |
| Am-242m | 8 9052E-09 | 22,320 13 | 22,320 13 | 0 00E+00 | 1.99E-04 | 1 99E-04 |
| Am-243 | 9 8602E-10 | 22,320 13 | 22,320 13 | 0 00E+00 | 2.20E-05 | 2.20E-05 |
| C-14 | 2 3045E-04 | 22,320 13 | 22,320 13 | 0 00E+00 | 5 14E+00 | 5 14E+00 |
| Cl-36 | 1 2261E-06 | 22,320 13 | 22,320 13 | 0 00E+00 | 2 74E-02 | 2.74E-02 |
| Cm-243 | 3 1730E-10 | 22,320 13 | 22,320 13 | 0 00E+00 | 7 08E-06 | 7 08E-06 |
| Cm-244 | 3 3977E-09 | 22,320 13 | 22,320 13 | 0 00E+00 | 7 58E-05 | 7.58E-05 |
| Co-60 | 2 6373E-01 | 22,320.13 | 22,320.13 | 0 00E+00 | 5 89E+03 | 5 89E+03 |
| Cs-134 | 8.7072E-05 | 22,320.13 | 22,320.13 | 0 00E+00 | 1 94E+00 | 1 94E+00 |
| Cs-135 | 3 0316E-05 | 22,320 13 | 22,320 13 | 0 00E+00 | 6 77E-01 | 6 77E-01 |
| Cs-137 | 1 8286E+00 | 22,320 13 | 22,320 13 | 0 00E+00 | 4 08E+04 | 4 08E+04 |
| Eu-154 | 1 4982E-03 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 34E+01 | 3 34E+01 |
| Eu-155 | 2 8236E-03 | 22,320 13 | 22,320 13 | 0 00E+00 | 6 30E+01 | 6 30E+01 |
| Fe-55 | 1 7687E-02 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 95E+02 | 3 95E+02 |
| H-3 | 4 4043E-03 | 22,320 13 | 22,320 13 | 0 00E+00 | 9 83E+01 | 9 83E+01 |
| I-129 | 7 3195E-07 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 63E-02 | 1 63E-02 |
| Kr-85 | 7 8769E-02 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 76E+03 | 1.76E+03 |
| Np-237 | 1 1484E-06 | 22,320 13 | 22,320 13 | 0 00E+00 | 2 56E-02 | 2.56E-02 |
| Pa-231 | 3.2396E-08 | 22,320 13 | 22,320 13 | 0 00E+00 | 7 23E-04 | 7.23E-04 |
| Pb-210 | 2 4409E-13 | 22,320 13 | 22,320.13 | 0 00E+00 | 5 45E-09 | 5 45E-09 |
| Pm-147 | 1.6331E-02 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 65E+02 | 3 65E+02 |
| Pu-238 | 3 1947E-04 | 22,320 13 | 22,320 13 | 0 00E+00 | 7 13E+00 | 7 13E+00 |
| Pu-239 | 6 6789E-04 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 49E+01 | 1 49E+01 |
| Pu-240 | 8 6922E-05 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 94E+00 | 1 94E+00 |
| Pu-241 | 1 1567E-03 | 22,320 13 | 22,320 13 | 0 00E+00 | 2 58E+01 | 2 58E+01 |
| Pu-242 | 1 9717E-09 | 22,320 13 | 22,320 13 | 0 00E+00 | 4 40E-05 | 4 40E-05 |
| Ra-226 | 8 6190E-13 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 92E-08 | 1 92E-08 |
| Ra-228 | 8 1498E-12 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 82E-07 | 1 82E-07 |
| Ru-106 | 1 7770E-07 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 97E-03 | 3.97E-03 |
| Se-79 | 1.3225E-05 | 22,320.13 | 22,320 13 | 0 00E+00 | 2 95E-01 | 2.95E-01 |
| Sn-126 | 1.1493E-05 | 22,320 13 | 22,320.13 | 0 00E+00 | 2 57E-01 | 2.57E-01 |
| Sr-90 | 1.7321E+00 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 87E+04 | 3 87E+04 |
| Tc-99 | 4 6656E-04 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 04E+01 | 1 04E+01 |
| Th-229 | 1.0110E-11 | 22,320 13 | 22,320 13 | 0 00E+00 | 2.26E-07 | 2 26E-07 |
| Th-230 | 1 1466E-10 | 22,320 13 | 22,320 13 | 0 00E+00 | 2 56E-06 | 2 56E-06 |
| Th-232 | 8 3245E-12 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 86E-07 | 1 86E-07 |
| Tl-208 | 2 3860E-08 | 22,320 13 | 22,320 13 | 0 00E+00 | 5.33E-04 | 5 33E-04 |
| U-232 | 6 4576E-08 | 22,320 13 | 22,320 13 | 0 00E+00 | 1 44E-03 | 1 44E-03 |
| U-233 | 3 1082E-09 | 22,320 13 | 22,320 13 | 0 00E+00 | 6 94E-05 | 6 94E-05 |
| U-234 | 3 7587E-07 | 22,320.13 | 22,320.13 | 0 00E+00 | 8 39E-03 | 8.39E-03 |
| U-235 | -2.7761E-06 | 22,320.13 | 0 00 | 9.54E-02 | 3 35E-02 | 9.54E-02 |
| U-236 | 1 6190E-05 | 22,320 13 | 22,320.13 | 0 00E+00 | 3 61E-01 | 3 61E-01 |
| U-238 | -2 8547E-09 | 22,320 13 | 0 00 | 1 03E-03 | 9 68E-04 | 1 03E-03 |
| Y-90 | 1.7321E+00 | 22,320 13 | 22,320 13 | 0 00E+00 | 3 87E+04 | 3 87E+04 |
| Other Radionuclides | | | | | 4 53E+04 | 4 53E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 124E+15 |
| 0 0250 | 4 413E+14 |
| 0 0375 | 3 809E+14 |
| 0 0575 | 4 109E+14 |
| 0 0850 | 2 485E+14 |
| 0 1250 | 1 614E+14 |
| 0.2250 | 2.132E+14 |
| 0.3750 | 9.307E+13 |
| 0.5750 | 1.520E+15 |
| 0 8500 | 1.585E+13 |
| 1.2500 | 4.414E+14 |
| 1 7500 | 4 082E+11 |
| 2.2500 | 2.352E+09 |
| 2 7500 | 2.588E+07 |
| 3.5000 | 5 466E+03 |
| 5 0000 | 5 538E+02 |
| 7.0000 | 6 114E+01 |
| 11.0000 | 6 860E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 54E+02 | 5.54E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 22,320 13 |
| Bounding | | 22,320 13 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PNL MIXED MATERIAL EXP DCC-2
SNF ID #: 431
Fuel Units & Descr: 1 - EXPERIMENT CAPSULE
Heavy Metal Mass: BOL= , EOL=20 631kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1984
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time: 25 years

Estimated Canister usage 18"x15": 0 07

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3562E-08 | 19,489 03 | 19,489 03 | 0 00E+00 | 2 64E-04 | 2 64E-04 |
| Am-241 | 1 0168E-04 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 98E+00 | 1 98E+00 |
| Am-242m | 8 9052E-09 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 74E-04 | 1 74E-04 |
| Am-243 | 9 8602E-10 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 92E-05 | 1 92E-05 |
| C-14 | 2 3045E-04 | 19,489 03 | 19,489 03 | 0 00E+00 | 4 49E+00 | 4 49E+00 |
| Cl-36 | 1.2261E-06 | 19,489 03 | 19,489 03 | 0 00E+00 | 2 39E-02 | 2 39E-02 |
| Cm-243 | 3 1730E-10 | 19,489 03 | 19,489 03 | 0 00E+00 | 6.18E-06 | 6 18E-06 |
| Cm-244 | 3 3977E-09 | 19,489 03 | 19,489 03 | 0 00E+00 | 6 62E-05 | 6 62E-05 |
| Co-60 | 2 6373E-01 | 19,489 03 | 19,489 03 | 0 00E+00 | 5 14E+03 | 5 14E+03 |
| Cs-134 | 8 7072E-05 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 70E+00 | 1 70E+00 |
| Cs-135 | 3 0316E-05 | 19,489 03 | 19,489 03 | 0 00E+00 | 5 91E-01 | 5 91E-01 |
| Cs-137 | 1 8286E+00 | 19,489 03 | 19,489 03 | 0 00E+00 | 3 56E+04 | 3 56E+04 |
| Eu-154 | 1 4982E-03 | 19,489 03 | 19,489 03 | 0 00E+00 | 2 92E+01 | 2 92E+01 |
| Eu-155 | 2 8236E-03 | 19,489 03 | 19,489 03 | 0 00E+00 | 5 50E+01 | 5 50E+01 |
| Fe-55 | 1 7687E-02 | 19,489 03 | 19,489 03 | 0 00E+00 | 3 45E+02 | 3 45E+02 |
| H-3 | 4 4043E-03 | 19,489 03 | 19,489 03 | 0 00E+00 | 8.58E+01 | 8 58E+01 |
| I-129 | 7 3195E-07 | 19,489 03 | 19,489 03 | 0 00E+00 | 1.43E-02 | 1 43E-02 |
| Kr-85 | 7 8769E-02 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 54E+03 | 1 54E+03 |
| Np-237 | 1 1484E-06 | 19,489 03 | 19,489 03 | 0 00E+00 | 2.24E-02 | 2.24E-02 |
| Pa-231 | 3 2396E-08 | 19,489 03 | 19,489 03 | 0 00E+00 | 6.31E-04 | 6.31E-04 |
| Pb-210 | 2 4409E-13 | 19,489 03 | 19,489 03 | 0 00E+00 | 4.76E-09 | 4 76E-09 |
| Pm-147 | 1 6331E-02 | 19,489 03 | 19,489 03 | 0 00E+00 | 3.18E+02 | 3 18E+02 |
| Pu-238 | 3 1947E-04 | 19,489 03 | 19,489 03 | 0 00E+00 | 6.23E+00 | 6.23E+00 |
| Pu-239 | 6 6789E-04 | 19,489 03 | 19,489 03 | 0 00E+00 | 1.30E+01 | 1.30E+01 |
| Pu-240 | 8 6922E-05 | 19 489 03 | 19,489 03 | 0 00E+00 | 1 69E+00 | 1 69E+00 |
| Pu-241 | 1 1567E-03 | 19,489 03 | 19,489 03 | 0 00E+00 | 2.25E+01 | 2.25E+01 |
| Pu-242 | 1 9717E-09 | 19,489 03 | 19,489 03 | 0 00E+00 | 3.84E-05 | 3 84E-05 |
| Ra-226 | 8 6190E-13 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 68E-08 | 1 68E-08 |
| Ra-228 | 8 1498E-12 | 19,489 03 | 19,489 03 | 0 00E+00 | 1.59E-07 | 1.59E-07 |
| Ru-106 | 1 7770E-07 | 19,489 03 | 19,489 03 | 0 00E+00 | 3 46E-03 | 3 46E-03 |
| Se-79 | 1 3225E-05 | 19,489 03 | 19,489 03 | 0 00E+00 | 2.58E-01 | 2.58E-01 |
| Sn-126 | 1 1493E-05 | 19,489 03 | 19,489 03 | 0 00E+00 | 2.24E-01 | 2.24E-01 |
| Sr-90 | 1 7321E+00 | 19,489 03 | 19,489 03 | 0 00E+00 | 3.38E+04 | 3.38E+04 |
| Tc-99 | 4 6656E-04 | 19,489 03 | 19,489 03 | 0 00E+00 | 9 09E+00 | 9 09E+00 |
| Th-229 | 1 0110E-11 | 19,489 03 | 19,489 03 | 0 00E+00 | 1.97E-07 | 1 97E-07 |
| Th-230 | 1 1466E-10 | 19,489 03 | 19,489 03 | 0 00E+00 | 2.23E-06 | 2.23E-06 |
| Th-232 | 8 3245E-12 | 19,489 03 | 19,489 03 | 0 00E+00 | 1 62E-07 | 1 62E-07 |
| Tl-208 | 2 3860E-08 | 19,489 03 | 19,489 03 | 0 00E+00 | 4 65E-04 | 4 65E-04 |
| U-232 | 6 4576E-08 | 19,489.03 | 19,489 03 | 0.00E+00 | 1.26E-03 | 1.26E-03 |
| U-233 | 3 1082E-09 | 19,489 03 | 19,489 03 | 0 00E+00 | 6 06E-05 | 6 06E-05 |
| U-234 | 3 7587E-07 | 19,489 03 | 19,489 03 | 0 00E+00 | 7.33E-03 | 7 33E-03 |
| U-235 | -2 7761E-06 | 19,489 03 | 0 00 | 8.33E-02 | 2.92E-02 | 8 33E-02 |
| U-236 | 1 6190E-05 | 19,489 03 | 19,489 03 | 0 00E+00 | 3 16E-01 | 3 16E-01 |
| U-238 | -2 8547E-09 | 19,489 03 | 0 00 | 9 01E-04 | 8 45E-04 | 9 01E-04 |
| Y-90 | 1 7321E+00 | 19 489 03 | 19,489 03 | 0 00E+00 | 3.38E+04 | 3.38E+04 |
| Other Radionuclides | | | | | 3.95E+04 | 3 95E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 854E+15 |
| 0 0250 | 3 853E+14 |
| 0 0375 | 3.326E+14 |
| 0 0575 | 3 588E+14 |
| 0 0850 | 2.170E+14 |
| 0.1250 | 1 410E+14 |
| 0.2250 | 1 862E+14 |
| 0.3750 | 8.127E+13 |
| 0.5750 | 1 327E+15 |
| 0.8500 | 1.384E+13 |
| 1.2500 | 3 854E+14 |
| 1 7500 | 3.565E+11 |
| 2.2500 | 2.053E+09 |
| 2 7500 | 2.259E+07 |
| 3.5000 | 4 773E+03 |
| 5 0000 | 4 836E+02 |
| 7 0000 | 5.339E+01 |
| 11.0000 | 5.990E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.84E+02 | 4.84E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.
This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 19,489 03 |
| Bounding | | 19 489 03 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: PNL MIXED MATERIAL EXP DCC-3 | [1]Fuel decay start date | 1985 | Estimated Canister usage 18"x15' |
| SNF ID #: 432 | Estimates as of | 2010 | |
| Fuel Units & Descr: 1 - FUEL MELTED IN EXP | Template | Pathfinder (Light Water, SST, 60 to 100%, U) | 0 07 |
| Heavy Metal Mass BOL= ; EOL=20.365kg | [2]Template Burnup(MWd) | 6 01 | |
| ROD Storage Site: INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 | |
| | Template Decay Time | 25 years | |

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 1.3562E-08 | 19,237 75 | 19,237.75 | 0 00E+00 | 2 61E-04 | 2 61E-04 |
| Am-241 | 1.0168E-04 | 19,237 75 | 19,237.75 | 0 00E+00 | 1 96E+00 | 1 96E+00 |
| Am-242m | 8 9052E-09 | 19,237.75 | 19,237.75 | 0 00E+00 | 1 71E-04 | 1 71E-04 |
| Am-243 | 9 8602E-10 | 19,237.75 | 19,237 75 | 0 00E+00 | 1 90E-05 | 1 90E-05 |
| C-14 | 2.3045E-04 | 19,237.75 | 19,237.75 | 0 00E+00 | 4 43E+00 | 4 43E+00 |
| Cl-36 | 1.2261E-06 | 19,237.75 | 19,237.75 | 0 00E+00 | 2 36E-02 | 2.36E-02 |
| Cm-243 | 3.1730E-10 | 19,237.75 | 19,237.75 | 0 00E+00 | 6 10E-06 | 6 10E-06 |
| Cm-244 | 3.3977E-09 | 19,237 75 | 19,237.75 | 0 00E+00 | 6 54E-05 | 6 54E-05 |
| Co-60 | 2 6373E-01 | 19,237.75 | 19,237.75 | 0 00E+00 | 5 07E+03 | 5.07E+03 |
| Cs-134 | 8.7072E-05 | 19,237.75 | 19,237 75 | 0 00E+00 | 1.68E+00 | 1.68E+00 |
| Cs-135 | 3.0316E-05 | 19,237.75 | 19,237.75 | 0 00E+00 | 5 83E-01 | 5 83E-01 |
| Cs-137 | 1 8286E+00 | 19,237.75 | 19,237.75 | 0 00E+00 | 3 52E+04 | 3.52E+04 |
| Eu-154 | 1.4982E-03 | 19,237 75 | 19,237.75 | 0 00E+00 | 2 88E+01 | 2 88E+01 |
| Eu-155 | 2.8236E-03 | 19,237.75 | 19,237 75 | 0 00E+00 | 5 43E+01 | 5 43E+01 |
| Fe-55 | 1.7687E-02 | 19,237.75 | 19,237.75 | 0 00E+00 | 3 40E+02 | 3.40E+02 |
| H-3 | 4 4043E-03 | 19,237.75 | 19,237.75 | 0 00E+00 | 8 47E+01 | 8 47E+01 |
| I-129 | 7.3195E-07 | 19,237 75 | 19,237.75 | 0 00E+00 | 1 41E-02 | 1.41E-02 |
| Kr-85 | 7.8769E-02 | 19,237.75 | 19,237.75 | 0 00E+00 | 1.52E+03 | 1.52E+03 |
| Np-237 | 1.1484E-06 | 19,237.75 | 19,237.75 | 0 00E+00 | 2.21E-02 | 2.21E-02 |
| Pa-231 | 3.2396E-08 | 19,237.75 | 19,237 75 | 0 00E+00 | 6.23E-04 | 6.23E-04 |
| Pb-210 | 2.4409E-13 | 19,237.75 | 19,237.75 | 0 00E+00 | 4 70E-09 | 4 70E-09 |
| Pm-147 | 1 6331E-02 | 19,237.75 | 19,237.75 | 0 00E+00 | 3 14E+02 | 3.14E+02 |
| Pu-238 | 3.1947E-04 | 19,237 75 | 19,237.75 | 0 00E+00 | 6.15E+00 | 6.15E+00 |
| Pu-239 | 6 6789E-04 | 19,237.75 | 19,237.75 | 0 00E+00 | 1.28E+01 | 1.28E+01 |
| Pu-240 | 8 6922E-05 | 19,237 75 | 19,237.75 | 0 00E+00 | 1.67E+00 | 1.67E+00 |
| Pu-241 | 1.1567E-03 | 19,237 75 | 19,237.75 | 0 00E+00 | 2.23E+01 | 2.23E+01 |
| Pu-242 | 1.9717E-09 | 19,237 75 | 19,237.75 | 0 00E+00 | 3 79E-05 | 3.79E-05 |
| Ra-226 | 8 6190E-13 | 19,237 75 | 19,237 75 | 0 00E+00 | 1 66E-08 | 1.66E-08 |
| Ra-228 | 8 1498E-12 | 19,237.75 | 19,237 75 | 0 00E+00 | 1.57E-07 | 1.57E-07 |
| Ru-106 | 1.7770E-07 | 19,237.75 | 19,237 75 | 0 00E+00 | 3 42E-03 | 3 42E-03 |
| Se-79 | 1.3225E-05 | 19,237.75 | 19,237 75 | 0 00E+00 | 2.54E-01 | 2.54E-01 |
| Sn-126 | 1.1493E-05 | 19,237 75 | 19,237.75 | 0 00E+00 | 2.21E-01 | 2.21E-01 |
| Sr-90 | 1.7321E+00 | 19,237.75 | 19,237.75 | 0 00E+00 | 3.33E+04 | 3.33E+04 |
| Tc-99 | 4 6656E-04 | 19,237.75 | 19,237 75 | 0 00E+00 | 8.98E+00 | 8 98E+00 |
| Th-229 | 1.0110E-11 | 19,237.75 | 19,237.75 | 0 00E+00 | 1 94E-07 | 1 94E-07 |
| Th-230 | 1.1466E-10 | 19,237 75 | 19,237.75 | 0 00E+00 | 2.21E-06 | 2.21E-06 |
| Th-232 | 8.3245E-12 | 19,237.75 | 19,237.75 | 0 00E+00 | 1 60E-07 | 1 60E-07 |
| Tl-208 | 2.3860E-08 | 19,237 75 | 19,237 75 | 0 00E+00 | 4.59E-04 | 4.59E-04 |
| U-232 | 6 4576E-08 | 19,237.75 | 19,237.75 | 0 00E+00 | 1.24E-03 | 1.24E-03 |
| U-233 | 3 1082E-09 | 19,237.75 | 19,237.75 | 0 00E+00 | 5 98E-05 | 5 98E-05 |
| U-234 | 3 7587E-07 | 19,237.75 | 19,237.75 | 0 00E+00 | 7.23E-03 | 7.23E-03 |
| U-235 | -2 7761E-06 | 19,237 75 | 0 00 | 8.23E-02 | 2 89E-02 | 8.23E-02 |
| U-236 | 1 6190E-05 | 19,237.75 | 19,237.75 | 0 00E+00 | 3 11E-01 | 3.11E-01 |
| U-238 | -2 8547E-09 | 19,237.75 | 0 00 | 8 89E-04 | 8.35E-04 | 8 89E-04 |
| Y-90 | 1 7321E+00 | 19,237.75 | 19,237.75 | 0 00E+00 | 3.33E+04 | 3.33E+04 |
| Other Radionuclides | | | | | 3.90E+04 | 3 90E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.831E+15 |
| 0 0250 | 3 803E+14 |
| 0 0375 | 3.283E+14 |
| 0 0575 | 3.542E+14 |
| 0 0850 | 2 142E+14 |
| 0 1250 | 1.391E+14 |
| 0.2250 | 1.838E+14 |
| 0.3750 | 8.022E+13 |
| 0.5750 | 1.310E+15 |
| 0.8500 | 1.366E+13 |
| 1.2500 | 3.805E+14 |
| 1 7500 | 3 519E+11 |
| 2.2500 | 2.027E+09 |
| 2 7500 | 2.230E+07 |
| 3.5000 | 4 711E+03 |
| 5 0000 | 4 773E+02 |
| 7.0000 | 5.270E+01 |
| 11.0000 | 5 913E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 77E+02 | 4 77E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding: | NONE | SST |
| BOL HM Constituents: | U | U |
| BOL Enrichment %: | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal: | | 19,237.75 |
| Bounding: | | 19,237 75 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PNL MOX FUEL
SNF ID #: 414
Fuel Units & Descr: 5 - SCRAP
Heavy Metal Mass: BOL= , EOL=0 23kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1988
Estimates as of: 2010
Template: (Worst Case)
[2]Template Burnup(MWd): 62.5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 20 years

Estimated Canister usage: 18"x15' 0 36

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 6288E-06 | 218 58 | 218 58 | 0 00E+00 | 3 56E-04 | 3 56E-04 |
| Am-241 | 6 9216E+00 | 218 58 | 218 58 | 0 00E+00 | 1 51E+03 | 1 51E+03 |
| Am-242m | 1 8032E-02 | 218 58 | 218 58 | 0 00E+00 | 3 94E+00 | 3 94E+00 |
| Am-243 | 1 6336E-02 | 218 58 | 218 58 | 0 00E+00 | 3 57E+00 | 3 57E+00 |
| C-14 | 1 2112E-01 | 218 58 | 218 58 | 0 00E+00 | 2 65E+01 | 2 65E+01 |
| Cl-36 | 2 2860E-03 | 218 58 | 218 58 | 0 00E+00 | 5 00E-01 | 5 00E-01 |
| Cm-243 | 1 2475E-03 | 218 58 | 218 58 | 0 00E+00 | 2 73E-01 | 2 73E-01 |
| Cm-244 | 2 9920E-01 | 218 58 | 218 58 | 0 00E+00 | 6 54E+01 | 6 54E+01 |
| Co-60 | 2 0197E+02 | 218 58 | 218 58 | 0 00E+00 | 4 41E+04 | 4 41E+04 |
| Cs-134 | 5 2728E-02 | 218 58 | 218 58 | 0 00E+00 | 1 15E+01 | 1 15E+01 |
| Cs-135 | 4 3976E-04 | 218 58 | 218 58 | 0 00E+00 | 9 61E-02 | 9 61E-02 |
| Cs-137 | 2 9760E+01 | 218 58 | 218 58 | 0 00E+00 | 6 50E+03 | 6 50E+03 |
| Eu-154 | 4 1838E+00 | 218 58 | 218 58 | 0 00E+00 | 9 14E+02 | 9 14E+02 |
| Eu-155 | 5 6060E-01 | 218 58 | 218 58 | 0 00E+00 | 1 23E+02 | 1.23E+02 |
| Fe-55 | 1 5985E+01 | 218 58 | 218 58 | 0 00E+00 | 3 49E+03 | 3 49E+03 |
| H-3 | 5 6412E-01 | 218 58 | 218 58 | 0 00E+00 | 1 23E+02 | 1 23E+02 |
| I-129 | 1 0618E-05 | 218 58 | 218 58 | 0 00E+00 | 2 32E-03 | 2 32E-03 |
| Kr-85 | 1 5783E+00 | 218 58 | 218 58 | 0 00E+00 | 3 45E+02 | 3 45E+02 |
| Np-237 | 1 5632E-04 | 218 58 | 218 58 | 0 00E+00 | 3 42E-02 | 3 42E-02 |
| Pa-231 | 2 8608E-06 | 218 58 | 218 58 | 0 00E+00 | 6 25E-04 | 6 25E-04 |
| Pb-210 | 3 7448E-09 | 218 58 | 218 58 | 0 00E+00 | 8 19E-07 | 8 19E-07 |
| Pm-147 | 8 8701E-01 | 218 58 | 218 58 | 0 00E+00 | 1 94E+02 | 1 94E+02 |
| Pu-238 | -4.8840E-01 | 218 58 | 0 00 | 5 91E+01 | 0 00E+00 | 5 91E+01 |
| Pu-239 | -4 8280E-02 | 218 58 | 0 00 | 7 15E+00 | 0 00E+00 | 7 15E+00 |
| Pu-240 | -3 0095E-01 | 218 58 | 0 00 | 9 13E+00 | 0 00E+00 | 9 13E+00 |
| Pu-241 | -5.2560E+01 | 218 58 | 0 00 | 2.35E+03 | 0 00E+00 | 2 35E+03 |
| Pu-242 | -1.1381E-04 | 218 58 | 0 00 | 3 95E-02 | 1 47E-02 | 3 95E-02 |
| Ra-226 | 1 6815E-08 | 218 58 | 218 58 | 0 00E+00 | 3 68E-06 | 3 68E-06 |
| Ra-228 | 5 6880E-07 | 218 58 | 218 58 | 0 00E+00 | 1 24E-04 | 1 24E-04 |
| Ru-106 | 1 2188E-04 | 218 58 | 218 58 | 0 00E+00 | 2 66E-02 | 2 66E-02 |
| Se-79 | 1 9186E-04 | 218 58 | 218 58 | 0 00E+00 | 4 19E-02 | 4 19E-02 |
| Sn-126 | 1 6671E-04 | 218 58 | 218 58 | 0 00E+00 | 3 64E-02 | 3 64E-02 |
| Sr-90 | 2 8288E+01 | 218 58 | 218 58 | 0 00E+00 | 6 18E+03 | 6 18E+03 |
| Tc-99 | 6 7678E-03 | 218 58 | 218 58 | 0 00E+00 | 1 48E+00 | 1 48E+00 |
| Th-229 | 8 9952E-07 | 218 58 | 218 58 | 0 00E+00 | 1 97E-04 | 1 97E-04 |
| Th-230 | 2 9941E-06 | 218 58 | 218 58 | 0 00E+00 | 6 54E-04 | 6 54E-04 |
| Th-232 | 6 0208E-07 | 218 58 | 218 58 | 0 00E+00 | 1 32E-04 | 1 32E-04 |
| Tl-208 | 1 0120E-04 | 218 58 | 218 58 | 0 00E+00 | 2 21E-02 | 2 21E-02 |
| U-232 | 2 7388E-04 | 218.58 | 218 58 | 0 00E+00 | 5 99E-02 | 5 99E-02 |
| U-233 | 3 6128E-04 | 218 58 | 218 58 | 0 00E+00 | 7 90E-02 | 7 90E-02 |
| U-234 | 1 2788E-02 | 218 58 | 218 58 | 0 00E+00 | 2 80E+00 | 2 80E+00 |
| U-235 | 5 7486E-04 | 218 58 | 218 58 | 1.98E-04 | 1 26E-01 | 1 26E-01 |
| U-236 | 2 3485E-04 | 218 58 | 218 58 | 0.00E+00 | 5 13E-02 | 5 13E-02 |
| U-238 | 1 1581E-04 | 218.58 | 218 58 | 2 46E-05 | 2 53E-02 | 2 53E-02 |
| Y-90 | 2 8288E+01 | 218.58 | 218 58 | 0 00E+00 | 6.18E+03 | 6 18E+03 |
| Other Radionuclides | | | | | 1 64E+04 | 1 64E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 4 467E+14 |
| 0 0250 | 8 798E+13 |
| 0 0375 | 7 895E+13 |
| 0 0575 | 9 858E+13 |
| 0 0850 | 4 533E+13 |
| 0 1250 | 4 178E+13 |
| 0 2250 | 3 746E+13 |
| 0 3750 | 1 567E+13 |
| 0 5750 | 2 462E+14 |
| 0 8500 | 1 914E+13 |
| 1 2500 | 3.286E+15 |
| 1 7500 | 5 975E+11 |
| 2.2500 | 1 733E+10 |
| 2.7500 | 8 316E+08 |
| 3 5000 | 9 726E+05 |
| 5 0000 | 4 029E+05 |
| 7 0000 | 4 631E+04 |
| 11 0000 | 5 311E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8.25E+02 | 8.27E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 218.58 |
| Bounding | | 218.58 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14 21 | |
| Bounding | 14 21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name PNL MOX FUEL
SNF ID # 415
Fuel Units & Descr 7 - FUEL MELTED IN EXP
Heavy Metal Mass BOL= , EOL=0 01kg
ROD Storage Site INEEL

[1]Fuel decay start date 1988
Estimates as of. 2010
Template (Worst Case)
[2]Template Burnup(MWd) 62.5
Template BOL Heavy Metal Mass (MT) 0 00186865
Template Decay Time 20 years

Estimated Canister usage: 18"x15' 0 51

**II. Estimates**

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.6288E-06 | 9 31 | 9 31 | 0 00E+00 | 1 52E-05 | 1.52E-05 |
| Am-241 | 6 9216E+00 | 9 31 | 9 31 | 0 00E+00 | 6 45E+01 | 6 45E+01 |
| Am-242m | 1 8032E-02 | 9 31 | 9 31 | 0 00E+00 | 1 68E-01 | 1.68E-01 |
| Am-243 | 1 6336E-02 | 9 31 | 9 31 | 0 00E+00 | 1 52E-01 | 1.52E-01 |
| C-14 | 1.2112E-01 | 9 31 | 9 31 | 0.00E+00 | 1 13E+00 | 1.13E+00 |
| Cl-36 | 2.2860E-03 | 9 31 | 9 31 | 0 00E+00 | 2 13E-02 | 2 13E-02 |
| Cm-243 | 1 2475E-03 | 9 31 | 9 31 | 0 00E+00 | 1.16E-02 | 1 16E-02 |
| Cm-244 | 2 9920E-01 | 9 31 | 9 31 | 0 00E+00 | 2 79E+00 | 2 79E+00 |
| Co-60 | 2 0197E+02 | 9 31 | 9.31 | 0 00E+00 | 1.88E+03 | 1 88E+03 |
| Cs-134 | 5 2728E-02 | 9 31 | 9.31 | 0 00E+00 | 4 91E-01 | 4 91E-01 |
| Cs-135 | 4.3976E-04 | 9 31 | 9 31 | 0 00E+00 | 4 10E-03 | 4 10E-03 |
| Cs-137 | 2 9760E+01 | 9.31 | 9 31 | 0 00E+00 | 2 77E+02 | 2 77E+02 |
| Eu-154 | 4.1838E+00 | 9 31 | 9 31 | 0 00E+00 | 3 90E+01 | 3 90E+01 |
| Eu-155 | 5 6060E-01 | 9 31 | 9 31 | 0 00E+00 | 5.22E+00 | 5 22E+00 |
| Fe-55 | 1.5985E+01 | 9 31 | 9 31 | 0 00E+00 | 1 49E+02 | 1 49E+02 |
| H-3 | 5 6412E-01 | 9 31 | 9 31 | 0 00E+00 | 5 25E+00 | 5.25E+00 |
| I-129 | 1 0618E-05 | 9 31 | 9 31 | 0 00E+00 | 9 89E-05 | 9 89E-05 |
| Kr-85 | 1 5783E+00 | 9 31 | 9 31 | 0 00E+00 | 1 47E+01 | 1.47E+01 |
| Np-237 | 1 5632E-04 | 9 31 | 9.31 | 0 00E+00 | 1.46E-03 | 1 46E-03 |
| Pa-231 | 2 8608E-06 | 9 31 | 9 31 | 0 00E+00 | 2 66E-05 | 2 66E-05 |
| Pb-210 | 3 7448E-09 | 9 31 | 9.31 | 0 00E+00 | 3 49E-08 | 3 49E-08 |
| Pm-147 | 8 8701E-01 | 9 31 | 9.31 | 0 00E+00 | 8.26E+00 | 8 26E+00 |
| Pu-238 | -4 8840E-01 | 9 31 | 0 00 | 2 52E+00 | 0 00E+00 | 2 52E+00 |
| Pu-239 | -4 8280E-02 | 9.31 | 0 00 | 3 05E-01 | 0 00E+00 | 3 05E-01 |
| Pu-240 | -3 0095E-01 | 9 31 | 0 00 | 3 89E-01 | 0 00E+00 | 3 89E-01 |
| Pu-241 | -5.2560E+01 | 9 31 | 0 00 | 1 00E+02 | 0 00E+00 | 1 00E+02 |
| Pu-242 | -1 1381E-04 | 9 31 | 0 00 | 1.68E-03 | 6 25E-04 | 1.68E-03 |
| Ra-226 | 1 6815E-08 | 9 31 | 9 31 | 0 00E+00 | 1 57E-07 | 1.57E-07 |
| Ra-228 | 5 6880E-07 | 9 31 | 9 31 | 0 00E+00 | 5 30E-06 | 5.30E-06 |
| Ru-106 | 1.2188E-04 | 9 31 | 9 31 | 0 00E+00 | 1 14E-03 | 1 14E-03 |
| Se-79 | 1 9186E-04 | 9 31 | 9 31 | 0 00E+00 | 1 79E-03 | 1 79E-03 |
| Sn-126 | 1 6671E-04 | 9 31 | 9.31 | 0 00E+00 | 1.55E-03 | 1.55E-03 |
| Sr-90 | 2 8288E+01 | 9 31 | 9.31 | 0 00E+00 | 2 63E+02 | 2 63E+02 |
| Tc-99 | 6 7678E-03 | 9 31 | 9.31 | 0 00E+00 | 6.30E-02 | 6 30E-02 |
| Th-229 | 8 9952E-07 | 9 31 | 9 31 | 0 00E+00 | 8.38E-06 | 8 38E-06 |
| Th-230 | 2 9941E-06 | 9.31 | 9 31 | 0 00E+00 | 2 79E-05 | 2 79E-05 |
| Th-232 | 6 0208E-07 | 9.31 | 9 31 | 0 00E+00 | 5 61E-06 | 5 61E-06 |
| Tl-208 | 1.0120E-04 | 9.31 | 9 31 | 0 00E+00 | 9 43E-04 | 9 43E-04 |
| U-232 | 2.7388E-04 | 9 31 | 9 31 | 0 00E+00 | 2 55E-03 | 2.55E-03 |
| U-233 | 3.6128E-04 | 9 31 | 9 31 | 0 00E+00 | 3 36E-03 | 3.36E-03 |
| U-234 | 1.2788E-02 | 9 31 | 9 31 | 0 00E+00 | 1 19E-01 | 1 19E-01 |
| U-235 | 5 7486E-04 | 9 31 | 9 31 | 8 43E-06 | 5 36E-03 | 5 36E-03 |
| U-236 | 2 3485E-04 | 9 31 | 9 31 | 0 00E+00 | 2.19E-03 | 2 19E-03 |
| U-238 | 1 1581E-04 | 9 31 | 9 31 | 1 05E-06 | 1.08E-03 | 1 08E-03 |
| Y-90 | 2 8288E+01 | 9 31 | 9 31 | 0 00E+00 | 2 63E+02 | 2 63E+02 |
| Other Radionuclides | | | | | 6 98E+02 | 6 98E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 903E+13 |
| 0 0250 | 3 749E+12 |
| 0 0375 | 3.364E+12 |
| 0 0575 | 4.201E+12 |
| 0 0850 | 1.932E+12 |
| 0 1250 | 1 780E+12 |
| 0.2250 | 1.596E+12 |
| 0.3750 | 6 675E+11 |
| 0 5750 | 1 049E+13 |
| 0.8500 | 8 155E+11 |
| 1.2500 | 1 400E+14 |
| 1 7500 | 2 546E+10 |
| 2.2500 | 7 382E+08 |
| 2.7500 | 3.543E+07 |
| 3 5000 | 4 144E+04 |
| 5 0000 | 1 717E+04 |
| 7 0000 | 1.973E+03 |
| 11 0000 | 2.263E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 51E+01 | 3.52E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 9 31 |
| Bounding | | 9 31 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14 21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PNL MOX FUEL 7055
SNF ID #: 416
Fuel Units & Descr: 12 - SCRAP
Heavy Metal Mass BOL= , EOL=0 058kg
ROD Storage Site INEEL

[1]Fuel decay start date: 1988
Estimates as of: 2010
Template: (Worst Case)
[2]Template Burnup(MWd): 62.5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time 20 years

Estimated Canister usage: 18"x15' 0 88

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 6288E-06 | 54 74 | 54 74 | 0 00E+00 | 8 92E-05 | 8 92E-05 |
| Am-241 | 6 9216E+00 | 54 74 | 54 74 | 0 00E+00 | 3 79E+02 | 3.79E+02 |
| Am-242m | 1 8032E-02 | 54 74 | 54 74 | 0 00E+00 | 9 87E-01 | 9 87E-01 |
| Am-243 | 1 6336E-02 | 54 74 | 54 74 | 0 00E+00 | 8 94E-01 | 8 94E-01 |
| C-14 | 1 2112E-01 | 54 74 | 54 74 | 0 00E+00 | 6 63E+00 | 6 63E+00 |
| Cl-36 | 2 2860E-03 | 54 74 | 54 74 | 0 00E+00 | 1 25E-01 | 1.25E-01 |
| Cm-243 | 1 2475E-03 | 54 74 | 54 74 | 0 00E+00 | 6 83E-02 | 6 83E-02 |
| Cm-244 | 2 9920E-01 | 54 74 | 54 74 | 0 00E+00 | 1 64E+01 | 1 64E+01 |
| Co-60 | 2 0197E+02 | 54 74 | 54 74 | 0 00E+00 | 1 11E+04 | 1 11E+04 |
| Cs-134 | 5 2728E-02 | 54 74 | 54 74 | 0 00E+00 | 2 89E+00 | 2 89E+00 |
| Cs-135 | 4 3976E-04 | 54 74 | 54 74 | 0 00E+00 | 2 41E-02 | 2 41E-02 |
| Cs-137 | 2 9760E+01 | 54 74 | 54 74 | 0 00E+00 | 1 63E+03 | 1 63E+03 |
| Eu-154 | 4.1838E+00 | 54 74 | 54 74 | 0 00E+00 | 2.29E+02 | 2 29E+02 |
| Eu-155 | 5 6060E-01 | 54 74 | 54 74 | 0 00E+00 | 3 07E+01 | 3 07E+01 |
| Fe-55 | 1 5985E+01 | 54 74 | 54 74 | 0 00E+00 | 8 75E+02 | 8 75E+02 |
| H-3 | 5 6412E-01 | 54 74 | 54 74 | 0 00E+00 | 3 09E+01 | 3 09E+01 |
| I-129 | 1 0618E-05 | 54 74 | 54 74 | 0 00E+00 | 5 81E-04 | 5 81E-04 |
| Kr-85 | 1.5783E+00 | 54 74 | 54 74 | 0 00E+00 | 8 64E+01 | 8 64E+01 |
| Np-237 | 1.5632E-04 | 54 74 | 54 74 | 0 00E+00 | 8 56E-03 | 8 56E-03 |
| Pa-231 | 2 8608E-06 | 54 74 | 54 74 | 0 00E+00 | 1 57E-04 | 1 57E-04 |
| Pb-210 | 3.7448E-09 | 54 74 | 54.74 | 0 00E+00 | 2 05E-07 | 2 05E-07 |
| Pm-147 | 8 8701E-01 | 54 74 | 54.74 | 0 00E+00 | 4 86E+01 | 4 86E+01 |
| Pu-238 | -4 8840E-01 | 54 74 | 0 00 | 1 48E+01 | 0 00E+00 | 1 48E+01 |
| Pu-239 | -4 8280E-02 | 54 74 | 0 00 | 1.79E+00 | 0 00E+00 | 1 79E+00 |
| Pu-240 | -3 0095E-01 | 54 74 | 0 00 | 2.29E+00 | 0 00E+00 | 2.29E+00 |
| Pu-241 | -5.2560E+01 | 54.74 | 0 00 | 5 89E+02 | 0 00E+00 | 5 89E+02 |
| Pu-242 | -1.1381E-04 | 54.74 | 0 00 | 9 90E-03 | 3.67E-03 | 9 90E-03 |
| Ra-226 | 1 6815E-08 | 54.74 | 54 74 | 0 00E+00 | 9.20E-07 | 9.20E-07 |
| Ra-228 | 5 6880E-07 | 54.74 | 54 74 | 0 00E+00 | 3 11E-05 | 3 11E-05 |
| Ru-106 | 1 2188E-04 | 54 74 | 54 74 | 0 00E+00 | 6 67E-03 | 6 67E-03 |
| Se-79 | 1 9186E-04 | 54 74 | 54 74 | 0 00E+00 | 1 05E-02 | 1.05E-02 |
| Sn-126 | 1 6671E-04 | 54 74 | 54 74 | 0 00E+00 | 9 13E-03 | 9.13E-03 |
| Sr-90 | 2 8288E+01 | 54 74 | 54 74 | 0 00E+00 | 1 55E+03 | 1.55E+03 |
| Tc-99 | 6 7678E-03 | 54 74 | 54 74 | 0 00E+00 | 3 70E-01 | 3.70E-01 |
| Th-229 | 8 9952E-07 | 54 74 | 54 74 | 0 00E+00 | 4 92E-05 | 4 92E-05 |
| Th-230 | 2 9941E-06 | 54 74 | 54 74 | 0 00E+00 | 1 64E-04 | 1 64E-04 |
| Th-232 | 6 0208E-07 | 54 74 | 54 74 | 0 00E+00 | 3 30E-05 | 3.30E-05 |
| Tl-208 | 1 0120E-04 | 54 74 | 54 74 | 0 00E+00 | 5 54E-03 | 5 54E-03 |
| U-232 | 2.7388E-04 | 54 74 | 54 74 | 0 00E+00 | 1 50E-02 | 1.50E-02 |
| U-233 | 3 6128E-04 | 54 74 | 54.74 | 0 00E+00 | 1 98E-02 | 1 98E-02 |
| U-234 | 1.2788E-02 | 54 74 | 54.74 | 0 00E+00 | 7 00E-01 | 7 00E-01 |
| U-235 | 5.7486E-04 | 54 74 | 54.74 | 4 96E-05 | 3 15E-02 | 3.15E-02 |
| U-236 | 2.3485E-04 | 54 74 | 54.74 | 0 00E+00 | 1.29E-02 | 1.29E-02 |
| U-238 | 1 1581E-04 | 54 74 | 54 74 | 6.17E-06 | 6.35E-03 | 6 35E-03 |
| Y-90 | 2 8288E+01 | 54 74 | 54 74 | 0 00E+00 | 1 55E+03 | 1 55E+03 |
| Other Radionuclides | | | | | 4 10E+03 | 4 10E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.119E+14 |
| 0 0250 | 2.203E+13 |
| 0 0375 | 1 977E+13 |
| 0 0575 | 2.469E+13 |
| 0 0850 | 1 135E+13 |
| 0 1250 | 1 046E+13 |
| 0.2250 | 9 382E+12 |
| 0 3750 | 3 924E+12 |
| 0 5750 | 6 165E+13 |
| 0.8500 | 4 793E+12 |
| 1.2500 | 8.229E+14 |
| 1 7500 | 1 496E+11 |
| 2.2500 | 4.339E+09 |
| 2 7500 | 2 083E+08 |
| 3.5000 | 2 436E+05 |
| 5 0000 | 1 009E+05 |
| 7 0000 | 1 160E+04 |
| 11.0000 | 1.330E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.06E+02 | 2.07E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 54 74 |
| Bounding | | 54 74 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup.
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name PNL MOX FUEL 7057
SNF ID #. 417
Fuel Units & Descr 4 - SCRAP
Heavy Metal Mass BOL= ; EOL=2.44kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1988
Estimates as of 2010
Template (Worst Case)
[2]Template Burnup(MWd) 62.5
Template BOL Heavy Metal Mass (MT): 0.00186865
Template Decay Time: 20 years

Estimated Canister usage
18"x15'
0 29

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 6288E-06 | 2,318 86 | 2,318 86 | 0 00E+00 | 3 78E-03 | 3 78E-03 |
| Am-241 | 6 9216E+00 | 2,318 86 | 2,318 86 | 0 00E+00 | 1 61E+04 | 1 61E+04 |
| Am-242m | 1 8032E-02 | 2,318 86 | 2,318 86 | 0 00E+00 | 4 18E+01 | 4 18E+01 |
| Am-243 | 1 6336E-02 | 2,318.86 | 2,318 86 | 0 00E+00 | 3 79E+01 | 3 79E+01 |
| C-14 | 1.2112E-01 | 2,318 86 | 2,318 86 | 0 00E+00 | 2.81E+02 | 2 81E+02 |
| Cl-36 | 2.2860E-03 | 2,318 86 | 2,318 86 | 0 00E+00 | 5.30E+00 | 5 30E+00 |
| Cm-243 | 1.2475E-03 | 2,318 86 | 2,318 86 | 0 00E+00 | 2 89E+00 | 2 89E+00 |
| Cm-244 | 2.9920E-01 | 2,318 86 | 2,318 86 | 0 00E+00 | 6 94E+02 | 6 94E+02 |
| Co-60 | 2 0197E+02 | 2,318 86 | 2,318 86 | 0 00E+00 | 4 68E+05 | 4 68E+05 |
| Cs-134 | 5.2728E-02 | 2,318 86 | 2,318 86 | 0 00E+00 | 1 22E+02 | 1.22E+02 |
| Cs-135 | 4 3976E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 1 02E+00 | 1.02E+00 |
| Cs-137 | 2 9760E+01 | 2,318 86 | 2,318 86 | 0 00E+00 | 6 90E+04 | 6 90E+04 |
| Eu-154 | 4 1838E+00 | 2,318 86 | 2,318 86 | 0 00E+00 | 9 70E+03 | 9 70E+03 |
| Eu-155 | 5 6060E-01 | 2,318 86 | 2,318 86 | 0 00E+00 | 1 30E+03 | 1.30E+03 |
| Fe-55 | 1 5985E+01 | 2,318 86 | 2,318.86 | 0 00E+00 | 3 71E+04 | 3 71E+04 |
| H-3 | 5 6412E-01 | 2,318 86 | 2,318 86 | 0 00E+00 | 1.31E+03 | 1 31E+03 |
| I-129 | 1 0618E-05 | 2,318 86 | 2,318 86 | 0 00E+00 | 2 46E-02 | 2 46E-02 |
| Kr-85 | 1.5783E+00 | 2,318 86 | 2,318 86 | 0 00E+00 | 3 66E+03 | 3 66E+03 |
| Np-237 | 1.5632E-04 | 2,318.86 | 2,318 86 | 0.00E+00 | 3 62E-01 | 3 62E-01 |
| Pa-231 | 2.8608E-06 | 2,318 86 | 2,318 86 | 0 00E+00 | 6 63E-03 | 6 63E-03 |
| Pb-210 | 3 7448E-09 | 2,318 86 | 2,318 86 | 0 00E+00 | 8 68E-06 | 8 68E-06 |
| Pm-147 | 8 8701E-01 | 2,318 86 | 2,318 86 | 0 00E+00 | 2 06E+03 | 2 06E+03 |
| Pu-238 | -4 8840E-01 | 2,318 86 | 0 00 | 6 27E+02 | 0 00E+00 | 6.27E+02 |
| Pu-239 | -4 8280E-02 | 2,318 86 | 0 00 | 7 59E+01 | 0 00E+00 | 7.59E+01 |
| Pu-240 | -3 0095E-01 | 2,318 86 | 0.00 | 9 69E+01 | 0 00E+00 | 9 69E+01 |
| Pu-241 | -5.2560E+01 | 2,318 86 | 0.00 | 2 49E+04 | 0 00E+00 | 2 49E+04 |
| Pu-242 | -1.1381E-04 | 2,318 86 | 0 00 | 4 19E-01 | 1.56E-01 | 4 19E-01 |
| Ra-226 | 1 6815E-08 | 2,318 86 | 2,318 86 | 0 00E+00 | 3.90E-05 | 3 90E-05 |
| Ra-228 | 5 6880E-07 | 2,318 86 | 2,318 86 | 0 00E+00 | 1.32E-03 | 1 32E-03 |
| Ru-106 | 1.2188E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 2 83E-01 | 2 83E-01 |
| Se-79 | 1.9186E-04 | 2,318.86 | 2,318 86 | 0 00E+00 | 4 45E-01 | 4 45E-01 |
| Sn-126 | 1.6671E-04 | 2,318 86 | 2,318 86 | 0.00E+00 | 3 87E-01 | 3 87E-01 |
| Sr-90 | 2 8288E+01 | 2,318 86 | 2,318 86 | 0.00E+00 | 6 56E+04 | 6 56E+04 |
| Tc-99 | 6 7678E-03 | 2,318 86 | 2,318 86 | 0 00E+00 | 1.57E+01 | 1.57E+01 |
| Th-229 | 8 9952E-07 | 2,318 86 | 2,318 86 | 0 00E+00 | 2 09E-03 | 2.09E-03 |
| Th-230 | 2 9941E-06 | 2,318 86 | 2,318 86 | 0 00E+00 | 6 94E-03 | 6 94E-03 |
| Th-232 | 6 0208E-07 | 2,318 86 | 2,318 86 | 0 00E+00 | 1 40E-03 | 1 40E-03 |
| Tl-208 | 1 0120E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 2.35E-01 | 2.35E-01 |
| U-232 | 2 7388E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 6.35E-01 | 6 35E-01 |
| U-233 | 3 6128E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 8.38E-01 | 8 38E-01 |
| U-234 | 1 2788E-02 | 2,318 86 | 2,318.86 | 0 00E+00 | 2 97E+01 | 2 97E+01 |
| U-235 | 5 7486E-04 | 2,318 86 | 2,318.86 | 2.10E-03 | 1.34E+00 | 1 34E+00 |
| U-236 | 2.3485E-04 | 2,318 86 | 2,318 86 | 0 00E+00 | 5 45E-01 | 5 45E-01 |
| U-238 | 1 1581E-04 | 2,318 86 | 2,318 86 | 2 61E-04 | 2 69E-01 | 2 69E-01 |
| Y-90 | 2 8288E+01 | 2,318.86 | 2,318 86 | 0 00E+00 | 6.56E+04 | 6 56E+04 |
| Other Radionuclides | | | | | 1 74E+05 | 1.74E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 739E+15 |
| 0 0250 | 9 334E+14 |
| 0 0375 | 8.376E+14 |
| 0 0575 | 1.046E+15 |
| 0 0850 | 4 809E+14 |
| 0 1250 | 4 432E+14 |
| 0.2250 | 3.974E+14 |
| 0.3750 | 1.662E+14 |
| 0.5750 | 2 612E+15 |
| 0.8500 | 2.030E+14 |
| 1.2500 | 3.486E+16 |
| 1 7500 | 6 339E+12 |
| 2.2500 | 1.838E+11 |
| 2 7500 | 8.822E+09 |
| 3.5000 | 1 032E+07 |
| 5 0000 | 4 274E+06 |
| 7 0000 | 4 913E+05 |
| 11 0000 | 5 634E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.75E+03 | 8 77E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | UNKNOWN | SST/Inconel |
| BOL HM Constituents | Pu and U | U Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences**

This fuel didn't closely match any existing templates, therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 2,318.86 |
| Bounding | | 2,318 86 |

**Basis for burnup used in estimate**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: PNL MOX PELLETS 7057
SNF ID #: 418
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass: BOL= , EOL=0 647kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1988
Estimates as of: 2010
Template (Worst Case)
[2]Template Burnup(MWd): 62 5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time 20 years

Estimated Canister usage
18"x15'
0 07

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 6288E-06 | 614 88 | 614 88 | 0 00E+00 | 1.00E-03 | 1 00E-03 |
| Am-241 | 6 9216E+00 | 614 88 | 614 88 | 0 00E+00 | 4 26E+03 | 4.26E+03 |
| Am-242m | 1 8032E-02 | 614 88 | 614 88 | 0 00E+00 | 1 11E+01 | 1.11E+01 |
| Am-243 | 1 6336E-02 | 614 88 | 614 88 | 0 00E+00 | 1 00E+01 | 1 00E+01 |
| C-14 | 1 2112E-01 | 614 88 | 614 88 | 0 00E+00 | 7 45E+01 | 7 45E+01 |
| Cl-36 | 2 2860E-03 | 614 88 | 614 88 | 0 00E+00 | 1 41E+00 | 1 41E+00 |
| Cm-243 | 1 2475E-03 | 614 88 | 614 88 | 0 00E+00 | 7.67E-01 | 7 67E-01 |
| Cm-244 | 2 9920E-01 | 614 88 | 614 88 | 0 00E+00 | 1 84E+02 | 1 84E+02 |
| Co-60 | 2 0197E+02 | 614 88 | 614 88 | 0 00E+00 | 1.24E+05 | 1.24E+05 |
| Cs-134 | 5 2728E-02 | 614 88 | 614 88 | 0 00E+00 | 3.24E+01 | 3.24E+01 |
| Cs-135 | 4 3976E-04 | 614 88 | 614 88 | 0 00E+00 | 2.70E-01 | 2 70E-01 |
| Cs-137 | 2 9760E+01 | 614 88 | 614 88 | 0 00E+00 | 1 83E+04 | 1 83E+04 |
| Eu-154 | 4 1838E+00 | 614 88 | 614 88 | 0 00E+00 | 2 57E+03 | 2 57E+03 |
| Eu-155 | 5 6060E-01 | 614 88 | 614 88 | 0 00E+00 | 3 45E+02 | 3 45E+02 |
| Fe-55 | 1 5985E+01 | 614 88 | 614 88 | 0 00E+00 | 9 83E+03 | 9 83E+03 |
| H-3 | 5 6412E-01 | 614 88 | 614 88 | 0 00E+00 | 3.47E+02 | 3 47E+02 |
| I-129 | 1 0618E-05 | 614 88 | 614 88 | 0 00E+00 | 6 53E-03 | 6 53E-03 |
| Kr-85 | 1 5783E+00 | 614 88 | 614 88 | 0 00E+00 | 9 70E+02 | 9 70E+02 |
| Np-237 | 1 5632E-04 | 614 88 | 614 88 | 0 00E+00 | 9 61E-02 | 9 61E-02 |
| Pa-231 | 2 8608E-06 | 614 88 | 614 88 | 0 00E+00 | 1.76E-03 | 1 76E-03 |
| Pb-210 | 3.7448E-09 | 614 88 | 614 88 | 0 00E+00 | 2.30E-06 | 2 30E-06 |
| Pm-147 | 8 8701E-01 | 614 88 | 614 88 | 0 00E+00 | 5 45E+02 | 5 45E+02 |
| Pu-238 | -4 8840E-01 | 614 88 | 0 00 | 1 66E+02 | 0 00E+00 | 1 66E+02 |
| Pu-239 | -4 8280E-02 | 614 88 | 0 00 | 2 01E+01 | 0 00E+00 | 2 01E+01 |
| Pu-240 | -3 0095E-01 | 614 88 | 0 00 | 2 57E+01 | 0 00E+00 | 2 57E+01 |
| Pu-241 | -5.2560E+01 | 614 88 | 0 00 | 6 61E+03 | 0 00E+00 | 6 61E+03 |
| Pu-242 | -1.1381E-04 | 614 88 | 0 00 | 1.11E-01 | 4.12E-02 | 1 11E-01 |
| Ra-226 | 1 6815E-08 | 614 88 | 614 88 | 0 00E+00 | 1.03E-05 | 1 03E-05 |
| Ra-228 | 5 6880E-07 | 614 88 | 614 88 | 0 00E+00 | 3.50E-04 | 3 50E-04 |
| Ru-106 | 1.2188E-04 | 614 88 | 614 88 | 0 00E+00 | 7 49E-02 | 7 49E-02 |
| Se-79 | 1 9186E-04 | 614 88 | 614 88 | 0 00E+00 | 1.18E-01 | 1 18E-01 |
| Sn-126 | 1 6671E-04 | 614 88 | 614 88 | 0 00E+00 | 1 03E-01 | 1 03E-01 |
| Sr-90 | 2 8288E+01 | 614 88 | 614 88 | 0 00E+00 | 1 74E+04 | 1.74E+04 |
| Tc-99 | 6.7678E-03 | 614 88 | 614 88 | 0 00E+00 | 4 16E+00 | 4.16E+00 |
| Th-229 | 8 9952E-07 | 614 88 | 614 88 | 0 00E+00 | 5.53E-04 | 5 53E-04 |
| Th-230 | 2 9941E-06 | 614 88 | 614 88 | 0 00E+00 | 1 84E-03 | 1 84E-03 |
| Th-232 | 6 0208E-07 | 614 88 | 614 88 | 0 00E+00 | 3.70E-04 | 3 70E-04 |
| Tl-208 | 1 0120E-04 | 614 88 | 614 88 | 0 00E+00 | 6.22E-02 | 6 22E-02 |
| U-232 | 2.7388E-04 | 614 88 | 614 88 | 0 00E+00 | 1 68E-01 | 1 68E-01 |
| U-233 | 3 6128E-04 | 614 88 | 614 88 | 0 00E+00 | 2.22E-01 | 2 22E-01 |
| U-234 | 1.2788E-02 | 614 88 | 614 88 | 0 00E+00 | 7 86E+00 | 7 86E+00 |
| U-235 | 5 7486E-04 | 614 88 | 614 88 | 5 57E-04 | 3.54E-01 | 3 54E-01 |
| U-236 | 2.3485E-04 | 614 88 | 614 88 | 0 00E+00 | 1 44E-01 | 1 44E-01 |
| U-238 | 1 1581E-04 | 614 88 | 614 88 | 6 93E-05 | 7.13E-02 | 7 13E-02 |
| Y-90 | 2 8288E+01 | 614 88 | 614 88 | 0 00E+00 | 1 74E+04 | 1.74E+04 |
| Other Radionuclides | | | | | 4 61E+04 | 4 61E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.257E+15 |
| 0 0250 | 2 475E+14 |
| 0 0375 | 2.221E+14 |
| 0 0575 | 2 773E+14 |
| 0 0850 | 1.275E+14 |
| 0 1250 | 1 175E+14 |
| 0 2250 | 1 054E+14 |
| 0 3750 | 4 407E+13 |
| 0 5750 | 6 925E+14 |
| 0 8500 | 5.384E+13 |
| 1.2500 | 9 243E+15 |
| 1 7500 | 1 681E+12 |
| 2.2500 | 4 874E+10 |
| 2.7500 | 2.339E+09 |
| 3.5000 | 2.736E+06 |
| 5 0000 | 1 133E+06 |
| 7 0000 | 1 303E+05 |
| 11 0000 | 1 494E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.32E+03 | 2.33E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | UNKNOWN | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 614 88 |
| Bounding | | 614 88 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name PNL MOX PINS 7057
SNF ID #. 419
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass BOL= , EOL=0 005kg
ROD Storage Site INEEL

[1]Fuel decay start date 1988
Estimates as of 2010
Template (Worst Case)
[2]Template Burnup(MWd) 62 5
Template BOL Heavy Metal Mass (MT) 0 00186865
Template Decay Time 20 years

Estimated Canister usage
18"x15'
0 07

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 6288E-06 | 4 75 | 4 75 | 0 00E+00 | 7 74E-06 | 7 74E-06 |
| Am-241 | 6 9216E+00 | 4 75 | 4 75 | 0 00E+00 | 3.29E+01 | 3 29E+01 |
| Am-242m | 1 8032E-02 | 4 75 | 4 75 | 0 00E+00 | 8 57E-02 | 8.57E-02 |
| Am-243 | 1 6336E-02 | 4.75 | 4 75 | 0 00E+00 | 7 76E-02 | 7.76E-02 |
| C-14 | 1.2112E-01 | 4.75 | 4 75 | 0 00E+00 | 5 76E-01 | 5 76E-01 |
| Cl-36 | 2 2860E-03 | 4 75 | 4 75 | 0 00E+00 | 1 09E-02 | 1 09E-02 |
| Cm-243 | 1.2475E-03 | 4 75 | 4.75 | 0 00E+00 | 5 93E-03 | 5 93E-03 |
| Cm-244 | 2 9920E-01 | 4 75 | 4.75 | 0 00E+00 | 1 42E+00 | 1 42E+00 |
| Co-60 | 2 0197E+02 | 4 75 | 4 75 | 0 00E+00 | 9 60E+02 | 9 60E+02 |
| Cs-134 | 5 2728E-02 | 4 75 | 4 75 | 0 00E+00 | 2.51E-01 | 2 51E-01 |
| Cs-135 | 4 3976E-04 | 4 75 | 4 75 | 0 00E+00 | 2 09E-03 | 2 09E-03 |
| Cs-137 | 2 9760E+01 | 4 75 | 4 75 | 0 00E+00 | 1.41E+02 | 1 41E+02 |
| Eu-154 | 4 1838E+00 | 4 75 | 4 75 | 0 00E+00 | 1 99E+01 | 1 99E+01 |
| Eu-155 | 5.6060E-01 | 4 75 | 4 75 | 0 00E+00 | 2 66E+00 | 2 66E+00 |
| Fe-55 | 1.5985E+01 | 4 75 | 4 75 | 0 00E+00 | 7 60E+01 | 7 60E+01 |
| H-3 | 5 6412E-01 | 4 75 | 4.75 | 0 00E+00 | 2 68E+00 | 2 68E+00 |
| I-129 | 1 0618E-05 | 4 75 | 4.75 | 0 00E+00 | 5 05E-05 | 5 05E-05 |
| Kr-85 | 1 5783E+00 | 4 75 | 4 75 | 0 00E+00 | 7 50E+00 | 7.50E+00 |
| Np-237 | 1 5632E-04 | 4 75 | 4 75 | 0 00E+00 | 7 43E-04 | 7 43E-04 |
| Pa-231 | 2 8608E-06 | 4 75 | 4 75 | 0 00E+00 | 1.36E-05 | 1 36E-05 |
| Pb-210 | 3 7448E-09 | 4 75 | 4 75 | 0 00E+00 | 1 78E-08 | 1 78E-08 |
| Pm-147 | 8 8701E-01 | 4 75 | 4 75 | 0 00E+00 | 4.21E+00 | 4 21E+00 |
| Pu-238 | -4 8840E-01 | 4 75 | 0 00 | 1 29E+00 | 0 00E+00 | 1 29E+00 |
| Pu-239 | -4 8280E-02 | 4 75 | 0 00 | 1 55E-01 | 0 00E+00 | 1.55E-01 |
| Pu-240 | -3 0095E-01 | 4 75 | 0 00 | 1 99E-01 | 0 00E+00 | 1.99E-01 |
| Pu-241 | -5 2560E+01 | 4 75 | 0 00 | 5 11E+01 | 0 00E+00 | 5.11E+01 |
| Pu-242 | -1 1381E-04 | 4 75 | 0.00 | 8 60E-04 | 3 19E-04 | 8 60E-04 |
| Ra-226 | 1 6815E-08 | 4 75 | 4 75 | 0 00E+00 | 7 99E-08 | 7 99E-08 |
| Ra-228 | 5 6880E-07 | 4 75 | 4 75 | 0 00E+00 | 2 70E-06 | 2 70E-06 |
| Ru-106 | 1 2188E-04 | 4 75 | 4 75 | 0 00E+00 | 5 79E-04 | 5 79E-04 |
| Se-79 | 1 9186E-04 | 4 75 | 4 75 | 0 00E+00 | 9.12E-04 | 9 12E-04 |
| Sn-126 | 1 6671E-04 | 4 75 | 4 75 | 0 00E+00 | 7.92E-04 | 7 92E-04 |
| Sr-90 | 2 8288E+01 | 4 75 | 4 75 | 0 00E+00 | 1.34E+02 | 1 34E+02 |
| Tc-99 | 6 7678E-03 | 4 75 | 4 75 | 0 00E+00 | 3.22E-02 | 3.22E-02 |
| Th-229 | 8 9952E-07 | 4 75 | 4 75 | 0 00E+00 | 4.27E-06 | 4.27E-06 |
| Th-230 | 2.9941E-06 | 4.75 | 4 75 | 0 00E+00 | 1 42E-05 | 1.42E-05 |
| Th-232 | 6 0208E-07 | 4 75 | 4 75 | 0 00E+00 | 2 86E-06 | 2.86E-06 |
| Tl-208 | 1 0120E-04 | 4 75 | 4.75 | 0 00E+00 | 4 81E-04 | 4 81E-04 |
| U-232 | 2 7388E-04 | 4 75 | 4.75 | 0.00E+00 | 1.30E-03 | 1.30E-03 |
| U-233 | 3 6128E-04 | 4 75 | 4 75 | 0 00E+00 | 1 72E-03 | 1 72E-03 |
| U-234 | 1.2788E-02 | 4 75 | 4 75 | 0 00E+00 | 6 08E-02 | 6 08E-02 |
| U-235 | 5 7486E-04 | 4 75 | 4 75 | 4.30E-06 | 2.74E-03 | 2 74E-03 |
| U-236 | 2 3485E-04 | 4 75 | 4 75 | 0 00E+00 | 1 12E-03 | 1.12E-03 |
| U-238 | 1 1581E-04 | 4 75 | 4 75 | 5 35E-07 | 5.51E-04 | 5.51E-04 |
| Y-90 | 2 8288E+01 | 4 75 | 4 75 | 0 00E+00 | 1.34E+02 | 1.34E+02 |
| Other Radionuclides | | | | | 3 56E+02 | 3.56E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 711E+12 |
| 0 0250 | 1.913E+12 |
| 0 0375 | 1 716E+12 |
| 0 0575 | 2.143E+12 |
| 0 0850 | 9.855E+11 |
| 0 1250 | 9 082E+11 |
| 0.2250 | 8 144E+11 |
| 0.3750 | 3 406E+11 |
| 0.5750 | 5.352E+12 |
| 0.8500 | 4 161E+11 |
| 1.2500 | 7 143E+13 |
| 1 7500 | 1.299E+10 |
| 2.2500 | 3 767E+08 |
| 2 7500 | 1 808E+07 |
| 3 5000 | 2 114E+04 |
| 5 0000 | 8 759E+03 |
| 7 0000 | 1.007E+03 |
| 11.0000 | 1 155E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 79E+01 | 1.80E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | UNKNOWN | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 4 75 |
| Bounding | | 4 75 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14 21 | |
| Bounding | 14 21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. PNL MOX STAR 3
SNF ID # 433
Fuel Units & Descr· 1 - SCRAP
Heavy Metal Mass BOL= , EOL=0 055kg
ROD Storage Site INEEL

[1]Fuel decay start date· 1984
Estimates as of: 2010
Template: (Worst Case)
[2]Template Burnup(MWd). 62.5
Template BOL Heavy Metal Mass (MT) 0 00186865
Template Decay Time· 25 years

Estimated Canister usage:
18"x15"
0 07

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 52.27 | 52.27 | 0 00E+00 | 1 03E-04 | 1 03E-04 |
| Am-241 | 7 8064E+00 | 52.27 | 52.27 | 0 00E+00 | 4 08E+02 | 4 08E+02 |
| Am-242m | 1 7632E-02 | 52.27 | 52.27 | 0 00E+00 | 9.22E-01 | 9 22E-01 |
| Am-243 | 1 6336E-02 | 52.27 | 52.27 | 0 00E+00 | 8.54E-01 | 8 54E-01 |
| C-14 | 1 2101E-01 | 52.27 | 52.27 | 0 00E+00 | 6 33E+00 | 6 33E+00 |
| Cl-36 | 2 2849E-03 | 52.27 | 52 27 | 0 00E+00 | 1.19E-01 | 1 19E-01 |
| Cm-243 | 1 1046E-03 | 52.27 | 52.27 | 0 00E+00 | 5.77E-02 | 5 77E-02 |
| Cm-244 | 2 4704E-01 | 52.27 | 52.27 | 0 00E+00 | 1.29E+01 | 1 29E+01 |
| Co-60 | 1 0466E+02 | 52.27 | 52.27 | 0 00E+00 | 5 47E+03 | 5 47E+03 |
| Cs-134 | 9 8289E-03 | 52.27 | 52.27 | 0 00E+00 | 5 14E-01 | 5 14E-01 |
| Cs-135 | 4 3976E-04 | 52.27 | 52.27 | 0 00E+00 | 2.30E-02 | 2 30E-02 |
| Cs-137 | 2 6526E+01 | 52.27 | 52.27 | 0 00E+00 | 1 39E+03 | 1 39E+03 |
| Eu-154 | 2 7975E+00 | 52.27 | 52.27 | 0 00E+00 | 1 46E+02 | 1 46E+02 |
| Eu-155 | 2 7881E-01 | 52.27 | 52.27 | 0 00E+00 | 1 46E+01 | 1 46E+01 |
| Fe-55 | 4 2151E+00 | 52.27 | 52.27 | 0 00E+00 | 2.20E+02 | 2.20E+02 |
| H-3 | 4.2599E-01 | 52.27 | 52.27 | 0 00E+00 | 2.23E+01 | 2.23E+01 |
| I-129 | 1 0618E-05 | 52.27 | 52.27 | 0 00E+00 | 5.55E-04 | 5 55E-04 |
| Kr-85 | 1 1426E+00 | 52.27 | 52.27 | 0 00E+00 | 5 97E+01 | 5 97E+01 |
| Np-237 | 1 5647E-04 | 52.27 | 52.27 | 0 00E+00 | 8.18E-03 | 8 18E-03 |
| Pa-231 | 2 8624E-06 | 52.27 | 52.27 | 0 00E+00 | 1.50E-04 | 1 50E-04 |
| Pb-210 | 9.2770E-09 | 52.27 | 52.27 | 0 00E+00 | 4 85E-07 | 4 85E-07 |
| Pm-147 | 2 3690E-01 | 52.27 | 52.27 | 0 00E+00 | 1.24E+01 | 1.24E+01 |
| Pu-238 | -6.1800E-01 | 52.27 | 0 00 | 1 41E+01 | 0 00E+00 | 1 41E+01 |
| Pu-239 | -4 8280E-02 | 52.27 | 0 00 | 1 71E+00 | 0 00E+00 | 1 71E+00 |
| Pu-240 | -3 0095E-01 | 52.27 | 0 00 | 2.18E+00 | 0 00E+00 | 2 18E+00 |
| Pu-241 | -7 4000E+01 | 52.27 | 0 00 | 5 62E+02 | 0 00E+00 | 5 62E+02 |
| Pu-242 | -1.1381E-04 | 52.27 | 0 00 | 9 45E-03 | 3 51E-03 | 9 45E-03 |
| Ra-226 | 3 2167E-08 | 52.27 | 52 27 | 0 00E+00 | 1.68E-06 | 1 68E-06 |
| Ra-228 | 5 9024E-07 | 52.27 | 52 27 | 0 00E+00 | 3.09E-05 | 3 09E-05 |
| Ru-106 | 3 9140E-06 | 52.27 | 52 27 | 0.00E+00 | 2.05E-04 | 2 05E-04 |
| Se-79 | 1 9184E-04 | 52.27 | 52 27 | 0 00E+00 | 1 00E-02 | 1 00E-02 |
| Sn-126 | 1 6671E-04 | 52.27 | 52 27 | 0 00E+00 | 8.71E-03 | 8 71E-03 |
| Sr-90 | 2 5126E+01 | 52.27 | 52 27 | 0 00E+00 | 1.31E+03 | 1.31E+03 |
| Tc-99 | 6 7678E-03 | 52.27 | 52 27 | 0 00E+00 | 3.54E-01 | 3 54E-01 |
| Th-229 | 1 2398E-06 | 52.27 | 52 27 | 0 00E+00 | 6.48E-05 | 6 48E-05 |
| Th-230 | 4 1442E-06 | 52.27 | 52 27 | 0 00E+00 | 2.17E-04 | 2 17E-04 |
| Th-232 | 6 0208E-07 | 52.27 | 52 27 | 0 00E+00 | 3.15E-05 | 3 15E-05 |
| Tl-208 | 9 6478E-05 | 52.27 | 52 27 | 0.00E+00 | 5.04E-03 | 5 04E-03 |
| U-232 | 2 6103E-04 | 52.27 | 52 27 | 0 00E+00 | 1.36E-02 | 1 36E-02 |
| U-233 | 3 6128E-04 | 52.27 | 52 27 | 0 00E+00 | 1.89E-02 | 1 89E-02 |
| U-234 | 1 2788E-02 | 52.27 | 52 27 | 0.00E+00 | 6.68E-01 | 6 68E-01 |
| U-235 | 5 7486E-04 | 52.27 | 52 27 | 4.73E-05 | 3.01E-02 | 3 01E-02 |
| U-236 | 2 3485E-04 | 52.27 | 52 27 | 0 00E+00 | 1.23E-02 | 1 23E-02 |
| U-238 | 1 1581E-04 | 52.27 | 52 27 | 5 89E-06 | 6.06E-03 | 6 06E-03 |
| Y-90 | 2 5126E+01 | 52.27 | 52 27 | 0 00E+00 | 1 31E+03 | 1 31E+03 |
| Other Radionuclides | | | | | 3 66E+03 | 3 66E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 8 753E+13 |
| 0 0250 | 1 734E+13 |
| 0 0375 | 1.547E+13 |
| 0 0575 | 2.112E+13 |
| 0 0850 | 9 133E+12 |
| 0 1250 | 7 943E+12 |
| 0.2250 | 7 759E+12 |
| 0.3750 | 3.270E+12 |
| 0 5750 | 5.216E+13 |
| 0 8500 | 3 143E+12 |
| 1 2500 | 4 079E+14 |
| 1 7500 | 9.883E+10 |
| 2.2500 | 2.147E+09 |
| 2.7500 | 1.839E+08 |
| 3.5000 | 1 880E+05 |
| 5 0000 | 7.999E+04 |
| 7 0000 | 9 184E+03 |
| 11 0000 | 1 052E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 17E+02 | 1.17E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator· | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Drfferences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 52.27 |
| Bounding | | 52.27 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PNL MOX STAR 4
SNF ID # 434
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass BOL= , EOL=0 06kg
ROD Storage Site INEEL

[1]Fuel decay start date: 1984
Estimates as of 2010
Template (Worst Case)
[2]Template Burnup(MWd) 62.5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 25 years

Estimated Canister usage
18"x15'
0 07

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 57.02 | 57 02 | 0.00E+00 | 1 12E-04 | 1.12E-04 |
| Am-241 | 7 8064E+00 | 57.02 | 57 02 | 0 00E+00 | 4 45E+02 | 4 45E+02 |
| Am-242m | 1.7632E-02 | 57 02 | 57 02 | 0 00E+00 | 1 01E+00 | 1 01E+00 |
| Am-243 | 1.6336E-02 | 57 02 | 57 02 | 0 00E+00 | 9 31E-01 | 9 31E-01 |
| C-14 | 1.2101E-01 | 57 02 | 57 02 | 0 00E+00 | 6 90E+00 | 6 90E+00 |
| Cl-36 | 2.2849E-03 | 57 02 | 57 02 | 0 00E+00 | 1 30E-01 | 1 30E-01 |
| Cm-243 | 1 1046E-03 | 57.02 | 57 02 | 0 00E+00 | 6 30E-02 | 6 30E-02 |
| Cm-244 | 2 4704E-01 | 57 02 | 57.02 | 0 00E+00 | 1 41E+01 | 1 41E+01 |
| Co-60 | 1 0466E+02 | 57 02 | 57.02 | 0 00E+00 | 5 97E+03 | 5 97E+03 |
| Cs-134 | 9 8289E-03 | 57 02 | 57.02 | 0 00E+00 | 5 60E-01 | 5 60E-01 |
| Cs-135 | 4 3976E-04 | 57 02 | 57 02 | 0 00E+00 | 2 51E-02 | 2.51E-02 |
| Cs-137 | 2 6526E+01 | 57.02 | 57 02 | 0 00E+00 | 1 51E+03 | 1.51E+03 |
| Eu-154 | 2 7975E+00 | 57.02 | 57 02 | 0 00E+00 | 1 60E+02 | 1 60E+02 |
| Eu-155 | 2 7881E-01 | 57.02 | 57 02 | 0 00E+00 | 1 59E+01 | 1.59E+01 |
| Fe-55 | 4 2151E+00 | 57.02 | 57 02 | 0 00E+00 | 2 40E+02 | 2.40E+02 |
| H-3 | 4.2599E-01 | 57.02 | 57 02 | 0 00E+00 | 2.43E+01 | 2 43E+01 |
| I-129 | 1 0618E-05 | 57 02 | 57 02 | 0 00E+00 | 6 05E-04 | 6 05E-04 |
| Kr-85 | 1.1426E+00 | 57 02 | 57 02 | 0.00E+00 | 6 52E+01 | 6 52E+01 |
| Np-237 | 1.5647E-04 | 57.02 | 57 02 | 0.00E+00 | 8 92E-03 | 8 92E-03 |
| Pa-231 | 2.8624E-06 | 57 02 | 57 02 | 0 00E+00 | 1 63E-04 | 1 63E-04 |
| Pb-210 | 9.2770E-09 | 57 02 | 57.02 | 0 00E+00 | 5 29E-07 | 5.29E-07 |
| Pm-147 | 2.3690E-01 | 57 02 | 57.02 | 0 00E+00 | 1.35E+01 | 1 35E+01 |
| Pu-238 | -6 1800E-01 | 57 02 | 0 00 | 1 54E+01 | 0 00E+00 | 1 54E+01 |
| Pu-239 | -4 8280E-02 | 57 02 | 0 00 | 1 87E+00 | 0 00E+00 | 1 87E+00 |
| Pu-240 | -3 0095E-01 | 57 02 | 0 00 | 2 38E+00 | 0 00E+00 | 2.38E+00 |
| Pu-241 | -7 4000E+01 | 57 02 | 0 00 | 6 13E+02 | 0 00E+00 | 6 13E+02 |
| Pu-242 | -1.1381E-04 | 57.02 | 0 00 | 1 03E-02 | 3.82E-03 | 1 03E-02 |
| Ra-226 | 3 2167E-08 | 57 02 | 57 02 | 0 00E+00 | 1.83E-06 | 1 83E-06 |
| Ra-228 | 5 9024E-07 | 57.02 | 57 02 | 0 00E+00 | 3.37E-05 | 3 37E-05 |
| Ru-106 | 3 9140E-06 | 57.02 | 57 02 | 0 00E+00 | 2.23E-04 | 2.23E-04 |
| Se-79 | 1 9184E-04 | 57 02 | 57 02 | 0 00E+00 | 1 09E-02 | 1 09E-02 |
| Sn-126 | 1 6671E-04 | 57 02 | 57 02 | 0 00E+00 | 9 51E-03 | 9 51E-03 |
| Sr-90 | 2.5126E+01 | 57 02 | 57.02 | 0 00E+00 | 1.43E+03 | 1.43E+03 |
| Tc-99 | 6 7678E-03 | 57 02 | 57 02 | 0 00E+00 | 3 86E-01 | 3 86E-01 |
| Th-229 | 1.2398E-06 | 57 02 | 57.02 | 0 00E+00 | 7 07E-05 | 7 07E-05 |
| Th-230 | 4 1442E-06 | 57 02 | 57.02 | 0 00E+00 | 2 36E-04 | 2 36E-04 |
| Th-232 | 6 0208E-07 | 57 02 | 57.02 | 0 00E+00 | 3 43E-05 | 3 43E-05 |
| Tl-208 | 9 6478E-05 | 57 02 | 57.02 | 0 00E+00 | 5 50E-03 | 5.50E-03 |
| U-232 | 2 6103E-04 | 57 02 | 57.02 | 0 00E+00 | 1 49E-02 | 1.49E-02 |
| U-233 | 3 6128E-04 | 57 02 | 57 02 | 0 00E+00 | 2 06E-02 | 2.06E-02 |
| U-234 | 1.2788E-02 | 57.02 | 57 02 | 0 00E+00 | 7.29E-01 | 7.29E-01 |
| U-235 | 5 7486E-04 | 57.02 | 57 02 | 5 16E-05 | 3.28E-02 | 3.28E-02 |
| U-236 | 2 3485E-04 | 57.02 | 57 02 | 0 00E+00 | 1.34E-02 | 1.34E-02 |
| U-238 | 1 1581E-04 | 57.02 | 57 02 | 6 42E-06 | 6 61E-03 | 6 61E-03 |
| Y-90 | 2 5126E+01 | 57.02 | 57 02 | 0 00E+00 | 1.43E+03 | 1 43E+03 |
| Other Radionuclides | | | | | 4 00E+03 | 4 00E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 548E+13 |
| 0 0250 | 1.892E+13 |
| 0 0375 | 1 688E+13 |
| 0 0575 | 2.304E+13 |
| 0 0850 | 9 963E+12 |
| 0 1250 | 8 665E+12 |
| 0.2250 | 8 464E+12 |
| 0.3750 | 3 567E+12 |
| 0.5750 | 5 690E+13 |
| 0 8500 | 3 429E+12 |
| 1.2500 | 4 450E+14 |
| 1 7500 | 1 078E+11 |
| 2.2500 | 2 343E+09 |
| 2 7500 | 2.006E+08 |
| 3 5000 | 2.051E+05 |
| 5 0000 | 8 726E+04 |
| 7 0000 | 1 002E+04 |
| 11 0000 | 1 148E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.27E+02 | 1.28E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 57.02 |
| Bounding | | 57 02 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup.
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. PNL MOX STAR 5
SNF ID #: 435
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass BOL= , EOL=0 139kg
ROD Storage Site. INEEL

[1]Fuel decay start date: 1985
Estimates as of: 2010
Template: (Worst Case)
[2]Template Burnup(MWd): 62 5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 25 years

Estimated Canister usage: 18"x15' — 0 07

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 132 10 | 132 10 | 0 00E+00 | 2 60E-04 | 2 60E-04 |
| Am-241 | 7 8064E+00 | 132 10 | 132 10 | 0 00E+00 | 1 03E+03 | 1 03E+03 |
| Am-242m | 1.7632E-02 | 132 10 | 132 10 | 0 00E+00 | 2 33E+00 | 2.33E+00 |
| Am-243 | 1.6336E-02 | 132 10 | 132 10 | 0 00E+00 | 2.16E+00 | 2.16E+00 |
| C-14 | 1.2101E-01 | 132 10 | 132 10 | 0 00E+00 | 1 60E+01 | 1 60E+01 |
| Cl-36 | 2.2849E-03 | 132 10 | 132 10 | 0 00E+00 | 3 02E-01 | 3 02E-01 |
| Cm-243 | 1 1046E-03 | 132 10 | 132 10 | 0 00E+00 | 1 46E-01 | 1.46E-01 |
| Cm-244 | 2 4704E-01 | 132 10 | 132 10 | 0 00E+00 | 3.26E+01 | 3.26E+01 |
| Co-60 | 1 0466E+02 | 132 10 | 132 10 | 0 00E+00 | 1 38E+04 | 1 38E+04 |
| Cs-134 | 9 8289E-03 | 132 10 | 132 10 | 0 00E+00 | 1.30E+00 | 1 30E+00 |
| Cs-135 | 4 3976E-04 | 132 10 | 132 10 | 0 00E+00 | 5 81E-02 | 5 81E-02 |
| Cs-137 | 2 6526E+01 | 132 10 | 132 10 | 0 00E+00 | 3 50E+03 | 3 50E+03 |
| Eu-154 | 2.7975E+00 | 132 10 | 132 10 | 0 00E+00 | 3 70E+02 | 3.70E+02 |
| Eu-155 | 2.7881E-01 | 132 10 | 132 10 | 0 00E+00 | 3 68E+01 | 3 68E+01 |
| Fe-55 | 4 2151E+00 | 132 10 | 132 10 | 0 00E+00 | 5.57E+02 | 5 57E+02 |
| H-3 | 4 2599E-01 | 132 10 | 132 10 | 0 00E+00 | 5 63E+01 | 5 63E+01 |
| I-129 | 1 0618E-05 | 132 10 | 132 10 | 0 00E+00 | 1 40E-03 | 1 40E-03 |
| Kr-85 | 1 1426E+00 | 132 10 | 132 10 | 0 00E+00 | 1.51E+02 | 1 51E+02 |
| Np-237 | 1 5647E-04 | 132 10 | 132.10 | 0 00E+00 | 2.07E-02 | 2 07E-02 |
| Pa-231 | 2 8624E-06 | 132 10 | 132.10 | 0 00E+00 | 3 78E-04 | 3 78E-04 |
| Pb-210 | 9 2770E-09 | 132.10 | 132 10 | 0 00E+00 | 1.23E-06 | 1.23E-06 |
| Pm-147 | 2 3690E-01 | 132.10 | 132 10 | 0 00E+00 | 3.13E+01 | 3 13E+01 |
| Pu-238 | -6.1800E-01 | 132.10 | 0 00 | 3 57E+01 | 0 00E+00 | 3 57E+01 |
| Pu-239 | -4 8280E-02 | 132.10 | 0 00 | 4 32E+00 | 0 00E+00 | 4 32E+00 |
| Pu-240 | -3 0095E-01 | 132.10 | 0 00 | 5 52E+00 | 0 00E+00 | 5 52E+00 |
| Pu-241 | -7 4000E+01 | 132.10 | 0 00 | 1 42E+03 | 0 00E+00 | 1 42E+03 |
| Pu-242 | -1 1381E-04 | 132.10 | 0 00 | 2 39E-02 | 8 86E-03 | 2 39E-02 |
| Ra-226 | 3 2167E-08 | 132.10 | 132.10 | 0 00E+00 | 4 25E-06 | 4 25E-06 |
| Ra-228 | 5 9024E-07 | 132 10 | 132.10 | 0 00E+00 | 7 80E-05 | 7 80E-05 |
| Ru-106 | 3 9140E-06 | 132 10 | 132 10 | 0 00E+00 | 5 17E-04 | 5 17E-04 |
| Se-79 | 1 9184E-04 | 132.10 | 132.10 | 0 00E+00 | 2 53E-02 | 2 53E-02 |
| Sn-126 | 1 6671E-04 | 132.10 | 132.10 | 0.00E+00 | 2 20E-02 | 2 20E-02 |
| Sr-90 | 2 5126E+01 | 132 10 | 132 10 | 0 00E+00 | 3 32E+03 | 3.32E+03 |
| Tc-99 | 6 7678E-03 | 132 10 | 132.10 | 0.00E+00 | 8 94E-01 | 8 94E-01 |
| Th-229 | 1.2398E-06 | 132 10 | 132.10 | 0.00E+00 | 1 64E-04 | 1 64E-04 |
| Th-230 | 4 1442E-06 | 132 10 | 132 10 | 0.00E+00 | 5 47E-04 | 5 47E-04 |
| Th-232 | 6.0208E-07 | 132 10 | 132 10 | 0 00E+00 | 7 95E-05 | 7 95E-05 |
| Tl-208 | 9 6478E-05 | 132 10 | 132 10 | 0 00E+00 | 1 27E-02 | 1.27E-02 |
| U-232 | 2 6103E-04 | 132 10 | 132 10 | 0 00E+00 | 3 45E-02 | 3 45E-02 |
| U-233 | 3 6128E-04 | 132 10 | 132 10 | 0 00E+00 | 4 77E-02 | 4 77E-02 |
| U-234 | 1.2788E-02 | 132 10 | 132 10 | 0 00E+00 | 1 69E+00 | 1 69E+00 |
| U-235 | 5 7486E-04 | 132.10 | 132 10 | 1.20E-04 | 7 61E-02 | 7 61E-02 |
| U-236 | 2.3485E-04 | 132.10 | 132.10 | 0 00E+00 | 3 10E-02 | 3.10E-02 |
| U-238 | 1 1581E-04 | 132.10 | 132.10 | 1 49E-05 | 1 53E-02 | 1.53E-02 |
| Y-90 | 2 5126E+01 | 132.10 | 132.10 | 0 00E+00 | 3.32E+03 | 3.32E+03 |
| Other Radionuclides | | | | | 9.26E+03 | 9.26E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 2.212E+14 |
| 0 0250 | 4 383E+13 |
| 0 0375 | 3 911E+13 |
| 0 0575 | 5 338E+13 |
| 0 0850 | 2 308E+13 |
| 0 1250 | 2 007E+13 |
| 0.2250 | 1 961E+13 |
| 0 3750 | 8.264E+12 |
| 0 5750 | 1 318E+14 |
| 0 8500 | 7 943E+12 |
| 1.2500 | 1 031E+15 |
| 1 7500 | 2.498E+11 |
| 2.2500 | 5 427E+09 |
| 2.7500 | 4 648E+08 |
| 3.5000 | 4 752E+05 |
| 5 0000 | 2.022E+05 |
| 7 0000 | 2.321E+04 |
| 11.0000 | 2 660E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.95E+02 | 2.96E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 132 10 |
| Bounding | | 132 10 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup.
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name PNL MOX STAR 6
SNF ID # 436
Fuel Units & Descr 1 - SCRAP
Heavy Metal Mass BOL= , EOL=0 069kg
ROD Storage Site INEEL

[1]Fuel decay start date 1985
Estimates as of. 2010
Template (Worst Case)
[2]Template Burnup(MWd): 62.5
Template BOL Heavy Metal Mass (MT) 0 00186865
Template Decay Time 25 years

Estimated Canister usage 18"x15'
0 07

**II. Estimates**

| Radionuclide | m: CI/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 65 57 | 65 57 | 0 00E+00 | 1.29E-04 | 1 29E-04 |
| Am-241 | 7 8064E+00 | 65 57 | 65 57 | 0 00E+00 | 5 12E+02 | 5 12E+02 |
| Am-242m | 1 7632E-02 | 65.57 | 65 57 | 0 00E+00 | 1 16E+00 | 1 16E+00 |
| Am-243 | 1 6336E-02 | 65 57 | 65 57 | 0 00E+00 | 1 07E+00 | 1 07E+00 |
| C-14 | 1 2101E-01 | 65 57 | 65 57 | 0 00E+00 | 7 94E+00 | 7 94E+00 |
| Cl-36 | 2 2849E-03 | 65.57 | 65 57 | 0 00E+00 | 1 50E-01 | 1.50E-01 |
| Cm-243 | 1.1046E-03 | 65 57 | 65 57 | 0 00E+00 | 7.24E-02 | 7.24E-02 |
| Cm-244 | 2 4704E-01 | 65 57 | 65 57 | 0 00E+00 | 1 62E+01 | 1 62E+01 |
| Co-60 | 1 0466E+02 | 65 57 | 65 57 | 0 00E+00 | 6 86E+03 | 6 86E+03 |
| Cs-134 | 9 8289E-03 | 65 57 | 65.57 | 0 00E+00 | 6 45E-01 | 6 45E-01 |
| Cs-135 | 4.3976E-04 | 65 57 | 65 57 | 0 00E+00 | 2.88E-02 | 2 88E-02 |
| Cs-137 | 2 6526E+01 | 65 57 | 65 57 | 0 00E+00 | 1 74E+03 | 1 74E+03 |
| Eu-154 | 2 7975E+00 | 65 57 | 65 57 | 0 00E+00 | 1.83E+02 | 1.83E+02 |
| Eu-155 | 2 7881E-01 | 65.57 | 65 57 | 0 00E+00 | 1.83E+01 | 1 83E+01 |
| Fe-55 | 4.2151E+00 | 65.57 | 65 57 | 0.00E+00 | 2 76E+02 | 2 76E+02 |
| H-3 | 4 2599E-01 | 65 57 | 65 57 | 0.00E+00 | 2 79E+01 | 2 79E+01 |
| I-129 | 1 0618E-05 | 65.57 | 65 57 | 0 00E+00 | 6 96E-04 | 6 96E-04 |
| Kr-85 | 1 1426E+00 | 65 57 | 65 57 | 0 00E+00 | 7 49E+01 | 7 49E+01 |
| Np-237 | 1.5647E-04 | 65 57 | 65 57 | 0 00E+00 | 1 03E-02 | 1 03E-02 |
| Pa-231 | 2 8624E-06 | 65 57 | 65.57 | 0 00E+00 | 1 88E-04 | 1 88E-04 |
| Pb-210 | 9.2770E-09 | 65 57 | 65 57 | 0 00E+00 | 6 08E-07 | 6.08E-07 |
| Pm-147 | 2.3690E-01 | 65 57 | 65.57 | 0 00E+00 | 1 55E+01 | 1.55E+01 |
| Pu-238 | -6 1800E-01 | 65 57 | 0 00 | 1 77E+01 | 0 00E+00 | 1.77E+01 |
| Pu-239 | -4 8280E-02 | 65.57 | 0.00 | 2 15E+00 | 0 00E+00 | 2.15E+00 |
| Pu-240 | -3 0095E-01 | 65 57 | 0 00 | 2 74E+00 | 0 00E+00 | 2.74E+00 |
| Pu-241 | -7 4000E+01 | 65.57 | 0 00 | 7 05E+02 | 0 00E+00 | 7.05E+02 |
| Pu-242 | -1 1381E-04 | 65.57 | 0 00 | 1.19E-02 | 4 40E-03 | 1 19E-02 |
| Ra-226 | 3.2167E-08 | 65 57 | 65 57 | 0 00E+00 | 2 11E-06 | 2 11E-06 |
| Ra-228 | 5 9024E-07 | 65.57 | 65 57 | 0 00E+00 | 3 87E-05 | 3 87E-05 |
| Ru-106 | 3 9140E-06 | 65 57 | 65 57 | 0 00E+00 | 2 57E-04 | 2 57E-04 |
| Se-79 | 1 9184E-04 | 65 57 | 65 57 | 0 00E+00 | 1 26E-02 | 1.26E-02 |
| Sn-126 | 1 6671E-04 | 65 57 | 65.57 | 0 00E+00 | 1 09E-02 | 1 09E-02 |
| Sr-90 | 2.5126E+01 | 65 57 | 65.57 | 0 00E+00 | 1 65E+03 | 1 65E+03 |
| Tc-99 | 6 7678E-03 | 65 57 | 65 57 | 0 00E+00 | 4 44E-01 | 4 44E-01 |
| Th-229 | 1.2398E-06 | 65 57 | 65.57 | 0 00E+00 | 8 13E-05 | 8.13E-05 |
| Th-230 | 4.1442E-06 | 65 57 | 65.57 | 0 00E+00 | 2 72E-04 | 2.72E-04 |
| Th-232 | 6 0208E-07 | 65 57 | 65.57 | 0 00E+00 | 3 95E-05 | 3 95E-05 |
| Tl-208 | 9 6478E-05 | 65.57 | 65 57 | 0 00E+00 | 6.33E-03 | 6.33E-03 |
| U-232 | 2 6103E-04 | 65 57 | 65 57 | 0 00E+00 | 1.71E-02 | 1.71E-02 |
| U-233 | 3 6128E-04 | 65 57 | 65 57 | 0 00E+00 | 2.37E-02 | 2.37E-02 |
| U-234 | 1.2788E-02 | 65 57 | 65 57 | 0 00E+00 | 8 39E-01 | 8 39E-01 |
| U-235 | 5 7486E-04 | 65 57 | 65 57 | 5 94E-05 | 3 78E-02 | 3 78E-02 |
| U-236 | 2 3485E-04 | 65 57 | 65.57 | 0 00E+00 | 1 54E-02 | 1 54E-02 |
| U-238 | 1 1581E-04 | 65 57 | 65 57 | 7.39E-06 | 7 60E-03 | 7 60E-03 |
| Y-90 | 2 5126E+01 | 65 57 | 65 57 | 0 00E+00 | 1 65E+03 | 1 65E+03 |
| Other Radionuclides | | | | | 4 60E+03 | 4 60E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 098E+14 |
| 0 0250 | 2 176E+13 |
| 0 0375 | 1 941E+13 |
| 0 0575 | 2 650E+13 |
| 0 0850 | 1 146E+13 |
| 0 1250 | 9 965E+12 |
| 0.2250 | 9 733E+12 |
| 0 3750 | 4 102E+12 |
| 0 5750 | 6.544E+13 |
| 0 8500 | 3 943E+12 |
| 1.2500 | 5.117E+14 |
| 1 7500 | 1.240E+11 |
| 2.2500 | 2.694E+09 |
| 2.7500 | 2.307E+08 |
| 3.5000 | 2.359E+05 |
| 5.0000 | 1.004E+05 |
| 7.0000 | 1 152E+04 |
| 11.0000 | 1.320E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.46E+02 | 1.47E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U Th & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 65.57 |
| Bounding | | 65.57 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name PNL MOX STAR 7
SNF ID #: 422
Fuel Units & Descr: 1 - SCRAP
Heavy Metal Mass BOL= ; EOL=0.348kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1985
Estimates as of: 2010
Template: (Worst Case)
[2]Template Burnup(MWd): 62 5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time: 25 years

Estimated Canister usage
18"x15'
0 07

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 330 72 | 330 72 | 0 00E+00 | 6 50E-04 | 6 50E-04 |
| Am-241 | 7 8064E+00 | 330 72 | 330 72 | 0 00E+00 | 2 58E+03 | 2.58E+03 |
| Am-242m | 1 7632E-02 | 330 72 | 330.72 | 0 00E+00 | 5 83E+00 | 5 83E+00 |
| Am-243 | 1 6336E-02 | 330.72 | 330.72 | 0 00E+00 | 5 40E+00 | 5 40E+00 |
| C-14 | 1 2101E-01 | 330 72 | 330 72 | 0 00E+00 | 4 00E+01 | 4 00E+01 |
| Cl-36 | 2 2849E-03 | 330 72 | 330 72 | 0 00E+00 | 7 56E-01 | 7 56E-01 |
| Cm-243 | 1 1046E-03 | 330 72 | 330.72 | 0 00E+00 | 3 65E-01 | 3 65E-01 |
| Cm-244 | 2 4704E-01 | 330 72 | 330.72 | 0 00E+00 | 8 17E+01 | 8.17E+01 |
| Co-60 | 1 0466E+02 | 330 72 | 330.72 | 0 00E+00 | 3 46E+04 | 3 46E+04 |
| Cs-134 | 9 8289E-03 | 330 72 | 330 72 | 0 00E+00 | 3.25E+00 | 3.25E+00 |
| Cs-135 | 4 3976E-04 | 330 72 | 330.72 | 0 00E+00 | 1 45E-01 | 1 45E-01 |
| Cs-137 | 2 6526E+01 | 330 72 | 330.72 | 0 00E+00 | 8 77E+03 | 8.77E+03 |
| Eu-154 | 2 7975E+00 | 330 72 | 330.72 | 0 00E+00 | 9 25E+02 | 9.25E+02 |
| Eu-155 | 2 7881E-01 | 330 72 | 330.72 | 0 00E+00 | 9.22E+01 | 9.22E+01 |
| Fe-55 | 4 2151E+00 | 330 72 | 330.72 | 0 00E+00 | 1.39E+03 | 1.39E+03 |
| H-3 | 4 2599E-01 | 330 72 | 330.72 | 0 00E+00 | 1 41E+02 | 1.41E+02 |
| I-129 | 1 0618E-05 | 330 72 | 330.72 | 0 00E+00 | 3 51E-03 | 3.51E-03 |
| Kr-85 | 1 1426E+00 | 330 72 | 330.72 | 0 00E+00 | 3 78E+02 | 3.78E+02 |
| Np-237 | 1 5647E-04 | 330 72 | 330.72 | 0 00E+00 | 5 17E-02 | 5.17E-02 |
| Pa-231 | 2 8624E-06 | 330 72 | 330 72 | 0 00E+00 | 9 47E-04 | 9 47E-04 |
| Pb-210 | 9 2770E-09 | 330 72 | 330.72 | 0 00E+00 | 3 07E-06 | 3 07E-06 |
| Pm-147 | 2 3690E-01 | 330 72 | 330.72 | 0 00E+00 | 7 83E+01 | 7.83E+01 |
| Pu-238 | -6.1800E-01 | 330 72 | 0 00 | 8 94E+01 | 0 00E+00 | 8 94E+01 |
| Pu-239 | -4 8280E-02 | 330 72 | 0 00 | 1 08E+01 | 0 00E+00 | 1 08E+01 |
| Pu-240 | -3 0095E-01 | 330 72 | 0 00 | 1.38E+01 | 0 00E+00 | 1.38E+01 |
| Pu-241 | -7.4000E+01 | 330 72 | 0 00 | 3.56E+03 | 0 00E+00 | 3.56E+03 |
| Pu-242 | -1.1381E-04 | 330 72 | 0 00 | 5.98E-02 | 2 22E-02 | 5 98E-02 |
| Ra-226 | 3 2167E-08 | 330 72 | 330.72 | 0 00E+00 | 1 06E-05 | 1 06E-05 |
| Ra-228 | 5 9024E-07 | 330 72 | 330.72 | 0 00E+00 | 1 95E-04 | 1 95E-04 |
| Ru-106 | 3 9140E-06 | 330 72 | 330.72 | 0 00E+00 | 1 29E-03 | 1 29E-03 |
| Se-79 | 1 9184E-04 | 330 72 | 330 72 | 0.00E+00 | 6.34E-02 | 6.34E-02 |
| Sn-126 | 1 6671E-04 | 330 72 | 330 72 | 0 00E+00 | 5 51E-02 | 5.51E-02 |
| Sr-90 | 2 5126E+01 | 330 72 | 330.72 | 0 00E+00 | 8.31E+03 | 8.31E+03 |
| Tc-99 | 6 7678E-03 | 330.72 | 330 72 | 0 00E+00 | 2.24E+00 | 2.24E+00 |
| Th-229 | 1 2398E-06 | 330 72 | 330 72 | 0.00E+00 | 4 10E-04 | 4.10E-04 |
| Th-230 | 4 1442E-06 | 330.72 | 330 72 | 0 00E+00 | 1.37E-03 | 1.37E-03 |
| Th-232 | 6 0208E-07 | 330 72 | 330 72 | 0 00E+00 | 1 99E-04 | 1.99E-04 |
| Tl-208 | 9 6478E-05 | 330.72 | 330 72 | 0 00E+00 | 3 19E-02 | 3.19E-02 |
| U-232 | 2 6103E-04 | 330.72 | 330 72 | 0 00E+00 | 8 63E-02 | 8 63E-02 |
| U-233 | 3 6128E-04 | 330.72 | 330 72 | 0 00E+00 | 1.19E-01 | 1.19E-01 |
| U-234 | 1.2788E-02 | 330.72 | 330 72 | 0 00E+00 | 4.23E+00 | 4.23E+00 |
| U-235 | 5 7486E-04 | 330 72 | 330 72 | 2.99E-04 | 1 90E-01 | 1 90E-01 |
| U-236 | 2 3485E-04 | 330.72 | 330 72 | 0.00E+00 | 7 77E-02 | 7.77E-02 |
| U-238 | 1 1581E-04 | 330.72 | 330 72 | 3.73E-05 | 3 83E-02 | 3 83E-02 |
| Y-90 | 2 5126E+01 | 330.72 | 330 72 | 0 00E+00 | 8.31E+03 | 8.31E+03 |
| Other Radionuclides | | | | | 2.32E+04 | 2.32E+04 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 5.538E+14 |
| 0 0250 | 1 097E+14 |
| 0 0375 | 9 791E+13 |
| 0 0575 | 1.336E+14 |
| 0 0850 | 5.779E+13 |
| 0 1250 | 5 026E+13 |
| 0 2250 | 4 909E+13 |
| 0 3750 | 2.069E+13 |
| 0 5750 | 3.300E+14 |
| 0 8500 | 1 989E+13 |
| 1 2500 | 2.581E+15 |
| 1 7500 | 6.253E+11 |
| 2.2500 | 1.359E+10 |
| 2.7500 | 1 164E+09 |
| 3 5000 | 1 190E+06 |
| 5 0000 | 5 061E+05 |
| 7 0000 | 5.811E+04 |
| 11 0000 | 6 659E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.38E+02 | 7 42E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment %. | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 330 72 |
| Bounding | | 330 72 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | PNL-3 | [1]Fuel decay start date | 1969 |
| SNF ID # | 420 | Estimates as of: | 2010 |
| Fuel Units & Descr | 6 - ROD | Template: | (Worst Case) |
| Heavy Metal Mass | BOL= , EOL=0 064kg | [2]Template Burnup(MWd) | 62 5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00186865 |
| | | Template Decay Time | 35 years |

Estimated Canister usage

| 18"x15' |
|---|
| 0 44 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3072E-06 | 61.01 | 61 01 | 0 00E+00 | 1 41E-04 | 1 41E-04 |
| Am-241 | 8 4448E+00 | 61.01 | 61 01 | 0 00E+00 | 5.15E+02 | 5.15E+02 |
| Am-242m | 1 6848E-02 | 61.01 | 61 01 | 0 00E+00 | 1.03E+00 | 1.03E+00 |
| Am-243 | 1 6320E-02 | 61 01 | 61 01 | 0 00E+00 | 9 96E-01 | 9 96E-01 |
| C-14 | 1.2090E-01 | 61 01 | 61 01 | 0 00E+00 | 7.38E+00 | 7.38E+00 |
| Cl-36 | 2.2849E-03 | 61 01 | 61 01 | 0 00E+00 | 1 39E-01 | 1.39E-01 |
| Cm-243 | 8 6624E-04 | 61 01 | 61 01 | 0 00E+00 | 5 29E-02 | 5.29E-02 |
| Cm-244 | 1.6848E-01 | 61 01 | 61 01 | 0 00E+00 | 1 03E+01 | 1.03E+01 |
| Co-60 | 2 8086E+01 | 61 01 | 61 01 | 0 00E+00 | 1.71E+03 | 1.71E+03 |
| Cs-134 | 3 4148E-04 | 61 01 | 61 01 | 0 00E+00 | 2 08E-02 | 2 08E-02 |
| Cs-135 | 4.3976E-04 | 61 01 | 61 01 | 0 00E+00 | 2 68E-02 | 2 68E-02 |
| Cs-137 | 2 1049E+01 | 61 01 | 61 01 | 0 00E+00 | 1.28E+03 | 1.28E+03 |
| Eu-154 | 1.2500E+00 | 61 01 | 61 01 | 0 00E+00 | 7 63E+01 | 7 63E+01 |
| Eu-155 | 6 8986E-02 | 61 01 | 61 01 | 0 00E+00 | 4 21E+00 | 4.21E+00 |
| Fe-55 | 2 9308E-01 | 61 01 | 61.01 | 0 00E+00 | 1 79E+01 | 1 79E+01 |
| H-3 | 2 4311E-01 | 61 01 | 61.01 | 0 00E+00 | 1 48E+01 | 1 48E+01 |
| I-129 | 1 0618E-05 | 61 01 | 61.01 | 0 00E+00 | 6 48E-04 | 6 48E-04 |
| Kr-85 | 5 9882E-01 | 61.01 | 61.01 | 0 00E+00 | 3 65E+01 | 3 65E+01 |
| Np-237 | 1 5668E-04 | 61 01 | 61.01 | 0 00E+00 | 9 56E-03 | 9 56E-03 |
| Pa-231 | 2 8656E-06 | 61.01 | 61.01 | 0.00E+00 | 1.75E-04 | 1 75E-04 |
| Pb-210 | 2 3918E-08 | 61.01 | 61 01 | 0.00E+00 | 1.46E-06 | 1 46E-06 |
| Pm-147 | 1 6900E-02 | 61.01 | 61 01 | 0 00E+00 | 1 03E+00 | 1 03E+00 |
| Pu-238 | -8 6120E-01 | 61.01 | 0.00 | 1.65E+01 | 0 00E+00 | 1 65E+01 |
| Pu-239 | -4 8440E-02 | 61.01 | 0.00 | 2.00E+00 | 0 00E+00 | 2 00E+00 |
| Pu-240 | -3 0095E-01 | 61 01 | 0 00 | 2.55E+00 | 0 00E+00 | 2 55E+00 |
| Pu-241 | -1 0411E+02 | 61 01 | 0 00 | 6 56E+02 | 0 00E+00 | 6 56E+02 |
| Pu-242 | -1 1381E-04 | 61 01 | 0 00 | 1.10E-02 | 4 09E-03 | 1.10E-02 |
| Ra-226 | 6 4400E-08 | 61 01 | 61 01 | 0 00E+00 | 3 93E-06 | 3.93E-06 |
| Ra-228 | 5 9952E-07 | 61 01 | 61 01 | 0 00E+00 | 3 66E-05 | 3 66E-05 |
| Ru-106 | 8.5526E-07 | 61 01 | 61 01 | 0 00E+00 | 5 22E-05 | 5.22E-05 |
| Se-79 | 1.9181E-04 | 61 01 | 61 01 | 0 00E+00 | 1 17E-02 | 1 17E-02 |
| Sn-126 | 1.6671E-04 | 61 01 | 61 01 | 0 00E+00 | 1 02E-02 | 1.02E-02 |
| Sr-90 | 1.9799E+01 | 61 01 | 61 01 | 0 00E+00 | 1.21E+03 | 1.21E+03 |
| Tc-99 | 6 7678E-03 | 61 01 | 61 01 | 0 00E+00 | 4 13E-01 | 4 13E-01 |
| Th-229 | 1 7488E-06 | 61 01 | 61 01 | 0 00E+00 | 1 07E-04 | 1 07E-04 |
| Th-230 | 5 8704E-06 | 61 01 | 61 01 | 0 00E+00 | 3 58E-04 | 3 58E-04 |
| Th-232 | 6 0208E-07 | 61 01 | 61 01 | 0 00E+00 | 3 67E-05 | 3 67E-05 |
| Tl-208 | 8 7573E-05 | 61 01 | 61 01 | 0 00E+00 | 5 34E-03 | 5 34E-03 |
| U-232 | 2 3706E-04 | 61 01 | 61.01 | 0 00E+00 | 1 45E-02 | 1 45E-02 |
| U-233 | 3 6128E-04 | 61 01 | 61.01 | 0 00E+00 | 2.20E-02 | 2 20E-02 |
| U-234 | 1 2788E-02 | 61.01 | 61.01 | 0 00E+00 | 7 80E-01 | 7 80E-01 |
| U-235 | 5 7486E-04 | 61.01 | 61.01 | 5.52E-05 | 3 51E-02 | 3 51E-02 |
| U-236 | 2 3485E-04 | 61.01 | 61.01 | 0 00E+00 | 1 43E-02 | 1 43E-02 |
| U-238 | 1 1581E-04 | 61.01 | 61 01 | 6.87E-06 | 7.07E-03 | 7 07E-03 |
| Y-90 | 1 9804E+01 | 61 01 | 61 01 | 0 00E+00 | 1.21E+03 | 1 21E+03 |
| Other Radionuclides | | | | | 3 76E+03 | 3 76E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7 477E+13 |
| 0 0250 | 1 488E+13 |
| 0 0375 | 1 300E+13 |
| 0 0575 | 2 045E+13 |
| 0 0850 | 7 982E+12 |
| 0 1250 | 6 256E+12 |
| 0 2250 | 6 915E+12 |
| 0 3750 | 2 958E+12 |
| 0 5750 | 4 809E+13 |
| 0 8500 | 1 838E+12 |
| 1.2500 | 1.285E+14 |
| 1 7500 | 5 683E+10 |
| 2.2500 | 6 737E+08 |
| 2.7500 | 1 899E+08 |
| 3.5000 | 1 519E+05 |
| 5 0000 | 6 453E+04 |
| 7 0000 | 7.390E+03 |
| 11.0000 | 8 455E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.01E+01 | 6.08E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | FAST | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 61 01 |
| Bounding | | 61 01 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14.21 | |
| Bounding | 14.21 | |

Estimated EOL HM/Given EOL HM: 591 64

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: PULSTAR - BUFFALO (6%RODS)
SNF ID #: 174
Fuel Units & Descr: 24 - CANISTER OF RODS
Heavy Metal Mass: BOL=254 671kg; EOL=252.202kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1978
Estimates as of: 2010
Template. PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61.92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage: 18"x10' 2 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 2,348 47 | 2,546 71 | 0 00E+00 | 1.56E-06 | 1 69E-06 |
| Am-241 | 1.3144E-01 | 2,348 47 | 2,546 71 | 0 00E+00 | 3 09E+02 | 3 35E+02 |
| Am-242m | 3 0039E-04 | 2,348 47 | 2,546 71 | 0 00E+00 | 7 05E-01 | 7 65E-01 |
| Am-243 | 6.2629E-04 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 47E+00 | 1 59E+00 |
| C-14 | 4 7965E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 13E-01 | 1 22E-01 |
| Cl-36 | 8 0297E-07 | 2,348 47 | 2 546 71 | 0 00E+00 | 1 89E-03 | 2 04E-03 |
| Cm-243 | 3 1993E-04 | 2,348 47 | 2,546 71 | 0 00E+00 | 7 51E-01 | 8 15E-01 |
| Cm-244 | 7.1851E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 69E+02 | 1 83E+02 |
| Co-60 | 9 5220E-03 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 24E+01 | 2.42E+01 |
| Cs-134 | 1 1662E-03 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 74E+00 | 2 97E+00 |
| Cs-135 | 1 4433E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 3 39E-02 | 3 68E-02 |
| Cs-137 | 1 7603E+00 | 2,348 47 | 2,546 71 | 0 00E+00 | 4 13E+03 | 4 48E+03 |
| Eu-154 | 4 5203E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 06E+02 | 1 15E+02 |
| Eu-155 | 7 1479E-03 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 68E+01 | 1 82E+01 |
| Fe-55 | 6 1919E-04 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 45E+00 | 1 58E+00 |
| H-3 | 3 6386E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 8 55E+01 | 9 27E+01 |
| I-129 | 9 8288E-07 | 2,348 47 | 2,546 71 | 0 00E+00 | 2.31E-03 | 2 50E-03 |
| Kr-85 | 5 3844E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 26E+02 | 1 37E+02 |
| Np-237 | 1 0546E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 48E-02 | 2 69E-02 |
| Pa-231 | 1 1370E-09 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 67E-06 | 2 90E-06 |
| Pb-210 | 3 3624E-11 | 2,348 47 | 2,546 71 | 0 00E+00 | 7 90E-08 | 8 56E-08 |
| Pm-147 | 5 1211E-03 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 20E+01 | 1 30E+01 |
| Pu-238 | 8 0669E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 89E+02 | 2 05E+02 |
| Pu-239 | 1 1626E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 73E+01 | 2 96E+01 |
| Pu-240 | 1 5097E-02 | 2,348 47 | 2,546 71 | 0 00E+00 | 3 55E+01 | 3 84E+01 |
| Pu-241 | 1 4567E+00 | 2,348 47 | 2,546 71 | 0 00E+00 | 3 42E+03 | 3 71E+03 |
| Pu-242 | 6 4260E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 1.51E-01 | 1 64E-01 |
| Ra-226 | 1 1392E-10 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 68E-07 | 2 90E-07 |
| Ra-228 | 5 1841E-12 | 2,348 47 | 2,546 71 | 0 00E+00 | 1.22E-08 | 1 32E-08 |
| Ru-106 | 5 9012E-07 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 39E-03 | 1 50E-03 |
| Se-79 | 1 2379E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 91E-02 | 3 15E-02 |
| Sn-126 | 2 5210E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 5 92E-02 | 6 42E-02 |
| Sr-90 | 1 1630E+00 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 73E+03 | 2 96E+03 |
| Tc-99 | 3 9357E-04 | 2,348 47 | 2,546 71 | 0 00E+00 | 9.24E-01 | 1 00E+00 |
| Th-229 | 8 5691E-11 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 01E-07 | 2 18E-07 |
| Th-230 | 1 4493E-08 | 2,348 47 | 2,546 71 | 0 00E+00 | 3 40E-05 | 3 69E-05 |
| Th-232 | 5 2923E-12 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 24E-08 | 1 35E-08 |
| Tl-208 | 1 9202E-07 | 2,348 47 | 2,546 71 | 0 00E+00 | 4 51E-04 | 4 89E-04 |
| U-232 | 5 2083E-07 | 2,348 47 | 2,546.71 | 0 00E+00 | 1.22E-03 | 1 33E-03 |
| U-233 | 2 4386E-08 | 2,348 47 | 2,546 71 | 0 00E+00 | 5 73E-05 | 6 21E-05 |
| U-234 | 4 7012E-05 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 10E-01 | 1 20E-01 |
| U-235 | -1 4492E-06 | 2,348 47 | 0 00 | 3 30E-02 | 2 96E-02 | 3 30E-02 |
| U-236 | 7 5759E-06 | 2,348 47 | 2,546 71 | 0 00E+00 | 1 78E-02 | 1 93E-02 |
| U-238 | -2 6129E-07 | 2,348 47 | 0 00 | 8 05E-02 | 7 98E-02 | 8 05E-02 |
| Y-90 | 1 1631E+00 | 2,348 47 | 2,546 71 | 0 00E+00 | 2 73E+03 | 2 96E+03 |
| Other Radionuclides | | | | | 3 97E+03 | 4 30E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 732E+14 |
| 0 0250 | 3 508E+13 |
| 0 0375 | 3 395E+13 |
| 0 0575 | 3 703E+13 |
| 0 0850 | 1 962E+13 |
| 0 1250 | 1 433E+13 |
| 0.2250 | 1 685E+13 |
| 0 3750 | 7 228E+12 |
| 0 5750 | 1 661E+14 |
| 0 8500 | 3.278E+12 |
| 1.2500 | 4 428E+12 |
| 1 7500 | 9 702E+10 |
| 2.2500 | 1 792E+07 |
| 2.7500 | 2 014E+07 |
| 3.5000 | 2 640E+06 |
| 5.0000 | 1 128E+06 |
| 7 0000 | 1 301E+05 |
| 11.0000 | 1 494E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6 44E+01 | 6 98E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 5 996 | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches PWR Template on all but one parameter (enrichment) making PWR a reasonable match.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal: | | 2,348 47 |
| Bounding | 2,546 71 | 4,696.95 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup taken directly from SFD (converted to MWd).

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.26 | |
| Bounding | 0.29 | 1 84 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | PULSTAR-N C STATE UNIV (4% ASSEMBLIES) | [1]Fuel decay start date | 2035 |
| SNF ID # | 175 | Estimates as of | 2010 |
| Fuel Units & Descr | 25 - 5 X 5 ROD ARRAY | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=316 87kg, EOL=315 902kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 5 years |

Estimated Canister usage

| 18"x10' |
|---|
| 1 25 |

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3547E-10 | 920 05 | 1,840 09 | 0 00E+00 | 2 17E-07 | 4.33E-07 |
| Am-241 | 6 5811E-02 | 920 05 | 1,840 09 | 0 00E+00 | 6 05E+01 | 1.21E+02 |
| Am-242m | 3 2913E-04 | 920 05 | 1,840 09 | 0 00E+00 | 3 03E-01 | 6 06E-01 |
| Am-243 | 6 2742E-04 | 920 05 | 1,840 09 | 0 00E+00 | 5 77E-01 | 1.15E+00 |
| C-14 | 4 8078E-05 | 920 05 | 1,840 09 | 0 00E+00 | 4 42E-02 | 8 85E-02 |
| Cl-36 | 8 0313E-07 | 920 05 | 1,840 09 | 0.00E+00 | 7 39E-04 | 1.48E-03 |
| Cm-243 | 5 2003E-04 | 920 05 | 1,840 09 | 0.00E+00 | 4 78E-01 | 9 57E-01 |
| Cm-244 | 1 5441E-01 | 920 05 | 1,840 09 | 0 00E+00 | 1 42E+02 | 2.84E+02 |
| Co-60 | 1.3196E-01 | 920.05 | 1,840 09 | 0 00E+00 | 1 21E+02 | 2 43E+02 |
| Cs-134 | 9 6528E-01 | 920.05 | 1,840 09 | 0 00E+00 | 8 88E+02 | 1 78E+03 |
| Cs-135 | 1 4433E-05 | 920.05 | 1,840 09 | 0 00E+00 | 1.33E-02 | 2 66E-02 |
| Cs-137 | 2.7939E+00 | 920 05 | 1,840 09 | 0 00E+00 | 2.57E+03 | 5 14E+03 |
| Eu-154 | 2.2626E-01 | 920 05 | 1,840 09 | 0 00E+00 | 2 08E+02 | 4 16E+02 |
| Eu-155 | 1.1680E-01 | 920 05 | 1,840 09 | 0 00E+00 | 1 07E+02 | 2 15E+02 |
| Fe-55 | 1.2760E-01 | 920 05 | 1,840 09 | 0 00E+00 | 1.17E+02 | 2 35E+02 |
| H-3 | 1.1168E-01 | 920 05 | 1,840 09 | 0 00E+00 | 1 03E+02 | 2 05E+02 |
| I-129 | 9 8288E-07 | 920 05 | 1,840 09 | 0 00E+00 | 9 04E-04 | 1 81E-03 |
| Kr-85 | 1 9606E-01 | 920 05 | 1,840 09 | 0 00E+00 | 1.80E+02 | 3 61E+02 |
| Np-237 | 9 6915E-06 | 920 05 | 1,840 09 | 0 00E+00 | 8 92E-03 | 1.78E-02 |
| Pa-231 | 8 5917E-10 | 920 05 | 1,840 09 | 0 00E+00 | 7 90E-07 | 1.58E-06 |
| Pb-210 | 1 6247E-12 | 920 05 | 1,840 09 | 0 00E+00 | 1 49E-09 | 2.99E-09 |
| Pm-147 | 1 0063E+00 | 920 05 | 1,840 09 | 0 00E+00 | 9 26E+02 | 1.85E+03 |
| Pu-238 | 9 4428E-02 | 920 05 | 1,840 09 | 0 00E+00 | 8 69E+01 | 1.74E+02 |
| Pu-239 | 1 1631E-02 | 920 05 | 1,840 09 | 0 00E+00 | 1 07E+01 | 2.14E+01 |
| Pu-240 | 1 4919E-02 | 920 05 | 1,840 09 | 0 00E+00 | 1.37E+01 | 2 75E+01 |
| Pu-241 | 3 8130E+00 | 920 05 | 1,840 09 | 0 00E+00 | 3 51E+03 | 7.02E+03 |
| Pu-242 | 6 4260E-05 | 920 05 | 1,840 09 | 0 00E+00 | 5 91E-02 | 1.18E-01 |
| Ra-226 | 1 2608E-11 | 920 05 | 1,840 09 | 0 00E+00 | 1.16E-08 | 2 32E-08 |
| Ra-228 | 3 8986E-12 | 920 05 | 1,840 09 | 0 00E+00 | 3 59E-09 | 7 17E-09 |
| Ru-106 | 5 4910E-01 | 920 05 | 1,840 09 | 0 00E+00 | 5 05E+02 | 1 01E+03 |
| Se-79 | 1 2380E-05 | 920 05 | 1,840 09 | 0 00E+00 | 1.14E-02 | 2 28E-02 |
| Sn-126 | 2 5210E-05 | 920.05 | 1,840 09 | 0 00E+00 | 2.32E-02 | 4 64E-02 |
| Sr-90 | 1 8718E+00 | 920.05 | 1,840 09 | 0 00E+00 | 1 72E+03 | 3 44E+03 |
| Tc-99 | 3 9357E-04 | 920.05 | 1,840 09 | 0 00E+00 | 3.62E-01 | 7.24E-01 |
| Th-229 | 2 9603E-11 | 920.05 | 1,840 09 | 0 00E+00 | 2.72E-08 | 5 45E-08 |
| Th-230 | 4.5559E-09 | 920 05 | 1,840 09 | 0 00E+00 | 4 19E-06 | 8.38E-06 |
| Th-232 | 5.2826E-12 | 920 05 | 1,840 09 | 0 00E+00 | 4 86E-09 | 9 72E-09 |
| Tl-208 | 1 9654E-07 | 920 05 | 1,840.09 | 0 00E+00 | 1 81E-04 | 3.62E-04 |
| U-232 | 5 7607E-07 | 920 05 | 1,840 09 | 0 00E+00 | 5.30E-04 | 1.06E-03 |
| U-233 | 2.3288E-08 | 920 05 | 1,840.09 | 0 00E+00 | 2 14E-05 | 4.29E-05 |
| U-234 | 4.1182E-05 | 920 05 | 1,840.09 | 0 00E+00 | 3 79E-02 | 7.58E-02 |
| U-235 | -1.4494E-06 | 920 05 | 0 00 | 2 76E-02 | 2 62E-02 | 2.76E-02 |
| U-236 | 7.5646E-06 | 920 05 | 1,840 09 | 0 00E+00 | 6 96E-03 | 1.39E-02 |
| U-238 | -2 6129E-07 | 920 05 | 0 00 | 1 02E-01 | 1 02E-01 | 1 02E-01 |
| Y-90 | 1.8718E+00 | 920 05 | 1,840 09 | 0 00E+00 | 1 72E+03 | 3 44E+03 |
| Other Radionuclides | | | | | 3 82E+03 | 7 64E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 626E+14 |
| 0 0250 | 6 048E+13 |
| 0 0375 | 5.662E+13 |
| 0 0575 | 5.276E+13 |
| 0 0850 | 3.332E+13 |
| 0 1250 | 3.016E+13 |
| 0.2250 | 2.835E+13 |
| 0.3750 | 1.591E+13 |
| 0.5750 | 2.933E+14 |
| 0.8500 | 6 786E+13 |
| 1.2500 | 3 156E+13 |
| 1 7500 | 4 894E+11 |
| 2.2500 | 2.456E+11 |
| 2 7500 | 8.226E+09 |
| 3.5000 | 1 055E+09 |
| 5 0000 | 1 732E+06 |
| 7 0000 | 1 997E+05 |
| 11 0000 | 2.294E+04 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 64E+01 | 1 13E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 4 025941269 | 0 to 5 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 920 05 |
| Bounding | | 1,840 09 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 08 | |
| Bounding | 0 17 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| **Fuel Name:** | PULSTAR-SUNY-BUFFALO (6% RODS) | [1]Fuel decay start date: | 1965 |
| **SNF ID #:** | 176 | Estimates as of: | 2010 |
| **Fuel Units & Descr:** | 996 - ROD | Template: | PWR (Light Water, Zirc, 0 to 5%, U) |
| **Heavy Metal Mass:** | BOL=537 541kg; EOL=499 992kg | [2]Template Burnup(MWd): | 61 92 |
| **ROD Storage Site:** | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00176911 |
| | | Template Decay Time: | 35 years |

Estimated Canister usage

| 18"x10' |
|---|
| 2 96 |

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 35,707.51 | 71,415 03 | 0 00E+00 | 3.13E-05 | 6.27E-05 |
| Am-241 | 1 4352E-01 | 35,707 51 | 71,415 03 | 0 00E+00 | 5 12E+03 | 1 02E+04 |
| Am-242m | 2 8698E-04 | 35,707.51 | 71,415 03 | 0 00E+00 | 1 02E+01 | 2 05E+01 |
| Am-243 | 6 2565E-04 | 35,707.51 | 71,415 03 | 0 00E+00 | 2 23E+01 | 4 47E+01 |
| C-14 | 4 7901E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 71E+00 | 3 42E+00 |
| Cl-36 | 8 0297E-07 | 35,707.51 | 71,415.03 | 0 00E+00 | 2 87E-02 | 5.73E-02 |
| Cm-243 | 2 5081E-04 | 35,707 51 | 71,415 03 | 0 00E+00 | 8 96E+00 | 1 79E+01 |
| Cm-244 | 4 9015E-02 | 35,707.51 | 71,415 03 | 0 00E+00 | 1 75E+03 | 3 50E+03 |
| Co-60 | 2 5581E-03 | 35,707.51 | 71,415 03 | 0 00E+00 | 9 13E+01 | 1 83E+02 |
| Cs-134 | 4 0536E-05 | 35,707 51 | 71,415 03 | 0.00E+00 | 1 45E+00 | 2 89E+00 |
| Cs-135 | 1 4433E-05 | 35,707 51 | 71,415.03 | 0 00E+00 | 5 15E-01 | 1 03E+00 |
| Cs-137 | 1 3979E+00 | 35,707 51 | 71,415.03 | 0 00E+00 | 4 99E+04 | 9 98E+04 |
| Eu-154 | 2 0203E-02 | 35,707 51 | 71,415 03 | 0.00E+00 | 7 21E+02 | 1 44E+03 |
| Eu-155 | 1 7684E-03 | 35,707 51 | 71,415.03 | 0 00E+00 | 6 31E+01 | 1 26E+02 |
| Fe-55 | 4 3136E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 54E+00 | 3 08E+00 |
| H-3 | 2 0769E-02 | 35,707 51 | 71,415 03 | 0 00E+00 | 7 42E+02 | 1 48E+03 |
| I-129 | 9 8288E-07 | 35,707 51 | 71,415 03 | 0 00E+00 | 3 51E-02 | 7 02E-02 |
| Kr-85 | 2 8214E-02 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 01E+03 | 2 01E+03 |
| Np-237 | 1 1218E-05 | 35,707.51 | 71,415 03 | 0 00E+00 | 4 01E-01 | 8 01E-01 |
| Pa-231 | 1 3036E-09 | 35,707 51 | 71,415 03 | 0 00E+00 | 4 65E-05 | 9 31E-05 |
| Pb-210 | 8 5078E-11 | 35,707 51 | 71,415 03 | 0 00E+00 | 3 04E-06 | 6 08E-06 |
| Pm-147 | 3 6531E-04 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 30E+01 | 2 61E+01 |
| Pu-238 | 7 4564E-02 | 35,707 51 | 71,415 03 | 0 00E+00 | 2 66E+03 | 5 32E+03 |
| Pu-239 | 1 1623E-02 | 35,707 51 | 71,415 03 | 0 00E+00 | 4 15E+02 | 8 30E+02 |
| Pu-240 | 1 5132E-02 | 35 707 51 | 71,415 03 | 0 00E+00 | 5 40E+02 | 1 08E+03 |
| Pu-241 | 9 0036E-01 | 35,707 51 | 71,415 03 | 0 00E+00 | 3 21E+04 | 6 43E+04 |
| Pu-242 | 6 4260E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 2 29E+00 | 4 59E+00 |
| Ra-226 | 2 2804E-10 | 35,707 51 | 71,415 03 | 0 00E+00 | 8 14E-06 | 1 63E-05 |
| Ra-228 | 5 2713E-12 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 88E-07 | 3 76E-07 |
| Ru-106 | 6 1160E-10 | 35,707 51 | 71,415 03 | 0 00E+00 | 2 18E-05 | 4 37E-05 |
| Se-79 | 1.2377E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 4 42E-01 | 8 84E-01 |
| Sn-126 | 2.5210E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 9 00E-01 | 1 80E+00 |
| Sr-90 | 9 1667E-01 | 35,707 51 | 71,415 03 | 0 00E+00 | 3.27E+04 | 6 55E+04 |
| Tc-99 | 3 9357E-04 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 41E+01 | 2 81E+01 |
| Th-229 | 1.2057E-10 | 35,707 51 | 71,415 03 | 0 00E+00 | 4 31E-06 | 8 61E-06 |
| Th-230 | 2.1043E-08 | 35,707 51 | 71,415 03 | 0 00E+00 | 7 51E-04 | 1 50E-03 |
| Th-232 | 5.2972E-12 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 89E-07 | 3 78E-07 |
| Tl-208 | 1.7474E-07 | 35,707 51 | 71,415 03 | 0 00E+00 | 6 24E-03 | 1 25E-02 |
| U-232 | 4 7368E-07 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 69E-02 | 3 38E-02 |
| U-233 | 2.5097E-08 | 35,707 51 | 71,415 03 | 0 00E+00 | 8 96E-04 | 1 79E-03 |
| U-234 | 5 0000E-05 | 35,707 51 | 71,415 03 | 0 00E+00 | 1 79E+00 | 3 57E+00 |
| U-235 | -1 4489E-06 | 35,707 51 | 0 00 | 6 93E-02 | 1 76E-02 | 6 93E-02 |
| U-236 | 7.5824E-06 | 35,707 51 | 71,415 03 | 0 00E+00 | 2.71E-01 | 5 41E-01 |
| U-238 | -2 6129E-07 | 35,707.51 | 0 00 | 1 70E-01 | 1 61E-01 | 1 70E-01 |
| Y-90 | 9 1699E-01 | 35,707.51 | 71,415 03 | 0 00E+00 | 3.27E+04 | 6 55E+04 |
| Other Radionuclides | | - | | | 4 79E+04 | 9 59E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 3 843E+15 |
| 0 0250 | 7 749E+14 |
| 0 0375 | 7.390E+14 |
| 0 0575 | 8 539E+14 |
| 0 0850 | 4.300E+14 |
| 0 1250 | 2 984E+14 |
| 0.2250 | 3 687E+14 |
| 0.3750 | 1 585E+14 |
| 0.5750 | 3 687E+15 |
| 0.8500 | 5 101E+13 |
| 1.2500 | 5 011E+13 |
| 1 7500 | 1 501E+12 |
| 2.2500 | 2 416E+08 |
| 2 7500 | 4 950E+08 |
| 3 5000 | 5 097E+07 |
| 5 0000 | 2 179E+07 |
| 7 0000 | 2.512E+06 |
| 11 0000 | 2.885E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8.21E+02 | 1 64E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 5 965123646 | 0 to 5 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches PWR Template on all but one parameter (enrichment) making PWR a reasonable match.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 35 707.51 |
| Bounding | | 71 415 03 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 90 | |
| Bounding | 3 80 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: RESIDUE FAILED PBF RODS
SNF ID #: 381
Fuel Units & Descr: 1 - DEBRIS
Heavy Metal Mass: BOL= ; EOL=1 109kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1985
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time: 25 years

Estimated Canister usage: HIC 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3562E-08 | 1,047 61 | 1,047 61 | 0 00E+00 | 1 42E-05 | 1 42E-05 |
| Am-241 | 1 0168E-04 | 1,047 61 | 1,047.61 | 0 00E+00 | 1 07E-01 | 1 07E-01 |
| Am-242m | 8 9052E-09 | 1,047 61 | 1,047.61 | 0 00E+00 | 9.33E-06 | 9 33E-06 |
| Am-243 | 9 8602E-10 | 1,047 61 | 1,047.61 | 0 00E+00 | 1 03E-06 | 1 03E-06 |
| C-14 | 2 3045E-04 | 1,047.61 | 1,047 61 | 0 00E+00 | 2 41E-01 | 2 41E-01 |
| Cl-36 | 1.2261E-06 | 1,047.61 | 1,047 61 | 0 00E+00 | 1.28E-03 | 1 28E-03 |
| Cm-243 | 3 1730E-10 | 1,047.61 | 1,047 61 | 0 00E+00 | 3.32E-07 | 3 32E-07 |
| Cm-244 | 3.3977E-09 | 1,047.61 | 1,047 61 | 0 00E+00 | 3 56E-06 | 3 56E-06 |
| Co-60 | 2 6373E-01 | 1,047 61 | 1,047 61 | 0 00E+00 | 2.76E+02 | 2 76E+02 |
| Cs-134 | 8 7072E-05 | 1,047 61 | 1,047 61 | 0 00E+00 | 9 12E-02 | 9 12E-02 |
| Cs-135 | 3 0316E-05 | 1,047 61 | 1,047 61 | 0 00E+00 | 3 18E-02 | 3 18E-02 |
| Cs-137 | 1 8286E+00 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.92E+03 | 1 92E+03 |
| Eu-154 | 1 4982E-03 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.57E+00 | 1 57E+00 |
| Eu-155 | 2 8236E-03 | 1,047 61 | 1,047 61 | 0 00E+00 | 2.96E+00 | 2 96E+00 |
| Fe-55 | 1 7687E-02 | 1,047 61 | 1,047 61 | 0 00E+00 | 1 85E+01 | 1 85E+01 |
| H-3 | 4 4043E-03 | 1,047 61 | 1,047 61 | 0 00E+00 | 4 61E+00 | 4 61E+00 |
| I-129 | 7.3195E-07 | 1,047 61 | 1,047 61 | 0 00E+00 | 7 67E-04 | 7.67E-04 |
| Kr-85 | 7.8769E-02 | 1,047 61 | 1,047 61 | 0 00E+00 | 8 25E+01 | 8.25E+01 |
| Np-237 | 1 1484E-06 | 1,047 61 | 1,047 61 | 0.00E+00 | 1 20E-03 | 1.20E-03 |
| Pa-231 | 3 2396E-08 | 1,047 61 | 1,047.61 | 0 00E+00 | 3 39E-05 | 3.39E-05 |
| Pb-210 | 2 4409E-13 | 1,047 61 | 1,047.61 | 0 00E+00 | 2 56E-10 | 2.56E-10 |
| Pm-147 | 1 6331E-02 | 1,047.61 | 1,047.61 | 0 00E+00 | 1 71E+01 | 1.71E+01 |
| Pu-238 | 3 1947E-04 | 1,047.61 | 1,047 61 | 0 00E+00 | 3 35E-01 | 3.35E-01 |
| Pu-239 | 6 6789E-04 | 1,047.61 | 1,047.61 | 0 00E+00 | 7 00E-01 | 7 00E-01 |
| Pu-240 | 8 6922E-05 | 1,047.61 | 1,047 61 | 0 00E+00 | 9 11E-02 | 9 11E-02 |
| Pu-241 | 1.1567E-03 | 1,047.61 | 1,047 61 | 0 00E+00 | 1.21E+00 | 1.21E+00 |
| Pu-242 | 1.9717E-09 | 1,047.61 | 1,047 61 | 0 00E+00 | 2 07E-06 | 2 07E-06 |
| Ra-226 | 8 6190E-13 | 1,047 61 | 1,047 61 | 0 00E+00 | 9 03E-10 | 9 03E-10 |
| Ra-228 | 8 1498E-12 | 1,047 61 | 1,047 61 | 0 00E+00 | 8.54E-09 | 8 54E-09 |
| Ru-106 | 1 7770E-07 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.86E-04 | 1 86E-04 |
| Se-79 | 1.3225E-05 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.39E-02 | 1 39E-02 |
| Sn-126 | 1 1493E-05 | 1,047.61 | 1,047 61 | 0 00E+00 | 1.20E-02 | 1.20E-02 |
| Sr-90 | 1 7321E+00 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.81E+03 | 1 81E+03 |
| Tc-99 | 4 6656E-04 | 1,047 61 | 1,047 61 | 0 00E+00 | 4 89E-01 | 4 89E-01 |
| Th-229 | 1 0110E-11 | 1,047 61 | 1,047 61 | 0 00E+00 | 1 06E-08 | 1 06E-08 |
| Th-230 | 1 1466E-10 | 1,047 61 | 1,047 61 | 0 00E+00 | 1.20E-07 | 1.20E-07 |
| Th-232 | 8 3245E-12 | 1,047 61 | 1,047 61 | 0 00E+00 | 8 72E-09 | 8 72E-09 |
| Tl-208 | 2 3860E-08 | 1,047 61 | 1,047 61 | 0 00E+00 | 2 50E-05 | 2.50E-05 |
| U-232 | 6 4576E-08 | 1,047 61 | 1,047.61 | 0 00E+00 | 6 77E-05 | 6.77E-05 |
| U-233 | 3 1082E-09 | 1,047 61 | 1,047.61 | 0.00E+00 | 3 26E-06 | 3.26E-06 |
| U-234 | 3 7587E-07 | 1,047 61 | 1,047.61 | 0 00E+00 | 3 94E-04 | 3.94E-04 |
| U-235 | -2.7761E-06 | 1,047.61 | 0 00 | 4 48E-03 | 1 57E-03 | 4 48E-03 |
| U-236 | 1 6190E-05 | 1,047.61 | 1,047.61 | 0 00E+00 | 1 70E-02 | 1 70E-02 |
| U-238 | -2.8547E-09 | 1,047.61 | 0 00 | 4 84E-05 | 4 54E-05 | 4 84E-05 |
| Y-90 | 1.7321E+00 | 1,047.61 | 1,047 61 | 0 00E+00 | 1 81E+03 | 1.81E+03 |
| Other Radionuclides | | | | | 2 13E+03 | 2.13E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 968E+13 |
| 0 0250 | 2.071E+13 |
| 0 0375 | 1 788E+13 |
| 0 0575 | 1.929E+13 |
| 0.0850 | 1 166E+13 |
| 0 1250 | 7.577E+12 |
| 0.2250 | 1.001E+13 |
| 0.3750 | 4.368E+12 |
| 0.5750 | 7 133E+13 |
| 0.8500 | 7.438E+11 |
| 1.2500 | 2 072E+13 |
| 1 7500 | 1.916E+10 |
| 2.2500 | 1 104E+08 |
| 2 7500 | 1.215E+06 |
| 3 5000 | 2.566E+02 |
| 5 0000 | 2.599E+01 |
| 7 0000 | 2.870E+00 |
| 11 0000 | 3.220E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.60E+01 | 2.60E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1,047.61 |
| Bounding | | 1,047.61 |

**Basis for burnup used in estimate:**
Nominal burnup set equal to bounding burnup
Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 10 12 | |
| Bounding | 10 12 | |

Estimated EOL HM/Given EOL HM: 1 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: ROBERT E. GINNA
SNF ID #: 182
Fuel Units & Descr: 40 - 14 X 14 ROD ARRAY
Heavy Metal Mass: BOL=15287.2kg; EOL=15126 928kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1972
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%. U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage
Bare Fuel Transfer

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 36E-04 | 1 92E-04 |
| Am-241 | 1 4352E-01 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 22E+04 | 3 14E+04 |
| Am-242m | 2 8698E-04 | 154,660 60 | 218,499 95 | 0 00E+00 | 4 44E+01 | 6 27E+01 |
| Am-243 | 6 2565E-04 | 154,660 60 | 218,499 95 | 0 00E+00 | 9 68E+01 | 1 37E+02 |
| C-14 | 4 7901E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 7 41E+00 | 1 05E+01 |
| Cl-36 | 8 0297E-07 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 24E-01 | 1 75E-01 |
| Cm-243 | 2 5081E-04 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 88E+01 | 5 48E+01 |
| Cm-244 | 4 9015E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 7 58E+03 | 1 07E+04 |
| Co-60 | 2 5581E-03 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 96E+02 | 5 59E+02 |
| Cs-134 | 4 0536E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 6 27E+00 | 8 86E+00 |
| Cs-135 | 1 4433E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 2.23E+00 | 3 15E+00 |
| Cs-137 | 1 3979E+00 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 16E+05 | 3 05E+05 |
| Eu-154 | 2 0203E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 12E+03 | 4 41E+03 |
| Eu-155 | 1 7684E-03 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 74E+02 | 3 86E+02 |
| Fe-55 | 4 3136E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 6 67E+00 | 9 43E+00 |
| H-3 | 2 0769E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 21E+03 | 4 54E+03 |
| I-129 | 9 8288E-07 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 52E-01 | 2 15E-01 |
| Kr-85 | 2 8214E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 4 36E+03 | 6 16E+03 |
| Np-237 | 1 1218E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 73E+00 | 2 45E+00 |
| Pa-231 | 1 3036E-09 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 02E-04 | 2 85E-04 |
| Pb-210 | 8 5078E-11 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 32E-05 | 1 86E-05 |
| Pm-147 | 3 6531E-04 | 154,660 60 | 218,499 95 | 0 00E+00 | 5 65E+01 | 7 98E+01 |
| Pu-238 | 7 4564E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 15E+04 | 1 63E+04 |
| Pu-239 | 1 1623E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 80E+03 | 2 54E+03 |
| Pu-240 | 1 5132E-02 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 34E+03 | 3 31E+03 |
| Pu-241 | 9 0036E-01 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 39E+05 | 1 97E+05 |
| Pu-242 | 6 4260E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 9 94E+00 | 1 40E+01 |
| Ra-226 | 2.2804E-10 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 53E-05 | 4 98E-05 |
| Ra-228 | 5.2713E-12 | 154,660 60 | 218,499 95 | 0 00E+00 | 8 15E-07 | 1 15E-06 |
| Ru-106 | 6 1160E-10 | 154,660 60 | 218,499 95 | 0 00E+00 | 9 46E-05 | 1 34E-04 |
| Se-79 | 1 2377E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 91E+00 | 2 70E+00 |
| Sn-126 | 2 5210E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 90E+00 | 5 51E+00 |
| Sr-90 | 9 1667E-01 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 42E+05 | 2 00E+05 |
| Tc-99 | 3 9357E-04 | 154,660 60 | 218,499 95 | 0 00E+00 | 6 09E+01 | 8 60E+01 |
| Th-229 | 1.2057E-10 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 86E-05 | 2 63E-05 |
| Th-230 | 2.1043E-08 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 25E-03 | 4 60E-03 |
| Th-232 | 5.2972E-12 | 154,660 60 | 218,499 95 | 0 00E+00 | 8 19E-07 | 1 16E-06 |
| Tl-208 | 1 7474E-07 | 154,660 60 | 218,499 95 | 0 00E+00 | 2 70E-02 | 3 82E-02 |
| U-232 | 4 7368E-07 | 154,660 60 | 218,499 95 | 0 00E+00 | 7 33E-02 | 1 03E-01 |
| U-233 | 2 5097E-08 | 154,660 60 | 218,499 95 | 0 00E+00 | 3 88E-03 | 5 48E-03 |
| U-234 | 5 0000E-05 | 154,660 60 | 218,499 95 | 0 00E+00 | 7 73E+00 | 1 09E+01 |
| U-235 | -1 4489E-06 | 154,660 60 | 0 00 | 1 15E+00 | 9 26E-01 | 1 15E+00 |
| U-236 | 7 5824E-06 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 17E+00 | 1 66E+00 |
| U-238 | -2 6129E-07 | 154,660 60 | 0 00 | 4 96E+00 | 4 92E+00 | 4 96E+00 |
| Y-90 | 9 1699E-01 | 154,660 60 | 218,499 95 | 0 00E+00 | 1 42E+05 | 2 00E+05 |
| Other Radionuclides | | | | | 2 08E+05 | 2 93E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 176E+16 |
| 0 0250 | 2.371E+15 |
| 0 0375 | 2.261E+15 |
| 0 0575 | 2.613E+15 |
| 0 0850 | 1.315E+15 |
| 0 1250 | 9 129E+14 |
| 0.2250 | 1 128E+15 |
| 0.3750 | 4 851E+14 |
| 0 5750 | 1 128E+16 |
| 0 8500 | 1.561E+14 |
| 1.2500 | 1.533E+14 |
| 1 7500 | 4.591E+12 |
| 2.2500 | 7.393E+08 |
| 2.7500 | 1.515E+09 |
| 3.5000 | 1.560E+08 |
| 5 0000 | 6 669E+07 |
| 7 0000 | 7 686E+06 |
| 11 0000 | 8.828E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.56E+03 | 5.03E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 3.480035585 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 154 660 60 | 152,411 09 | Nominal burnup taken directly from SFD (converted to MWd). |
| Bounding | 218 499 95 | 304 822.18 | Bounding burnup taken directly from SFD (converted to MWd). |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.29 | 0 99 |
| Bounding | 0 41 | 1 40 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | ROVER (UBM) | [1]Fuel decay start date: | 2050 |
| SNF ID # | 840 | Estimates as of: | 2010 |
| Fuel Units & Descr | 65 - PARTICULATE | Template | (Worst Case) |
| Heavy Metal Mass | BOL=119 775kg, EOL=119 775kg | [2]Template Burnup(MWd) | 62.5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 00186865 |
| | | Template Decay Time: | 5 years |

Estimated Canister usage 18"x15' 5 91

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7456E-07 | 2,276 58 | 4,553 16 | 0 00E+00 | 1.99E-03 | 3 98E-03 |
| Am-241 | 4 2816E+00 | 2,276 58 | 4,553.16 | 0 00E+00 | 9 75E+03 | 1 95E+04 |
| Am-242m | 1 9312E-02 | 2,276 58 | 4,553 16 | 0 00E+00 | 4 40E+01 | 8 79E+01 |
| Am-243 | 1 6368E-02 | 2,276 58 | 4,553 16 | 0 00E+00 | 3 73E+01 | 7 45E+01 |
| C-14 | 1.2134E-01 | 2,276 58 | 4,553 16 | 0 00E+00 | 2.76E+02 | 5 52E+02 |
| Cl-36 | 2.2860E-03 | 2,276 58 | 4,553 16 | 0 00E+00 | 5.20E+00 | 1 04E+01 |
| Cm-243 | 1.7968E-03 | 2,276 58 | 4,553 16 | 0 00E+00 | 4 09E+00 | 8 18E+00 |
| Cm-244 | 5.3120E-01 | 2,276 58 | 4,553 16 | 0 00E+00 | 1.21E+03 | 2 42E+03 |
| Co-60 | 1 4534E+03 | 2,276 58 | 4,553 16 | 0 00E+00 | 3 31E+06 | 6 62E+06 |
| Cs-134 | 8.1336E+00 | 2,276 58 | 4,553 16 | 0 00E+00 | 1 85E+04 | 3 70E+04 |
| Cs-135 | 4.3976E-04 | 2,276 58 | 4,553 16 | 0.00E+00 | 1 00E+00 | 2 00E+00 |
| Cs-137 | 4.2070E+01 | 2,276.58 | 4,553 16 | 0 00E+00 | 9 58E+04 | 1 92E+05 |
| Eu-154 | 1 4005E+01 | 2,276.58 | 4,553 16 | 0 00E+00 | 3 19E+04 | 6 38E+04 |
| Eu-155 | 4 5553E+00 | 2,276.58 | 4,553 16 | 0 00E+00 | 1 04E+04 | 2 07E+04 |
| Fe-55 | 8 7194E+02 | 2,276 58 | 4,553 16 | 0 00E+00 | 1 99E+06 | 3 97E+06 |
| H-3 | 1.3083E+00 | 2,276 58 | 4,553 16 | 0 00E+00 | 2 98E+03 | 5 96E+03 |
| I-129 | 1 0618E-05 | 2,276 58 | 4,553 16 | 0 00E+00 | 2 42E-02 | 4 83E-02 |
| Kr-85 | 4 1611E+00 | 2,276 58 | 4,553 16 | 0 00E+00 | 9 47E+03 | 1.89E+04 |
| Np-237 | 1 5617E-04 | 2,276 58 | 4,553 16 | 0 00E+00 | 3 56E-01 | 7 11E-01 |
| Pa-231 | 2 8576E-06 | 2,276 58 | 4,553 16 | 0 00E+00 | 6.51E-03 | 1.30E-02 |
| Pb-210 | 3 1687E-10 | 2,276 58 | 4,553 16 | 0 00E+00 | 7.21E-07 | 1 44E-06 |
| Pm-147 | 4 6559E+01 | 2,276 58 | 4,553 16 | 0 00E+00 | 1 06E+05 | 2 12E+05 |
| Pu-238 | 3 7728E+00 | 2,276 58 | 4,553 16 | 0 00E+00 | 8 59E+03 | 1 72E+04 |
| Pu-239 | 4 1680E-01 | 2,276 58 | 4,553 16 | 0 00E+00 | 9 49E+02 | 1 90E+03 |
| Pu-240 | 2 9264E-01 | 2,276 58 | 4,553 16 | 0 00E+00 | 6 66E+02 | 1.33E+03 |
| Pu-241 | 2 0640E+02 | 2,276 58 | 4,553 16 | 0 00E+00 | 4 70E+05 | 9 40E+05 |
| Pu-242 | 2 4560E-03 | 2,276 58 | 4,553 16 | 0 00E+00 | 5.59E+00 | 1 12E+01 |
| Ra-226 | 3 0225E-09 | 2,276 58 | 4,553 16 | 0 00E+00 | 6 88E-06 | 1 38E-05 |
| Ra-228 | 4 4512E-07 | 2,276.58 | 4,553 16 | 0 00E+00 | 1 01E-03 | 2 03E-03 |
| Ru-106 | 3.6772E+00 | 2,276.58 | 4,553 16 | 0 00E+00 | 8 37E+03 | 1 67E+04 |
| Se-79 | 1 9188E-04 | 2,276.58 | 4,553 16 | 0 00E+00 | 4 37E-01 | 8 74E-01 |
| Sn-126 | 1 6673E-04 | 2,276.58 | 4,553 16 | 0 00E+00 | 3 80E-01 | 7.59E-01 |
| Sr-90 | 4 0404E+01 | 2,276 58 | 4,553 16 | 0 00E+00 | 9.20E+04 | 1 84E+05 |
| Tc-99 | 6 7678E-03 | 2,276 58 | 4,553 16 | 0.00E+00 | 1 54E+01 | 3 08E+01 |
| Th-229 | 4 1968E-07 | 2,276.58 | 4,553 16 | 0 00E+00 | 9 55E-04 | 1.91E-03 |
| Th-230 | 1 2679E-06 | 2,276.58 | 4,553 16 | 0 00E+00 | 2 89E-03 | 5 77E-03 |
| Th-232 | 6 0208E-07 | 2,276 58 | 4,553 16 | 0 00E+00 | 1.37E-03 | 2 74E-03 |
| Tl-208 | 1 0992E-04 | 2,276 58 | 4,553 16 | 0 00E+00 | 2 50E-01 | 5 00E-01 |
| U-232 | 3 1650E-04 | 2,276 58 | 4,553 16 | 0 00E+00 | 7.21E-01 | 1.44E+00 |
| U-233 | 3 6144E-04 | 2,276 58 | 4,553 16 | 0 00E+00 | 8.23E-01 | 1 65E+00 |
| U-234 | 1.2788E-02 | 2,276 58 | 4,553 16 | 0 00E+00 | 2 91E+01 | 5 82E+01 |
| U-235 | 5 7486E-04 | 2,276 58 | 4,553 16 | 2 41E-01 | 1.55E+00 | 2 86E+00 |
| U-236 | 2.3485E-04 | 2,276 58 | 4,553 16 | 0 00E+00 | 5.35E-01 | 1 07E+00 |
| U-238 | 1.1581E-04 | 2,276 58 | 4,553 16 | 2 81E-03 | 2.66E-01 | 5 30E-01 |
| Y-90 | 4 0428E+01 | 2,276 58 | 4,553 16 | 0 00E+00 | 9.20E+04 | 1 84E+05 |
| Other Radionuclides | | | | | 2 88E+05 | 5 75E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 664E+16 |
| 0 0250 | 5.207E+15 |
| 0 0375 | 4 516E+15 |
| 0 0575 | 4 402E+15 |
| 0 0850 | 2 396E+15 |
| 0 1250 | 2 560E+15 |
| 0.2250 | 1 612E+15 |
| 0.3750 | 7 648E+14 |
| 0.5750 | 9 568E+15 |
| 0.8500 | 2 576E+15 |
| 1.2500 | 4 911E+17 |
| 1 7500 | 4 442E+13 |
| 2.2500 | 2 094E+13 |
| 2 7500 | 1 745E+11 |
| 3.5000 | 1 744E+10 |
| 5 0000 | 1.544E+07 |
| 7.0000 | 1 776E+06 |
| 11 0000 | 2.038E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.65E+04 | 1 13E+05 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | (Worst Case) |
| Fuel Cladding | NONE | SST/Inconel |
| BOL HM Constituents | U | U, Th & Pu |
| BOL Enrichment % | 93 02375258 | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 2,276 58 |
| Bounding | | 4,553 16 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 57 | |
| Bounding | 1 14 | |

Estimated EOL HM/Given EOL HM: 13 02

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SHIPPINGPORT LWBR BLKT I
SNF ID #: 374
Fuel Units & Descr: 3 - 443 ROD ARRAY
Heavy Metal Mass: BOL=3795 7kg, EOL=3755.2kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1982
Estimates as of: 2010
Template: LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd): 10269 14
Template BOL Heavy Metal Mass (MT): 0 45991251
Template Decay Time: 25 years

Estimated Canister usage 24"x15' 3 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8.3425E-05 | 50,103 24 | 88,060 24 | 0 00E+00 | 4 18E+00 | 7 35E+00 |
| Am-241 | 2.2387E-04 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 12E+01 | 1 97E+01 |
| Am-242m | 1 5512E-06 | 50,103 24 | 88,060 24 | 0 00E+00 | 7 77E-02 | 1.37E-01 |
| Am-243 | 3.1181E-07 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 56E-02 | 2.75E-02 |
| C-14 | 9 2539E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 4 64E+00 | 8 15E+00 |
| Cl-36 | 1 8103E-06 | 50,103 24 | 88,060 24 | 0 00E+00 | 9 07E-02 | 1.59E-01 |
| Cm-243 | 3 9020E-07 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 96E-02 | 3.44E-02 |
| Cm-244 | 2 0742E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 04E+00 | 1 83E+00 |
| Co-60 | 3.2554E-03 | 50,103 24 | 88 060 24 | 0 00E+00 | 1 63E+02 | 2 87E+02 |
| Cs-134 | 7.3823E-04 | 50,103 24 | 88,060.24 | 0 00E+00 | 3 70E+01 | 6.50E+01 |
| Cs-135 | 2 8639E-05 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 43E+00 | 2 52E+00 |
| Cs-137 | 1 8609E+00 | 50,103 24 | 88,060 24 | 0 00E+00 | 9 32E+04 | 1 64E+05 |
| Eu-154 | 1 9262E-02 | 50,103 24 | 88,060.24 | 0 00E+00 | 9 65E+02 | 1 70E+03 |
| Eu-155 | 2 6721E-03 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 34E+02 | 2 35E+02 |
| Fe-55 | 3.3099E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 66E+00 | 2 91E+00 |
| H-3 | 3.7296E-03 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 87E+02 | 3.28E+02 |
| I-129 | 1.5853E-06 | 50,103 24 | 88,060.24 | 0 00E+00 | 7 94E-02 | 1 40E-01 |
| Kr-85 | 1 1958E-01 | 50,103 24 | 88,060 24 | 0 00E+00 | 5 99E+03 | 1 05E+04 |
| Np-237 | 1.2513E-07 | 50,103 24 | 88,060.24 | 0 00E+00 | 6.27E-03 | 1.10E-02 |
| Pa-231 | 1.2017E-04 | 50,103 24 | 88,060.24 | 0 00E+00 | 6 02E+00 | 1 06E+01 |
| Pb-210 | 1 1939E-08 | 50,103 24 | 88,060 24 | 0 00E+00 | 5 98E-04 | 1.05E-03 |
| Pm-147 | 3 6819E-03 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 84E+02 | 3.24E+02 |
| Pu-238 | 4 5953E-04 | 50,103 24 | 88,060.24 | 0 00E+00 | 2 30E+01 | 4 05E+01 |
| Pu-239 | 2.7529E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 38E+00 | 2 42E+00 |
| Pu-240 | 1 6184E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 8.11E-01 | 1 43E+00 |
| Pu-241 | 2 3780E-03 | 50,103 24 | 88,060 24 | 0 00E+00 | 1 19E+02 | 2 09E+02 |
| Pu-242 | 4 0821E-08 | 50,103 24 | 88,060.24 | 0 00E+00 | 2 05E-03 | 3 59E-03 |
| Ra-226 | 1 4471E-08 | 50,103 24 | 88,060.24 | 0 00E+00 | 7 25E-04 | 1.27E-03 |
| Ra-228 | 4 5651E-06 | 50,103.24 | 88,060.24 | 0 00E+00 | 2 29E-01 | 4.02E-01 |
| Ru-106 | 3 8971E-08 | 50,103.24 | 88,060.24 | 0 00E+00 | 1 95E-03 | 3 43E-03 |
| Se-79 | 3 5417E-05 | 50,103 24 | 88,060.24 | 0 00E+00 | 1 77E+00 | 3.12E+00 |
| Sn-126 | 3 9848E-05 | 50,103.24 | 88,060.24 | 0 00E+00 | 2 00E+00 | 3 51E+00 |
| Sr-90 | 1 8940E+00 | 50,103.24 | 88,060.24 | 0 00E+00 | 9 49E+04 | 1 67E+05 |
| Tc-99 | 3 2534E-04 | 50,103.24 | 88,060.24 | 0 00E+00 | 1 63E+01 | 2 86E+01 |
| Th-229 | 4 6839E-05 | 50,103.24 | 88,060.24 | 0 00E+00 | 2 35E+00 | 4 12E+00 |
| Th-230 | 1 0322E-06 | 50,103 24 | 88,060.24 | 0 00E+00 | 5 17E-02 | 9 09E-02 |
| Th-232 | -9 0328E-08 | 50,103.24 | 0 00 | 4 01E-01 | 3 96E-01 | 4 01E-01 |
| Tl-208 | 1 5386E-02 | 50,103.24 | 88,060.24 | 0 00E+00 | 7 71E+02 | 1.35E+03 |
| U-232 | 4 1639E-02 | 50,103.24 | 88,060.24 | 0 00E+00 | 2 09E+03 | 3 67E+03 |
| U-233 | -3.3244E-03 | 50,103.24 | 0 00 | 1 35E+03 | 1 18E+03 | 1 35E+03 |
| U-234 | 8 1769E-04 | 50,103.24 | 88,060.24 | 0 00E+00 | 4 10E+01 | 7 20E+01 |
| U-235 | 5 7813E-08 | 50,103.24 | 88,060.24 | 2 76E-04 | 3 17E-03 | 5.37E-03 |
| U-236 | 1 3273E-07 | 50,103.24 | 88,060.24 | 0 00E+00 | 6 65E-03 | 1.17E-02 |
| U-238 | -3.1121E-10 | 50,103.24 | 0 00 | 1 76E-04 | 1 61E-04 | 1 76E-04 |
| Y-90 | 1 8940E+00 | 50,103.24 | 88,060.24 | 0 00E+00 | 9 49E+04 | 1 67E+05 |
| Other Radionuclides | | | | | 1 03E+05 | 1 81E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 9.216E+15 |
| 0 0250 | 1 902E+15 |
| 0 0375 | 1 629E+15 |
| 0 0575 | 1 776E+15 |
| 0 0850 | 1 127E+15 |
| 0 1250 | 7.219E+14 |
| 0.2250 | 1 006E+15 |
| 0.3750 | 4 084E+14 |
| 0 5750 | 6.185E+15 |
| 0 8500 | 1.224E+14 |
| 1.2500 | 7 742E+13 |
| 1 7500 | 7.381E+12 |
| 2.2500 | 2.971E+08 |
| 2 7500 | 4 757E+13 |
| 3.5000 | 1 879E+05 |
| 5 0000 | 5.851E+04 |
| 7 0000 | 4.394E+03 |
| 11 0000 | 3 485E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 66E+03 | 2.89E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 0 089989331 | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 50,103.24 | 39 413 10 |
| Bounding | 88 060.24 | 78 826 19 |

**Basis for burnup used in estimate:**
Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup taken directly from SFD (converted to MWd).

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.59 | 0 79 |
| Bounding | 1 04 | 0 90 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name SHIPPINGPORT LWBR BLKT II
SNF ID # 375
Fuel Units & Descr 3 - 261 ROD ARRAY
Heavy Metal Mass BOL=4373 5kg, EOL=4331 7kg
ROD Storage Site INEEL

[1]Fuel decay start date 1982
Estimates as of 2010
Template LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd) 10269 14
Template BOL Heavy Metal Mass (MT) 0 45991251
Template Decay Time 25 years

Estimated Canister usage 24"x15' 3 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 64,290 45 | 110,212 20 | 0 00E+00 | 5 36E+00 | 9 19E+00 |
| Am-241 | 2 2387E-04 | 64,290 45 | 110,212 20 | 0 00E+00 | 1 44E+01 | 2 47E+01 |
| Am-242m | 1.5512E-06 | 64,290 45 | 110,212 20 | 0 00E+00 | 9 97E-02 | 1 71E-01 |
| Am-243 | 3 1181E-07 | 64,290 45 | 110,212 20 | 0 00E+00 | 2 00E-02 | 3 44E-02 |
| C-14 | 9 2539E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 5.95E+00 | 1 02E+01 |
| Cl-36 | 1.8103E-06 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 16E-01 | 2 00E-01 |
| Cm-243 | 3 9020E-07 | 64,290 45 | 110,212.20 | 0 00E+00 | 2 51E-02 | 4.30E-02 |
| Cm-244 | 2 0742E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 1.33E+00 | 2 29E+00 |
| Co-60 | 3.2554E-03 | 64,290 45 | 110,212.20 | 0 00E+00 | 2 09E+02 | 3 59E+02 |
| Cs-134 | 7 3823E-04 | 64,290 45 | 110,212.20 | 0.00E+00 | 4 75E+01 | 8 14E+01 |
| Cs-135 | 2 8639E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 84E+00 | 3 16E+00 |
| Cs-137 | 1 8609E+00 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 20E+05 | 2 05E+05 |
| Eu-154 | 1 9262E-02 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 24E+03 | 2.12E+03 |
| Eu-155 | 2 6721E-03 | 64,290 45 | 110,212 20 | 0 00E+00 | 1 72E+02 | 2.94E+02 |
| Fe-55 | 3 3099E-05 | 64,290 45 | 110,212 20 | 0 00E+00 | 2 13E+00 | 3 65E+00 |
| H-3 | 3 7296E-03 | 64,290 45 | 110,212 20 | 0 00E+00 | 2 40E+02 | 4 11E+02 |
| I-129 | 1.5853E-06 | 64,290 45 | 110,212 20 | 0 00E+00 | 1.02E-01 | 1 75E-01 |
| Kr-85 | 1.1958E-01 | 64,290 45 | 110,212 20 | 0 00E+00 | 7.69E+03 | 1.32E+04 |
| Np-237 | 1.2513E-07 | 64,290 45 | 110,212.20 | 0 00E+00 | 8 04E-03 | 1 38E-02 |
| Pa-231 | 1.2017E-04 | 64,290 45 | 110,212.20 | 0 00E+00 | 7.73E+00 | 1 32E+01 |
| Pb-210 | 1 1939E-08 | 64,290 45 | 110,212.20 | 0 00E+00 | 7.68E-04 | 1.32E-03 |
| Pm-147 | 3 6819E-03 | 64,290 45 | 110,212.20 | 0 00E+00 | 2.37E+02 | 4 06E+02 |
| Pu-238 | 4 5953E-04 | 64,290 45 | 110,212.20 | 0.00E+00 | 2 95E+01 | 5 06E+01 |
| Pu-239 | 2 7529E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 77E+00 | 3 03E+00 |
| Pu-240 | 1 6184E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 1 04E+00 | 1.78E+00 |
| Pu-241 | 2 3780E-03 | 64,290 45 | 110,212 20 | 0 00E+00 | 1 53E+02 | 2 62E+02 |
| Pu-242 | 4 0821E-08 | 64,290 45 | 110,212 20 | 0 00E+00 | 2 62E-03 | 4.50E-03 |
| Ra-226 | 1 4471E-08 | 64,290 45 | 110,212 20 | 0 00E+00 | 9 30E-04 | 1.59E-03 |
| Ra-228 | 4 5651E-06 | 64,290 45 | 110,212 20 | 0 00E+00 | 2 93E-01 | 5 03E-01 |
| Ru-106 | 3.8971E-08 | 64,290 45 | 110,212 20 | 0 00E+00 | 2.51E-03 | 4.30E-03 |
| Se-79 | 3.5417E-05 | 64,290 45 | 110,212 20 | 0 00E+00 | 2.28E+00 | 3 90E+00 |
| Sn-126 | 3 9848E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 2.56E+00 | 4 39E+00 |
| Sr-90 | 1 8940E+00 | 64,290 45 | 110,212.20 | 0 00E+00 | 1.22E+05 | 2 09E+05 |
| Tc-99 | 3.2534E-04 | 64,290 45 | 110,212.20 | 0 00E+00 | 2.09E+01 | 3 59E+01 |
| Th-229 | 4 6839E-05 | 64,290 45 | 110,212.20 | 0 00E+00 | 3 01E+00 | 5 16E+00 |
| Th-230 | 1 0322E-06 | 64,290 45 | 110,212.20 | 0 00E+00 | 6 64E-02 | 1 14E-01 |
| Th-232 | -9 0328E-08 | 64,290 45 | 0 00 | 4.62E-01 | 4 56E-01 | 4 62E-01 |
| Tl-208 | 1 5386E-02 | 64,290 45 | 110,212.20 | 0 00E+00 | 9 89E+02 | 1 70E+03 |
| U-232 | 4 1639E-02 | 64,290 45 | 110,212.20 | 0 00E+00 | 2 68E+03 | 4.59E+03 |
| U-233 | -3 3244E-03 | 64,290 45 | 0 00 | 1.55E+03 | 1.34E+03 | 1.55E+03 |
| U-234 | 8 1769E-04 | 64,290 45 | 110,212 20 | 0 00E+00 | 5 26E+01 | 9.01E+01 |
| U-235 | 5 7813E-08 | 64,290 45 | 110,212 20 | 3 18E-04 | 4 03E-03 | 6 69E-03 |
| U-236 | 1.3273E-07 | 64,290 45 | 110,212.20 | 0 00E+00 | 8.53E-03 | 1 46E-02 |
| U-238 | -3 1121E-10 | 64,290 45 | 0 00 | 2 03E-04 | 1.83E-04 | 2 03E-04 |
| Y-90 | 1.8940E+00 | 64,290 45 | 110,212.20 | 0 00E+00 | 1.22E+05 | 2 09E+05 |
| Other Radionuclides | | | | | 1.32E+05 | 2 27E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0.0150 | 1 153E+16 |
| 0 0250 | 2.381E+15 |
| 0 0375 | 2 039E+15 |
| 0 0575 | 2.223E+15 |
| 0 0850 | 1.411E+15 |
| 0 1250 | 9 035E+14 |
| 0.2250 | 1 259E+15 |
| 0 3750 | 5 112E+14 |
| 0 5750 | 7 741E+15 |
| 0 8500 | 1.532E+14 |
| 1.2500 | 9 690E+13 |
| 1 7500 | 9.238E+12 |
| 2.2500 | 3 718E+08 |
| 2.7500 | 5.954E+13 |
| 3.5000 | 2.343E+05 |
| 5.0000 | 7.297E+04 |
| 7.0000 | 5 482E+03 |
| 11 0000 | 4.351E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.12E+03 | 3 61E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 0 071220718 | 60 to 100 |

**Basis for Parameter Differences**

This Template was used for the following reasons
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate. |
|---|---|---|---|
| Nominal | 64,290 45 | 40 678 11 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 110,212.20 | 81,356.22 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 66 | 0 63 |
| Bounding | 1 13 | 0 74 |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: SHIPPINGPORT LWBR BLKT III
SNF ID #: 376
Fuel Units & Descr: 6 - 445 ROD ARRAY
Heavy Metal Mass: BOL=8776.5kg, EOL=8700 87kg
ROD Storage Site: INEEL

[1]Fuel decay start date. 1982
Estimates as of. 2010
Template: LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd). 10269 14
Template BOL Heavy Metal Mass (MT). 0 45991251
Template Decay Time: 25 years

Estimated Canister usage: 24"x15' 6 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 08E+01 | 1 85E+01 |
| Am-241 | 2 2387E-04 | 129,014 55 | 221,167 80 | 0.00E+00 | 2 89E+01 | 4 95E+01 |
| Am-242m | 1 5512E-06 | 129,014 55 | 221,167 80 | 0.00E+00 | 2 00E-01 | 3 43E-01 |
| Am-243 | 3 1181E-07 | 129,014 55 | 221,167 80 | 0 00E+00 | 4 02E-02 | 6 90E-02 |
| C-14 | 9 2539E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 19E+01 | 2 05E+01 |
| Cl-36 | 1 8103E-06 | 129,014 55 | 221,167 80 | 0 00E+00 | 2 34E-01 | 4 00E-01 |
| Cm-243 | 3 9020E-07 | 129,014 55 | 221,167 80 | 0 00E+00 | 5 03E-02 | 8 63E-02 |
| Cm-244 | 2 0742E-05 | 129 014 55 | 221,167 80 | 0 00E+00 | 2 68E+00 | 4.59E+00 |
| Co-60 | 3 2554E-03 | 129,014 55 | 221,167 80 | 0 00E+00 | 4.20E+02 | 7.20E+02 |
| Cs-134 | 7.3823E-04 | 129,014 55 | 221,167 80 | 0 00E+00 | 9 52E+01 | 1 63E+02 |
| Cs-135 | 2 8639E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 3 69E+00 | 6.33E+00 |
| Cs-137 | 1 8609E+00 | 129,014 55 | 221,167 80 | 0 00E+00 | 2 40E+05 | 4.12E+05 |
| Eu-154 | 1 9262E-02 | 129,014 55 | 221,167 80 | 0 00E+00 | 2 49E+03 | 4.26E+03 |
| Eu-155 | 2 6721E-03 | 129,014 55 | 221,167 80 | 0 00E+00 | 3.45E+02 | 5 91E+02 |
| Fe-55 | 3 3099E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 4.27E+00 | 7 32E+00 |
| H-3 | 3 7296E-03 | 129,014.55 | 221,167 80 | 0 00E+00 | 4 81E+02 | 8.25E+02 |
| I-129 | 1 5853E-06 | 129,014.55 | 221,167 80 | 0 00E+00 | 2.05E-01 | 3 51E-01 |
| Kr-85 | 1.1958E-01 | 129,014.55 | 221,167 80 | 0 00E+00 | 1 54E+04 | 2 64E+04 |
| Np-237 | 1.2513E-07 | 129,014.55 | 221,167 80 | 0 00E+00 | 1.61E-02 | 2.77E-02 |
| Pa-231 | 1.2017E-04 | 129,014.55 | 221,167 80 | 0 00E+00 | 1 55E+01 | 2 66E+01 |
| Pb-210 | 1.1939E-08 | 129,014.55 | 221,167 80 | 0 00E+00 | 1.54E-03 | 2 64E-03 |
| Pm-147 | 3 6819E-03 | 129,014.55 | 221,167 80 | 0 00E+00 | 4 75E+02 | 8.14E+02 |
| Pu-238 | 4 5953E-04 | 129,014 55 | 221,167 80 | 0 00E+00 | 5 93E+01 | 1 02E+02 |
| Pu-239 | 2.7529E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 3 55E+00 | 6 09E+00 |
| Pu-240 | 1.6184E-05 | 129,014 55 | 221,167 80 | 0 00E+00 | 2 09E+00 | 3 58E+00 |
| Pu-241 | 2.3780E-03 | 129,014 55 | 221,167 80 | 0 00E+00 | 3 07E+02 | 5 26E+02 |
| Pu-242 | 4 0821E-08 | 129,014 55 | 221,167 80 | 0 00E+00 | 5.27E-03 | 9 03E-03 |
| Ra-226 | 1 4471E-08 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 87E-03 | 3 20E-03 |
| Ra-228 | 4 5651E-06 | 129,014 55 | 221,167.80 | 0 00E+00 | 5 89E-01 | 1 01E+00 |
| Ru-106 | 3 8971E-08 | 129,014 55 | 221,167 80 | 0 00E+00 | 5 03E-03 | 8 62E-03 |
| Se-79 | 3 5417E-05 | 129,014 55 | 221,167.80 | 0 00E+00 | 4 57E+00 | 7 83E+00 |
| Sn-126 | 3 9848E-05 | 129,014 55 | 221,167.80 | 0.00E+00 | 5 14E+00 | 8 81E+00 |
| Sr-90 | 1 8940E+00 | 129,014 55 | 221,167.80 | 0.00E+00 | 2 44E+05 | 4 19E+05 |
| Tc-99 | 3 2534E-04 | 129,014 55 | 221,167 80 | 0.00E+00 | 4.20E+01 | 7.20E+01 |
| Th-229 | 4 6839E-05 | 129,014 55 | 221,167 80 | 0.00E+00 | 6 04E+00 | 1 04E+01 |
| Th-230 | 1 0322E-06 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 33E-01 | 2 28E-01 |
| Th-232 | -9 0328E-08 | 129,014 55 | 0.00 | 9.27E-01 | 9 15E-01 | 9 27E-01 |
| Tl-208 | 1 5386E-02 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 99E+03 | 3 40E+03 |
| U-232 | 4 1639E-02 | 129,014 55 | 221,167 80 | 0 00E+00 | 5.37E+03 | 9.21E+03 |
| U-233 | -3.3244E-03 | 129,014 55 | 0 00 | 3 12E+03 | 2 69E+03 | 3.12E+03 |
| U-234 | 8 1769E-04 | 129,014 55 | 221,167 80 | 0 00E+00 | 1 05E+02 | 1 81E+02 |
| U-235 | 5 7813E-08 | 129,014 55 | 221,167 80 | 6 38E-04 | 8 10E-03 | 1.34E-02 |
| U-236 | 1 3273E-07 | 129,014 55 | 221,167 80 | 0 00E+00 | 1.71E-02 | 2 94E-02 |
| U-238 | -3 1121E-10 | 129,014.55 | 0 00 | 4 08E-04 | 3 68E-04 | 4 08E-04 |
| Y-90 | 1 8940E+00 | 129,014 55 | 221,167 80 | 0 00E+00 | 2 44E+05 | 4.19E+05 |
| Other Radionuclides | | | | | 2 66E+05 | 4.56E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.314E+16 |
| 0 0250 | 4 778E+15 |
| 0 0375 | 4 091E+15 |
| 0 0575 | 4 462E+15 |
| 0 0850 | 2 831E+15 |
| 0 1250 | 1 813E+15 |
| 0 2250 | 2.527E+15 |
| 0 3750 | 1 026E+15 |
| 0 5750 | 1.553E+16 |
| 0 8500 | 3 074E+14 |
| 1.2500 | 1 944E+14 |
| 1 7500 | 1.854E+13 |
| 2.2500 | 7 462E+08 |
| 2 7500 | 1 195E+14 |
| 3 5000 | 4 701E+05 |
| 5 0000 | 1 464E+05 |
| 7 0000 | 1 100E+04 |
| 11 0000 | 8 732E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.25E+03 | 7.25E+03 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 0 072866152 | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 129,014 55 | 73,600.31 |
| Bounding | 221,167 80 | 147,200 62 |

**Basis for burnup used in estimate:**
Nominal burnup taken directly from SFD (converted to MWd).
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 66 | 0 57 |
| Bounding | 1 13 | 0 67 |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name SHIPPINGPORT LWBR REFLCT IV
SNF ID # 371
Fuel Units & Descr. 9 - 261 ROD ARRAY
Heavy Metal Mass BOL=11491 6kg, EOL=11491 5kg
ROD Storage Site INEEL

[1]Fuel decay start date. 1982
Estimates as of 2010
Template LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd) 10269 14
Template BOL Heavy Metal Mass (MT) 0 45991251
Template Decay Time 25 years

Estimated Canister usage
24"x15'
9 00

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 8 3425E-05 | 25,281 52 | 51,712 20 | 0 00E+00 | 2 11E+00 | 4 31E+00 |
| Am-241 | 2 2387E-04 | 25,281.52 | 51,712 20 | 0 00E+00 | 5 66E+00 | 1 16E+01 |
| Am-242m | 1 5512E-06 | 25,281.52 | 51,712.20 | 0 00E+00 | 3 92E-02 | 8 02E-02 |
| Am-243 | 3 1181E-07 | 25,281.52 | 51,712.20 | 0 00E+00 | 7 88E-03 | 1.61E-02 |
| C-14 | 9.2539E-05 | 25,281.52 | 51,712.20 | 0 00E+00 | 2.34E+00 | 4 79E+00 |
| Cl-36 | 1.8103E-06 | 25,281 52 | 51,712.20 | 0 00E+00 | 4 58E-02 | 9 36E-02 |
| Cm-243 | 3 9020E-07 | 25,281 52 | 51,712.20 | 0 00E+00 | 9 86E-03 | 2 02E-02 |
| Cm-244 | 2 0742E-05 | 25,281 52 | 51,712.20 | 0 00E+00 | 5 24E-01 | 1.07E+00 |
| Co-60 | 3 2554E-03 | 25,281 52 | 51,712 20 | 0 00E+00 | 8 23E+01 | 1 68E+02 |
| Cs-134 | 7.3823E-04 | 25,281.52 | 51,712 20 | 0 00E+00 | 1 87E+01 | 3 82E+01 |
| Cs-135 | 2 8639E-05 | 25,281.52 | 51,712 20 | 0 00E+00 | 7.24E-01 | 1 48E+00 |
| Cs-137 | 1 8609E+00 | 25,281.52 | 51,712 20 | 0 00E+00 | 4 70E+04 | 9 62E+04 |
| Eu-154 | 1 9262E-02 | 25,281.52 | 51,712.20 | 0 00E+00 | 4.87E+02 | 9 96E+02 |
| Eu-155 | 2 6721E-03 | 25,281.52 | 51,712.20 | 0 00E+00 | 6 76E+01 | 1.38E+02 |
| Fe-55 | 3.3099E-05 | 25,281 52 | 51,712.20 | 0 00E+00 | 8 37E-01 | 1 71E+00 |
| H-3 | 3 7296E-03 | 25,281 52 | 51,712.20 | 0 00E+00 | 9 43E+01 | 1 93E+02 |
| I-129 | 1.5853E-06 | 25,281 52 | 51,712.20 | 0 00E+00 | 4 01E-02 | 8.20E-02 |
| Kr-85 | 1 1958E-01 | 25,281.52 | 51,712.20 | 0 00E+00 | 3 02E+03 | 6 18E+03 |
| Np-237 | 1.2513E-07 | 25,281.52 | 51,712 20 | 0 00E+00 | 3 16E-03 | 6 47E-03 |
| Pa-231 | 1 2017E-04 | 25,281.52 | 51,712 20 | 0 00E+00 | 3 04E+00 | 6.21E+00 |
| Pb-210 | 1 1939E-08 | 25,281.52 | 51,712 20 | 0 00E+00 | 3 02E-04 | 6 17E-04 |
| Pm-147 | 3 6819E-03 | 25,281.52 | 51,712 20 | 0 00E+00 | 9 31E+01 | 1 90E+02 |
| Pu-238 | 4 5953E-04 | 25,281.52 | 51,712.20 | 0 00E+00 | 1.16E+01 | 2 38E+01 |
| Pu-239 | 2 7529E-05 | 25,281 52 | 51,712.20 | 0 00E+00 | 6 96E-01 | 1 42E+00 |
| Pu-240 | 1.6184E-05 | 25,281 52 | 51,712.20 | 0 00E+00 | 4 09E-01 | 8.37E-01 |
| Pu-241 | 2.3780E-03 | 25,281 52 | 51,712.20 | 0 00E+00 | 6 01E+01 | 1.23E+02 |
| Pu-242 | 4 0821E-08 | 25,281 52 | 51,712.20 | 0 00E+00 | 1 03E-03 | 2 11E-03 |
| Ra-226 | 1 4471E-08 | 25,281.52 | 51,712 20 | 0 00E+00 | 3 66E-04 | 7.48E-04 |
| Ra-228 | 4 5651E-06 | 25,281.52 | 51,712 20 | 0 00E+00 | 1.15E-01 | 2 36E-01 |
| Ru-106 | 3 8971E-08 | 25,281.52 | 51,712 20 | 0 00E+00 | 9 85E-04 | 2 02E-03 |
| Se-79 | 3 5417E-05 | 25,281.52 | 51,712 20 | 0 00E+00 | 8 95E-01 | 1 83E+00 |
| Sn-126 | 3 9848E-05 | 25,281.52 | 51,712.20 | 0 00E+00 | 1 01E+00 | 2 06E+00 |
| Sr-90 | 1 8940E+00 | 25,281.52 | 51,712 20 | 0.00E+00 | 4 79E+04 | 9 79E+04 |
| Tc-99 | 3.2534E-04 | 25,281.52 | 51,712.20 | 0 00E+00 | 8.23E+00 | 1 68E+01 |
| Th-229 | 4 6839E-05 | 25,281 52 | 51,712.20 | 0 00E+00 | 1.18E+00 | 2 42E+00 |
| Th-230 | 1 0322E-06 | 25,281 52 | 51,712.20 | 0 00E+00 | 2 61E-02 | 5.34E-02 |
| Th-232 | -9 0328E-08 | 25,281 52 | 0 00 | 1 21E+00 | 1.21E+00 | 1.21E+00 |
| Tl-208 | 1.5386E-02 | 25,281.52 | 51,712.20 | 0 00E+00 | 3 89E+02 | 7.96E+02 |
| U-232 | 4 1639E-02 | 25,281.52 | 51,712 20 | 0 00E+00 | 1 05E+03 | 2 15E+03 |
| U-233 | -3.3244E-03 | 25,281.52 | 0 00 | 4 08E+03 | 4 00E+03 | 4 08E+03 |
| U-234 | 8 1769E-04 | 25,281.52 | 51,712 20 | 0 00E+00 | 2 07E+01 | 4 23E+01 |
| U-235 | 5 7813E-08 | 25,281.52 | 51,712.20 | 8.35E-04 | 2.30E-03 | 3 82E-03 |
| U-236 | 1.3273E-07 | 25,281 52 | 51,712.20 | 0 00E+00 | 3.36E-03 | 6 86E-03 |
| U-238 | -3 1121E-10 | 25,281 52 | 0 00 | 5.34E-04 | 5.26E-04 | 5.34E-04 |
| Y-90 | 1.8940E+00 | 25,281 52 | 51,712.20 | 0 00E+00 | 4.79E+04 | 9 79E+04 |
| Other Radionuclides | | | | | 5.21E+04 | 1.07E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5 422E+15 |
| 0 0250 | 1 117E+15 |
| 0 0375 | 9 567E+14 |
| 0 0575 | 1 043E+15 |
| 0.0850 | 6 620E+14 |
| 0 1250 | 4 240E+14 |
| 0.2250 | 5 910E+14 |
| 0 3750 | 2.399E+14 |
| 0.5750 | 3 632E+15 |
| 0 8500 | 7.187E+13 |
| 1.2500 | 4 546E+13 |
| 1 7500 | 4.334E+12 |
| 2.2500 | 1 745E+08 |
| 2.7500 | 2 794E+13 |
| 3.5000 | 1.318E+05 |
| 5.0000 | 4 077E+04 |
| 7.0000 | 2 997E+03 |
| 11 0000 | 2.311E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.34E+02 | 1.79E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 25,281.52 | 97.22 |
| Bounding | 51 712.20 | 194 44 |

**Basis for burnup used in estimate:**
Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 10 | 0 00 |
| Bounding | 0.20 | 0 00 |

Estimated EOL HM/Given EOL HM
1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: SHIPPINGPORT LWBR REFLCT V
SNF ID #: 372
Fuel Units & Descr: 6 - 166 ROD ARRAY
Heavy Metal Mass BOL=5850kg, EOL=5844 7kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1982
Estimates as of: 2010
Template: LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd): 10269 14
Template BOL Heavy Metal Mass (MT): 0 45991251
Template Decay Time: 25 years

Estimated Canister usage: 24"x15": 6 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 07E+00 | 2 20E+00 |
| Am-241 | 2.2387E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 88E+00 | 5 89E+00 |
| Am-242m | 1 5512E-06 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 00E-02 | 4 08E-02 |
| Am-243 | 3 1181E-07 | 12,870 00 | 26,325 00 | 0 00E+00 | 4 01E-03 | 8 21E-03 |
| C-14 | 9.2539E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 1.19E+00 | 2 44E+00 |
| Cl-36 | 1 8103E-06 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 33E-02 | 4 77E-02 |
| Cm-243 | 3.9020E-07 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 02E-03 | 1 03E-02 |
| Cm-244 | 2 0742E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 67E-01 | 5 46E-01 |
| Co-60 | 3.2554E-03 | 12,870 00 | 26,325 00 | 0 00E+00 | 4.19E+01 | 8 57E+01 |
| Cs-134 | 7 3823E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 9.50E+00 | 1 94E+01 |
| Cs-135 | 2 8639E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 3 69E-01 | 7 54E-01 |
| Cs-137 | 1 8609E+00 | 12,870 00 | 26,325 00 | 0 00E+00 | 2.39E+04 | 4 90E+04 |
| Eu-154 | 1 9262E-02 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 48E+02 | 5 07E+02 |
| Eu-155 | 2 6721E-03 | 12,870 00 | 26,325 00 | 0 00E+00 | 3 44E+01 | 7.03E+01 |
| Fe-55 | 3 3099E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 4.26E-01 | 8 71E-01 |
| H-3 | 3 7296E-03 | 12,870 00 | 26,325 00 | 0 00E+00 | 4 80E+01 | 9 82E+01 |
| I-129 | 1 5853E-06 | 12,870 00 | 26,325 00 | 0 00E+00 | 2.04E-02 | 4 17E-02 |
| Kr-85 | 1 1958E-01 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 54E+03 | 3.15E+03 |
| Np-237 | 1 2513E-07 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 61E-03 | 3.29E-03 |
| Pa-231 | 1 2017E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 55E+00 | 3.16E+00 |
| Pb-210 | 1 1939E-08 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 54E-04 | 3.14E-04 |
| Pm-147 | 3 6819E-03 | 12,870 00 | 26,325 00 | 0 00E+00 | 4 74E+01 | 9 69E+01 |
| Pu-238 | 4 5953E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 91E+00 | 1.21E+01 |
| Pu-239 | 2.7529E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 3 54E-01 | 7.25E-01 |
| Pu-240 | 1 6184E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 08E-01 | 4.26E-01 |
| Pu-241 | 2.3780E-03 | 12,870.00 | 26,325 00 | 0 00E+00 | 3 06E+01 | 6 26E+01 |
| Pu-242 | 4 0821E-08 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 25E-04 | 1 07E-03 |
| Ra-226 | 1 4471E-08 | 12,870 00 | 26,325.00 | 0 00E+00 | 1 86E-04 | 3 81E-04 |
| Ra-228 | 4 5651E-06 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 88E-02 | 1 20E-01 |
| Ru-106 | 3.8971E-08 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 02E-04 | 1 03E-03 |
| Se-79 | 3 5417E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 4 56E-01 | 9 32E-01 |
| Sn-126 | 3 9848E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 13E-01 | 1 05E+00 |
| Sr-90 | 1 8940E+00 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 44E+04 | 4 99E+04 |
| Tc-99 | 3.2534E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 4 19E+00 | 8 56E+00 |
| Th-229 | 4 6839E-05 | 12,870 00 | 26,325 00 | 0 00E+00 | 6 03E-01 | 1.23E+00 |
| Th-230 | 1 0322E-06 | 12,870 00 | 26,325 00 | 0 00E+00 | 1.33E-02 | 2 72E-02 |
| Th-232 | -9 0328E-08 | 12,870 00 | 0 00 | 6 18E-01 | 6.17E-01 | 6 18E-01 |
| Tl-208 | 1 5386E-02 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 98E+02 | 4.05E+02 |
| U-232 | 4.1639E-02 | 12,870 00 | 26,325 00 | 0 00E+00 | 5 36E+02 | 1.10E+03 |
| U-233 | -3 3244E-03 | 12,870 00 | 0 00 | 2 08E+03 | 2 03E+03 | 2 08E+03 |
| U-234 | 8 1769E-04 | 12,870 00 | 26,325 00 | 0 00E+00 | 1 05E+01 | 2.15E+01 |
| U-235 | 5 7813E-08 | 12,870 00 | 26,325 00 | 4 25E-04 | 1 17E-03 | 1.95E-03 |
| U-236 | 1.3273E-07 | 12,870 00 | 26,325 00 | 0 00E+00 | 1.71E-03 | 3.49E-03 |
| U-238 | -3 1121E-10 | 12,870 00 | 0.00 | 2 72E-04 | 2 68E-04 | 2.72E-04 |
| Y-90 | 1 8940E+00 | 12,870 00 | 26,325 00 | 0 00E+00 | 2 44E+04 | 4 99E+04 |
| Other Radionuclides | | | | | 2 65E+04 | 5 42E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 760E+15 |
| 0 0250 | 5 687E+14 |
| 0 0375 | 4 870E+14 |
| 0 0575 | 5.311E+14 |
| 0 0850 | 3 370E+14 |
| 0 1250 | 2 158E+14 |
| 0.2250 | 3 008E+14 |
| 0 3750 | 1.221E+14 |
| 0 5750 | 1.849E+15 |
| 0 8500 | 3 659E+13 |
| 1 2500 | 2.314E+13 |
| 1 7500 | 2.207E+12 |
| 2.2500 | 8.885E+07 |
| 2 7500 | 1 422E+13 |
| 3 5000 | 6 708E+04 |
| 5 0000 | 2.075E+04 |
| 7 0000 | 1.526E+03 |
| 11 0000 | 1 176E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 76E+02 | 9 12E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal: | 12,870 00 | 5,157.57 |
| Bounding | 26 325 00 | 10,315 14 |

**Basis for burnup used in estimate:**
Nominal burnup taken directly from SFD (converted to MWd).
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 10 | 0 40 |
| Bounding | 0.20 | 0.39 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name SHIPPINGPORT LWBR SCRAP
SNF ID # 377
Fuel Units & Descr 7 - CANISTER OF SCRAP
Heavy Metal Mass BOL=3127kg EOL=3116 4kg
ROD Storage Site: INEEL

[1]Fuel decay start date 1982
Estimates as of 2010
Template LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd) 10269 14
Template BOL Heavy Metal Mass (MT) 0 45991251
Template Decay Time 25 years

Estimated Canister usage
HIC
7 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 10,315 62 | 166,981.81 | 0 00E+00 | 8 61E-01 | 1.39E+01 |
| Am-241 | 2.2387E-04 | 10,315 62 | 166,981.81 | 0 00E+00 | 2 31E+00 | 3 74E+01 |
| Am-242m | 1.5512E-06 | 10,315 62 | 166,981.81 | 0 00E+00 | 1 60E-02 | 2 59E-01 |
| Am-243 | 3 1181E-07 | 10,315 62 | 166,981.81 | 0 00E+00 | 3 22E-03 | 5 21E-02 |
| C-14 | 9.2539E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 9 55E-01 | 1.55E+01 |
| Cl-36 | 1.8103E-06 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 87E-02 | 3 02E-01 |
| Cm-243 | 3 9020E-07 | 10,315 62 | 166,981 81 | 0 00E+00 | 4 03E-03 | 6 52E-02 |
| Cm-244 | 2 0742E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 2 14E-01 | 3 46E+00 |
| Co-60 | 3 2554E-03 | 10,315 62 | 166,981 81 | 0 00E+00 | 3 36E+01 | 5 44E+02 |
| Cs-134 | 7.3823E-04 | 10,315 62 | 166,981 81 | 0 00E+00 | 7 62E+00 | 1.23E+02 |
| Cs-135 | 2 8639E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 2.95E-01 | 4 78E+00 |
| Cs-137 | 1 8609E+00 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 92E+04 | 3 11E+05 |
| Eu-154 | 1 9262E-02 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 99E+02 | 3 22E+03 |
| Eu-155 | 2 6721E-03 | 10,315 62 | 166,981 81 | 0 00E+00 | 2.76E+01 | 4 46E+02 |
| Fe-55 | 3 3099E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 3 41E-01 | 5 53E+00 |
| H-3 | 3 7296E-03 | 10,315 62 | 166,981 81 | 0 00E+00 | 3 85E+01 | 6.23E+02 |
| I-129 | 1.5853E-06 | 10,315 62 | 166,981.81 | 0 00E+00 | 1 64E-02 | 2.65E-01 |
| Kr-85 | 1.1958E-01 | 10,315 62 | 166,981.81 | 0 00E+00 | 1.23E+03 | 2 00E+04 |
| Np-237 | 1.2513E-07 | 10,315 62 | 166,981.81 | 0 00E+00 | 1 29E-03 | 2.09E-02 |
| Pa-231 | 1.2017E-04 | 10,315 62 | 166,981 81 | 0 00E+00 | 1.24E+00 | 2 01E+01 |
| Pb-210 | 1 1939E-08 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 23E-04 | 1.99E-03 |
| Pm-147 | 3 6819E-03 | 10,315 62 | 166,981 81 | 0 00E+00 | 3 80E+01 | 6.15E+02 |
| Pu-238 | 4 5953E-04 | 10,315 62 | 166,981 81 | 0 00E+00 | 4 74E+00 | 7.67E+01 |
| Pu-239 | 2 7529E-05 | 10,315 62 | 166,981 81 | 0.00E+00 | 2 84E-01 | 4 60E+00 |
| Pu-240 | 1 6184E-05 | 10,315 62 | 166,981 81 | 0.00E+00 | 1 67E-01 | 2 70E+00 |
| Pu-241 | 2 3780E-03 | 10,315 62 | 166,981 81 | 0 00E+00 | 2 45E+01 | 3 97E+02 |
| Pu-242 | 4 0821E-08 | 10,315 62 | 166,981 81 | 0 00E+00 | 4.21E-04 | 6 82E-03 |
| Ra-226 | 1 4471E-08 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 49E-04 | 2 42E-03 |
| Ra-228 | 4 5651E-06 | 10,315 62 | 166,981 81 | 0 00E+00 | 4.71E-02 | 7 62E-01 |
| Ru-106 | 3.8971E-08 | 10,315 62 | 166,981 81 | 0 00E+00 | 4.02E-04 | 6 51E-03 |
| Se-79 | 3.5417E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 3.65E-01 | 5 91E+00 |
| Sn-126 | 3.9848E-05 | 10,315 62 | 166,981 81 | 0 00E+00 | 4 11E-01 | 6 65E+00 |
| Sr-90 | 1 8940E+00 | 10,315 62 | 166,981.81 | 0 00E+00 | 1.95E+04 | 3 16E+05 |
| Tc-99 | 3.2534E-04 | 10,315 62 | 166,981.81 | 0 00E+00 | 3.36E+00 | 5 43E+01 |
| Th-229 | 4 6839E-05 | 10,315 62 | 166,981.81 | 0 00E+00 | 4 83E-01 | 7.82E+00 |
| Th-230 | 1 0322E-06 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 06E-02 | 1.72E-01 |
| Th-232 | -9 0328E-08 | 10,315 62 | 0 00 | 3 30E-01 | 3 29E-01 | 3.30E-01 |
| Tl-208 | 1 5386E-02 | 10,315 62 | 166,981 81 | 0.00E+00 | 1.59E+02 | 2.57E+03 |
| U-232 | 4 1639E-02 | 10,315 62 | 166,981 81 | 0 00E+00 | 4.30E+02 | 6.95E+03 |
| U-233 | -3.3244E-03 | 10,315 62 | 0 00 | 1 11E+03 | 1 08E+03 | 1.11E+03 |
| U-234 | 8 1769E-04 | 10,315 62 | 166,981 81 | 0 00E+00 | 8 44E+00 | 1.37E+02 |
| U-235 | 5 7813E-08 | 10,315 62 | 166,981 81 | 2.27E-04 | 8 24E-04 | 9 88E-03 |
| U-236 | 1.3273E-07 | 10,315 62 | 166,981 81 | 0 00E+00 | 1.37E-03 | 2.22E-02 |
| U-238 | -3 1121E-10 | 10,315 62 | 0.00 | 1 45E-04 | 1 42E-04 | 1 45E-04 |
| Y-90 | 1.8940E+00 | 10,315 62 | 166,981 81 | 0 00E+00 | 1 95E+04 | 3 16E+05 |
| Other Radionuclides | | | | | 2.12E+04 | 3 44E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 747E+16 |
| 0 0250 | 3 607E+15 |
| 0 0375 | 3 089E+15 |
| 0 0575 | 3.368E+15 |
| 0 0850 | 2 137E+15 |
| 0 1250 | 1.369E+15 |
| 0.2250 | 1.908E+15 |
| 0 3750 | 7 744E+14 |
| 0.5750 | 1.173E+16 |
| 0.8500 | 2.321E+14 |
| 1.2500 | 1.468E+14 |
| 1 7500 | 1 400E+13 |
| 2.2500 | 5 634E+08 |
| 2 7500 | 9 021E+13 |
| 3 5000 | 3 469E+05 |
| 5 0000 | 1.081E+05 |
| 7 0000 | 8 149E+03 |
| 11 0000 | 6 493E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 65E+02 | 5.44E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons
This fuel matches on all parameters except enrichment (unknown)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 10,315 62 |
| Bounding | 166 981.81 | 20 631.25 |

**Basis for burnup used in estimate:**
Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 15 | |
| Bounding | 2.39 | 0 12 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SHIPPINGPORT LWBR SCRAP (LINER 15718)
SNF ID #: 379
Fuel Units & Descr: 1 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=244 6kg, EOL=242.9kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1982
Estimates as of 2010
Template. LWBR (Light Water, Zirc, 60 to 100%, Th and U)
[2]Template Burnup(MWd). 10269 14
Template BOL Heavy Metal Mass (MT): 0 45991251
Template Decay Time 25 years

Estimated Canister usage HIC: 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_a$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_a$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 38E-01 | 1 09E+00 |
| Am-241 | 2.2387E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 70E-01 | 2 92E+00 |
| Am-242m | 1 5512E-06 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 57E-03 | 2 03E-02 |
| Am-243 | 3 1181E-07 | 1,654 38 | 13,061 64 | 0 00E+00 | 5 16E-04 | 4 07E-03 |
| C-14 | 9.2539E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 53E-01 | 1.21E+00 |
| Cl-36 | 1 8103E-06 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 99E-03 | 2 36E-02 |
| Cm-243 | 3 9020E-07 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 46E-04 | 5 10E-03 |
| Cm-244 | 2 0742E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 43E-02 | 2 71E-01 |
| Co-60 | 3 2554E-03 | 1,654 38 | 13,061 64 | 0 00E+00 | 5 39E+00 | 4.25E+01 |
| Cs-134 | 7 3823E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 22E+00 | 9 64E+00 |
| Cs-135 | 2 8639E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 4 74E-02 | 3 74E-01 |
| Cs-137 | 1 8609E+00 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 08E+03 | 2 43E+04 |
| Eu-154 | 1 9262E-02 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 19E+01 | 2 52E+02 |
| Eu-155 | 2 6721E-03 | 1,654 38 | 13,061 64 | 0 00E+00 | 4 42E+00 | 3 49E+01 |
| Fe-55 | 3 3099E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 5 48E-02 | 4 32E-01 |
| H-3 | 3 7296E-03 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 17E+00 | 4 87E+01 |
| I-129 | 1 5853E-06 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 62E-03 | 2 07E-02 |
| Kr-85 | 1 1958E-01 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 98E+02 | 1 56E+03 |
| Np-237 | 1.2513E-07 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 07E-04 | 1 63E-03 |
| Pa-231 | 1 2017E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 99E-01 | 1 57E+00 |
| Pb-210 | 1 1939E-08 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 98E-05 | 1 56E-04 |
| Pm-147 | 3 6819E-03 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 09E+00 | 4 81E+01 |
| Pu-238 | 4 5953E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 7 60E-01 | 6 00E+00 |
| Pu-239 | 2 7529E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 4 55E-02 | 3 60E-01 |
| Pu-240 | 1 6184E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 68E-02 | 2 11E-01 |
| Pu-241 | 2 3780E-03 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 93E+00 | 3 11E+01 |
| Pu-242 | 4 0821E-08 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 75E-05 | 5 33E-04 |
| Ra-226 | 1 4471E-08 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 39E-05 | 1 89E-04 |
| Ra-228 | 4 5651E-06 | 1,654 38 | 13,061 64 | 0 00E+00 | 7 55E-03 | 5 96E-02 |
| Ru-106 | 3 8971E-08 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 45E-05 | 5 09E-04 |
| Se-79 | 3 5417E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 5 86E-02 | 4 63E-01 |
| Sn-126 | 3 9848E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 59E-02 | 5 20E-01 |
| Sr-90 | 1 8940E+00 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 13E+03 | 2 47E+04 |
| Tc-99 | 3.2534E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 5 38E-01 | 4.25E+00 |
| Th-229 | 4 6839E-05 | 1,654 38 | 13,061 64 | 0 00E+00 | 7 75E-02 | 6 12E-01 |
| Th-230 | 1 0322E-06 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 71E-03 | 1 35E-02 |
| Th-232 | -9 0328E-08 | 1,654 38 | 0 00 | 2 58E-02 | 2 57E-02 | 2 58E-02 |
| Tl-208 | 1 5386E-02 | 1,654 38 | 13,061 64 | 0 00E+00 | 2 55E+01 | 2 01E+02 |
| U-232 | 4 1639E-02 | 1,654 38 | 13,061 64 | 0 00E+00 | 6 89E+01 | 5 44E+02 |
| U-233 | -3 3244E-03 | 1,654 38 | 0 00 | 8 69E+01 | 8 14E+01 | 8 69E+01 |
| U-234 | 8 1769E-04 | 1,654 38 | 13,061 64 | 0 00E+00 | 1 35E+00 | 1 07E+01 |
| U-235 | 5 7813E-08 | 1,654 38 | 13,061 64 | 1 78E-05 | 1.13E-04 | 7.73E-04 |
| U-236 | 1 3273E-07 | 1,654 38 | 13,061 64 | 0 00E+00 | 2.20E-04 | 1 73E-03 |
| U-238 | -3 1121E-10 | 1,654 38 | 0 00 | 1 14E-05 | 1 08E-05 | 1 14E-05 |
| Y-90 | 1 8940E+00 | 1,654 38 | 13,061 64 | 0 00E+00 | 3 13E+03 | 2 47E+04 |
| Other Radionuclides | | | | | 3 41E+03 | 2 69E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | - |
| 0.0150 | 1.367E+15 |
| 0.0250 | 2.821E+14 |
| 0 0375 | 2.416E+14 |
| 0 0575 | 2 635E+14 |
| 0 0850 | 1.672E+14 |
| 0 1250 | 1.071E+14 |
| 0.2250 | 1 493E+14 |
| 0.3750 | 6.058E+13 |
| 0.5750 | 9 174E+14 |
| 0.8500 | 1.815E+13 |
| 1.2500 | 1 148E+13 |
| 1 7500 | 1.095E+12 |
| 2.2500 | 4 407E+07 |
| 2 7500 | 7.056E+12 |
| 3.5000 | 2 713E+04 |
| 5 0000 | 8 459E+03 |
| 7.0000 | 6.374E+02 |
| 11 0000 | 5 079E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.59E+01 | 4.25E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 0 71 | 60 to 100 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1 654 38 |
| Bounding | 13 061 64 | 3,308 75 |

**Basis for burnup used in estimate:**
Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 30 | |
| Bounding | 2.39 | 0.25 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | | |
|---|---|---|---|---|
| Fuel Name | SHIPPINGPORT LWBR SEED | [1]Fuel decay start date | 1982 | Estimated Canister usage |
| SNF ID # | 380 | Estimates as of | 2010 | 18"x15' |
| Fuel Units & Descr | 12 - 619 ROD HEX ARRAY | Template | LWBR (Light Water, Zirc, 60 to 100% Th and U) | 12 00 |
| Heavy Metal Mass | BOL=5218 3kg, EOL=5110 5kg | [2]Template Burnup(MWd): | 10269 14 | |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 45991251 | |
| | | Template Decay Time | 25 years | |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 3425E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 1.30E+01 | 2 32E+01 |
| Am-241 | 2 2387E-04 | 155,505 33 | 278,657.20 | 0 00E+00 | 3 48E+01 | 6 24E+01 |
| Am-242m | 1 5512E-06 | 155,505 33 | 278,657 20 | 0 00E+00 | 2 41E-01 | 4 32E-01 |
| Am-243 | 3 1181E-07 | 155,505 33 | 278,657 20 | 0 00E+00 | 4 85E-02 | 8 69E-02 |
| C-14 | 9 2539E-05 | 155,505 33 | 278,657 20 | 0 00E+00 | 1 44E+01 | 2 58E+01 |
| Cl-36 | 1 8103E-06 | 155,505 33 | 278,657 20 | 0 00E+00 | 2 82E-01 | 5 04E-01 |
| Cm-243 | 3 9020E-07 | 155,505 33 | 278,657 20 | 0 00E+00 | 6 07E-02 | 1 09E-01 |
| Cm-244 | 2 0742E-05 | 155,505 33 | 278,657 20 | 0 00E+00 | 3.23E+00 | 5 78E+00 |
| Co-60 | 3 2554E-03 | 155,505 33 | 278,657.20 | 0 00E+00 | 5 06E+02 | 9 07E+02 |
| Cs-134 | 7 3823E-04 | 155,505 33 | 278,657.20 | 0 00E+00 | 1.15E+02 | 2 06E+02 |
| Cs-135 | 2 8639E-05 | 155,505 33 | 278,657 20 | 0 00E+00 | 4 45E+00 | 7 98E+00 |
| Cs-137 | 1 8609E+00 | 155,505 33 | 278,657 20 | 0 00E+00 | 2.89E+05 | 5 19E+05 |
| Eu-154 | 1 9262E-02 | 155,505 33 | 278,657 20 | 0 00E+00 | 3 00E+03 | 5 37E+03 |
| Eu-155 | 2 6721E-03 | 155,505 33 | 278,657 20 | 0 00E+00 | 4.16E+02 | 7 45E+02 |
| Fe-55 | 3 3099E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 5.15E+00 | 9.22E+00 |
| H-3 | 3 7296E-03 | 155,505 33 | 278,657.20 | 0 00E+00 | 5 80E+02 | 1 04E+03 |
| I-129 | 1 5853E-06 | 155,505 33 | 278,657.20 | 0 00E+00 | 2.47E-01 | 4 42E-01 |
| Kr-85 | 1 1958E-01 | 155,505 33 | 278,657 20 | 0 00E+00 | 1.86E+04 | 3 33E+04 |
| Np-237 | 1 2513E-07 | 155,505 33 | 278,657.20 | 0 00E+00 | 1 95E-02 | 3 49E-02 |
| Pa-231 | 1 2017E-04 | 155,505 33 | 278,657 20 | 0 00E+00 | 1.87E+01 | 3 35E+01 |
| Pb-210 | 1 1939E-08 | 155,505 33 | 278,657 20 | 0 00E+00 | 1 86E-03 | 3 33E-03 |
| Pm-147 | 3 6819E-03 | 155,505 33 | 278,657.20 | 0 00E+00 | 5.73E+02 | 1 03E+03 |
| Pu-238 | 4 5953E-04 | 155,505 33 | 278,657.20 | 0 00E+00 | 7.15E+01 | 1.28E+02 |
| Pu-239 | 2 7529E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 4.28E+00 | 7 67E+00 |
| Pu-240 | 1 6184E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 2.52E+00 | 4 51E+00 |
| Pu-241 | 2 3780E-03 | 155,505 33 | 278,657.20 | 0 00E+00 | 3 70E+02 | 6 63E+02 |
| Pu-242 | 4 0821E-08 | 155,505 33 | 278,657.20 | 0 00E+00 | 6.35E-03 | 1 14E-02 |
| Ra-226 | 1 4471E-08 | 155,505 33 | 278,657.20 | 0.00E+00 | 2.25E-03 | 4 03E-03 |
| Ra-228 | 4 5651E-06 | 155,505 33 | 278,657.20 | 0 00E+00 | 7.10E-01 | 1.27E+00 |
| Ru-106 | 3 8971E-08 | 155,505 33 | 278,657.20 | 0.00E+00 | 6 06E-03 | 1 09E-02 |
| Se-79 | 3 5417E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 5 51E+00 | 9 87E+00 |
| Sn-126 | 3 9848E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 6.20E+00 | 1 11E+01 |
| Sr-90 | 1 8940E+00 | 155,505 33 | 278,657.20 | 0 00E+00 | 2 95E+05 | 5.28E+05 |
| Tc-99 | 3 2534E-04 | 155,505 33 | 278,657.20 | 0 00E+00 | 5 06E+01 | 9 07E+01 |
| Th-229 | 4 6839E-05 | 155,505 33 | 278,657.20 | 0 00E+00 | 7.28E+00 | 1.31E+01 |
| Th-230 | 1 0322E-06 | 155,505 33 | 278,657.20 | 0 00E+00 | 1.61E-01 | 2 88E-01 |
| Th-232 | -9 0328E-08 | 155,505 33 | 0 00 | 5.51E-01 | 5.37E-01 | 5 51E-01 |
| Tl-208 | 1.5386E-02 | 155,505 33 | 278,657.20 | 0.00E+00 | 2 39E+03 | 4.29E+03 |
| U-232 | 4 1639E-02 | 155,505 33 | 278,657.20 | 0.00E+00 | 6 48E+03 | 1 16E+04 |
| U-233 | -3 3244E-03 | 155,505 33 | 0 00 | 1.85E+03 | 1.34E+03 | 1 85E+03 |
| U-234 | 8 1769E-04 | 155,505 33 | 278,657.20 | 0.00E+00 | 1.27E+02 | 2.28E+02 |
| U-235 | 5 7813E-08 | 155,505 33 | 278,657.20 | 3.79E-04 | 9.37E-03 | 1 65E-02 |
| U-236 | 1.3273E-07 | 155,505 33 | 278,657.20 | 0 00E+00 | 2.06E-02 | 3 70E-02 |
| U-238 | -3 1121E-10 | 155,505 33 | 0 00 | 2 42E-04 | 1.94E-04 | 2 42E-04 |
| Y-90 | 1 8940E+00 | 155,505 33 | 278,657.20 | 0 00E+00 | 2 95E+05 | 5.28E+05 |
| Other Radionuclides | | | | | 3 20E+05 | 5 74E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.915E+16 |
| 0 0250 | 6 019E+15 |
| 0 0375 | 5 154E+15 |
| 0 0575 | 5 621E+15 |
| 0 0850 | 3.567E+15 |
| 0 1250 | 2.284E+15 |
| 0.2250 | 3 184E+15 |
| 0.3750 | 1.292E+15 |
| 0.5750 | 1.957E+16 |
| 0.8500 | 3.873E+14 |
| 1.2500 | 2.450E+14 |
| 1 7500 | 2.336E+13 |
| 2.2500 | 9 401E+08 |
| 2 7500 | 1.505E+14 |
| 3.5000 | 5 788E+05 |
| 5 0000 | 1 805E+05 |
| 7.0000 | 1.360E+04 |
| 11.0000 | 1 083E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 07E+03 | 9 07E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | Th and U | Th and U |
| BOL Enrichment % | 0 070817874 | 60 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 155,505.33 | 104 906.57 |
| Bounding | 278 657.20 | 209 813 14 |

**Basis for burnup used in estimate:**

Nominal burnup taken directly from SFD (converted to MWd)

Bounding burnup taken directly from SFD (converted to MWd)

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1 33 | 0 67 |
| Bounding | 2.39 | 0 75 |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SHIPPINGPORT PWR C1 BLKT
SNF ID #: 191
Fuel Units & Descr: 36 - 17 FLAT PLATES
Heavy Metal Mass: BOL=583 92kg; EOL=569 66kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1969
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 61 92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 35 years

Estimated Canister usage: 18"x15' — 36 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8.7758E-10 | 13,560.21 | 27,120 41 | 0 00E+00 | 1.19E-05 | 2 38E-05 |
| Am-241 | 1.4352E-01 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 95E+03 | 3 89E+03 |
| Am-242m | 2 8698E-04 | 13,560.21 | 27,120 41 | 0 00E+00 | 3 89E+00 | 7 78E+00 |
| Am-243 | 6 2565E-04 | 13,560.21 | 27,120 41 | 0 00E+00 | 8.48E+00 | 1 70E+01 |
| C-14 | 4 7901E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 6 50E-01 | 1 30E+00 |
| Cl-36 | 8 0297E-07 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 09E-02 | 2 18E-02 |
| Cm-243 | 2 5081E-04 | 13,560 21 | 27,120 41 | 0 00E+00 | 3.40E+00 | 6 80E+00 |
| Cm-244 | 4 9015E-02 | 13,560 21 | 27,120 41 | 0 00E+00 | 6 65E+02 | 1 33E+03 |
| Co-60 | 2 5581E-03 | 13,560 21 | 27,120 41 | 0 00E+00 | 3 47E+01 | 6 94E+01 |
| Cs-134 | 4 0536E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 5 50E-01 | 1 10E+00 |
| Cs-135 | 1 4433E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 96E-01 | 3 91E-01 |
| Cs-137 | 1 3979E+00 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 90E+04 | 3 79E+04 |
| Eu-154 | 2 0203E-02 | 13,560 21 | 27,120 41 | 0 00E+00 | 2.74E+02 | 5 48E+02 |
| Eu-155 | 1 7684E-03 | 13,560 21 | 27,120 41 | 0 00E+00 | 2.40E+01 | 4 80E+01 |
| Fe-55 | 4 3136E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 5 85E-01 | 1 17E+00 |
| H-3 | 2 0769E-02 | 13,560.21 | 27,120 41 | 0 00E+00 | 2 82E+02 | 5 63E+02 |
| I-129 | 9 8288E-07 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 33E-02 | 2.67E-02 |
| Kr-85 | 2 8214E-02 | 13,560.21 | 27,120 41 | 0 00E+00 | 3 83E+02 | 7 65E+02 |
| Np-237 | 1 1218E-05 | 13,560.21 | 27,120 41 | 0.00E+00 | 1 52E-01 | 3 04E-01 |
| Pa-231 | 1.3036E-09 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 77E-05 | 3 54E-05 |
| Pb-210 | 8.5078E-11 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 15E-06 | 2 31E-06 |
| Pm-147 | 3 6531E-04 | 13,560.21 | 27,120 41 | 0 00E+00 | 4 95E+00 | 9 91E+00 |
| Pu-238 | 7.4564E-02 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 01E+03 | 2 02E+03 |
| Pu-239 | 1.1623E-02 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 58E+02 | 3.15E+02 |
| Pu-240 | 1.5132E-02 | 13,560.21 | 27,120 41 | 0 00E+00 | 2 05E+02 | 4.10E+02 |
| Pu-241 | 9 0036E-01 | 13,560.21 | 27,120 41 | 0 00E+00 | 1 22E+04 | 2 44E+04 |
| Pu-242 | 6 4260E-05 | 13,560.21 | 27,120 41 | 0 00E+00 | 8 71E-01 | 1 74E+00 |
| Ra-226 | 2.2804E-10 | 13,560.21 | 27,120 41 | 0 00E+00 | 3 09E-06 | 6 18E-06 |
| Ra-228 | 5.2713E-12 | 13,560.21 | 27,120 41 | 0 00E+00 | 7.15E-08 | 1 43E-07 |
| Ru-106 | 6 1160E-10 | 13,560.21 | 27,120 41 | 0 00E+00 | 8.29E-06 | 1 66E-05 |
| Se-79 | 1.2377E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 68E-01 | 3 36E-01 |
| Sn-126 | 2 5210E-05 | 13,560.21 | 27,120 41 | 0 00E+00 | 3 42E-01 | 6 84E-01 |
| Sr-90 | 9 1667E-01 | 13,560.21 | 27,120 41 | 0 00E+00 | 1.24E+04 | 2 49E+04 |
| Tc-99 | 3 9357E-04 | 13,560.21 | 27,120 41 | 0 00E+00 | 5 34E+00 | 1 07E+01 |
| Th-229 | 1 2057E-10 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 64E-06 | 3 27E-06 |
| Th-230 | 2 1043E-08 | 13,560 21 | 27,120 41 | 0 00E+00 | 2.85E-04 | 5 71E-04 |
| Th-232 | 5 2972E-12 | 13,560 21 | 27,120 41 | 0 00E+00 | 7.18E-08 | 1 44E-07 |
| Tl-208 | 1 7474E-07 | 13,560 21 | 27,120 41 | 0 00E+00 | 2.37E-03 | 4 74E-03 |
| U-232 | 4 7368E-07 | 13,560 21 | 27,120 41 | 0 00E+00 | 6 42E-03 | 1.28E-02 |
| U-233 | 2 5097E-08 | 13,560 21 | 27,120 41 | 0 00E+00 | 3.40E-04 | 6 81E-04 |
| U-234 | 5 0000E-05 | 13,560 21 | 27,120 41 | 0 00E+00 | 6.78E-01 | 1 36E+00 |
| U-235 | -1 4489E-06 | 13,560.21 | 0.00 | 1 24E-02 | 0.00E+00 | 1.24E-02 |
| U-236 | 7 5824E-06 | 13,560 21 | 27,120 41 | 0 00E+00 | 1 03E-01 | 2.06E-01 |
| U-238 | -2 6129E-07 | 13,560 21 | 0.00 | 1 94E-01 | 1 91E-01 | 1.94E-01 |
| Y-90 | 9 1699E-01 | 13,560 21 | 27,120 41 | 0 00E+00 | 1.24E+04 | 2 49E+04 |
| Other Radionuclides | | | | | 1 82E+04 | 3 64E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 459E+15 |
| 0 0250 | 2 943E+14 |
| 0 0375 | 2.806E+14 |
| 0 0575 | 3.243E+14 |
| 0 0850 | 1 633E+14 |
| 0 1250 | 1 133E+14 |
| 0 2250 | 1 400E+14 |
| 0.3750 | 6 021E+13 |
| 0 5750 | 1 400E+15 |
| 0 8500 | 1 937E+13 |
| 1 2500 | 1 903E+13 |
| 1 7500 | 5 698E+11 |
| 2.2500 | 9 176E+07 |
| 2.7500 | 1 880E+08 |
| 3.5000 | 1 936E+07 |
| 5.0000 | 8 276E+06 |
| 7.0000 | 9 539E+05 |
| 11.0000 | 1 096E+05 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.12E+02 | 6.24E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 0 98643828 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 6 481 51 | 13 560.21 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 27,120 41 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 66 | 2 09 |
| Bounding | 1 33 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | SHIPPINGPORT PWR C2 BLKT | [1]Fuel decay start date | 1974 |
| SNF ID # | 192 | Estimates as of | 2010 |
| Fuel Units & Descr | 17 - 17 FLAT PLATES | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=1323 635kg EOL=1038 999kg | [2]Template Burnup(MWd) | 61 92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 35 years |

Estimated Canister usage: 18"x15' — 17 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 7758E-10 | 270,675 47 | 541,350 94 | 0 00E+00 | 2 38E-04 | 4 75E-04 |
| Am-241 | 1 4352E-01 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 88E+04 | 7 77E+04 |
| Am-242m | 2 8698E-04 | 270,675 47 | 541,350 94 | 0 00E+00 | 7 77E+01 | 1 55E+02 |
| Am-243 | 6.2565E-04 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 69E+02 | 3 39E+02 |
| C-14 | 4 7901E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 1.30E+01 | 2.59E+01 |
| Cl-36 | 8 0297E-07 | 270,675 47 | 541,350 94 | 0 00E+00 | 2.17E-01 | 4 35E-01 |
| Cm-243 | 2 5081E-04 | 270,675 47 | 541,350 94 | 0 00E+00 | 6.79E+01 | 1 36E+02 |
| Cm-244 | 4 9015E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 1.33E+04 | 2 65E+04 |
| Co-60 | 2 5581E-03 | 270,675 47 | 541,350 94 | 0 00E+00 | 6 92E+02 | 1.38E+03 |
| Cs-134 | 4 0536E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 1.10E+01 | 2.19E+01 |
| Cs-135 | 1 4433E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 91E+00 | 7.81E+00 |
| Cs-137 | 1 3979E+00 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 78E+05 | 7.57E+05 |
| Eu-154 | 2 0203E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 5 47E+03 | 1 09E+04 |
| Eu-155 | 1 7684E-03 | 270,675.47 | 541,350 94 | 0 00E+00 | 4 79E+02 | 9 57E+02 |
| Fe-55 | 4 3136E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 17E+01 | 2.34E+01 |
| H-3 | 2 0769E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 5 62E+03 | 1 12E+04 |
| I-129 | 9 8288E-07 | 270,675 47 | 541,350 94 | 0 00E+00 | 2 66E-01 | 5 32E-01 |
| Kr-85 | 2 8214E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 7 64E+03 | 1 53E+04 |
| Np-237 | 1.1218E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 04E+00 | 6 07E+00 |
| Pa-231 | 1.3036E-09 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 53E-04 | 7 06E-04 |
| Pb-210 | 8 5078E-11 | 270,675 47 | 541,350 94 | 0.00E+00 | 2 30E-05 | 4 61E-05 |
| Pm-147 | 3 6531E-04 | 270,675 47 | 541,350 94 | 0 00E+00 | 9 89E+01 | 1 98E+02 |
| Pu-238 | 7.4564E-02 | 270,675 47 | 541,350 94 | 0.00E+00 | 2 02E+04 | 4 04E+04 |
| Pu-239 | 1 1623E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 3.15E+03 | 6 29E+03 |
| Pu-240 | 1.5132E-02 | 270,675 47 | 541,350 94 | 0 00E+00 | 4 10E+03 | 8 19E+03 |
| Pu-241 | 9 0036E-01 | 270,675 47 | 541,350 94 | 0 00E+00 | 2 44E+05 | 4 87E+05 |
| Pu-242 | 6 4260E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 1.74E+01 | 3 48E+01 |
| Ra-226 | 2 2804E-10 | 270,675 47 | 541,350 94 | 0 00E+00 | 6 17E-05 | 1.23E-04 |
| Ra-228 | 5 2713E-12 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 43E-06 | 2.85E-06 |
| Ru-106 | 6 1160E-10 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 66E-04 | 3 31E-04 |
| Se-79 | 1.2377E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 3.35E+00 | 6.70E+00 |
| Sn-126 | 2 5210E-05 | 270 675 47 | 541,350 94 | 0 00E+00 | 6 82E+00 | 1.36E+01 |
| Sr-90 | 9 1667E-01 | 270,675 47 | 541,350 94 | 0 00E+00 | 2 48E+05 | 4 96E+05 |
| Tc-99 | 3 9357E-04 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 07E+02 | 2 13E+02 |
| Th-229 | 1.2057E-10 | 270,675 47 | 541,350 94 | 0 00E+00 | 3 26E-05 | 6 53E-05 |
| Th-230 | 2.1043E-08 | 270,675 47 | 541,350 94 | 0 00E+00 | 5 70E-03 | 1 14E-02 |
| Th-232 | 5.2972E-12 | 270,675 47 | 541,350 94 | 0 00E+00 | 1 43E-06 | 2 87E-06 |
| Tl-208 | 1.7474E-07 | 270,675 47 | 541,350.94 | 0 00E+00 | 4 73E-02 | 9 46E-02 |
| U-232 | 4.7368E-07 | 270,675 47 | 541,350.94 | 0 00E+00 | 1.28E-01 | 2 56E-01 |
| U-233 | 2.5097E-08 | 270,675 47 | 541,350 94 | 0 00E+00 | 6 79E-03 | 1.36E-02 |
| U-234 | 5 0000E-05 | 270,675 47 | 541,350 94 | 0 00E+00 | 1.35E+01 | 2 71E+01 |
| U-235 | -1 4489E-06 | 270,675 47 | 0 00 | 2.03E-02 | 0 00E+00 | 2 03E-02 |
| U-236 | 7.5824E-06 | 270,675 47 | 541,350 94 | 0 00E+00 | 2 05E+00 | 4.10E+00 |
| U-238 | -2 6129E-07 | 270,675 47 | 0 00 | 4 42E-01 | 3 71E-01 | 4 42E-01 |
| Y-90 | 9 1699E-01 | 270,675 47 | 541,350 94 | 0 00E+00 | 2.48E+05 | 4 96E+05 |
| Other Radionuclides | | | | | 3 63E+05 | 7.27E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.913E+16 |
| 0 0250 | 5 874E+15 |
| 0 0375 | 5 602E+15 |
| 0 0575 | 6 473E+15 |
| 0 0850 | 3.259E+15 |
| 0 1250 | 2.262E+15 |
| 0 2250 | 2.795E+15 |
| 0 3750 | 1.202E+15 |
| 0 5750 | 2.795E+16 |
| 0 8500 | 3.867E+14 |
| 1.2500 | 3 798E+14 |
| 1 7500 | 1 137E+13 |
| 2.2500 | 1.832E+09 |
| 2.7500 | 3 752E+09 |
| 3.5000 | 3 864E+08 |
| 5.0000 | 1 652E+08 |
| 7.0000 | 1 904E+07 |
| 11.0000 | 2 187E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6.23E+03 | 1.25E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences* |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 0 71 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 18,892.25 | 270 675 47 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 541,350 94 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5.84 | 14 33 |
| Bounding | 11 69 | |

Estimated EOL HM/Given EOL HM: 1 17

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name. SHIPPINGPORT PWR-C1-S4
SNF ID #: 194
Fuel Units & Descr: 1 - 17 FLAT PLATES
Heavy Metal Mass: BOL=3 024kg; EOL=2 063kg
ROD Storage Site: INEEL

[1]Fuel decay start date. 1964
Estimates as of 2010
Template Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd). 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time 35 years

Estimated Canister usage: 18"x15" 1 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2.3344E-08 | 908 00 | 1,815 99 | 0 00E+00 | 2.12E-05 | 4 24E-05 |
| Am-241 | 1.1135E-04 | 908 00 | 1,815 99 | 0 00E+00 | 1 01E-01 | 2 02E-01 |
| Am-242m | 8.5075E-09 | 908 00 | 1,815 99 | 0 00E+00 | 7 72E-06 | 1 54E-05 |
| Am-243 | 9.8519E-10 | 908 00 | 1,815 99 | 0 00E+00 | 8 95E-07 | 1 79E-06 |
| C-14 | 2.3012E-04 | 908 00 | 1,815 99 | 0 00E+00 | 2 09E-01 | 4 18E-01 |
| Cl-36 | 1.2261E-06 | 908.00 | 1,815 99 | 0 00E+00 | 1 11E-03 | 2.23E-03 |
| Cm-243 | 2 4875E-10 | 908 00 | 1,815 99 | 0 00E+00 | 2 26E-07 | 4 52E-07 |
| Cm-244 | 2 3178E-09 | 908.00 | 1,815 99 | 0 00E+00 | 2 10E-06 | 4.21E-06 |
| Co-60 | 7 0849E-02 | 908 00 | 1,815 99 | 0 00E+00 | 6 43E+01 | 1.29E+02 |
| Cs-134 | 3 0266E-06 | 908.00 | 1,815 99 | 0 00E+00 | 2 75E-03 | 5.50E-03 |
| Cs-135 | 3 0316E-05 | 908 00 | 1,815 99 | 0 00E+00 | 2 75E-02 | 5 51E-02 |
| Cs-137 | 1 4511E+00 | 908 00 | 1,815 99 | 0 00E+00 | 1 32E+03 | 2 64E+03 |
| Eu-154 | 6 6955E-04 | 908 00 | 1,815 99 | 0 00E+00 | 6 08E-01 | 1.22E+00 |
| Eu-155 | 6 9850E-04 | 908 00 | 1,815 99 | 0 00E+00 | 6 34E-01 | 1 27E+00 |
| Fe-55 | 1 2318E-03 | 908 00 | 1,815 99 | 0 00E+00 | 1.12E+00 | 2 24E+00 |
| H-3 | 2 5141E-03 | 908 00 | 1,815 99 | 0 00E+00 | 2.28E+00 | 4 57E+00 |
| I-129 | 7 3195E-07 | 908 00 | 1,815 99 | 0 00E+00 | 6 65E-04 | 1 33E-03 |
| Kr-85 | 4 1281E-02 | 908 00 | 1,815 99 | 0 00E+00 | 3.75E+01 | 7 50E+01 |
| Np-237 | 1 1489E-06 | 908 00 | 1,815.99 | 0 00E+00 | 1.04E-03 | 2 09E-03 |
| Pa-231 | 4 5241E-08 | 908 00 | 1,815 99 | 0 00E+00 | 4.11E-05 | 8 22E-05 |
| Pb-210 | 6 4476E-13 | 908 00 | 1,815.99 | 0 00E+00 | 5 85E-10 | 1 17E-09 |
| Pm-147 | 1 1651E-03 | 908 00 | 1,815 99 | 0 00E+00 | 1 06E+00 | 2 12E+00 |
| Pu-238 | 2 9517E-04 | 908 00 | 1,815 99 | 0 00E+00 | 2 68E-01 | 5 36E-01 |
| Pu-239 | 6 6772E-04 | 908 00 | 1,815 99 | 0 00E+00 | 6 06E-01 | 1 21E+00 |
| Pu-240 | 8 6839E-05 | 908 00 | 1,815 99 | 0 00E+00 | 7 88E-02 | 1 58E-01 |
| Pu-241 | 7.1514E-04 | 908 00 | 1,815 99 | 0 00E+00 | 6 49E-01 | 1.30E+00 |
| Pu-242 | 1 9717E-09 | 908 00 | 1,815 99 | 0 00E+00 | 1 79E-06 | 3 58E-06 |
| Ra-226 | 1.7654E-12 | 908 00 | 1,815 99 | 0 00E+00 | 1 60E-09 | 3.21E-09 |
| Ra-228 | 8.2928E-12 | 908 00 | 1,815 99 | 0 00E+00 | 7 53E-09 | 1.51E-08 |
| Ru-106 | 1 8419E-10 | 908.00 | 1,815 99 | 0 00E+00 | 1 67E-07 | 3.34E-07 |
| Se-79 | 1.3223E-05 | 908.00 | 1,815 99 | 0 00E+00 | 1 20E-02 | 2 40E-02 |
| Sn-126 | 1.1493E-05 | 908 00 | 1,815 99 | 0 00E+00 | 1 04E-02 | 2 09E-02 |
| Sr-90 | 1 3649E+00 | 908 00 | 1,815 99 | 0.00E+00 | 1.24E+03 | 2 48E+03 |
| Tc-99 | 4 6656E-04 | 908 00 | 1,815 99 | 0 00E+00 | 4 24E-01 | 8 47E-01 |
| Th-229 | 1 4547E-11 | 908 00 | 1,815 99 | 0 00E+00 | 1 32E-08 | 2 64E-08 |
| Th-230 | 1 6617E-10 | 908 00 | 1,815 99 | 0 00E+00 | 1 51E-07 | 3 02E-07 |
| Th-232 | 8.3361E-12 | 908 00 | 1,815 99 | 0 00E+00 | 7.57E-09 | 1 51E-08 |
| Tl-208 | 2 1664E-08 | 908 00 | 1,815 99 | 0 00E+00 | 1.97E-05 | 3 93E-05 |
| U-232 | 5 8669E-08 | 908 00 | 1,815.99 | 0 00E+00 | 5.33E-05 | 1 07E-04 |
| U-233 | 3 1847E-09 | 908 00 | 1,815 99 | 0 00E+00 | 2 89E-06 | 5 78E-06 |
| U-234 | 3 8769E-07 | 908 00 | 1,815 99 | 0 00E+00 | 3.52E-04 | 7 04E-04 |
| U-235 | -2 7761E-06 | 908 00 | 0 00 | 6 08E-03 | 3 56E-03 | 6 08E-03 |
| U-236 | 1 6190E-05 | 908 00 | 1,815 99 | 0 00E+00 | 1 47E-02 | 2 94E-02 |
| U-238 | -2 8547E-09 | 908 00 | 0 00 | 7 12E-05 | 6 86E-05 | 7 12E-05 |
| Y-90 | 1.3652E+00 | 908 00 | 1,815 99 | 0 00E+00 | 1 24E+03 | 2.48E+03 |
| Other Radionuclides | | | | | 1 50E+03 | 3 00E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.355E+14 |
| 0 0250 | 2 817E+13 |
| 0 0375 | 2 436E+13 |
| 0 0575 | 2 626E+13 |
| 0 0850 | 1 587E+13 |
| 0 1250 | 1 030E+13 |
| 0.2250 | 1.366E+13 |
| 0.3750 | 5.957E+12 |
| 0.5750 | 9.813E+13 |
| 0.8500 | 9.933E+11 |
| 1.2500 | 9.873E+12 |
| 1 7500 | 2.562E+10 |
| 2.2500 | 5.319E+07 |
| 2.7500 | 1.538E+06 |
| 3.5000 | 1.083E+02 |
| 5.0000 | 4 454E+01 |
| 7 0000 | 4 918E+00 |
| 11 0000 | 5 518E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.59E+01 | 3.17E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 92 9998016 | 60 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.
This fuel matches Pathfinder Template on all but one parameter (cladding, but substituting Stainless Steel is a good conservative assumption).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 908.00 |
| Bounding | | 1 815.99 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 6 44 | |
| Bounding | 12.87 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | SHIPPINGPORT PWR-C2-S1 | [1]Fuel decay start date | 1969 |
| SNF ID # | 195 | Estimates as of | 2010 |
| Fuel Units & Descr | 19 - 19 FLAT PLATES | Template | Pathfinder (Light Water, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=343.226kg, EOL=220 031kg | [2]Template Burnup(MWd) | 6 01 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00012882 |
| | | Template Decay Time | 35 years |

Estimated Canister usage 18"x15' 19 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 116,375 01 | 232,750.02 | 0 00E+00 | 2 72E-03 | 5 43E-03 |
| Am-241 | 1.1135E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.30E+01 | 2 59E+01 |
| Am-242m | 8 5075E-09 | 116,375 01 | 232,750 02 | 0 00E+00 | 9 90E-04 | 1 98E-03 |
| Am-243 | 9 8519E-10 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 15E-04 | 2.29E-04 |
| C-14 | 2 3012E-04 | 116,375 01 | 232,750 02 | 0.00E+00 | 2 68E+01 | 5.36E+01 |
| Cl-36 | 1 2261E-06 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 43E-01 | 2.85E-01 |
| Cm-243 | 2 4875E-10 | 116,375 01 | 232,750 02 | 0 00E+00 | 2 89E-05 | 5 79E-05 |
| Cm-244 | 2 3178E-09 | 116,375 01 | 232,750 02 | 0 00E+00 | 2.70E-04 | 5.39E-04 |
| Co-60 | 7.0849E-02 | 116,375 01 | 232,750 02 | 0 00E+00 | 8.25E+03 | 1 65E+04 |
| Cs-134 | 3 0266E-06 | 116,375 01 | 232,750 02 | 0 00E+00 | 3.52E-01 | 7 04E-01 |
| Cs-135 | 3 0316E-05 | 116,375 01 | 232,750 02 | 0 00E+00 | 3.53E+00 | 7 06E+00 |
| Cs-137 | 1.4511E+00 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.69E+05 | 3 38E+05 |
| Eu-154 | 6 6955E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 7 79E+01 | 1 56E+02 |
| Eu-155 | 6 9850E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 8 13E+01 | 1 63E+02 |
| Fe-55 | 1 2318E-03 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 43E+02 | 2 87E+02 |
| H-3 | 2 5141E-03 | 116,375 01 | 232,750 02 | 0 00E+00 | 2 93E+02 | 5 85E+02 |
| I-129 | 7 3195E-07 | 116,375 01 | 232,750 02 | 0 00E+00 | 8 52E-02 | 1.70E-01 |
| Kr-85 | 4 1281E-02 | 116,375 01 | 232,750 02 | 0 00E+00 | 4 80E+03 | 9 61E+03 |
| Np-237 | 1.1489E-06 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.34E-01 | 2 67E-01 |
| Pa-231 | 4.5241E-08 | 116,375 01 | 232,750 02 | 0 00E+00 | 5.26E-03 | 1 05E-02 |
| Pb-210 | 6 4476E-13 | 116,375 01 | 232,750 02 | 0 00E+00 | 7.50E-08 | 1 50E-07 |
| Pm-147 | 1 1651E-03 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.36E+02 | 2 71E+02 |
| Pu-238 | 2 9517E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 3 44E+01 | 6 87E+01 |
| Pu-239 | 6 6772E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 7 77E+01 | 1 55E+02 |
| Pu-240 | 8 6839E-05 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 01E+01 | 2 02E+01 |
| Pu-241 | 7 1514E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 8 32E+01 | 1 66E+02 |
| Pu-242 | 1 9717E-09 | 116,375 01 | 232,750 02 | 0 00E+00 | 2 29E-04 | 4.59E-04 |
| Ra-226 | 1 7654E-12 | 116,375 01 | 232,750 02 | 0 00E+00 | 2 05E-07 | 4 11E-07 |
| Ra-228 | 8.2928E-12 | 116,375 01 | 232,750 02 | 0 00E+00 | 9 65E-07 | 1 93E-06 |
| Ru-106 | 1 8419E-10 | 116,375 01 | 232,750 02 | 0 00E+00 | 2.14E-05 | 4.29E-05 |
| Se-79 | 1.3223E-05 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.54E+00 | 3 08E+00 |
| Sn-126 | 1.1493E-05 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.34E+00 | 2 67E+00 |
| Sr-90 | 1.3649E+00 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.59E+05 | 3 18E+05 |
| Tc-99 | 4 6656E-04 | 116,375 01 | 232,750 02 | 0 00E+00 | 5.43E+01 | 1 09E+02 |
| Th-229 | 1 4547E-11 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 69E-06 | 3.39E-06 |
| Th-230 | 1 6617E-10 | 116,375 01 | 232,750 02 | 0 00E+00 | 1 93E-05 | 3 87E-05 |
| Th-232 | 8 3361E-12 | 116,375.01 | 232,750 02 | 0 00E+00 | 9 70E-07 | 1.94E-06 |
| Tl-208 | 2 1664E-08 | 116,375 01 | 232,750 02 | 0.00E+00 | 2 52E-03 | 5 04E-03 |
| U-232 | 5 8669E-08 | 116,375 01 | 232,750 02 | 0 00E+00 | 6 83E-03 | 1.37E-02 |
| U-233 | 3 1847E-09 | 116,375 01 | 232,750 02 | 0 00E+00 | 3 71E-04 | 7 41E-04 |
| U-234 | 3 8769E-07 | 116,375 01 | 232,750 02 | 0 00E+00 | 4 51E-02 | 9 02E-02 |
| U-235 | -2 7761E-06 | 116,375 01 | 0 00 | 6 90E-01 | 3.67E-01 | 6 90E-01 |
| U-236 | 1.6190E-05 | 116,375 01 | 232,750 02 | 0 00E+00 | 1.88E+00 | 3 77E+00 |
| U-238 | -2 8547E-09 | 116,375 01 | 0 00 | 8 07E-03 | 7 74E-03 | 8 07E-03 |
| Y-90 | 1.3652E+00 | 116,375 01 | 232,750.02 | 0 00E+00 | 1.59E+05 | 3 18E+05 |
| Other Radionuclides | | | | | 1 92E+05 | 3 84E+05 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 1 737E+16 |
| 0 0250 | 3.610E+15 |
| 0 0375 | 3 122E+15 |
| 0 0575 | 3.366E+15 |
| 0 0850 | 2.034E+15 |
| 0 1250 | 1.320E+15 |
| 0.2250 | 1 750E+15 |
| 0.3750 | 7 635E+14 |
| 0 5750 | 1.258E+16 |
| 0 8500 | 1.273E+14 |
| 1 2500 | 1.265E+15 |
| 1 7500 | 3.284E+12 |
| 2.2500 | 6 818E+09 |
| 2.7500 | 1 971E+08 |
| 3.5000 | 1.387E+04 |
| 5.0000 | 5 705E+03 |
| 7.0000 | 6.299E+02 |
| 11 0000 | 7.068E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.03E+03 | 4.06E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator[1] | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment %[1] | 93 00008304 | 60 to 100 |

**Basis for Parameter Differences[1]**

This Template was used for the following reasons

This fuel matches Pathfinder Template on all but one parameter (cladding but substituting Stainless Steel is a good conservative assumption)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 116,375 01 |
| Bounding | | 232,750 02 |

**Basis for burnup used in estimate[1]**

Nominal burnup calculated from the heavy metal mass destroyed

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 7.27 | |
| Bounding[1] | 14.54 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SHIPPINGPORT PWR-C2-S2
SNF ID #: 196
Fuel Units & Descr: 20 - 19 FLAT PLATES
Heavy Metal Mass: BOL=419 354kg, EOL=301.588kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1974
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time: 35 years

Estimated Canister usage: 18"x15' — 20 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2.3344E-08 | 111,247 37 | 222,494 74 | 0 00E+00 | 2 60E-03 | 5 19E-03 |
| Am-241 | 1.1135E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 24E+01 | 2 48E+01 |
| Am-242m | 8 5075E-09 | 111,247 37 | 222,494 74 | 0 00E+00 | 9 46E-04 | 1 89E-03 |
| Am-243 | 9 8519E-10 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 10E-04 | 2 19E-04 |
| C-14 | 2.3012E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 2 56E+01 | 5 12E+01 |
| Cl-36 | 1.2261E-06 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 36E-01 | 2 73E-01 |
| Cm-243 | 2.4875E-10 | 111,247 37 | 222,494 74 | 0 00E+00 | 2 77E-05 | 5 53E-05 |
| Cm-244 | 2.3178E-09 | 111,247 37 | 222,494 74 | 0 00E+00 | 2 58E-04 | 5 16E-04 |
| Co-60 | 7 0849E-02 | 111,247 37 | 222,494 74 | 0 00E+00 | 7 88E+03 | 1 58E+04 |
| Cs-134 | 3 0266E-06 | 111,247.37 | 222,494 74 | 0 00E+00 | 3 37E-01 | 6 73E-01 |
| Cs-135 | 3 0316E-05 | 111,247.37 | 222,494 74 | 0 00E+00 | 3 37E+00 | 6 75E+00 |
| Cs-137 | 1 4511E+00 | 111,247.37 | 222,494 74 | 0 00E+00 | 1 61E+05 | 3.23E+05 |
| Eu-154 | 6 6955E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 7 45E+01 | 1 49E+02 |
| Eu-155 | 6 9850E-04 | 111,247.37 | 222,494 74 | 0 00E+00 | 7 77E+01 | 1.55E+02 |
| Fe-55 | 1.2318E-03 | 111,247.37 | 222,494 74 | 0 00E+00 | 1 37E+02 | 2.74E+02 |
| H-3 | 2 5141E-03 | 111,247.37 | 222,494 74 | 0 00E+00 | 2 80E+02 | 5 59E+02 |
| I-129 | 7 3195E-07 | 111,247.37 | 222,494 74 | 0 00E+00 | 8 14E-02 | 1 63E-01 |
| Kr-85 | 4 1281E-02 | 111,247.37 | 222,494 74 | 0 00E+00 | 4 59E+03 | 9 18E+03 |
| Np-237 | 1 1489E-06 | 111,247.37 | 222,494 74 | 0 00E+00 | 1 28E-01 | 2 56E-01 |
| Pa-231 | 4 5241E-08 | 111,247.37 | 222,494 74 | 0 00E+00 | 5 03E-03 | 1 01E-02 |
| Pb-210 | 6 4476E-13 | 111,247 37 | 222,494 74 | 0 00E+00 | 7 17E-08 | 1 43E-07 |
| Pm-147 | 1 1651E-03 | 111,247 37 | 222,494 74 | 0 00E+00 | 1.30E+02 | 2.59E+02 |
| Pu-238 | 2 9517E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 3 28E+01 | 6 57E+01 |
| Pu-239 | 6 6772E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 7 43E+01 | 1 49E+02 |
| Pu-240 | 8 6839E-05 | 111,247 37 | 222,494 74 | 0 00E+00 | 9 66E+00 | 1 93E+01 |
| Pu-241 | 7 1514E-04 | 111,247 37 | 222,494 74 | 0 00E+00 | 7 96E+01 | 1.59E+02 |
| Pu-242 | 1 9717E-09 | 111,247 37 | 222,494 74 | 0 00E+00 | 2 19E-04 | 4.39E-04 |
| Ra-226 | 1 7654E-12 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 96E-07 | 3 93E-07 |
| Ra-228 | 8 2928E-12 | 111,247 37 | 222,494.74 | 0 00E+00 | 9 23E-07 | 1 85E-06 |
| Ru-106 | 1 8419E-10 | 111,247 37 | 222,494.74 | 0 00E+00 | 2 05E-05 | 4.10E-05 |
| Se-79 | 1 3223E-05 | 111,247 37 | 222,494.74 | 0.00E+00 | 1.47E+00 | 2 94E+00 |
| Sn-126 | 1 1493E-05 | 111,247 37 | 222,494.74 | 0.00E+00 | 1.28E+00 | 2 56E+00 |
| Sr-90 | 1 3649E+00 | 111,247 37 | 222,494 74 | 0 00E+00 | 1.52E+05 | 3 04E+05 |
| Tc-99 | 4 6656E-04 | 111,247 37 | 222,494.74 | 0 00E+00 | 5.19E+01 | 1 04E+02 |
| Th-229 | 1 4547E-11 | 111,247 37 | 222,494 74 | 0.00E+00 | 1 62E-06 | 3.24E-06 |
| Th-230 | 1 6617E-10 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 85E-05 | 3 70E-05 |
| Th-232 | 8 3361E-12 | 111,247 37 | 222,494 74 | 0 00E+00 | 9.27E-07 | 1 85E-06 |
| Tl-208 | 2.1664E-08 | 111,247 37 | 222,494 74 | 0 00E+00 | 2.41E-03 | 4 82E-03 |
| U-232 | 5 8669E-08 | 111,247 37 | 222,494 74 | 0 00E+00 | 6.53E-03 | 1 31E-02 |
| U-233 | 3 1847E-09 | 111,247 37 | 222,494 74 | 0 00E+00 | 3.54E-04 | 7 09E-04 |
| U-234 | 3 8769E-07 | 111,247 37 | 222,494 74 | 0 00E+00 | 4.31E-02 | 8 63E-02 |
| U-235 | -2 7761E-06 | 111,247 37 | 0 00 | 8 43E-01 | 5.34E-01 | 8 43E-01 |
| U-236 | 1.6190E-05 | 111,247 37 | 222,494 74 | 0 00E+00 | 1 80E+00 | 3 60E+00 |
| U-238 | -2 8547E-09 | 111,247 37 | 0 00 | 9 87E-03 | 9 55E-03 | 9 87E-03 |
| Y-90 | 1.3652E+00 | 111,247.37 | 222,494 74 | 0 00E+00 | 1 52E+05 | 3 04E+05 |
| Other Radionuclides | | | | | 1 84E+05 | 3 67E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0.0150 | 1 661E+16 |
| 0 0250 | 3 451E+15 |
| 0 0375 | 2 985E+15 |
| 0 0575 | 3 217E+15 |
| 0 0850 | 1 944E+15 |
| 0 1250 | 1 262E+15 |
| 0.2250 | 1 673E+15 |
| 0.3750 | 7 299E+14 |
| 0 5750 | 1 202E+16 |
| 0 8500 | 1 217E+14 |
| 1.2500 | 1 210E+15 |
| 1 7500 | 3 139E+12 |
| 2.2500 | 6 517E+09 |
| 2.7500 | 1 884E+08 |
| 3 5000 | 1 328E+04 |
| 5 0000 | 5 461E+03 |
| 7 0000 | 6 030E+02 |
| 11 0000 | 6 766E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 94E+03 | 3.88E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 00000016 | 60 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons:
This fuel matches Pathfinder Template on all but one parameter (cladding, but substituting Stainless Steel is a good conservative assumption)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 111,247.37 |
| Bounding | | 222 494 74 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 5.69 | |
| Bounding | 11 37 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SM-1A
SNF ID #: 201
Fuel Units & Descr: 93 - ASSEMBLY
Heavy Metal Mass BOL=79 775kg, EOL=65 751kg
ROD Storage Site INEEL

[1]Fuel decay start date 1971
Estimates as of 2010
Template Pathfinder (Light Water SST, 60 to 100%, U)
[2]Template Burnup(MWd). 6 01
Template BOL Heavy Metal Mass (MT) 0 00012882
Template Decay Time 35 years

Estimated Canister usage 18"x10' 5 81

**II. Estimates**

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 3344E-08 | 13,248 12 | 26,496 23 | 0 00E+00 | 3 09E-04 | 6 19E-04 |
| Am-241 | 1.1135E-04 | 13,248 12 | 26,496 23 | 0 00E+00 | 1 48E+00 | 2 95E+00 |
| Am-242m | 8.5075E-09 | 13,248 12 | 26,496 23 | 0 00E+00 | 1.13E-04 | 2.25E-04 |
| Am-243 | 9 8519E-10 | 13,248 12 | 26,496 23 | 0 00E+00 | 1.31E-05 | 2 61E-05 |
| C-14 | 2.3012E-04 | 13,248 12 | 26,496 23 | 0.00E+00 | 3 05E+00 | 6 10E+00 |
| Cl-36 | 1.2261E-06 | 13 248 12 | 26,496.23 | 0.00E+00 | 1.62E-02 | 3.25E-02 |
| Cm-243 | 2 4875E-10 | 13,248 12 | 26,496.23 | 0.00E+00 | 3 30E-06 | 6.59E-06 |
| Cm-244 | 2 3178E-09 | 13,248 12 | 26,496 23 | 0 00E+00 | 3 07E-05 | 6.14E-05 |
| Co-60 | 7 0849E-02 | 13,248 12 | 26,496.23 | 0 00E+00 | 9.39E+02 | 1 88E+03 |
| Cs-134 | 3 0266E-06 | 13,248 12 | 26,496.23 | 0 00E+00 | 4 01E-02 | 8 02E-02 |
| Cs-135 | 3 0316E-05 | 13,248 12 | 26,496.23 | 0 00E+00 | 4 02E-01 | 8 03E-01 |
| Cs-137 | 1 4511E+00 | 13,248 12 | 26,496.23 | 0 00E+00 | 1.92E+04 | 3 84E+04 |
| Eu-154 | 6 6955E-04 | 13,248 12 | 26,496.23 | 0 00E+00 | 8 87E+00 | 1.77E+01 |
| Eu-155 | 6 9850E-04 | 13,248 12 | 26,496.23 | 0 00E+00 | 9.25E+00 | 1.85E+01 |
| Fe-55 | 1 2318E-03 | 13,248 12 | 26,496 23 | 0 00E+00 | 1 63E+01 | 3.26E+01 |
| H-3 | 2 5141E-03 | 13,248 12 | 26,496 23 | 0 00E+00 | 3 33E+01 | 6 66E+01 |
| I-129 | 7.3195E-07 | 13,248 12 | 26,496 23 | 0 00E+00 | 9 70E-03 | 1 94E-02 |
| Kr-85 | 4 1281E-02 | 13,248 12 | 26,496 23 | 0 00E+00 | 5 47E+02 | 1 09E+03 |
| Np-237 | 1.1489E-06 | 13,248 12 | 26,496 23 | 0 00E+00 | 1.52E-02 | 3 04E-02 |
| Pa-231 | 4 5241E-08 | 13,248 12 | 26,496 23 | 0 00E+00 | 5 99E-04 | 1.20E-03 |
| Pb-210 | 6 4476E-13 | 13,248 12 | 26,496 23 | 0 00E+00 | 8 54E-09 | 1 71E-08 |
| Pm-147 | 1.1651E-03 | 13,248 12 | 26,496 23 | 0 00E+00 | 1 54E+01 | 3 09E+01 |
| Pu-238 | 2.9517E-04 | 13,248 12 | 26,496.23 | 0.00E+00 | 3 91E+00 | 7 82E+00 |
| Pu-239 | 6 6772E-04 | 13,248 12 | 26,496.23 | 0 00E+00 | 8 85E+00 | 1 77E+01 |
| Pu-240 | 8 6839E-05 | 13,248 12 | 26,496.23 | 0 00E+00 | 1.15E+00 | 2.30E+00 |
| Pu-241 | 7 1514E-04 | 13,248 12 | 26,496.23 | 0 00E+00 | 9 47E+00 | 1.89E+01 |
| Pu-242 | 1 9717E-09 | 13,248 12 | 26,496.23 | 0 00E+00 | 2.61E-05 | 5.22E-05 |
| Ra-226 | 1 7654E-12 | 13,248 12 | 26,496.23 | 0 00E+00 | 2.34E-08 | 4 68E-08 |
| Ra-228 | 8 2928E-12 | 13,248 12 | 26,496.23 | 0 00E+00 | 1 10E-07 | 2.20E-07 |
| Ru-106 | 1 8419E-10 | 13,248 12 | 26,496.23 | 0 00E+00 | 2 44E-06 | 4 88E-06 |
| Se-79 | 1 3223E-05 | 13,248 12 | 26,496.23 | 0 00E+00 | 1.75E-01 | 3 50E-01 |
| Sn-126 | 1 1493E-05 | 13,248 12 | 26,496.23 | 0 00E+00 | 1 52E-01 | 3 05E-01 |
| Sr-90 | 1 3649E+00 | 13,248.12 | 26,496.23 | 0 00E+00 | 1 81E+04 | 3 62E+04 |
| Tc-99 | 4 6656E-04 | 13,248 12 | 26,496 23 | 0 00E+00 | 6 18E+00 | 1.24E+01 |
| Th-229 | 1 4547E-11 | 13,248 12 | 26,496 23 | 0 00E+00 | 1 93E-07 | 3 85E-07 |
| Th-230 | 1 6617E-10 | 13,248 12 | 26,496 23 | 0 00E+00 | 2 20E-06 | 4 40E-06 |
| Th-232 | 8 3361E-12 | 13,248 12 | 26,496 23 | 0 00E+00 | 1.10E-07 | 2 21E-07 |
| Tl-208 | 2.1664E-08 | 13,248 12 | 26,496 23 | 0 00E+00 | 2.87E-04 | 5 74E-04 |
| U-232 | 5 8669E-08 | 13,248 12 | 26,496.23 | 0 00E+00 | 7 77E-04 | 1.55E-03 |
| U-233 | 3 1847E-09 | 13,248 12 | 26,496.23 | 0 00E+00 | 4.22E-05 | 8 44E-05 |
| U-234 | 3 8769E-07 | 13,248 12 | 26,496.23 | 0 00E+00 | 5.14E-03 | 1.03E-02 |
| U-235 | -2 7761E-06 | 13,248 12 | 0 00 | 1.60E-01 | 1.24E-01 | 1.60E-01 |
| U-236 | 1 6190E-05 | 13,248 12 | 26,496.23 | 0 00E+00 | 2.14E-01 | 4.29E-01 |
| U-238 | -2 8547E-09 | 13,248 12 | 0 00 | 1 87E-03 | 1.84E-03 | 1.87E-03 |
| Y-90 | 1.3652E+00 | 13,248 12 | 26,496.23 | 0 00E+00 | 1 81E+04 | 3 62E+04 |
| Other Radionuclides | | | | | 2.19E+04 | 4.37E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 978E+15 |
| 0 0250 | 4 110E+14 |
| 0 0375 | 3 555E+14 |
| 0 0575 | 3 832E+14 |
| 0 0850 | 2.315E+14 |
| 0 1250 | 1 503E+14 |
| 0 2250 | 1 993E+14 |
| 0 3750 | 8 692E+13 |
| 0 5750 | 1 432E+15 |
| 0 8500 | 1 449E+13 |
| 1.2500 | 1 441E+14 |
| 1 7500 | 3 738E+11 |
| 2.2500 | 7 761E+08 |
| 2 7500 | 2.244E+07 |
| 3.5000 | 1.587E+03 |
| 5.0000 | 6.528E+02 |
| 7.0000 | 7.208E+01 |
| 11.0000 | 8 089E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.31E+02 | 4 63E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences |
|---|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | SST | SST | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 93 01311673 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 408 77 | 13,248 12 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 26 496.23 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 3.56 | 32 41 | 1 01 |
| Bounding | 7.12 | | |

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SNAP
SNF ID #: 203
Fuel Units & Descr: 615 - DECLAD ROD
Heavy Metal Mass: BOL= , EOL=29 766kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1958
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 50 years

Estimated Canister usage

| HIC |
|---|
| 6 15 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 4992E-09 | 28,414 84 | 28,414 84 | 0 00E+00 | 2 70E-04 | 2 70E-04 |
| Am-241 | 4 0120E-03 | 28,414 84 | 28,414 84 | 0 00E+00 | 1 14E+02 | 1 14E+02 |
| Am-242m | 1.1510E-06 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 27E-02 | 3.27E-02 |
| Am-243 | 1 4713E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 4 18E-03 | 4 18E-03 |
| C-14 | 1.2800E-04 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 64E+00 | 3 64E+00 |
| Cl-36 | 2 8120E-06 | 28,414 84 | 28,414 84 | 0 00E+00 | 7 99E-02 | 7 99E-02 |
| Cm-243 | 6.0120E-08 | 28,414 84 | 28,414 84 | 0 00E+00 | 1 71E-03 | 1 71E-03 |
| Cm-244 | 3 0331E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 8 62E-03 | 8 62E-03 |
| Co-60 | 3 4647E-03 | 28,414 84 | 28,414 84 | 0.00E+00 | 9 84E+01 | 9 84E+01 |
| Cs-134 | 2 4632E-08 | 28,414 84 | 28,414 84 | 0 00E+00 | 7 00E-04 | 7 00E-04 |
| Cs-135 | 3.2195E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 9 15E-01 | 9 15E-01 |
| Cs-137 | 9 7519E-01 | 28,414 84 | 28,414 84 | 0 00E+00 | 2.77E+04 | 2 77E+04 |
| Eu-154 | 4 0947E-04 | 28,414 84 | 28,414 84 | 0 00E+00 | 1.16E+01 | 1 16E+01 |
| Eu-155 | 5 4586E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 1.55E+00 | 1 55E+00 |
| Fe-55 | 4 7955E-06 | 28,414 84 | 28,414 84 | 0 00E+00 | 1.36E-01 | 1 36E-01 |
| H-3 | 8 9038E-04 | 28,414 84 | 28,414 84 | 0 00E+00 | 2.53E+01 | 2 53E+01 |
| I-129 | 7 3684E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 2 09E-02 | 2 09E-02 |
| Kr-85 | 1 3791E-02 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 92E+02 | 3 92E+02 |
| Np-237 | 1 3038E-06 | 28,414 84 | 28,414 84 | 0 00E+00 | 3.70E-02 | 3 70E-02 |
| Pa-231 | 1 5534E-08 | 28,414 84 | 28,414 84 | 0 00E+00 | 4 41E-04 | 4 41E-04 |
| Pb-210 | 7 1759E-13 | 28,414 84 | 28,414 84 | 0 00E+00 | 2 04E-08 | 2 04E-08 |
| Pm-147 | 1 4547E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 4.13E-01 | 4 13E-01 |
| Pu-238 | 7 2827E-04 | 28,414 84 | 28,414 84 | 0 00E+00 | 2 07E+01 | 2 07E+01 |
| Pu-239 | 5 5218E-03 | 28,414 84 | 28,414 84 | 0 00E+00 | 1 57E+02 | 1.57E+02 |
| Pu-240 | 2 1173E-03 | 28,414 84 | 28,414 84 | 0 00E+00 | 6 02E+01 | 6 02E+01 |
| Pu-241 | 1 1702E-02 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 33E+02 | 3.33E+02 |
| Pu-242 | 2 3128E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 6 57E-03 | 6 57E-03 |
| Ra-226 | 1 6827E-12 | 28,414 84 | 28,414 84 | 0 00E+00 | 4 78E-08 | 4 78E-08 |
| Ra-228 | 2 5263E-10 | 28,414 84 | 28,414 84 | 0 00E+00 | 7 18E-06 | 7.18E-06 |
| Ru-106 | 3 4090E-15 | 28,414 84 | 28,414 84 | 0 00E+00 | 9 69E-11 | 9 69E-11 |
| Se-79 | 1 3012E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 70E-01 | 3 70E-01 |
| Sn-126 | 1 2162E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 46E-01 | 3 46E-01 |
| Sr-90 | 8 9323E-01 | 28,414 84 | 28,414 84 | 0 00E+00 | 2 54E+04 | 2 54E+04 |
| Tc-99 | 4 4241E-04 | 28,414 84 | 28,414 84 | 0 00E+00 | 1 26E+01 | 1 26E+01 |
| Th-229 | 7 6902E-10 | 28,414.84 | 28,414.84 | 0 00E+00 | 2 19E-05 | 2.19E-05 |
| Th-230 | 1 3059E-10 | 28,414.84 | 28,414 84 | 0 00E+00 | 3 71E-06 | 3.71E-06 |
| Th-232 | 2 5278E-10 | 28,414 84 | 28,414 84 | 0 00E+00 | 7 18E-06 | 7 18E-06 |
| Tl-208 | 1.1892E-08 | 28,414.84 | 28,414 84 | 0.00E+00 | 3 38E-04 | 3.38E-04 |
| U-232 | 3 1970E-08 | 28,414 84 | 28,414 84 | 0 00E+00 | 9 08E-04 | 9 08E-04 |
| U-233 | 1.2232E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 48E-03 | 3 48E-03 |
| U-234 | 2 8662E-07 | 28,414 84 | 28,414 84 | 0 00E+00 | 8 14E-03 | 8.14E-03 |
| U-235 | -2 6194E-06 | 28,414 84 | 0 00 | 2.57E-02 | 0 00E+00 | 2.57E-02 |
| U-236 | 1.2696E-05 | 28,414 84 | 28,414 84 | 0 00E+00 | 3 61E-01 | 3 61E-01 |
| U-238 | -3 6331E-08 | 28,414 84 | 0 00 | 1 60E-02 | 1 50E-02 | 1 60E-02 |
| Y-90 | 8 9338E-01 | 28,414 84 | 28,414 84 | 0 00E+00 | 2.54E+04 | 2 54E+04 |
| Other Radionuclides | | | | | 2.80E+04 | 2 80E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1.387E+15 |
| 0 0250 | 2.881E+14 |
| 0 0375 | 2.508E+14 |
| 0 0575 | 2.702E+14 |
| 0 0850 | 1 622E+14 |
| 0 1250 | 1 053E+14 |
| 0.2250 | 1.398E+14 |
| 0.3750 | 6 097E+13 |
| 0.5750 | 1 031E+15 |
| 0 8500 | 1 014E+13 |
| 1.2500 | 1 085E+13 |
| 1 7500 | 2 617E+11 |
| 2.2500 | 6 667E+07 |
| 2.7500 | 1.202E+07 |
| 3.5000 | 3 476E+04 |
| 5.0000 | 1 463E+04 |
| 7 0000 | 1 650E+03 |
| 11 0000 | 1 876E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 18E+02 | 3.18E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | NONE | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | | 10 to 20 1 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on all parameters except cladding (SST is conservative) and enrichment (unknown).

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 28 414 84 |
| Bounding | | 28 414 84 |

**Basis for burnup used in estimate:**

Nominal burnup set equal to bounding burnup.

Bounding burnup estimated by assuming BOL heavy metal mass was twice EOL.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 14 00 | |
| Bounding | 14 00 | |

Estimated EOL HM/Given EOL HM: 1 78

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | SODIUM LOOP SAFETY FAC | [1]Fuel decay start date | 1981 |
| SNF ID # | 352 | Estimates as of. | 2010 |
| Fuel Units & Descr | 20 - ROD | Template | (Worst Case) |
| Heavy Metal Mass | BOL=4.2kg; EOL=3.968kg | [2]Template Burnup(MWd) | 62.5 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00186865 |
| | | Template Decay Time | 25 years |

Estimated Canister usage 18"x10' 0 42

**II. Estimates**

| Radionuclide | m<br>Ci/MWd From Template | $x_n$<br>Nominal Fuel Burnup (MWd)[2] | $x_b$<br>Bounding Fuel Burnup (MWd)[2] | b<br>Initial Activity (Ci) | $y_n$<br>Nominal Fuel Inventories(Ci) | $y_b$<br>Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 220 48 | 440 96 | 0 00E+00 | 4.33E-04 | 8 66E-04 |
| Am-241 | 7 8064E+00 | 220 48 | 440 96 | 0 00E+00 | 1 72E+03 | 3 44E+03 |
| Am-242m | 1.7632E-02 | 220 48 | 440 96 | 0 00E+00 | 3 89E+00 | 7.78E+00 |
| Am-243 | 1 6336E-02 | 220 48 | 440 96 | 0 00E+00 | 3 60E+00 | 7.20E+00 |
| C-14 | 1.2101E-01 | 220 48 | 440 96 | 0 00E+00 | 2 67E+01 | 5.34E+01 |
| Cl-36 | 2.2849E-03 | 220 48 | 440 96 | 0 00E+00 | 5 04E-01 | 1.01E+00 |
| Cm-243 | 1.1046E-03 | 220 48 | 440 96 | 0 00E+00 | 2.44E-01 | 4 87E-01 |
| Cm-244 | 2.4704E-01 | 220 48 | 440 96 | 0 00E+00 | 5 45E+01 | 1.09E+02 |
| Co-60 | 1.0466E+02 | 220 48 | 440 96 | 0 00E+00 | 2.31E+04 | 4 62E+04 |
| Cs-134 | 9 8289E-03 | 220 48 | 440 96 | 0 00E+00 | 2 17E+00 | 4.33E+00 |
| Cs-135 | 4.3976E-04 | 220 48 | 440 96 | 0 00E+00 | 9.70E-02 | 1 94E-01 |
| Cs-137 | 2 6526E+01 | 220 48 | 440 96 | 0.00E+00 | 5 85E+03 | 1 17E+04 |
| Eu-154 | 2 7975E+00 | 220 48 | 440 96 | 0 00E+00 | 6 17E+02 | 1.23E+03 |
| Eu-155 | 2 7881E-01 | 220 48 | 440 96 | 0.00E+00 | 6 15E+01 | 1.23E+02 |
| Fe-55 | 4.2151E+00 | 220 48 | 440 96 | 0.00E+00 | 9.29E+02 | 1 86E+03 |
| H-3 | 4 2599E-01 | 220 48 | 440 96 | 0 00E+00 | 9 39E+01 | 1 88E+02 |
| I-129 | 1 0618E-05 | 220 48 | 440 96 | 0 00E+00 | 2.34E-03 | 4 68E-03 |
| Kr-85 | 1 1426E+00 | 220 48 | 440 96 | 0 00E+00 | 2.52E+02 | 5 04E+02 |
| Np-237 | 1.5647E-04 | 220 48 | 440 96 | 0 00E+00 | 3 45E-02 | 6 90E-02 |
| Pa-231 | 2 8624E-06 | 220 48 | 440 96 | 0 00E+00 | 6 31E-04 | 1 26E-03 |
| Pb-210 | 9 2770E-09 | 220 48 | 440 96 | 0 00E+00 | 2 05E-06 | 4 09E-06 |
| Pm-147 | 2.3690E-01 | 220 48 | 440 96 | 0 00E+00 | 5.22E+01 | 1 04E+02 |
| Pu-238 | -6 1800E-01 | 220 48 | 0 00 | 5 40E+02 | 4 03E+02 | 5 40E+02 |
| Pu-239 | -4 8280E-02 | 220 48 | 0 00 | 6 53E+01 | 5 47E+01 | 6 53E+01 |
| Pu-240 | -3 0095E-01 | 220 48 | 0 00 | 8 34E+01 | 1.70E+01 | 8 34E+01 |
| Pu-241 | -7 4000E+01 | 220 48 | 0 00 | 2 15E+04 | 5 15E+03 | 2 15E+04 |
| Pu-242 | -1.1381E-04 | 220 48 | 0 00 | 3 61E-01 | 3 36E-01 | 3 61E-01 |
| Ra-226 | 3 2167E-08 | 220 48 | 440 96 | 0 00E+00 | 7 09E-06 | 1 42E-05 |
| Ra-228 | 5 9024E-07 | 220 48 | 440 96 | 0 00E+00 | 1 30E-04 | 2 60E-04 |
| Ru-106 | 3 9140E-06 | 220 48 | 440 96 | 0 00E+00 | 8 63E-04 | 1 73E-03 |
| Se-79 | 1 9184E-04 | 220 48 | 440.96 | 0 00E+00 | 4.23E-02 | 8 46E-02 |
| Sn-126 | 1 6671E-04 | 220 48 | 440.96 | 0 00E+00 | 3 68E-02 | 7.35E-02 |
| Sr-90 | 2 5126E+01 | 220 48 | 440 96 | 0 00E+00 | 5 54E+03 | 1 11E+04 |
| Tc-99 | 6 7678E-03 | 220 48 | 440.96 | 0 00E+00 | 1 49E+00 | 2 98E+00 |
| Th-229 | 1 2398E-06 | 220 48 | 440.96 | 0 00E+00 | 2 73E-04 | 5 47E-04 |
| Th-230 | 4 1442E-06 | 220 48 | 440.96 | 0 00E+00 | 9 14E-04 | 1 83E-03 |
| Th-232 | 6 0208E-07 | 220 48 | 440 96 | 0 00E+00 | 1.33E-04 | 2 65E-04 |
| Tl-208 | 9 6478E-05 | 220 48 | 440 96 | 0 00E+00 | 2 13E-02 | 4.25E-02 |
| U-232 | 2 6103E-04 | 220 48 | 440 96 | 0 00E+00 | 5 76E-02 | 1.15E-01 |
| U-233 | 3 6128E-04 | 220 48 | 440 96 | 0 00E+00 | 7 97E-02 | 1.59E-01 |
| U-234 | 1.2788E-02 | 220 48 | 440 96 | 0 00E+00 | 2 82E+00 | 5 64E+00 |
| U-235 | 5 7486E-04 | 220 48 | 440 96 | 1 81E-03 | 1.29E-01 | 2.55E-01 |
| U-236 | 2.3485E-04 | 220 48 | 440 96 | 0 00E+00 | 5 18E-02 | 1.04E-01 |
| U-238 | 1.1581E-04 | 220 48 | 440 96 | 2 25E-04 | 2 58E-02 | 5.13E-02 |
| Y-90 | 2.5126E+01 | 220 48 | 440 96 | 0 00E+00 | 5 54E+03 | 1 11E+04 |
| Other Radionuclides | | | | | 1 55E+04 | 3 09E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.418E+14 |
| 0 0250 | 1 463E+14 |
| 0 0375 | 1.305E+14 |
| 0 0575 | 1 782E+14 |
| 0 0850 | 7 705E+13 |
| 0 1250 | 6 701E+13 |
| 0.2250 | 6.545E+13 |
| 0 3750 | 2 759E+13 |
| 0 5750 | 4.401E+14 |
| 0 8500 | 2.652E+13 |
| 1.2500 | 3 441E+15 |
| 1 7500 | 8.337E+11 |
| 2.2500 | 1.812E+10 |
| 2 7500 | 1.552E+09 |
| 3 5000 | 1 648E+06 |
| 5 0000 | 7.009E+05 |
| 7 0000 | 8.043E+04 |
| 11 0000 | 9.215E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 08E+02 | 1.01E+03 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | 78 235 | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates, therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 42.00 | 220 48 |
| Bounding | | 440 96 |

**Basis for burnup used in estimate**

Nominal burnup calculated from the heavy metal mass destroyed.

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.57 | 5.25 |
| Bounding | 3 14 | |

Estimated EOL HM/Given EOL HM: 35.21

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SODIUM LOOP SAFETY FAC.
SNF ID # 367
Fuel Units & Descr 12 - ROD
Heavy Metal Mass: BOL=6.256kg, EOL=7 332kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1981
Estimates as of: 2010
Template. (Worst Case)
[2]Template Burnup(MWd): 62.5
Template BOL Heavy Metal Mass (MT): 0 00186865
Template Decay Time 25 years

Estimated Canister usage 18"x10'
0 25

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 9648E-06 | 62.56 | 125 11 | 0 00E+00 | 1 23E-04 | 2 46E-04 |
| Am-241 | 7 8064E+00 | 62.56 | 125 11 | 0 00E+00 | 4 88E+02 | 9.77E+02 |
| Am-242m | 1.7632E-02 | 62.56 | 125 11 | 0 00E+00 | 1 10E+00 | 2.21E+00 |
| Am-243 | 1 6336E-02 | 62.56 | 125 11 | 0 00E+00 | 1 02E+00 | 2 04E+00 |
| C-14 | 1 2101E-01 | 62.56 | 125 11 | 0 00E+00 | 7 57E+00 | 1.51E+01 |
| Cl-36 | 2 2849E-03 | 62.56 | 125 11 | 0 00E+00 | 1 43E-01 | 2 86E-01 |
| Cm-243 | 1 1046E-03 | 62 56 | 125 11 | 0 00E+00 | 6 91E-02 | 1 38E-01 |
| Cm-244 | 2 4704E-01 | 62.56 | 125 11 | 0 00E+00 | 1 55E+01 | 3 09E+01 |
| Co-60 | 1 0466E+02 | 62 56 | 125 11 | 0 00E+00 | 6 55E+03 | 1 31E+04 |
| Cs-134 | 9 8289E-03 | 62 56 | 125 11 | 0 00E+00 | 6 15E-01 | 1 23E+00 |
| Cs-135 | 4 3976E-04 | 62 56 | 125 11 | 0 00E+00 | 2 75E-02 | 5 50E-02 |
| Cs-137 | 2 6526E+01 | 62 56 | 125 11 | 0 00E+00 | 1 66E+03 | 3 32E+03 |
| Eu-154 | 2 7975E+00 | 62 56 | 125.11 | 0 00E+00 | 1 75E+02 | 3 50E+02 |
| Eu-155 | 2 7881E-01 | 62 56 | 125 11 | 0 00E+00 | 1 74E+01 | 3 49E+01 |
| Fe-55 | 4 2151E+00 | 62 56 | 125.11 | 0 00E+00 | 2 64E+02 | 5 27E+02 |
| H-3 | 4 2599E-01 | 62 56 | 125.11 | 0 00E+00 | 2 66E+01 | 5 33E+01 |
| I-129 | 1 0618E-05 | 62 56 | 125.11 | 0 00E+00 | 6 64E-04 | 1 33E-03 |
| Kr-85 | 1 1426E+00 | 62 56 | 125 11 | 0 00E+00 | 7 15E+01 | 1 43E+02 |
| Np-237 | 1 5647E-04 | 62 56 | 125 11 | 0 00E+00 | 9 79E-03 | 1 96E-02 |
| Pa-231 | 2 8624E-06 | 62 56 | 125 11 | 0 00E+00 | 1 79E-04 | 3 58E-04 |
| Pb-210 | 9 2770E-09 | 62 56 | 125 11 | 0 00E+00 | 5 80E-07 | 1 16E-06 |
| Pm-147 | 2 3690E-01 | 62 56 | 125 11 | 0 00E+00 | 1 48E+01 | 2 96E+01 |
| Pu-238 | -6 1800E-01 | 62 56 | 0 00 | 8 04E+02 | 7 65E+02 | 8 04E+02 |
| Pu-239 | -4 8280E-02 | 62 56 | 0 00 | 9 73E+01 | 9 43E+01 | 9 73E+01 |
| Pu-240 | -3 0095E-01 | 62 56 | 0 00 | 1.24E+02 | 1 05E+02 | 1.24E+02 |
| Pu-241 | -7 4000E+01 | 62.56 | 0 00 | 3.20E+04 | 2.73E+04 | 3.20E+04 |
| Pu-242 | -1 1381E-04 | 62 56 | 0 00 | 5 38E-01 | 5 31E-01 | 5.38E-01 |
| Ra-226 | 3.2167E-08 | 62 56 | 125 11 | 0 00E+00 | 2 01E-06 | 4 02E-06 |
| Ra-228 | 5.9024E-07 | 62 56 | 125 11 | 0 00E+00 | 3 69E-05 | 7.38E-05 |
| Ru-106 | 3 9140E-06 | 62.56 | 125 11 | 0 00E+00 | 2 45E-04 | 4 90E-04 |
| Se-79 | 1.9184E-04 | 62 56 | 125 11 | 0.00E+00 | 1 20E-02 | 2.40E-02 |
| Sn-126 | 1.6671E-04 | 62.56 | 125 11 | 0 00E+00 | 1 04E-02 | 2 09E-02 |
| Sr-90 | 2.5126E+01 | 62.56 | 125 11 | 0 00E+00 | 1 57E+03 | 3.14E+03 |
| Tc-99 | 6 7678E-03 | 62.56 | 125 11 | 0 00E+00 | 4 23E-01 | 8 47E-01 |
| Th-229 | 1.2398E-06 | 62.56 | 125 11 | 0 00E+00 | 7 76E-05 | 1.55E-04 |
| Th-230 | 4 1442E-06 | 62.56 | 125 11 | 0 00E+00 | 2 59E-04 | 5 18E-04 |
| Th-232 | 6 0208E-07 | 62.56 | 125 11 | 0 00E+00 | 3 77E-05 | 7 53E-05 |
| Tl-208 | 9 6478E-05 | 62 56 | 125 11 | 0 00E+00 | 6 04E-03 | 1 21E-02 |
| U-232 | 2 6103E-04 | 62.56 | 125 11 | 0 00E+00 | 1 63E-02 | 3 27E-02 |
| U-233 | 3 6128E-04 | 62 56 | 125 11 | 0 00E+00 | 2.26E-02 | 4 52E-02 |
| U-234 | 1 2788E-02 | 62 56 | 125 11 | 0 00E+00 | 8 00E-01 | 1 60E+00 |
| U-235 | 5 7486E-04 | 62 56 | 125 11 | 2 69E-03 | 3 87E-02 | 7 46E-02 |
| U-236 | 2 3485E-04 | 62 56 | 125 11 | 0 00E+00 | 1 47E-02 | 2 94E-02 |
| U-238 | 1 1581E-04 | 62 56 | 125 11 | 3 35E-04 | 7 58E-03 | 1 48E-02 |
| Y-90 | 2 5126E+01 | 62 56 | 125 11 | 0 00E+00 | 1 57E+03 | 3 14E+03 |
| Other Radionuclides | | | | | 4 39E+03 | 8 77E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.157E+14 |
| 0 0250 | 4 152E+13 |
| 0 0375 | 3.705E+13 |
| 0 0575 | 5.055E+13 |
| 0 0850 | 2.186E+13 |
| 0 1250 | 1 901E+13 |
| 0.2250 | 1 857E+13 |
| 0 3750 | 7 828E+12 |
| 0 5750 | 1.249E+14 |
| 0 8500 | 7.523E+12 |
| 1 2500 | 9 763E+14 |
| 1 7500 | 2.366E+11 |
| 2.2500 | 5 140E+09 |
| 2.7500 | 4 404E+08 |
| 3.5000 | 5 634E+05 |
| 5 0000 | 2.393E+05 |
| 7 0000 | 2.739E+04 |
| 11 0000 | 3 135E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.72E+02 | 3 14E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | (Worst Case) |
| Fuel Cladding | SST | SST/Inconel |
| BOL HM Constituents | Pu and U | U, Th, & Pu |
| BOL Enrichment % | 87 054 | 0 to 100 |

**Basis for Parameter Differences:**

This fuel didn't closely match any existing templates therefore the worst case template was used.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 62.56 | -1,022.96 |
| Bounding | | 125 11 |

**Basis for burnup used in estimate:**

Nominal burnup taken directly from SFD (converted to MWd)
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 30 | -16 35 |
| Bounding | 0 60 | |

Estimated EOL HM/Given EOL HM: 5 94

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | SPEC (ORME) | [1]Fuel decay start date: | 1958 |
| SNF ID # | 208 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - FLAT PLATES IN CAN | Template | HFBR (Heavy Water, Alum , 10 to 20%, U) |
| Heavy Metal Mass | BOL=2.39kg EOL=2.39kg | [2]Template Burnup(MWd): | 15 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00034251 |
| | | Template Decay Time | 50 years |

Estimated Canister usage: HIC 1 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 9527E-09 | 45 43 | 90 86 | 0 00E+00 | 1 80E-07 | 3 59E-07 |
| Am-241 | 2 9407E-02 | 45 43 | 90 86 | 0 00E+00 | 1.34E+00 | 2.67E+00 |
| Am-242m | 7.7733E-06 | 45 43 | 90 86 | 0 00E+00 | 3 53E-04 | 7 06E-04 |
| Am-243 | 6 3827E-06 | 45 43 | 90 86 | 0 00E+00 | 2 90E-04 | 5 80E-04 |
| C-14 | 2 9513E-08 | 45 43 | 90 86 | 0 00E+00 | 1.34E-06 | 2.68E-06 |
| Cl-36 | 5 9507E-35 | 45 43 | 90 86 | 0 00E+00 | 2 70E-33 | 5 41E-33 |
| Cm-243 | 1 0647E-06 | 45 43 | 90 86 | 0 00E+00 | 4 84E-05 | 9 67E-05 |
| Cm-244 | 3 4907E-05 | 45 43 | 90 86 | 0 00E+00 | 1.59E-03 | 3 17E-03 |
| Co-60 | 3 1593E-07 | 45 43 | 90 86 | 0 00E+00 | 1.44E-05 | 2.87E-05 |
| Cs-134 | 8 9067E-08 | 45 43 | 90 86 | 0 00E+00 | 4.05E-06 | 8.09E-06 |
| Cs-135 | 4 8607E-06 | 45 43 | 90 86 | 0 00E+00 | 2.21E-04 | 4.42E-04 |
| Cs-137 | 1 0113E+00 | 45 43 | 90 86 | 0 00E+00 | 4.59E+01 | 9 19E+01 |
| Eu-154 | 1 8607E-03 | 45 43 | 90 86 | 0 00E+00 | 8.45E-02 | 1.69E-01 |
| Eu-155 | 6 1700E-05 | 45 43 | 90 86 | 0 00E+00 | 2.80E-03 | 5 61E-03 |
| Fe-55 | 4 7627E-07 | 45 43 | 90 86 | 0 00E+00 | 2.16E-05 | 4.33E-05 |
| H-3 | 8 6600E-04 | 45 43 | 90 86 | 0 00E+00 | 3.93E-02 | 7.87E-02 |
| I-129 | 7.1600E-07 | 45 43 | 90 86 | 0 00E+00 | 3.25E-05 | 6.51E-05 |
| Kr-85 | 1 4713E-02 | 45 43 | 90 86 | 0 00E+00 | 6.68E-01 | 1.34E+00 |
| Np-237 | 4 0773E-06 | 45 43 | 90 86 | 0 00E+00 | 1.85E-04 | 3.70E-04 |
| Pa-231 | 6 7867E-09 | 45 43 | 90 86 | 0 00E+00 | 3 08E-07 | 6.17E-07 |
| Pb-210 | 1.2127E-12 | 45 43 | 90 86 | 0 00E+00 | 5 51E-11 | 1.10E-10 |
| Pm-147 | 1 6720E-05 | 45 43 | 90 86 | 0 00E+00 | 7 60E-04 | 1.52E-03 |
| Pu-238 | 4 3627E-03 | 45 43 | 90 86 | 0 00E+00 | 1 98E-01 | 3 96E-01 |
| Pu-239 | 1 0307E-02 | 45 43 | 90 86 | 0 00E+00 | 4 68E-01 | 9 37E-01 |
| Pu-240 | 5 4007E-03 | 45 43 | 90 86 | 0 00E+00 | 2 45E-01 | 4 91E-01 |
| Pu-241 | 8 8667E-02 | 45 43 | 90 86 | 0 00E+00 | 4 03E+00 | 8 06E+00 |
| Pu-242 | 3 0713E-06 | 45 43 | 90 86 | 0 00E+00 | 1 40E-04 | 2 79E-04 |
| Ra-226 | 3 2767E-12 | 45 43 | 90 86 | 0 00E+00 | 1 49E-10 | 2 98E-10 |
| Ra-228 | 3 5827E-14 | 45 43 | 90 86 | 0 00E+00 | 1 63E-12 | 3.26E-12 |
| Ru-106 | 9 3133E-15 | 45 43 | 90 86 | 0 00E+00 | 4.23E-13 | 8 46E-13 |
| Se-79 | 1 2533E-05 | 45 43 | 90 86 | 0 00E+00 | 5 69E-04 | 1 14E-03 |
| Sn-126 | 1 1393E-05 | 45 43 | 90 86 | 0 00E+00 | 5 18E-04 | 1 04E-03 |
| Sr-90 | 9 0067E-01 | 45 43 | 90 86 | 0 00E+00 | 4 09E+01 | 8 18E+01 |
| Tc-99 | 4 3533E-04 | 45 43 | 90 86 | 0 00E+00 | 1 98E-02 | 3 96E-02 |
| Th-229 | 3 5147E-12 | 45 43 | 90 86 | 0 00E+00 | 1 60E-10 | 3 19E-10 |
| Th-230 | 3 2487E-10 | 45 43 | 90 86 | 0 00E+00 | 1 48E-08 | 2 95E-08 |
| Th-232 | 4 2020E-14 | 45.43 | 90 86 | 0 00E+00 | 1 91E-12 | 3 82E-12 |
| Tl-208 | 5 7620E-09 | 45 43 | 90 86 | 0.00E+00 | 2 62E-07 | 5 24E-07 |
| U-232 | 1 5613E-08 | 45 43 | 90 86 | 0 00E+00 | 7 09E-07 | 1.42E-06 |
| U-233 | 1 1207E-09 | 45.43 | 90 86 | 0 00E+00 | 5 09E-08 | 1 02E-07 |
| U-234 | 9 8267E-07 | 45 43 | 90 86 | 0 00E+00 | 4 46E-05 | 8 93E-05 |
| U-235 | -2.5335E-06 | 45 43 | 0 00 | 2 66E-04 | 1 51E-04 | 2 66E-04 |
| U-236 | 1 3007E-05 | 45 43 | 90 86 | 0 00E+00 | 5 91E-04 | 1 18E-03 |
| U-238 | -1 4207E-08 | 45.43 | 0 00 | 7 62E-04 | 7 61E-04 | 7 62E-04 |
| Y-90 | 9 0133E-01 | 45 43 | 90 86 | 0 00E+00 | 4 09E+01 | 8 19E+01 |
| Other Radionuclides | | | | | 4.37E+01 | 8 74E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 507E+12 |
| 0 0250 | 9 334E+11 |
| 0 0375 | 8 169E+11 |
| 0 0575 | 9 049E+11 |
| 0 0850 | 5.242E+11 |
| 0 1250 | 3 421E+11 |
| 0.2250 | 4 517E+11 |
| 0.3750 | 1 967E+11 |
| 0.5750 | 3 416E+12 |
| 0.8500 | 3 482E+10 |
| 1.2500 | 1.382E+10 |
| 1 7500 | 9.201E+08 |
| 2.2500 | 9 103E+04 |
| 2.7500 | 1.879E+04 |
| 3.5000 | 3.590E+02 |
| 5.0000 | 1.503E+02 |
| 7.0000 | 1 687E+01 |
| 11.0000 | 1.911E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 71E-01 | 1 14E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | ORGANIC | HEAVY WATER |
| Fuel Cladding | ALUM | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 5 146443515 | 10 to 20 |

**Basis for Parameter Differences:**

This Template was used for the following reasons

This fuel matches on cladding and BOL heavy metal, heavy water is a conservative assumption for moderator, and it is fairly close on enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 45.43 |
| Bounding | | 90.86 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 43 | |
| Bounding | 0 87 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: SPSS (SPERT)
SNF ID #: 213
Fuel Units & Descr: 1 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=0 59kg; EOL=0 588kg
ROD Storage Site. INEEL

[1]Fuel decay start date: 1959
Estimates as of: 2010
Template: Pathfinder (Light Water, SST, 60 to 100%, U)
[2]Template Burnup(MWd). 6 01
Template BOL Heavy Metal Mass (MT): 0 00012882
Template Decay Time: 50 years

Estimated Canister usage: 18"x10' 0 08

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 3 4276E-08 | 1 89 | 3 78 | 0 00E+00 | 6 48E-08 | 1.30E-07 |
| Am-241 | 1 1458E-04 | 1 89 | 3 78 | 0 00E+00 | 2 16E-04 | 4.33E-04 |
| Am-242m | 7 9468E-09 | 1 89 | 3 78 | 0 00E+00 | 1.50E-08 | 3 00E-08 |
| Am-243 | 9 8386E-10 | 1 89 | 3.78 | 0 00E+00 | 1 86E-09 | 3 72E-09 |
| C-14 | 2 2978E-04 | 1 89 | 3.78 | 0 00E+00 | 4.34E-04 | 8 68E-04 |
| Cl-36 | 1 2261E-06 | 1 89 | 3.78 | 0 00E+00 | 2.32E-06 | 4 63E-06 |
| Cm-243 | 1 7271E-10 | 1 89 | 3.78 | 0 00E+00 | 3.26E-10 | 6 53E-10 |
| Cm-244 | 1 3058E-09 | 1 89 | 3.78 | 0 00E+00 | 2 47E-09 | 4 93E-09 |
| Co-60 | 9 8636E-03 | 1.89 | 3.78 | 0 00E+00 | 1 86E-02 | 3 73E-02 |
| Cs-134 | 1 9617E-08 | 1 89 | 3 78 | 0 00E+00 | 3 71E-08 | 7 41E-08 |
| Cs-135 | 3 0316E-05 | 1 89 | 3 78 | 0 00E+00 | 5 73E-05 | 1 15E-04 |
| Cs-137 | 1 0263E+00 | 1 89 | 3 78 | 0 00E+00 | 1.94E+00 | 3 88E+00 |
| Eu-154 | 2 0017E-04 | 1 89 | 3 78 | 0 00E+00 | 3 78E-04 | 7 56E-04 |
| Eu-155 | 8 5957E-05 | 1 89 | 3 78 | 0 00E+00 | 1 62E-04 | 3 25E-04 |
| Fe-55 | 2 2646E-05 | 1 89 | 3 78 | 0 00E+00 | 4 28E-05 | 8 56E-05 |
| H-3 | 1 0835E-03 | 1 89 | 3 78 | 0 00E+00 | 2 05E-03 | 4 09E-03 |
| I-129 | 7 3195E-07 | 1 89 | 3 78 | 0 00E+00 | 1 38E-06 | 2 77E-06 |
| Kr-85 | 1 5661E-02 | 1 89 | 3 78 | 0 00E+00 | 2 96E-02 | 5 92E-02 |
| Np-237 | 1 1494E-06 | 1 89 | 3 78 | 0 00E+00 | 2 17E-06 | 4 34E-06 |
| Pa-231 | 5 8070E-08 | 1 89 | 3 78 | 0 00E+00 | 1 10E-07 | 2 19E-07 |
| Pb-210 | 1 2985E-12 | 1 89 | 3 78 | 0 00E+00 | 2 45E-12 | 4 91E-12 |
| Pm-147 | 2 2196E-05 | 1 89 | 3 78 | 0 00E+00 | 4 19E-05 | 8 39E-05 |
| Pu-238 | 2 6223E-04 | 1 89 | 3 78 | 0 00E+00 | 4 95E-04 | 9 91E-04 |
| Pu-239 | 6 6739E-04 | 1 89 | 3 78 | 0 00E+00 | 1 26E-03 | 2 52E-03 |
| Pu-240 | 8 6705E-05 | 1 89 | 3 78 | 0 00E+00 | 1 64E-04 | 3 28E-04 |
| Pu-241 | 3 4759E-04 | 1 89 | 3 78 | 0 00E+00 | 6 57E-04 | 1 31E-03 |
| Pu-242 | 1 9717E-09 | 1 89 | 3 78 | 0 00E+00 | 3 73E-09 | 7 45E-09 |
| Ra-226 | 3 0000E-12 | 1 89 | 3 78 | 0 00E+00 | 5 67E-12 | 1 13E-11 |
| Ra-228 | 8 3328E-12 | 1 89 | 3 78 | 0 00E+00 | 1 57E-11 | 3.15E-11 |
| Ru-106 | 6 1464E-15 | 1 89 | 3 78 | 0 00E+00 | 1 16E-14 | 2.32E-14 |
| Se-79 | 1 3221E-05 | 1 89 | 3 78 | 0 00E+00 | 2 50E-05 | 5 00E-05 |
| Sn-126 | 1 1491E-05 | 1 89 | 3 78 | 0 00E+00 | 2 17E-05 | 4.34E-05 |
| Sr-90 | 9 5541E-01 | 1 89 | 3 78 | 0 00E+00 | 1 81E+00 | 3 61E+00 |
| Tc-99 | 4 6656E-04 | 1 89 | 3 78 | 0 00E+00 | 8 81E-04 | 1.76E-03 |
| Th-229 | 1 9085E-11 | 1 89 | 3 78 | 0 00E+00 | 3 61E-11 | 7.21E-11 |
| Th-230 | 2.1913E-10 | 1 89 | 3 78 | 0 00E+00 | 4 14E-10 | 8.28E-10 |
| Th-232 | 8 3478E-12 | 1 89 | 3 78 | 0 00E+00 | 1 58E-11 | 3.15E-11 |
| Tl-208 | 1 8752E-08 | 1 89 | 3 78 | 0 00E+00 | 3 54E-08 | 7 09E-08 |
| U-232 | 5 0782E-08 | 1 89 | 3 78 | 0 00E+00 | 9 59E-08 | 1 92E-07 |
| U-233 | 3.2596E-09 | 1 89 | 3 78 | 0 00E+00 | 6 16E-09 | 1.23E-08 |
| U-234 | 3 9817E-07 | 1 89 | 3 78 | 0 00E+00 | 7 52E-07 | 1 50E-06 |
| U-235 | -2.7761E-06 | 1 89 | 0 00 | 1.19E-03 | 1.18E-03 | 1.19E-03 |
| U-236 | 1 6190E-05 | 1 89 | 3 78 | 0 00E+00 | 3.06E-05 | 6 12E-05 |
| U-238 | -2 8547E-09 | 1 89 | 0 00 | 1 38E-05 | 1 38E-05 | 1 38E-05 |
| Y-90 | 9.5557E-01 | 1 89 | 3.78 | 0 00E+00 | 1 81E+00 | 3 61E+00 |
| Other Radionuclides | | | | | 2 30E+00 | 4 61E+00 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 971E+11 |
| 0 0250 | 4 095E+10 |
| 0 0375 | 3 550E+10 |
| 0 0575 | 3 818E+10 |
| 0 0850 | 2 307E+10 |
| 0 1250 | 1 497E+10 |
| 0.2250 | 1 990E+10 |
| 0.3750 | 8 670E+09 |
| 0 5750 | 1 444E+11 |
| 0 8500 | 1 425E+09 |
| 1.2500 | 3.246E+09 |
| 1 7500 | 3 670E+07 |
| 2.2500 | 1 860E+04 |
| 2 7500 | 2.534E+03 |
| 3.5000 | 3.334E-01 |
| 5 0000 | 1 385E-01 |
| 7 0000 | 1 541E-02 |
| 11 0000 | 1 736E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.21E-02 | 4 41E-02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 051 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | | 1 89 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 3 78 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 07 | |
| Bounding | 0 14 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | TMI-2 | [1]Fuel decay start date. | 1979 |
| SNF ID # | 228 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - CANISTER OF SCRAP | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=0.032kg, EOL=0 032kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site: | INEEL | Template BOL Heavy Metal Mass (MT). | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage

| 18"x10' |
|---|
| 0 06 |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 0 19 | 0 38 | 0 00E+00 | 1.26E-10 | 2.52E-10 |
| Am-241 | 1.3144E-01 | 0 19 | 0 38 | 0 00E+00 | 2.50E-02 | 5 00E-02 |
| Am-242m | 3 0039E-04 | 0 19 | 0 38 | 0 00E+00 | 5 71E-05 | 1.14E-04 |
| Am-243 | 6.2629E-04 | 0 19 | 0 38 | 0 00E+00 | 1.19E-04 | 2.38E-04 |
| C-14 | 4 7965E-05 | 0 19 | 0 38 | 0 00E+00 | 9 12E-06 | 1.82E-05 |
| Cl-36 | 8 0297E-07 | 0 19 | 0 38 | 0 00E+00 | 1.53E-07 | 3 05E-07 |
| Cm-243 | 3 1993E-04 | 0 19 | 0 38 | 0 00E+00 | 6 08E-05 | 1.22E-04 |
| Cm-244 | 7 1851E-02 | 0 19 | 0 38 | 0 00E+00 | 1.37E-02 | 2 73E-02 |
| Co-60 | 9 5220E-03 | 0 19 | 0.38 | 0 00E+00 | 1 81E-03 | 3 62E-03 |
| Cs-134 | 1 1662E-03 | 0 19 | 0.38 | 0 00E+00 | 2.22E-04 | 4 44E-04 |
| Cs-135 | 1 4433E-05 | 0 19 | 0.38 | 0 00E+00 | 2 75E-06 | 5.49E-06 |
| Cs-137 | 1 7603E+00 | 0 19 | 0.38 | 0 00E+00 | 3.35E-01 | 6 70E-01 |
| Eu-154 | 4 5203E-02 | 0 19 | 0.38 | 0 00E+00 | 8 60E-03 | 1 72E-02 |
| Eu-155 | 7 1479E-03 | 0 19 | 0.38 | 0 00E+00 | 1.36E-03 | 2 72E-03 |
| Fe-55 | 6 1919E-04 | 0 19 | 0.38 | 0 00E+00 | 1 18E-04 | 2.36E-04 |
| H-3 | 3 6386E-02 | 0 19 | 0 38 | 0 00E+00 | 6 92E-03 | 1.38E-02 |
| I-129 | 9 8288E-07 | 0 19 | 0 38 | 0 00E+00 | 1 87E-07 | 3 74E-07 |
| Kr-85 | 5 3844E-02 | 0 19 | 0 38 | 0 00E+00 | 1 02E-02 | 2 05E-02 |
| Np-237 | 1 0546E-05 | 0 19 | 0 38 | 0 00E+00 | 2 01E-06 | 4 01E-06 |
| Pa-231 | 1.1370E-09 | 0 19 | 0 38 | 0 00E+00 | 2 16E-10 | 4 32E-10 |
| Pb-210 | 3.3624E-11 | 0 19 | 0 38 | 0 00E+00 | 6 39E-12 | 1.28E-11 |
| Pm-147 | 5 1211E-03 | 0 19 | 0 38 | 0 00E+00 | 9 74E-04 | 1 95E-03 |
| Pu-238 | 8.0669E-02 | 0 19 | 0 38 | 0 00E+00 | 1 53E-02 | 3 07E-02 |
| Pu-239 | 1.1626E-02 | 0 19 | 0 38 | 0 00E+00 | 2.21E-03 | 4 42E-03 |
| Pu-240 | 1.5097E-02 | 0 19 | 0 38 | 0 00E+00 | 2 87E-03 | 5 74E-03 |
| Pu-241 | 1.4567E+00 | 0 19 | 0 38 | 0 00E+00 | 2 77E-01 | 5 54E-01 |
| Pu-242 | 6 4260E-05 | 0 19 | 0 38 | 0.00E+00 | 1.22E-05 | 2 44E-05 |
| Ra-226 | 1 1392E-10 | 0 19 | 0 38 | 0.00E+00 | 2 17E-11 | 4 33E-11 |
| Ra-228 | 5 1841E-12 | 0 19 | 0 38 | 0 00E+00 | 9 86E-13 | 1.97E-12 |
| Ru-106 | 5 9012E-07 | 0 19 | 0 38 | 0 00E+00 | 1.12E-07 | 2.24E-07 |
| Se-79 | 1.2379E-05 | 0 19 | 0 38 | 0 00E+00 | 2.35E-06 | 4 71E-06 |
| Sn-126 | 2.5210E-05 | 0 19 | 0 38 | 0 00E+00 | 4.79E-06 | 9 59E-06 |
| Sr-90 | 1 1630E+00 | 0 19 | 0 38 | 0 00E+00 | 2.21E-01 | 4.42E-01 |
| Tc-99 | 3 9357E-04 | 0 19 | 0 38 | 0 00E+00 | 7.49E-05 | 1.50E-04 |
| Th-229 | 8 5691E-11 | 0 19 | 0 38 | 0 00E+00 | 1 63E-11 | 3.26E-11 |
| Th-230 | 1 4493E-08 | 0 19 | 0 38 | 0 00E+00 | 2 76E-09 | 5.51E-09 |
| Th-232 | 5 2923E-12 | 0 19 | 0 38 | 0 00E+00 | 1 01E-12 | 2.01E-12 |
| Tl-208 | 1 9202E-07 | 0 19 | 0.38 | 0 00E+00 | 3 65E-08 | 7.30E-08 |
| U-232 | 5 2083E-07 | 0 19 | 0.38 | 0 00E+00 | 9 91E-08 | 1 98E-07 |
| U-233 | 2 4386E-08 | 0 19 | 0.38 | 0 00E+00 | 4 64E-09 | 9.28E-09 |
| U-234 | 4 7012E-05 | 0 19 | 0.38 | 0 00E+00 | 8 94E-06 | 1 79E-05 |
| U-235 | -1.4492E-06 | 0 19 | 0.00 | 2 50E-06 | 2 22E-06 | 2 50E-06 |
| U-236 | 7 5759E-06 | 0 19 | 0.38 | 0 00E+00 | 1.44E-06 | 2 88E-06 |
| U-238 | -2 6129E-07 | 0 19 | 0 00 | 1 04E-05 | 1 04E-05 | 1 04E-05 |
| Y-90 | 1 1631E+00 | 0 19 | 0.38 | 0 00E+00 | 2 21E-01 | 4 42E-01 |
| Other Radionuclides | | | | | 3 21E-01 | 6 43E-01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 587E+10 |
| 0 0250 | 5.239E+09 |
| 0 0375 | 5 070E+09 |
| 0 0575 | 5 531E+09 |
| 0 0850 | 2 931E+09 |
| 0 1250 | 2 141E+09 |
| 0.2250 | 2 516E+09 |
| 0.3750 | 1 080E+09 |
| 0.5750 | 2 481E+10 |
| 0 8500 | 4 897E+08 |
| 1.2500 | 6 614E+08 |
| 1 7500 | 1 449E+07 |
| 2.2500 | 2 677E+03 |
| 2 7500 | 3 009E+03 |
| 3.5000 | 3 942E+02 |
| 5 0000 | 1 685E+02 |
| 7 0000 | 1 943E+01 |
| 11 0000 | 2.231E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5.21E-03 | 1.04E-02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 3 588 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | | 0 19 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 0.38 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 17 | |
| Bounding | 0 34 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TMI-2 CORE DEBRIS
SNF ID #: 914
Fuel Units & Descr: 341 - DEBRIS
Heavy Metal Mass: BOL=82038.394kg; EOL=81749.226kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1979
Estimates as of: 2010
Template: PWR (Light Water, Zirc, 0 to 5% U)
[2]Template Burnup(MWd): 61.92
Template BOL Heavy Metal Mass (MT): 0 00176911
Template Decay Time: 25 years

Estimated Canister usage
18"x15'
341 00

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 83E-04 | 3.65E-04 |
| Am-241 | 1 3144E-01 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 61E+04 | 7.23E+04 |
| Am-242m | 3 0039E-04 | 274,985 09 | 549,970 18 | 0 00E+00 | 8 26E+01 | 1 65E+02 |
| Am-243 | 6.2629E-04 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 72E+02 | 3 44E+02 |
| C-14 | 4 7965E-05 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 32E+01 | 2 64E+01 |
| Cl-36 | 8 0297E-07 | 274,985 09 | 549,970 18 | 0 00E+00 | 2 21E-01 | 4 42E-01 |
| Cm-243 | 3.1993E-04 | 274,985 09 | 549,970 18 | 0 00E+00 | 8 80E+01 | 1.76E+02 |
| Cm-244 | 7.1851E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 98E+04 | 3 95E+04 |
| Co-60 | 9 5220E-03 | 274,985 09 | 549,970 18 | 0 00E+00 | 2 62E+03 | 5.24E+03 |
| Cs-134 | 1.1662E-03 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 21E+02 | 6 41E+02 |
| Cs-135 | 1 4433E-05 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 97E+00 | 7.94E+00 |
| Cs-137 | 1.7603E+00 | 274,985 09 | 549,970 18 | 0 00E+00 | 4 84E+05 | 9 68E+05 |
| Eu-154 | 4 5203E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 24E+04 | 2 49E+04 |
| Eu-155 | 7 1479E-03 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 97E+03 | 3 93E+03 |
| Fe-55 | 6 1919E-04 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 70E+02 | 3 41E+02 |
| H-3 | 3 6386E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 00E+04 | 2 00E+04 |
| I-129 | 9 8288E-07 | 274,985 09 | 549,970 18 | 0 00E+00 | 2.70E-01 | 5 41E-01 |
| Kr-85 | 5 3844E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 48E+04 | 2 96E+04 |
| Np-237 | 1 0546E-05 | 274,985 09 | 549,970 18 | 0 00E+00 | 2 90E+00 | 5 80E+00 |
| Pa-231 | 1 1370E-09 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 13E-04 | 6 25E-04 |
| Pb-210 | 3 3624E-11 | 274,985 09 | 549,970 18 | 0 00E+00 | 9 25E-06 | 1 85E-05 |
| Pm-147 | 5 1211E-03 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 41E+03 | 2 82E+03 |
| Pu-238 | 8 0669E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 2 22E+04 | 4 44E+04 |
| Pu-239 | 1 1626E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 20E+03 | 6 39E+03 |
| Pu-240 | 1 5097E-02 | 274,985 09 | 549,970 18 | 0 00E+00 | 4 15E+03 | 8 30E+03 |
| Pu-241 | 1 4567E+00 | 274,985 09 | 549,970 18 | 0 00E+00 | 4 01E+05 | 8 01E+05 |
| Pu-242 | 6 4260E-05 | 274,985.09 | 549,970 18 | 0 00E+00 | 1 77E+01 | 3 53E+01 |
| Ra-226 | 1 1392E-10 | 274,985 09 | 549,970 18 | 0 00E+00 | 3.13E-05 | 6 27E-05 |
| Ra-228 | 5 1841E-12 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 43E-06 | 2 85E-06 |
| Ru-106 | 5 9012E-07 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 62E-01 | 3 25E-01 |
| Se-79 | 1 2379E-05 | 274,985 09 | 549,970 18 | 0 00E+00 | 3 40E+00 | 6 81E+00 |
| Sn-126 | 2 5210E-05 | 274,985 09 | 549,970 18 | 0 00E+00 | 6 93E+00 | 1.39E+01 |
| Sr-90 | 1 1630E+00 | 274,985 09 | 549,970 18 | 0 00E+00 | 3.20E+05 | 6 40E+05 |
| Tc-99 | 3 9357E-04 | 274,985 09 | 549,970 18 | 0 00E+00 | 1 08E+02 | 2 16E+02 |
| Th-229 | 8 5691E-11 | 274,985.09 | 549,970 18 | 0 00E+00 | 2.36E-05 | 4 71E-05 |
| Th-230 | 1 4493E-08 | 274,985.09 | 549,970.18 | 0 00E+00 | 3.99E-03 | 7 97E-03 |
| Th-232 | 5 2923E-12 | 274,985 09 | 549,970.18 | 0 00E+00 | 1 46E-06 | 2 91E-06 |
| Tl-208 | 1 9202E-07 | 274,985 09 | 549,970.18 | 0 00E+00 | 5.28E-02 | 1 06E-01 |
| U-232 | 5 2083E-07 | 274,985 09 | 549,970.18 | 0 00E+00 | 1 43E-01 | 2 86E-01 |
| U-233 | 2 4386E-08 | 274,985 09 | 549,970 18 | 0 00E+00 | 6.71E-03 | 1 34E-02 |
| U-234 | 4 7012E-05 | 274,985 09 | 549,970.18 | 0 00E+00 | 1.29E+01 | 2 59E+01 |
| U-235 | -1 4492E-06 | 274,985 09 | 0 00 | 4 50E+00 | 4 10E+00 | 4 50E+00 |
| U-236 | 7 5759E-06 | 274,985 09 | 549,970.18 | 0 00E+00 | 2 08E+00 | 4 17E+00 |
| U-238 | -2 6129E-07 | 274,985 09 | 0 00 | 2 69E+01 | 2 68E+01 | 2 69E+01 |
| Y-90 | 1 1631E+00 | 274,985 09 | 549,970.18 | 0 00E+00 | 3.20E+05 | 6 40E+05 |
| Other Radionuclides | | | | | 4 65E+05 | 9 29E+05 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 740E+16 |
| 0 0250 | 7.575E+15 |
| 0 0375 | 7.331E+15 |
| 0 0575 | 7 997E+15 |
| 0 0850 | 4.238E+15 |
| 0 1250 | 3 096E+15 |
| 0 2250 | 3 638E+15 |
| 0.3750 | 1.561E+15 |
| 0 5750 | 3 587E+16 |
| 0.8500 | 7 080E+14 |
| 1 2500 | 9 563E+14 |
| 1 7500 | 2.095E+13 |
| 2.2500 | 3 870E+09 |
| 2.7500 | 4 350E+09 |
| 3.5000 | 5 701E+08 |
| 5.0000 | 2 437E+08 |
| 7 0000 | 2.809E+07 |
| 11 0000 | 3.226E+06 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.54E+03 | 1.51E+04 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LIGHT WATER | LIGHT WATER |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 2.539514873 | 0 to 5 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 260 471 90 | 274,985.09 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | 489,359 02 | 549 970 18 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 10 | 1.06 |
| Bounding | 0 19 | 1 12 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | TMI-2 CORE DEBRIS (D-153 & 388) | [1]Fuel decay start date | 1979 |
| SNF ID # | 229 | Estimates as of | 2010 |
| Fuel Units & Descr | 2 - DEBRIS | Template | PWR (Light Water, Zirc, 0 to 5%, U) |
| Heavy Metal Mass | BOL=19 08kg EOL=19 01kg | [2]Template Burnup(MWd) | 61.92 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 00176911 |
| | | Template Decay Time | 25 years |

Estimated Canister usage 18"x15': 2 00

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 6 6376E-10 | 66 57 | 133 13 | 0 00E+00 | 4 42E-08 | 8 84E-08 |
| Am-241 | 1.3144E-01 | 66 57 | 133 13 | 0 00E+00 | 8.75E+00 | 1 75E+01 |
| Am-242m | 3 0039E-04 | 66 57 | 133 13 | 0 00E+00 | 2 00E-02 | 4 00E-02 |
| Am-243 | 6.2629E-04 | 66 57 | 133 13 | 0 00E+00 | 4 17E-02 | 8 34E-02 |
| C-14 | 4 7965E-05 | 66 57 | 133.13 | 0 00E+00 | 3 19E-03 | 6 39E-03 |
| Cl-36 | 8 0297E-07 | 66 57 | 133 13 | 0 00E+00 | 5 35E-05 | 1 07E-04 |
| Cm-243 | 3 1993E-04 | 66 57 | 133 13 | 0 00E+00 | 2 13E-02 | 4 26E-02 |
| Cm-244 | 7 1851E-02 | 66 57 | 133 13 | 0 00E+00 | 4 78E+00 | 9 57E+00 |
| Co-60 | 9 5220E-03 | 66 57 | 133 13 | 0 00E+00 | 6 34E-01 | 1 27E+00 |
| Cs-134 | 1 1662E-03 | 66.57 | 133 13 | 0 00E+00 | 7 76E-02 | 1.55E-01 |
| Cs-135 | 1 4433E-05 | 66 57 | 133 13 | 0 00E+00 | 9 61E-04 | 1 92E-03 |
| Cs-137 | 1 7603E+00 | 66 57 | 133 13 | 0 00E+00 | 1 17E+02 | 2 34E+02 |
| Eu-154 | 4 5203E-02 | 66 57 | 133 13 | 0 00E+00 | 3 01E+00 | 6 02E+00 |
| Eu-155 | 7.1479E-03 | 66 57 | 133 13 | 0 00E+00 | 4 76E-01 | 9 52E-01 |
| Fe-55 | 6.1919E-04 | 66 57 | 133 13 | 0 00E+00 | 4.12E-02 | 8.24E-02 |
| H-3 | 3 6386E-02 | 66 57 | 133 13 | 0 00E+00 | 2 42E+00 | 4 84E+00 |
| I-129 | 9.8288E-07 | 66 57 | 133 13 | 0 00E+00 | 6 54E-05 | 1.31E-04 |
| Kr-85 | 5.3844E-02 | 66 57 | 133 13 | 0 00E+00 | 3.58E+00 | 7 17E+00 |
| Np-237 | 1 0546E-05 | 66 57 | 133.13 | 0 00E+00 | 7 02E-04 | 1 40E-03 |
| Pa-231 | 1 1370E-09 | 66 57 | 133 13 | 0 00E+00 | 7 57E-08 | 1 51E-07 |
| Pb-210 | 3 3624E-11 | 66 57 | 133.13 | 0 00E+00 | 2 24E-09 | 4 48E-09 |
| Pm-147 | 5 1211E-03 | 66 57 | 133 13 | 0.00E+00 | 3 41E-01 | 6 82E-01 |
| Pu-238 | 8 0669E-02 | 66 57 | 133 13 | 0.00E+00 | 5 37E+00 | 1 07E+01 |
| Pu-239 | 1 1626E-02 | 66 57 | 133 13 | 0 00E+00 | 7 74E-01 | 1 55E+00 |
| Pu-240 | 1 5097E-02 | 66.57 | 133 13 | 0 00E+00 | 1 00E+00 | 2 01E+00 |
| Pu-241 | 1 4567E+00 | 66.57 | 133 13 | 0 00E+00 | 9 70E+01 | 1 94E+02 |
| Pu-242 | 6 4260E-05 | 66.57 | 133 13 | 0 00E+00 | 4 28E-03 | 8 56E-03 |
| Ra-226 | 1 1392E-10 | 66.57 | 133 13 | 0 00E+00 | 7.58E-09 | 1.52E-08 |
| Ra-228 | 5 1841E-12 | 66 57 | 133 13 | 0 00E+00 | 3 45E-10 | 6 90E-10 |
| Ru-106 | 5 9012E-07 | 66 57 | 133 13 | 0 00E+00 | 3 93E-05 | 7.86E-05 |
| Se-79 | 1.2379E-05 | 66 57 | 133 13 | 0 00E+00 | 8.24E-04 | 1 65E-03 |
| Sn-126 | 2.5210E-05 | 66 57 | 133 13 | 0 00E+00 | 1.68E-03 | 3.36E-03 |
| Sr-90 | 1.1630E+00 | 66 57 | 133 13 | 0 00E+00 | 7.74E+01 | 1.55E+02 |
| Tc-99 | 3.9357E-04 | 66 57 | 133 13 | 0 00E+00 | 2 62E-02 | 5.24E-02 |
| Th-229 | 8 5691E-11 | 66 57 | 133 13 | 0 00E+00 | 5 70E-09 | 1 14E-08 |
| Th-230 | 1.4493E-08 | 66 57 | 133.13 | 0 00E+00 | 9 65E-07 | 1 93E-06 |
| Th-232 | 5.2923E-12 | 66 57 | 133 13 | 0 00E+00 | 3 52E-10 | 7 05E-10 |
| Tl-208 | 1.9202E-07 | 66 57 | 133 13 | 0 00E+00 | 1.28E-05 | 2 56E-05 |
| U-232 | 5 2083E-07 | 66 57 | 133 13 | 0 00E+00 | 3 47E-05 | 6 93E-05 |
| U-233 | 2.4386E-08 | 66 57 | 133 13 | 0 00E+00 | 1 62E-06 | 3 25E-06 |
| U-234 | 4 7012E-05 | 66.57 | 133 13 | 0 00E+00 | 3 13E-03 | 6.26E-03 |
| U-235 | -1.4492E-06 | 66.57 | 0 00 | 1.29E-03 | 1 19E-03 | 1.29E-03 |
| U-236 | 7 5759E-06 | 66.57 | 133 13 | 0 00E+00 | 5 04E-04 | 1 01E-03 |
| U-238 | -2.6129E-07 | 66.57 | 0 00 | 6 21E-03 | 6 19E-03 | 6.21E-03 |
| Y-90 | 1 1631E+00 | 66 57 | 133 13 | 0 00E+00 | 7 74E+01 | 1.55E+02 |
| Other Radionuclides | | | | | 1 12E+02 | 2.25E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 9 053E+12 |
| 0 0250 | 1.834E+12 |
| 0 0375 | 1 775E+12 |
| 0 0575 | 1 936E+12 |
| 0 0850 | 1 026E+12 |
| 0 1250 | 7 494E+11 |
| 0.2250 | 8 807E+11 |
| 0 3750 | 3 779E+11 |
| 0 5750 | 8 683E+12 |
| 0 8500 | 1 714E+11 |
| 1 2500 | 2.315E+11 |
| 1 7500 | 5 072E+09 |
| 2.2500 | 9 369E+05 |
| 2.7500 | 1.053E+06 |
| 3.5000 | 1.380E+05 |
| 5.0000 | 5.898E+04 |
| 7.0000 | 6.800E+03 |
| 11.0000 | 7.810E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.83E+00 | 3 65E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator: | LIGHT WATER | LIGHT WATER | |
| Fuel Cladding | ZIRC | ZIRC | |
| BOL HM Constituents: | U | U | |
| BOL Enrichment %: | 3 125 | 0 to 5 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 60 58 | 66.57 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 113 81 | 133.13 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 10 | 1 10 |
| Bounding | 0.20 | 1 17 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TORY-IIA
SNF ID #: 230
Fuel Units & Descr: 146 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=48 647kg, EOL=48 647kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1962
Estimates as of: 2010
Template: HFBR (Heavy Water, Alum , 40 to 100%, U)
[2]Template Burnup(MWd): 164 6
Template BOL Heavy Metal Mass (MT) 0 000377
Template Decay Time: 35 years

Estimated Canister usage: HIC 3 65

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 5869E-10 | 896 18 | 1,792 36 | 0 00E+00 | 8 59E-07 | 1.72E-06 |
| Am-241 | 1 0109E-02 | 896 18 | 1,792 36 | 0 00E+00 | 9 06E+00 | 1 81E+01 |
| Am-242m | 1.2789E-06 | 896 18 | 1,792 36 | 0 00E+00 | 1.15E-03 | 2.29E-03 |
| Am-243 | 3.7047E-05 | 896 18 | 1,792 36 | 0 00E+00 | 3 32E-02 | 6 64E-02 |
| C-14 | 2 6416E-08 | 896 18 | 1,792 36 | 0 00E+00 | 2 37E-05 | 4 73E-05 |
| Cl-36 | 4 4441E-31 | 896 18 | 1,792 36 | 0 00E+00 | 3 98E-28 | 7.97E-28 |
| Cm-243 | 3 9605E-06 | 896 18 | 1,792 36 | 0 00E+00 | 3 55E-03 | 7.10E-03 |
| Cm-244 | 2 6227E-03 | 896 18 | 1,792 36 | 0 00E+00 | 2 35E+00 | 4 70E+00 |
| Co-60 | 6.7740E-06 | 896 18 | 1,792 36 | 0 00E+00 | 6 07E-03 | 1.21E-02 |
| Cs-134 | 6 8894E-05 | 896 18 | 1,792 36 | 0 00E+00 | 6 17E-02 | 1.23E-01 |
| Cs-135 | 4.2564E-06 | 896 18 | 1,792 36 | 0 00E+00 | 3 81E-03 | 7 63E-03 |
| Cs-137 | 1.4399E+00 | 896 18 | 1,792 36 | 0 00E+00 | 1 29E+03 | 2 58E+03 |
| Eu-154 | 1.5522E-02 | 896 18 | 1,792 36 | 0 00E+00 | 1 39E+01 | 2.78E+01 |
| Eu-155 | 1.7588E-03 | 896 18 | 1,792 36 | 0 00E+00 | 1 58E+00 | 3.15E+00 |
| Fe-55 | 2.4933E-05 | 896 18 | 1,792 36 | 0 00E+00 | 2 23E-02 | 4 47E-02 |
| H-3 | 1.9945E-03 | 896 18 | 1,792 36 | 0 00E+00 | 1 79E+00 | 3.57E+00 |
| I-129 | 6 6403E-07 | 896 18 | 1,792 36 | 0 00E+00 | 5 95E-04 | 1.19E-03 |
| Kr-85 | 4.1002E-02 | 896 18 | 1,792 36 | 0 00E+00 | 3 67E+01 | 7 35E+01 |
| Np-237 | 3.1610E-05 | 896 18 | 1,792 36 | 0 00E+00 | 2 83E-02 | 5 67E-02 |
| Pa-231 | 1.8876E-09 | 896 18 | 1,792 36 | 0 00E+00 | 1 69E-06 | 3.38E-06 |
| Pb-210 | 8.3840E-11 | 896 18 | 1,792 36 | 0 00E+00 | 7 51E-08 | 1.50E-07 |
| Pm-147 | 4 6501E-04 | 896 18 | 1,792 36 | 0 00E+00 | 4 17E-01 | 8.33E-01 |
| Pu-238 | 1.3645E-01 | 896 18 | 1,792 36 | 0 00E+00 | 1.22E+02 | 2 45E+02 |
| Pu-239 | 6 9502E-04 | 896 18 | 1,792 36 | 0 00E+00 | 6 23E-01 | 1.25E+00 |
| Pu-240 | 3.8183E-04 | 896 18 | 1,792 36 | 0 00E+00 | 3 42E-01 | 6 84E-01 |
| Pu-241 | 6.5310E-02 | 896 18 | 1,792 36 | 0 00E+00 | 5 85E+01 | 1 17E+02 |
| Pu-242 | 3.0911E-06 | 896 18 | 1,792 36 | 0 00E+00 | 2 77E-03 | 5.54E-03 |
| Ra-226 | 2.3512E-10 | 896 18 | 1,792 36 | 0 00E+00 | 2 11E-07 | 4.21E-07 |
| Ra-228 | 3.3366E-14 | 896 18 | 1,792 36 | 0 00E+00 | 2 99E-11 | 5 98E-11 |
| Ru-106 | 2 4490E-10 | 896 18 | 1,792 36 | 0 00E+00 | 2 19E-07 | 4.39E-07 |
| Se-79 | 1.2333E-05 | 896 18 | 1,792 36 | 0 00E+00 | 1 11E-02 | 2.21E-02 |
| Sn-126 | 1 0194E-05 | 896 18 | 1,792 36 | 0 00E+00 | 9 14E-03 | 1 83E-02 |
| Sr-90 | 1.3348E+00 | 896 18 | 1,792 36 | 0 00E+00 | 1.20E+03 | 2 39E+03 |
| Tc-99 | 3 8056E-04 | 896 18 | 1,792 36 | 0 00E+00 | 3 41E-01 | 6.82E-01 |
| Th-229 | 1 7868E-11 | 896 18 | 1,792 36 | 0 00E+00 | 1 60E-08 | 3.20E-08 |
| Th-230 | 2 3348E-08 | 896 18 | 1,792 36 | 0 00E+00 | 2 09E-05 | 4.18E-05 |
| Th-232 | 4 1288E-14 | 896 18 | 1,792 36 | 0 00E+00 | 3 70E-11 | 7.40E-11 |
| Tl-208 | 4 3190E-08 | 896.18 | 1,792.36 | 0 00E+00 | 3 87E-05 | 7.74E-05 |
| U-232 | 1.1707E-07 | 896 18 | 1,792 36 | 0 00E+00 | 1 05E-04 | 2.10E-04 |
| U-233 | 7.2175E-09 | 896.18 | 1,792 36 | 0 00E+00 | 6 47E-06 | 1.29E-05 |
| U-234 | 6.1543E-05 | 896 18 | 1,792.36 | 0 00E+00 | 5 52E-02 | 1.10E-01 |
| U-235 | -2 8661E-06 | 896 18 | 0 00 | 9 80E-02 | 9 54E-02 | 9 80E-02 |
| U-236 | 1 6701E-05 | 896.18 | 1,792 36 | 0 00E+00 | 1 50E-02 | 2.99E-02 |
| U-238 | -9 4194E-09 | 896.18 | 0 00 | 1 12E-03 | 1 11E-03 | 1.12E-03 |
| Y-90 | 1 3348E+00 | 896.18 | 1,792 36 | 0 00E+00 | 1.20E+03 | 2.39E+03 |
| Other Radionuclides | | | | | 1.24E+03 | 2 47E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.324E+14 |
| 0 0250 | 2 720E+13 |
| 0 0375 | 2.384E+13 |
| 0 0575 | 2.565E+13 |
| 0 0850 | 1.535E+13 |
| 0 1250 | 1 035E+13 |
| 0 2250 | 1.327E+13 |
| 0 3750 | 5 757E+12 |
| 0 5750 | 9 616E+13 |
| 0 8500 | 1 424E+12 |
| 1.2500 | 8.509E+11 |
| 1 7500 | 4 025E+10 |
| 2.2500 | 2 787E+06 |
| 2 7500 | 2.801E+06 |
| 3 5000 | 7 448E+04 |
| 5 0000 | 3 165E+04 |
| 7 0000 | 3 624E+03 |
| 11 0000 | 4 147E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 89E+01 | 3.78E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | BERYLLIUM | HEAVY WATER |
| Fuel Cladding | NONE | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 175 | 40 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.

This fuel matches on all parameters except cladding (none) and moderator (Heavy Water is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 896 18 |
| Bounding | | 1,792.36 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass.

Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 04 | |
| Bounding | 0 08 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TORY-IIC
SNF ID #: 231
Fuel Units & Descr: 655 - CANISTER OF SCRAP
Heavy Metal Mass: BOL=59 081kg EOL=59 081kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1964
Estimates as of: 2010
Template: HFBR (Heavy Water, Alum , 40 to 100%, U)
[2]Template Burnup(MWd): 164 6
Template BOL Heavy Metal Mass (MT): 0 000377
Template Decay Time: 35 years

Estimated Canister usage: 18"x10' — 13 10

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 9 5869E-10 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 04E-06 | 2 09E-06 |
| Am-241 | 1 0109E-02 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 10E+01 | 2 20E+01 |
| Am-242m | 1.2789E-06 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 39E-03 | 2 78E-03 |
| Am-243 | 3 7047E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 4 03E-02 | 8 06E-02 |
| C-14 | 2 6416E-08 | 1,088 39 | 2,176 79 | 0 00E+00 | 2 88E-05 | 5 75E-05 |
| Cl-36 | 4 4441E-31 | 1,088 39 | 2,176 79 | 0 00E+00 | 4 84E-28 | 9 67E-28 |
| Cm-243 | 3 9605E-06 | 1,088 39 | 2,176 79 | 0 00E+00 | 4.31E-03 | 8 62E-03 |
| Cm-244 | 2 6227E-03 | 1,088 39 | 2,176 79 | 0 00E+00 | 2 85E+00 | 5 71E+00 |
| Co-60 | 6 7740E-06 | 1,088.39 | 2,176 79 | 0 00E+00 | 7.37E-03 | 1.47E-02 |
| Cs-134 | 6 8894E-05 | 1,088.39 | 2,176 79 | 0 00E+00 | 7.50E-02 | 1.50E-01 |
| Cs-135 | 4 2564E-06 | 1,088.39 | 2,176 79 | 0 00E+00 | 4 63E-03 | 9.27E-03 |
| Cs-137 | 1 4399E+00 | 1,088 39 | 2,176 79 | 0 00E+00 | 1.57E+03 | 3 13E+03 |
| Eu-154 | 1.5522E-02 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 69E+01 | 3 38E+01 |
| Eu-155 | 1 7588E-03 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 91E+00 | 3 83E+00 |
| Fe-55 | 2 4933E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 2.71E-02 | 5 43E-02 |
| H-3 | 1 9945E-03 | 1,088 39 | 2,176 79 | 0 00E+00 | 2.17E+00 | 4.34E+00 |
| I-129 | 6 6403E-07 | 1,088 39 | 2,176 79 | 0 00E+00 | 7.23E-04 | 1 45E-03 |
| Kr-85 | 4.1002E-02 | 1,088 39 | 2,176 79 | 0.00E+00 | 4 46E+01 | 8 93E+01 |
| Np-237 | 3.1610E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 3 44E-02 | 6 88E-02 |
| Pa-231 | 1 8876E-09 | 1,088 39 | 2,176 79 | 0 00E+00 | 2 05E-06 | 4 11E-06 |
| Pb-210 | 8 3840E-11 | 1,088 39 | 2,176 79 | 0 00E+00 | 9 13E-08 | 1 83E-07 |
| Pm-147 | 4 6501E-04 | 1,088 39 | 2,176 79 | 0 00E+00 | 5 06E-01 | 1 01E+00 |
| Pu-238 | 1.3645E-01 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 49E+02 | 2 97E+02 |
| Pu-239 | 6 9502E-04 | 1,088 39 | 2,176 79 | 0 00E+00 | 7 56E-01 | 1 51E+00 |
| Pu-240 | 3 8183E-04 | 1,088 39 | 2,176 79 | 0 00E+00 | 4 16E-01 | 8 31E-01 |
| Pu-241 | 6 5310E-02 | 1,088 39 | 2,176.79 | 0 00E+00 | 7 11E+01 | 1 42E+02 |
| Pu-242 | 3 0911E-06 | 1,088.39 | 2,176 79 | 0 00E+00 | 3 36E-03 | 6 73E-03 |
| Ra-226 | 2 3512E-10 | 1,088.39 | 2,176 79 | 0 00E+00 | 2 56E-07 | 5 12E-07 |
| Ra-228 | 3 3366E-14 | 1,088.39 | 2,176 79 | 0 00E+00 | 3 63E-11 | 7.26E-11 |
| Ru-106 | 2 4490E-10 | 1,088 39 | 2,176 79 | 0 00E+00 | 2 67E-07 | 5.33E-07 |
| Se-79 | 1 2333E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 1.34E-02 | 2.68E-02 |
| Sn-126 | 1 0194E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 1.11E-02 | 2.22E-02 |
| Sr-90 | 1.3348E+00 | 1,088 39 | 2,176 79 | 0 00E+00 | 1 45E+03 | 2 91E+03 |
| Tc-99 | 3 8056E-04 | 1,088 39 | 2,176 79 | 0 00E+00 | 4.14E-01 | 8.28E-01 |
| Th-229 | 1 7868E-11 | 1,088 39 | 2,176 79 | 0 00E+00 | 1.94E-08 | 3 89E-08 |
| Th-230 | 2.3348E-08 | 1,088 39 | 2,176 79 | 0 00E+00 | 2.54E-05 | 5 08E-05 |
| Th-232 | 4.1288E-14 | 1,088 39 | 2,176 79 | 0 00E+00 | 4 49E-11 | 8 99E-11 |
| Tl-208 | 4.3190E-08 | 1,088 39 | 2,176 79 | 0.00E+00 | 4 70E-05 | 9 40E-05 |
| U-232 | 1.1707E-07 | 1,088 39 | 2,176 79 | 0 00E+00 | 1.27E-04 | 2 55E-04 |
| U-233 | 7.2175E-09 | 1,088 39 | 2,176 79 | 0 00E+00 | 7 86E-06 | 1 57E-05 |
| U-234 | 6 1543E-05 | 1,088 39 | 2,176 79 | 0 00E+00 | 6 70E-02 | 1 34E-01 |
| U-235 | -2 8661E-06 | 1,088.39 | 0 00 | 1 19E-01 | 1 16E-01 | 1.19E-01 |
| U-236 | 1 6701E-05 | 1,088.39 | 2,176 79 | 0 00E+00 | 1 82E-02 | 3 64E-02 |
| U-238 | -9 4194E-09 | 1,088 39 | 0.00 | 1 36E-03 | 1 35E-03 | 1 36E-03 |
| Y-90 | 1.3348E+00 | 1,088.39 | 2,176 79 | 0 00E+00 | 1 45E+03 | 2 91E+03 |
| Other Radionuclides | | | | | 1 50E+03 | 3 00E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 608E+14 |
| 0 0250 | 3.304E+13 |
| 0 0375 | 2.895E+13 |
| 0 0575 | 3 115E+13 |
| 0 0850 | 1 864E+13 |
| 0 1250 | 1.257E+13 |
| 0.2250 | 1 611E+13 |
| 0.3750 | 6 991E+12 |
| 0.5750 | 1 168E+14 |
| 0.8500 | 1 730E+12 |
| 1.2500 | 1 033E+12 |
| 1 7500 | 4 889E+10 |
| 2.2500 | 3.384E+06 |
| 2 7500 | 3 402E+06 |
| 3 5000 | 9.045E+04 |
| 5 0000 | 3.844E+04 |
| 7 0000 | 4 401E+03 |
| 11 0000 | 5 036E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.30E+01 | 4.59E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | BERYLLIUM | HEAVY WATER |
| Fuel Cladding | NONE | ALUM |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 93 147 | 40 to 100 |

**Basis for Parameter Differences:**

This Template was used for the following reasons.
This fuel matches on all parameters except cladding (none) and moderator (Heavy Water is conservative)

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | | 1,088.39 |
| Bounding | | 2,176 79 |

**Basis for burnup used in estimate:**

Nominal burnup assumed to be 2% of BOL heavy metal mass.
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 04 | |
| Bounding | 0 08 | -- |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TREAT DRIVER
SNF ID #: 232
Fuel Units & Descr: 391 - ASSEMBLY
Heavy Metal Mass. BOL=15 64kg, EOL=14 897kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1994
Estimates as of: 2010
Template: N-Reactor (Graphite, Zirc, 0 to 5%, U)
[2]Template Burnup(MWd): 69600
Template BOL Heavy Metal Mass (MT). 11 6
Template Decay Time 15 years

Estimated Canister usage
18"x15'
14 48

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 0 0000E+00 | 783.73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-241 | 7 2313E-02 | 783.73 | 1,567 46 | 0 00E+00 | 5 67E+01 | 1 13E+02 |
| Am-242m | 6 2011E-05 | 783.73 | 1,567 46 | 0 00E+00 | 4 86E-02 | 9 72E-02 |
| Am-243 | 4 6336E-05 | 783.73 | 1,567 46 | 0 00E+00 | 3 63E-02 | 7 26E-02 |
| C-14 | 9 2170E-05 | 783.73 | 1,567.46 | 0 00E+00 | 7 22E-02 | 1 44E-01 |
| Cl-36 | 0 0000E+00 | 783.73 | 1,567.46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 0 0000E+00 | 783.73 | 1,567.46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 7 4511E-04 | 783.73 | 1,567.46 | 0 00E+00 | 5 84E-01 | 1 17E+00 |
| Co-60 | 3 4842E-04 | 783.73 | 1,567.46 | 0 00E+00 | 2 73E-01 | 5 46E-01 |
| Cs-134 | 1 0795E-03 | 783.73 | 1,567.46 | 0 00E+00 | 8 46E-01 | 1 69E+00 |
| Cs-135 | 1 0066E-05 | 783.73 | 1,567.46 | 0 00E+00 | 7 89E-03 | 1 58E-02 |
| Cs-137 | 1 6092E+00 | 783.73 | 1,567.46 | 0 00E+00 | 1.26E+03 | 2 52E+03 |
| Eu-154 | 1 8822E-02 | 783 73 | 1,567 46 | 0 00E+00 | 1 48E+01 | 2 95E+01 |
| Eu-155 | 1 7672E-03 | 783 73 | 1,567 46 | 0 00E+00 | 1 39E+00 | 2 77E+00 |
| Fe-55 | 9 0172E-05 | 783 73 | 1,567 46 | 0 00E+00 | 7 07E-02 | 1 41E-01 |
| H-3 | 4 3506E-03 | 783 73 | 1,567 46 | 0 00E+00 | 3 41E+00 | 6 82E+00 |
| I-129 | 8 6006E-07 | 783 73 | 1,567 46 | 0 00E+00 | 6 74E-04 | 1 35E-03 |
| Kr-85 | 6 1652E-02 | 783 73 | 1,567 46 | 0 00E+00 | 4 83E+01 | 9 66E+01 |
| Np-237 | 7 7672E-06 | 783 73 | 1,567 46 | 0 00E+00 | 6 09E-03 | 1 22E-02 |
| Pa-231 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pb-210 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pm-147 | 1 8175E-02 | 783 73 | 1,567 46 | 0 00E+00 | 1 42E+01 | 2 85E+01 |
| Pu-238 | 2 2170E-02 | 783 73 | 1,567 46 | 0 00E+00 | 1 74E+01 | 3 47E+01 |
| Pu-239 | 2 8836E-02 | 783 73 | 1,567 46 | 0 00E+00 | 2 26E+01 | 4 52E+01 |
| Pu-240 | 2.2830E-02 | 783 73 | 1,567 46 | 0 00E+00 | 1 79E+01 | 3 58E+01 |
| Pu-241 | 1 1362E+00 | 783 73 | 1,567 46 | 0 00E+00 | 8 90E+02 | 1 78E+03 |
| Pu-242 | 1 4526E-05 | 783 73 | 1,567 46 | 0 00E+00 | 1 14E-02 | 2 28E-02 |
| Ra-226 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-228 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ru-106 | 4.2672E-06 | 783 73 | 1,567 46 | 0 00E+00 | 3 34E-03 | 6 69E-03 |
| Se-79 | 1 0901E-05 | 783 73 | 1,567 46 | 0 00E+00 | 8 54E-03 | 1 71E-02 |
| Sn-126 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 1 1546E+00 | 783 73 | 1,567 46 | 0 00E+00 | 9 05E+02 | 1 81E+03 |
| Tc-99 | 3 6494E-04 | 783 73 | 1,567 46 | 0 00E+00 | 2 86E-01 | 5 72E-01 |
| Th-229 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-230 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-232 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Tl-208 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-232 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 0 0000E+00 | 783 73 | 1,567 46 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-234 | 6 3994E-05 | 783 73 | 1,567 46 | 0 00E+00 | 5 02E-02 | 1 00E-01 |
| U-235 | -1.2944E-06 | 783 73 | 0 00 | 3 13E-02 | 3 02E-02 | 3.13E-02 |
| U-236 | 1.1932E-05 | 783 73 | 1,567 46 | 0 00E+00 | 9 35E-03 | 1.87E-02 |
| U-238 | -3 0619E-07 | 783 73 | 0 00 | 3 94E-04 | 1 54E-04 | 3 94E-04 |
| Y-90 | 1.1550E+00 | 783 73 | 1,567 46 | 0 00E+00 | 9 05E+02 | 1 81E+03 |
| Other Radionuclides | | | | | 1 21E+03 | 2 42E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 030E+14 |
| 0 0250 | 2 113E+13 |
| 0 0375 | 1 970E+13 |
| 0 0575 | 2.115E+13 |
| 0 0850 | 1 180E+13 |
| 0 1250 | 8 058E+12 |
| 0.2250 | 1 014E+13 |
| 0 3750 | 4 374E+12 |
| 0.5750 | 9 345E+13 |
| 0 8500 | 1 282E+12 |
| 1.2500 | 8 559E+11 |
| 1 7500 | 3 542E+10 |
| 2.2500 | 2.707E+06 |
| 2.7500 | 9 736E+04 |
| 3.5000 | 4.567E+04 |
| 5.0000 | 1 641E+04 |
| 7.0000 | 1 868E+03 |
| 11 0000 | 2.133E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.61E+01 | 3.23E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | GRAPHITE | GRAPHITE |
| Fuel Cladding | ZIRC | ZIRC |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 92.5 | 0 to 5 |

**Basis for Parameter Differences:**
This Template was used for the following reasons:
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 30 19 | 783 73 |
| Bounding | | 1,567 46 |

**Basis for burnup used in estimate:**
Nominal burnup calculated from the heavy metal mass destroyed.
Bounding burnup assumed to be twice nominal burnup.

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 8 35 | 25 96 |
| Bounding | 16 70 | |

Estimated EOL HM/Given EOL HM: 1 01

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | | |
|---|---|---|---|---|
| Fuel Name | TRIGA 8.5/20 FFCR OSU | [1]Fuel decay start date | 2025 | Estimated Canister usage 18"x10' |
| SNF ID # | 1039 | Estimates as of. | 2010 | 0 04 |
| Fuel Units & Descr. | 3 - ELEMENT | Template | TRIGA-SS (LW/U-Zrx, SST, 10 to 20% U) | |
| Heavy Metal Mass | BOL=0 48kg EOL=0 472kg | [2]Template Burnup(MWd) | 6 65 | |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0.000195 | |
| | | Template Decay Time | 5 years | |

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 7.73 | 15.46 | 0 00E+00 | 6 59E-09 | 1 32E-08 |
| Am-241 | 1 8331E-03 | 7.73 | 15 46 | 0 00E+00 | 1.42E-02 | 2 83E-02 |
| Am-242m | 1.4129E-06 | 7.73 | 15.46 | 0 00E+00 | 1.09E-05 | 2 19E-05 |
| Am-243 | 1.4774E-07 | 7.73 | 15 46 | 0 00E+00 | 1.14E-06 | 2 28E-06 |
| C-14 | 1.2871E-04 | 7.73 | 15.46 | 0 00E+00 | 9 95E-04 | 1 99E-03 |
| Cl-36 | 2 8120E-06 | 7.73 | 15.46 | 0 00E+00 | 2.17E-05 | 4 35E-05 |
| Cm-243 | 1.7940E-07 | 7.73 | 15 46 | 0 00E+00 | 1.39E-06 | 2 77E-06 |
| Cm-244 | 1.6962E-06 | 7.73 | 15.46 | 0 00E+00 | 1.31E-05 | 2 62E-05 |
| Co-60 | 1.2839E+00 | 7.73 | 15 46 | 0 00E+00 | 9 93E+00 | 1 99E+01 |
| Cs-134 | 9 0541E-02 | 7.73 | 15.46 | 0 00E+00 | 7.00E-01 | 1 40E+00 |
| Cs-135 | 3.2195E-05 | 7.73 | 15.46 | 0 00E+00 | 2.49E-04 | 4 98E-04 |
| Cs-137 | 2.7564E+00 | 7.73 | 15 46 | 0 00E+00 | 2.13E+01 | 4.26E+01 |
| Eu-154 | 1.5368E-02 | 7.73 | 15 46 | 0 00E+00 | 1 19E-01 | 2 38E-01 |
| Eu-155 | 2.9293E-02 | 7.73 | 15.46 | 0 00E+00 | 2.27E-01 | 4 53E-01 |
| Fe-55 | 7.7158E-01 | 7.73 | 15 46 | 0 00E+00 | 5 97E+00 | 1 19E+01 |
| H-3 | 1.1111E-02 | 7.73 | 15 46 | 0 00E+00 | 8 59E-02 | 1 72E-01 |
| I-129 | 7.3684E-07 | 7.73 | 15 46 | 0 00E+00 | 5 70E-06 | 1 14E-05 |
| Kr-85 | 2.5263E-01 | 7.73 | 15 46 | 0 00E+00 | 1.95E+00 | 3 91E+00 |
| Np-237 | 1.2427E-06 | 7.73 | 15 46 | 0 00E+00 | 9 61E-06 | 1 92E-05 |
| Pa-231 | 3 8511E-09 | 7.73 | 15 46 | 0 00E+00 | 2 98E-08 | 5 96E-08 |
| Pb-210 | 7.3880E-15 | 7.73 | 15 46 | 0 00E+00 | 5 71E-14 | 1 14E-13 |
| Pm-147 | 2.1023E+00 | 7.73 | 15 46 | 0 00E+00 | 1.63E+01 | 3 25E+01 |
| Pu-238 | 1.0383E-03 | 7.73 | 15 46 | 0 00E+00 | 8 03E-03 | 1 61E-02 |
| Pu-239 | 5.5293E-03 | 7.73 | 15 46 | 0 00E+00 | 4.28E-02 | 8 55E-02 |
| Pu-240 | 2.1278E-03 | 7.73 | 15 46 | 0 00E+00 | 1 65E-02 | 3 29E-02 |
| Pu-241 | 1.0195E-01 | 7.73 | 15 46 | 0 00E+00 | 7 88E-01 | 1 58E+00 |
| Pu-242 | 2.3128E-07 | 7.73 | 15 46 | 0 00E+00 | 1 79E-06 | 3 58E-06 |
| Ra-226 | 5.2782E-14 | 7.73 | 15 46 | 0 00E+00 | 4 08E-13 | 8 16E-13 |
| Ra-228 | 1.9338E-10 | 7.73 | 15 46 | 0 00E+00 | 1.50E-09 | 2 99E-09 |
| Ru-106 | 9 1684E-02 | 7.73 | 15 46 | 0 00E+00 | 7 09E-01 | 1 42E+00 |
| Se-79 | 1.3018E-05 | 7.73 | 15 46 | 0 00E+00 | 1 01E-04 | 2 01E-04 |
| Sn-126 | 1.2167E-05 | 7.73 | 15 46 | 0 00E+00 | 9 41E-05 | 1 88E-04 |
| Sr-90 | 2.6045E+00 | 7.73 | 15 46 | 0 00E+00 | 2 01E+01 | 4 03E+01 |
| Tc-99 | 4.4241E-04 | 7.73 | 15 46 | 0 00E+00 | 3 42E-03 | 6 84E-03 |
| Th-229 | 1.3713E-10 | 7.73 | 15 46 | 0 00E+00 | 1 06E-09 | 2.12E-09 |
| Th-230 | 1.8090E-11 | 7.73 | 15 46 | 0 00E+00 | 1 40E-10 | 2 80E-10 |
| Th-232 | 2.5278E-10 | 7.73 | 15 46 | 0 00E+00 | 1 95E-09 | 3 91E-09 |
| Tl-208 | 1.6947E-08 | 7.73 | 15 46 | 0 00E+00 | 1.31E-07 | 2.62E-07 |
| U-232 | 4.8737E-08 | 7.73 | 15 46 | 0 00E+00 | 3 77E-07 | 7.54E-07 |
| U-233 | 1.2203E-07 | 7.73 | 15 46 | 0 00E+00 | 9 44E-07 | 1.89E-06 |
| U-234 | 1.5925E-07 | 7.73 | 15 46 | 0 00E+00 | 1 23E-06 | 2 46E-06 |
| U-235 | -2 6194E-06 | 7.73 | 0 00 | 2 06E-04 | 1 86E-04 | 2.06E-04 |
| U-236 | 1.2693E-05 | 7.73 | 15 46 | 0 00E+00 | 9 81E-05 | 1.96E-04 |
| U-238 | -3 6331E-08 | 7.73 | 0.00 | 1.29E-04 | 1.29E-04 | 1.29E-04 |
| Y-90 | 2.6060E+00 | 7.73 | 15 46 | 0 00E+00 | 2 02E+01 | 4 03E+01 |
| Other Radionuclides | | | | | 2 79E+01 | 5 58E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2 499E+12 |
| 0 0250 | 5 500E+11 |
| 0 0375 | 4 684E+11 |
| 0 0575 | 4 807E+11 |
| 0 0850 | 2 978E+11 |
| 0 1250 | 2 163E+11 |
| 0.2250 | 2 526E+11 |
| 0.3750 | 1.282E+11 |
| 0.5750 | 1 704E+12 |
| 0.8500 | 7 315E+10 |
| 1.2500 | 1 486E+12 |
| 1 7500 | 9 903E+08 |
| 2.2500 | 1 596E+09 |
| 2 7500 | 1.267E+07 |
| 3.5000 | 1 474E+06 |
| 5 0000 | 8 403E+00 |
| 7.0000 | 9.516E-01 |
| 11.0000 | 1 084E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 50E-01 | 9 00E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences* |
|---|---|---|---|
| Reactor Moderator: | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE | |
| Fuel Cladding | SST | SST | |
| BOL HM Constituents* | U | U | |
| BOL Enrichment %: | 19 9 | 10 to 20 1 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate* |
|---|---|---|---|
| Nominal | 4 68 | 7 73 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 15 46 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0 47 | 1 65 | 1 00 |
| Bounding | 0 94 | | |

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA 8.5/20 FFCR UNIV OF CAL-IRVINE
SNF ID #: 1050
Fuel Units & Descr: 2 - ELEMENT
Heavy Metal Mass: BOL=0.383kg EOL=0 38kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2035
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd). 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 5 years

Estimated Canister usage. 18"x10' 0 02

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 3 73 | 7 47 | 0 00E+00 | 3 18E-09 | 6.36E-09 |
| Am-241 | 1 8331E-03 | 3 73 | 7 47 | 0 00E+00 | 6 85E-03 | 1.37E-02 |
| Am-242m | 1 4129E-06 | 3 73 | 7 47 | 0 00E+00 | 5 28E-06 | 1.06E-05 |
| Am-243 | 1 4774E-07 | 3 73 | 7 47 | 0 00E+00 | 5 52E-07 | 1.10E-06 |
| C-14 | 1 2871E-04 | 3 73 | 7 47 | 0 00E+00 | 4 81E-04 | 9 61E-04 |
| Cl-36 | 2 8120E-06 | 3 73 | 7 47 | 0 00E+00 | 1 05E-05 | 2.10E-05 |
| Cm-243 | 1 7940E-07 | 3 73 | 7 47 | 0 00E+00 | 6 70E-07 | 1.34E-06 |
| Cm-244 | 1 6962E-06 | 3 73 | 7 47 | 0 00E+00 | 6 33E-06 | 1.27E-05 |
| Co-60 | 1 2839E+00 | 3 73 | 7 47 | 0 00E+00 | 4 79E+00 | 9.59E+00 |
| Cs-134 | 9 0541E-02 | 3 73 | 7 47 | 0 00E+00 | 3 38E-01 | 6 76E-01 |
| Cs-135 | 3 2195E-05 | 3 73 | 7 47 | 0 00E+00 | 1 20E-04 | 2 40E-04 |
| Cs-137 | 2 7564E+00 | 3 73 | 7.47 | 0 00E+00 | 1 03E+01 | 2.06E+01 |
| Eu-154 | 1 5368E-02 | 3 73 | 7 47 | 0 00E+00 | 5.74E-02 | 1 15E-01 |
| Eu-155 | 2 9293E-02 | 3 73 | 7.47 | 0.00E+00 | 1 09E-01 | 2 19E-01 |
| Fe-55 | 7 7158E-01 | 3.73 | 7 47 | 0 00E+00 | 2 88E+00 | 5 76E+00 |
| H-3 | 1 1111E-02 | 3.73 | 7.47 | 0 00E+00 | 4.15E-02 | 8 30E-02 |
| I-129 | 7 3684E-07 | 3.73 | 7.47 | 0 00E+00 | 2.75E-06 | 5 50E-06 |
| Kr-85 | 2 5263E-01 | 3.73 | 7.47 | 0 00E+00 | 9 43E-01 | 1 89E+00 |
| Np-237 | 1 2427E-06 | 3.73 | 7.47 | 0 00E+00 | 4 64E-06 | 9 28E-06 |
| Pa-231 | 3 8511E-09 | 3.73 | 7.47 | 0 00E+00 | 1 44E-08 | 2 88E-08 |
| Pb-210 | 7 3880E-15 | 3.73 | 7.47 | 0 00E+00 | 2 76E-14 | 5 52E-14 |
| Pm-147 | 2 1023E+00 | 3.73 | 7.47 | 0 00E+00 | 7 85E+00 | 1 57E+01 |
| Pu-238 | 1 0383E-03 | 3.73 | 7.47 | 0 00E+00 | 3 88E-03 | 7 76E-03 |
| Pu-239 | 5 5293E-03 | 3 73 | 7.47 | 0 00E+00 | 2 07E-02 | 4 13E-02 |
| Pu-240 | 2 1278E-03 | 3 73 | 7 47 | 0 00E+00 | 7.95E-03 | 1 59E-02 |
| Pu-241 | 1 0195E-01 | 3 73 | 7 47 | 0 00E+00 | 3 81E-01 | 7 62E-01 |
| Pu-242 | 2.3128E-07 | 3 73 | 7 47 | 0 00E+00 | 8 64E-07 | 1 73E-06 |
| Ra-226 | 5.2782E-14 | 3 73 | 7 47 | 0 00E+00 | 1 97E-13 | 3 94E-13 |
| Ra-228 | 1 9338E-10 | 3 73 | 7 47 | 0 00E+00 | 7.22E-10 | 1 44E-09 |
| Ru-106 | 9 1684E-02 | 3 73 | 7 47 | 0 00E+00 | 3 42E-01 | 6 85E-01 |
| Se-79 | 1.3018E-05 | 3 73 | 7 47 | 0 00E+00 | 4 86E-05 | 9 72E-05 |
| Sn-126 | 1.2167E-05 | 3 73 | 7 47 | 0 00E+00 | 4 54E-05 | 9 09E-05 |
| Sr-90 | 2 6045E+00 | 3 73 | 7 47 | 0 00E+00 | 9.73E+00 | 1 95E+01 |
| Tc-99 | 4 4241E-04 | 3 73 | 7 47 | 0 00E+00 | 1 65E-03 | 3 30E-03 |
| Th-229 | 1.3713E-10 | 3 73 | 7 47 | 0 00E+00 | 5 12E-10 | 1 02E-09 |
| Th-230 | 1.8090E-11 | 3 73 | 7 47 | 0 00E+00 | 6 76E-11 | 1 35E-10 |
| Th-232 | 2.5278E-10 | 3 73 | 7 47 | 0 00E+00 | 9 44E-10 | 1 89E-09 |
| Tl-208 | 1.6947E-08 | 3 73 | 7 47 | 0 00E+00 | 6 33E-08 | 1.27E-07 |
| U-232 | 4 8737E-08 | 3 73 | 7 47 | 0 00E+00 | 1 82E-07 | 3 64E-07 |
| U-233 | 1.2203E-07 | 3 73 | 7 47 | 0 00E+00 | 4 56E-07 | 9 11E-07 |
| U-234 | 1 5925E-07 | 3 73 | 7 47 | 0 00E+00 | 5 95E-07 | 1 19E-06 |
| U-235 | -2 6194E-06 | 3 73 | 0 00 | 1 66E-04 | 1 56E-04 | 1 66E-04 |
| U-236 | 1.2693E-05 | 3 73 | 7 47 | 0 00E+00 | 4 74E-05 | 9 48E-05 |
| U-238 | -3 6331E-08 | 3 73 | 0 00 | 1 03E-04 | 1 03E-04 | 1 03E-04 |
| Y-90 | 2 6060E+00 | 3 73 | 7 47 | 0 00E+00 | 9 73E+00 | 1 95E+01 |
| Other Radionuclides | | | | | 1 35E+01 | 2 69E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.207E+12 |
| 0 0250 | 2 656E+11 |
| 0 0375 | 2.262E+11 |
| 0 0575 | 2.322E+11 |
| 0 0850 | 1 438E+11 |
| 0 1250 | 1 045E+11 |
| 0.2250 | 1.220E+11 |
| 0.3750 | 6 193E+10 |
| 0.5750 | 8.233E+11 |
| 0 8500 | 3 533E+10 |
| 1.2500 | 7 175E+11 |
| 1 7500 | 4 783E+08 |
| 2.2500 | 7 710E+08 |
| 2 7500 | 6 118E+06 |
| 3 5000 | 7 120E+05 |
| 5 0000 | 4 153E+00 |
| 7 0000 | 4 704E-01 |
| 11 0000 | 5 361E-02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.17E-01 | 4.35E-01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 00002088 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 3 73 | 2.86 | Nominal burnup taken directly from SFD (converted to MWd). |
| Bounding | | 7 47 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.29 | 0 77 |
| Bounding | 0 57 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA 8 5/20 FFCR UNIV OF CAL-IRVINE | [1]Fuel decay start date | 2035 |
| SNF ID # | 1052 | Estimates as of | 2010 |
| Fuel Units & Descr | 1 - ELEMENT | Template | TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U) |
| Heavy Metal Mass | BOL=0 183kg EOL=0 183kg | [2]Template Burnup(MWd) | 6 65 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 000195 |
| | | Template Decay Time | 5 years |

Estimated Canister usage
18"x10'
0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-241 | 1 8331E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-242m | 1 4129E-06 | 0 00 | 0 00 | 0.00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 1 4774E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| C-14 | 1 2871E-04 | 0 00 | 0 00 | 0 00E+00 | 0.00E+00 | 0 00E+00 |
| Cl-36 | 2 8120E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 1 7940E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 1 6962E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Co-60 | 1.2839E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-134 | 9 0541E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-135 | 3.2195E-05 | 0 00 | 0.00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-137 | 2 7564E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Eu-154 | 1 5368E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Eu-155 | 2 9293E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Fe-55 | 7 7158E-01 | 0 00 | 0 00 | 0.00E+00 | 0 00E+00 | 0 00E+00 |
| H-3 | 1 1111E-02 | 0 00 | 0 00 | 0.00E+00 | 0 00E+00 | 0 00E+00 |
| I-129 | 7 3684E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Kr-85 | 2 5263E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Np-237 | 1 2427E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pa-231 | 3 8511E-09 | 0 00 | 0 00 | 0 00E+00 | 0.00E+00 | 0 00E+00 |
| Pb-210 | 7.3880E-15 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pm-147 | 2 1023E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-238 | 1 0383E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-239 | 5 5293E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-240 | 2.1278E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-241 | 1 0195E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-242 | 2.3128E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-226 | 5.2782E-14 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-228 | 1 9338E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ru-106 | 9 1684E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Se-79 | 1 3018E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sn-126 | 1 2167E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 2 6045E+00 | 0 00 | 0 00 | 0 00E+00 | 0.00E+00 | 0 00E+00 |
| Tc-99 | 4 4241E-04 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-229 | 1 3713E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-230 | 1 8090E-11 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-232 | 2 5278E-10 | 0.00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Tl-208 | 1 6947E-08 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-232 | 4 8737E-08 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-233 | 1.2203E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-234 | 1.5925E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-235 | -2 6194E-06 | 0 00 | 0 00 | 7.92E-05 | 7 92E-05 | 7.92E-05 |
| U-236 | 1.2693E-05 | 0 00 | 0 00 | 0.00E+00 | 0 00E+00 | 0 00E+00 |
| U-238 | -3 6331E-08 | 0 00 | 0 00 | 4 93E-05 | 4.93E-05 | 4 93E-05 |
| Y-90 | 2 6060E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0.00E+00 |
| Other Radionuclides | | | | | 0 00E+00 | 0 00E+00 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 961E+06 |
| 0 0250 | 0 000E+00 |
| 0 0375 | 2.676E+03 |
| 0 0575 | 1 621E+03 |
| 0 0850 | 2.286E+05 |
| 0 1250 | 4.514E+05 |
| 0.2250 | 1.598E+06 |
| 0.3750 | 3.986E+03 |
| 0.5750 | 1.961E+02 |
| 0 8500 | 3 056E+01 |
| 1.2500 | 1.802E+00 |
| 1 7500 | 8.816E-01 |
| 2.2500 | 5 107E-01 |
| 2.7500 | 2 967E-01 |
| 3 5000 | 2 653E-01 |
| 5 0000 | 1 140E-01 |
| 7 0000 | 1.312E-02 |
| 11 0000 | 1 508E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.32E-06 | 3.32E-06 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 99996708 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 0 00 | |
| Bounding | | |

Basis for burnup used in estimate:

Nominal burnup taken directly from SFD (converted to MWd)

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | |
| Bounding | 0 00 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (ACPR 12/20) JAPAN
SNF ID #: 480
Fuel Units & Descr: 182 - ELEMENT
Heavy Metal Mass: BOL=48.357kg; EOL=48.23kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 5 years

Estimated Canister usage: 18"x10" 1 64

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 455 87 | 911 73 | 0 00E+00 | 3 88E-07 | 7.77E-07 |
| Am-241 | 1 8331E-03 | 455 87 | 911 73 | 0 00E+00 | 8.36E-01 | 1.67E+00 |
| Am-242m | 1 4129E-06 | 455 87 | 911 73 | 0 00E+00 | 6 44E-04 | 1.29E-03 |
| Am-243 | 1 4774E-07 | 455 87 | 911 73 | 0 00E+00 | 6.74E-05 | 1.35E-04 |
| C-14 | 1.2871E-04 | 455 87 | 911 73 | 0 00E+00 | 5.87E-02 | 1.17E-01 |
| Cl-36 | 2 8120E-06 | 455 87 | 911 73 | 0 00E+00 | 1.28E-03 | 2.56E-03 |
| Cm-243 | 1.7940E-07 | 455 87 | 911 73 | 0 00E+00 | 8.18E-05 | 1 64E-04 |
| Cm-244 | 1 6962E-06 | 455 87 | 911 73 | 0 00E+00 | 7.73E-04 | 1 55E-03 |
| Co-60 | 1.2839E+00 | 455 87 | 911 73 | 0 00E+00 | 5 85E+02 | 1.17E+03 |
| Cs-134 | 9 0541E-02 | 455 87 | 911 73 | 0 00E+00 | 4 13E+01 | 8.25E+01 |
| Cs-135 | 3.2195E-05 | 455 87 | 911 73 | 0 00E+00 | 1.47E-02 | 2.94E-02 |
| Cs-137 | 2 7564E+00 | 455 87 | 911 73 | 0 00E+00 | 1 26E+03 | 2.51E+03 |
| Eu-154 | 1.5368E-02 | 455 87 | 911 73 | 0.00E+00 | 7 01E+00 | 1 40E+01 |
| Eu-155 | 2 9293E-02 | 455 87 | 911.73 | 0 00E+00 | 1 34E+01 | 2 67E+01 |
| Fe-55 | 7.7158E-01 | 455 87 | 911 73 | 0 00E+00 | 3 52E+02 | 7.03E+02 |
| H-3 | 1.1111E-02 | 455 87 | 911 73 | 0 00E+00 | 5 07E+00 | 1 01E+01 |
| I-129 | 7 3684E-07 | 455 87 | 911.73 | 0 00E+00 | 3 36E-04 | 6.72E-04 |
| Kr-85 | 2 5263E-01 | 455 87 | 911.73 | 0.00E+00 | 1 15E+02 | 2 30E+02 |
| Np-237 | 1.2427E-06 | 455 87 | 911.73 | 0 00E+00 | 5 67E-04 | 1.13E-03 |
| Pa-231 | 3 8511E-09 | 455 87 | 911 73 | 0 00E+00 | 1 76E-06 | 3.51E-06 |
| Pb-210 | 7 3880E-15 | 455 87 | 911.73 | 0 00E+00 | 3 37E-12 | 6.74E-12 |
| Pm-147 | 2 1023E+00 | 455 87 | 911.73 | 0 00E+00 | 9 58E+02 | 1 92E+03 |
| Pu-238 | 1 0383E-03 | 455 87 | 911.73 | 0 00E+00 | 4 73E-01 | 9 47E-01 |
| Pu-239 | 5 5293E-03 | 455 87 | 911.73 | 0 00E+00 | 2 52E+00 | 5 04E+00 |
| Pu-240 | 2 1278E-03 | 455 87 | 911.73 | 0 00E+00 | 9 70E-01 | 1 94E+00 |
| Pu-241 | 1 0195E-01 | 455 87 | 911.73 | 0 00E+00 | 4 65E+01 | 9 30E+01 |
| Pu-242 | 2 3128E-07 | 455 87 | 911.73 | 0 00E+00 | 1 05E-04 | 2.11E-04 |
| Ra-226 | 5 2782E-14 | 455 87 | 911 73 | 0 00E+00 | 2 41E-11 | 4 81E-11 |
| Ra-228 | 1 9338E-10 | 455 87 | 911.73 | 0 00E+00 | 8 82E-08 | 1 76E-07 |
| Ru-106 | 9 1684E-02 | 455 87 | 911 73 | 0 00E+00 | 4 18E+01 | 8 36E+01 |
| Se-79 | 1 3018E-05 | 455 87 | 911 73 | 0 00E+00 | 5 93E-03 | 1 19E-02 |
| Sn-126 | 1.2167E-05 | 455 87 | 911 73 | 0 00E+00 | 5 55E-03 | 1.11E-02 |
| Sr-90 | 2 6045E+00 | 455 87 | 911 73 | 0 00E+00 | 1 19E+03 | 2 37E+03 |
| Tc-99 | 4 4241E-04 | 455 87 | 911 73 | 0 00E+00 | 2 02E-01 | 4 03E-01 |
| Th-229 | 1 3713E-10 | 455 87 | 911 73 | 0 00E+00 | 6 25E-08 | 1.25E-07 |
| Th-230 | 1 8090E-11 | 455 87 | 911 73 | 0 00E+00 | 8 25E-09 | 1 65E-08 |
| Th-232 | 2 5278E-10 | 455 87 | 911 73 | 0 00E+00 | 1 15E-07 | 2.30E-07 |
| Tl-208 | 1 6947E-08 | 455 87 | 911 73 | 0 00E+00 | 7 73E-06 | 1 55E-05 |
| U-232 | 4 8737E-08 | 455 87 | 911 73 | 0 00E+00 | 2 22E-05 | 4 44E-05 |
| U-233 | 1 2203E-07 | 455 87 | 911 73 | 0 00E+00 | 5 56E-05 | 1 11E-04 |
| U-234 | 1 5925E-07 | 455 87 | 911 73 | 0 00E+00 | 7 26E-05 | 1 45E-04 |
| U-235 | -2 6194E-06 | 455 87 | 0 00 | 2 08E-02 | 1 97E-02 | 2 08E-02 |
| U-236 | 1 2693E-05 | 455 87 | 911 73 | 0 00E+00 | 5 79E-03 | 1 16E-02 |
| U-238 | -3 6331E-08 | 455 87 | 0.00 | 1 30E-02 | 1 30E-02 | 1 30E-02 |
| Y-90 | 2 6060E+00 | 455 87 | 911 73 | 0 00E+00 | 1.19E+03 | 2 38E+03 |
| Other Radionuclides | | | | | 1.64E+03 | 3 29E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 474E+14 |
| 0 0250 | 3.242E+13 |
| 0 0375 | 2.761E+13 |
| 0 0575 | 2.834E+13 |
| 0 0850 | 1 756E+13 |
| 0 1250 | 1 275E+13 |
| 0 2250 | 1 490E+13 |
| 0 3750 | 7 559E+12 |
| 0 5750 | 1 005E+14 |
| 0 8500 | 4 313E+12 |
| 1.2500 | 8 759E+13 |
| 1 7500 | 5 838E+10 |
| 2.2500 | 9 411E+10 |
| 2 7500 | 7 468E+08 |
| 3 5000 | 8 691E+07 |
| 5 0000 | 5 079E+02 |
| 7 0000 | 5 754E+01 |
| 11 0000 | 6 557E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.65E+01 | 5.31E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 95031243 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 455 87 | 121 62 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 911 73 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 28 | 0.27 |
| Bounding | 0 55 | |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name: | TRIGA (ACPR 12/20) PENN STATE UNIV | [1]Fuel decay start date | 2035 |
| SNF ID #: | 1002 | Estimates as of | 2010 |
| Fuel Units & Descr: | 46 - ELEMENT | Template | TRIGA-SS (LW/U-Zrx SST, 10 to 20%, U) |
| Heavy Metal Mass: | BOL=12 779kg EOL=12 006kg | [2]Template Burnup(MWd) | 6 65 |
| ROD Storage Site: | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000195 |
| | | Template Decay Time | 5 years |

Estimated Canister usage: 18"x10' — 0 41

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 737 72 | 1,475 44 | 0 00E+00 | 6.28E-07 | 1.26E-06 |
| Am-241 | 1 8331E-03 | 737.72 | 1,475 44 | 0 00E+00 | 1.35E+00 | 2 70E+00 |
| Am-242m | 1 4129E-06 | 737 72 | 1,475 44 | 0 00E+00 | 1.04E-03 | 2 08E-03 |
| Am-243 | 1 4774E-07 | 737 72 | 1,475 44 | 0 00E+00 | 1.09E-04 | 2.18E-04 |
| C-14 | 1.2871E-04 | 737 72 | 1,475 44 | 0 00E+00 | 9 49E-02 | 1 90E-01 |
| Cl-36 | 2 8120E-06 | 737.72 | 1,475 44 | 0 00E+00 | 2.07E-03 | 4 15E-03 |
| Cm-243 | 1 7940E-07 | 737.72 | 1,475 44 | 0 00E+00 | 1.32E-04 | 2 65E-04 |
| Cm-244 | 1 6962E-06 | 737 72 | 1,475 44 | 0 00E+00 | 1.25E-03 | 2 50E-03 |
| Co-60 | 1 2839E+00 | 737 72 | 1,475 44 | 0 00E+00 | 9 47E+02 | 1 89E+03 |
| Cs-134 | 9 0541E-02 | 737.72 | 1,475 44 | 0 00E+00 | 6 68E+01 | 1 34E+02 |
| Cs-135 | 3 2195E-05 | 737 72 | 1,475 44 | 0 00E+00 | 2.38E-02 | 4 75E-02 |
| Cs-137 | 2 7564E+00 | 737.72 | 1,475 44 | 0 00E+00 | 2 03E+03 | 4 07E+03 |
| Eu-154 | 1 5368E-02 | 737.72 | 1,475 44 | 0 00E+00 | 1.13E+01 | 2 27E+01 |
| Eu-155 | 2 9293E-02 | 737.72 | 1,475 44 | 0 00E+00 | 2.16E+01 | 4 32E+01 |
| Fe-55 | 7 7158E-01 | 737.72 | 1,475 44 | 0 00E+00 | 5 69E+02 | 1 14E+03 |
| H-3 | 1 1111E-02 | 737.72 | 1,475 44 | 0 00E+00 | 8.20E+00 | 1 64E+01 |
| I-129 | 7 3684E-07 | 737.72 | 1,475 44 | 0 00E+00 | 5.44E-04 | 1 09E-03 |
| Kr-85 | 2 5263E-01 | 737.72 | 1,475 44 | 0 00E+00 | 1 86E+02 | 3 73E+02 |
| Np-237 | 1 2427E-06 | 737.72 | 1,475 44 | 0 00E+00 | 9 17E-04 | 1 83E-03 |
| Pa-231 | 3 8511E-09 | 737.72 | 1,475 44 | 0 00E+00 | 2 84E-06 | 5 68E-06 |
| Pb-210 | 7 3880E-15 | 737.72 | 1,475 44 | 0 00E+00 | 5.45E-12 | 1 09E-11 |
| Pm-147 | 2 1023E+00 | 737.72 | 1,475 44 | 0 00E+00 | 1.55E+03 | 3 10E+03 |
| Pu-238 | 1 0383E-03 | 737.72 | 1,475 44 | 0 00E+00 | 7.66E-01 | 1 53E+00 |
| Pu-239 | 5 5293E-03 | 737.72 | 1,475 44 | 0 00E+00 | 4 08E+00 | 8 16E+00 |
| Pu-240 | 2 1278E-03 | 737.72 | 1,475 44 | 0 00E+00 | 1.57E+00 | 3 14E+00 |
| Pu-241 | 1 0195E-01 | 737.72 | 1,475 44 | 0 00E+00 | 7.52E+01 | 1 50E+02 |
| Pu-242 | 2 3128E-07 | 737.72 | 1,475 44 | 0 00E+00 | 1.71E-04 | 3 41E-04 |
| Ra-226 | 5 2782E-14 | 737.72 | 1,475 44 | 0 00E+00 | 3 89E-11 | 7.79E-11 |
| Ra-228 | 1 9338E-10 | 737.72 | 1,475 44 | 0 00E+00 | 1.43E-07 | 2 85E-07 |
| Ru-106 | 9 1684E-02 | 737.72 | 1,475 44 | 0 00E+00 | 6 76E+01 | 1 35E+02 |
| Se-79 | 1.3018E-05 | 737.72 | 1,475.44 | 0 00E+00 | 9 60E-03 | 1 92E-02 |
| Sn-126 | 1.2167E-05 | 737.72 | 1,475 44 | 0 00E+00 | 8.98E-03 | 1 80E-02 |
| Sr-90 | 2 6045E+00 | 737.72 | 1,475 44 | 0 00E+00 | 1 92E+03 | 3 84E+03 |
| Tc-99 | 4 4241E-04 | 737.72 | 1,475.44 | 0 00E+00 | 3.26E-01 | 6 53E-01 |
| Th-229 | 1.3713E-10 | 737 72 | 1,475 44 | 0 00E+00 | 1.01E-07 | 2 02E-07 |
| Th-230 | 1 8090E-11 | 737.72 | 1,475 44 | 0 00E+00 | 1.33E-08 | 2.67E-08 |
| Th-232 | 2 5278E-10 | 737.72 | 1,475 44 | 0 00E+00 | 1.86E-07 | 3 73E-07 |
| Tl-208 | 1 6947E-08 | 737.72 | 1,475 44 | 0 00E+00 | 1.25E-05 | 2.50E-05 |
| U-232 | 4 8737E-08 | 737.72 | 1,475 44 | 0 00E+00 | 3 60E-05 | 7.19E-05 |
| U-233 | 1.2203E-07 | 737 72 | 1,475 44 | 0 00E+00 | 9 00E-05 | 1 80E-04 |
| U-234 | 1.5925E-07 | 737 72 | 1,475 44 | 0 00E+00 | 1.17E-04 | 2.35E-04 |
| U-235 | -2.6194E-06 | 737 72 | 0 00 | 5 47E-03 | 3.54E-03 | 5 47E-03 |
| U-236 | 1.2693E-05 | 737.72 | 1,475 44 | 0 00E+00 | 9.36E-03 | 1.87E-02 |
| U-238 | -3 6331E-08 | 737 72 | 0 00 | 3 44E-03 | 3 42E-03 | 3 44E-03 |
| Y-90 | 2 6060E+00 | 737 72 | 1,475 44 | 0 00E+00 | 1.92E+03 | 3 85E+03 |
| Other Radionuclides | | | | | 2 66E+03 | 5 32E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.385E+14 |
| 0 0250 | 5.247E+13 |
| 0 0375 | 4 468E+13 |
| 0 0575 | 4.587E+13 |
| 0 0850 | 2.841E+13 |
| 0 1250 | 2 063E+13 |
| 0 2250 | 2 410E+13 |
| 0 3750 | 1.223E+13 |
| 0 5750 | 1 626E+14 |
| 0 8500 | 6 979E+12 |
| 1.2500 | 1 417E+14 |
| 1 7500 | 9 448E+10 |
| 2.2500 | 1.523E+11 |
| 2 7500 | 1.209E+09 |
| 3 5000 | 1 406E+08 |
| 5 0000 | 7.812E+02 |
| 7 0000 | 8.843E+01 |
| 11 0000 | 1 007E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.29E+01 | 8 59E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 79999842 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 240.93 | 737 72 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 1,475.44 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.69 | 3.06 |
| Bounding | 3.39 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (ACPR 12/20) SLOVENIA
SNF ID #: 932
Fuel Units & Descr: 1 - ELEMENT
Heavy Metal Mass: BOL=0.276kg, EOL=0.276kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1999
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0.000195
Template Decay Time: 10 years

Estimated Canister usage: 18"x10" 0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 3731E-09 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-241 | 2 3865E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-242m | 1 3812E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Am-243 | 1 4767E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| C-14 | 1.2863E-04 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cl-36 | 2 8120E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-243 | 1 5895E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cm-244 | 1 4008E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Co-60 | 6 6541E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-134 | 1 6887E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-135 | 3.2195E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Cs-137 | 2 4556E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Eu-154 | 1 0268E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Eu-155 | 1 4570E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Fe-55 | 2 0361E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| H-3 | 8 3940E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| I-129 | 7 3684E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Kr-85 | 1 8286E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Np-237 | 1 2462E-06 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pa-231 | 4 9143E-09 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pb-210 | 1 7173E-14 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pm-147 | 5 6165E-01 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-238 | 9 9820E-04 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-239 | 5 5293E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-240 | 2 1263E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-241 | 8 0165E-02 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Pu-242 | 2 3128E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-226 | 9 9774E-14 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ra-228 | 2 1729E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Ru-106 | 2 9519E-03 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Se-79 | 1 3017E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sn-126 | 1 2167E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Sr-90 | 2 3128E+00 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Tc-99 | 4 4241E-04 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-229 | 1 9459E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-230 | 2 5564E-11 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Th-232 | 2 5278E-10 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Tl-208 | 1 6947E-08 | 0.00 | 0 00 | 0 00E+00 | 0.00E+00 | 0 00E+00 |
| U-232 | 4 6812E-08 | 0.00 | 0.00 | 0 00E+00 | 0.00E+00 | 0 00E+00 |
| U-233 | 1.2206E-07 | 0 00 | 0.00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-234 | 1 7323E-07 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-235 | -2 6194E-06 | 0 00 | 0 00 | 1.18E-04 | 1 18E-04 | 1 18E-04 |
| U-236 | 1.2693E-05 | 0 00 | 0 00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| U-238 | -3 6331E-08 | 0 00 | 0 00 | 7 42E-05 | 7 42E-05 | 7 42E-05 |
| Y-90 | 2 3128E+00 | 0 00 | 0.00 | 0 00E+00 | 0 00E+00 | 0 00E+00 |
| Other Radionuclides | | | | | 0 00E+00 | 0 00E+00 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.933E+06 |
| 0 0250 | 0 000E+00 |
| 0 0375 | 4 000E+03 |
| 0 0575 | 2 436E+03 |
| 0 0850 | 3 418E+05 |
| 0 1250 | 6 747E+05 |
| 0.2250 | 2.388E+06 |
| 0 3750 | 5 959E+03 |
| 0 5750 | 2 931E+02 |
| 0 8500 | 4 573E+01 |
| 1.2500 | 2 713E+00 |
| 1 7500 | 1 327E+00 |
| 2.2500 | 7 689E-01 |
| 2 7500 | 4 467E-01 |
| 3.5000 | 3 994E-01 |
| 5 0000 | 1 716E-01 |
| 7 0000 | 1 975E-02 |
| 11 0000 | 2.271E-03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 98E-06 | 4 98E-06 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 88316824 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 0 00 | |
| Bounding | | |

Basis for burnup used in estimate:

Nominal burnup taken directly from SFD (converted to MWd)

Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 00 | |
| Bounding | 0 00 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: TRIGA (ACPR) ROMANIA
SNF ID #: 1077
Fuel Units & Descr: 75 - ELEMENT
Heavy Metal Mass BOL=14 7kg EOL=14 445kg
ROD Storage Site INEEL

[1]Fuel decay start date 1999
Estimates as of 2010
Template TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 000195
Template Decay Time 10 years

Estimated Canister usage 18"x10' 0 68

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3731E-09 | 243 42 | 486.85 | 0 00E+00 | 3 34E-07 | 6 68E-07 |
| Am-241 | 2 3865E-03 | 243 42 | 486 85 | 0.00E+00 | 5 81E-01 | 1 16E+00 |
| Am-242m | 1.3812E-06 | 243 42 | 486 85 | 0 00E+00 | 3 36E-04 | 6.72E-04 |
| Am-243 | 1 4767E-07 | 243 42 | 486 85 | 0.00E+00 | 3 59E-05 | 7.19E-05 |
| C-14 | 1 2863E-04 | 243.42 | 486 85 | 0.00E+00 | 3 13E-02 | 6.26E-02 |
| Cl-36 | 2 8120E-06 | 243 42 | 486 85 | 0 00E+00 | 6 85E-04 | 1.37E-03 |
| Cm-243 | 1 5895E-07 | 243 42 | 486 85 | 0 00E+00 | 3 87E-05 | 7 74E-05 |
| Cm-244 | 1 4008E-06 | 243 42 | 486 85 | 0 00E+00 | 3 41E-04 | 6 82E-04 |
| Co-60 | 6 6541E-01 | 243 42 | 486 85 | 0 00E+00 | 1 62E+02 | 3.24E+02 |
| Cs-134 | 1 6887E-02 | 243 42 | 486 85 | 0 00E+00 | 4 11E+00 | 8.22E+00 |
| Cs-135 | 3.2195E-05 | 243 42 | 486 85 | 0 00E+00 | 7 84E-03 | 1 57E-02 |
| Cs-137 | 2 4556E+00 | 243 42 | 486 85 | 0 00E+00 | 5 98E+02 | 1.20E+03 |
| Eu-154 | 1 0268E-02 | 243 42 | 486 85 | 0 00E+00 | 2 50E+00 | 5 00E+00 |
| Eu-155 | 1.4570E-02 | 243 42 | 486 85 | 0 00E+00 | 3 55E+00 | 7 09E+00 |
| Fe-55 | 2 0361E-01 | 243 42 | 486 85 | 0 00E+00 | 4 96E+01 | 9 91E+01 |
| H-3 | 8.3940E-03 | 243 42 | 486 85 | 0 00E+00 | 2 04E+00 | 4 09E+00 |
| I-129 | 7.3684E-07 | 243 42 | 486 85 | 0 00E+00 | 1.79E-04 | 3 59E-04 |
| Kr-85 | 1 8286E-01 | 243 42 | 486 85 | 0 00E+00 | 4 45E+01 | 8 90E+01 |
| Np-237 | 1.2462E-06 | 243 42 | 486 85 | 0 00E+00 | 3 03E-04 | 6 07E-04 |
| Pa-231 | 4 9143E-09 | 243 42 | 486 85 | 0 00E+00 | 1.20E-06 | 2 39E-06 |
| Pb-210 | 1 7173E-14 | 243 42 | 486 85 | 0 00E+00 | 4 18E-12 | 8 36E-12 |
| Pm-147 | 5 6165E-01 | 243 42 | 486 85 | 0 00E+00 | 1.37E+02 | 2 73E+02 |
| Pu-238 | 9 9820E-04 | 243.42 | 486 85 | 0 00E+00 | 2 43E-01 | 4 86E-01 |
| Pu-239 | 5 5293E-03 | 243.42 | 486.85 | 0 00E+00 | 1.35E+00 | 2 69E+00 |
| Pu-240 | 2 1263E-03 | 243.42 | 486 85 | 0 00E+00 | 5 18E-01 | 1 04E+00 |
| Pu-241 | 8 0165E-02 | 243 42 | 486 85 | 0 00E+00 | 1 95E+01 | 3 90E+01 |
| Pu-242 | 2 3128E-07 | 243 42 | 486 85 | 0 00E+00 | 5 63E-05 | 1.13E-04 |
| Ra-226 | 9 9774E-14 | 243 42 | 486 85 | 0 00E+00 | 2 43E-11 | 4.86E-11 |
| Ra-228 | 2 1729E-10 | 243 42 | 486 85 | 0 00E+00 | 5 29E-08 | 1 06E-07 |
| Ru-106 | 2 9519E-03 | 243 42 | 486 85 | 0 00E+00 | 7 19E-01 | 1.44E+00 |
| Se-79 | 1 3017E-05 | 243 42 | 486 85 | 0 00E+00 | 3 17E-03 | 6 34E-03 |
| Sn-126 | 1.2167E-05 | 243 42 | 486 85 | 0 00E+00 | 2 96E-03 | 5 92E-03 |
| Sr-90 | 2.3128E+00 | 243 42 | 486 85 | 0 00E+00 | 5 63E+02 | 1 13E+03 |
| Tc-99 | 4 4241E-04 | 243 42 | 486 85 | 0 00E+00 | 1 08E-01 | 2 15E-01 |
| Th-229 | 1.9459E-10 | 243 42 | 486 85 | 0 00E+00 | 4 74E-08 | 9 47E-08 |
| Th-230 | 2.5564E-11 | 243 42 | 486 85 | 0 00E+00 | 6.22E-09 | 1 24E-08 |
| Th-232 | 2.5278E-10 | 243 42 | 486 85 | 0 00E+00 | 6.15E-08 | 1 23E-07 |
| Tl-208 | 1.6947E-08 | 243 42 | 486 85 | 0 00E+00 | 4.13E-06 | 8 25E-06 |
| U-232 | 4 6812E-08 | 243 42 | 486 85 | 0 00E+00 | 1.14E-05 | 2.28E-05 |
| U-233 | 1.2206E-07 | 243 42 | 486 85 | 0 00E+00 | 2 97E-05 | 5 94E-05 |
| U-234 | 1 7323E-07 | 243 42 | 486 85 | 0 00E+00 | 4.22E-05 | 8 43E-05 |
| U-235 | -2 6194E-06 | 243 42 | 0.00 | 6 32E-03 | 5 68E-03 | 6.32E-03 |
| U-236 | 1.2693E-05 | 243 42 | 486 85 | 0 00E+00 | 3 09E-03 | 6.18E-03 |
| U-238 | -3 6331E-08 | 243 42 | 0 00 | 3 96E-03 | 3 95E-03 | 3 96E-03 |
| Y-90 | 2 3128E+00 | 243.42 | 486.85 | 0 00E+00 | 5 63E+02 | 1.13E+03 |
| Other Radionuclides | | | | | 5 97E+02 | 1.19E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6.290E+13 |
| 0 0250 | 1.332E+13 |
| 0 0375 | 1 138E+13 |
| 0.0575 | 1.213E+13 |
| 0 0850 | 7.359E+12 |
| 0 1250 | 4 838E+12 |
| 0.2250 | 6.277E+12 |
| 0.3750 | 2 883E+12 |
| 0 5750 | 4 517E+13 |
| 0 8500 | 8 063E+11 |
| 1.2500 | 2 424E+13 |
| 1 7500 | 1 459E+10 |
| 2.2500 | 7 620E+08 |
| 2 7500 | 1.261E+07 |
| 3 5000 | 1 495E+06 |
| 5 0000 | 2.632E+02 |
| 7 0000 | 2.978E+01 |
| 11 0000 | 3 391E+00 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 9.53E+00 | 1 91E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 19 898 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 0 00 | 243 42 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 486.85 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 49 | |
| Bounding | 0 97 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (DEMOUNTABLE) U OF AZ
SNF ID #: 971
Fuel Units & Descr: 1 - ELEMENT
Heavy Metal Mass. BOL=0 195kg, EOL=0 181kg
ROD Storage Site INEEL

[1]Fuel decay start date: 2035
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6.65
Template BOL Heavy Metal Mass (MT): 0.000195
Template Decay Time: 5 years

Estimated Canister usage 18"x10'
0 01

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 13 46 | 26 92 | 0 00E+00 | 1 15E-08 | 2 29E-08 |
| Am-241 | 1 8331E-03 | 13 46 | 26 92 | 0 00E+00 | 2 47E-02 | 4 93E-02 |
| Am-242m | 1 4129E-06 | 13 46 | 26 92 | 0 00E+00 | 1 90E-05 | 3 80E-05 |
| Am-243 | 1 4774E-07 | 13 46 | 26 92 | 0 00E+00 | 1 99E-06 | 3 98E-06 |
| C-14 | 1 2871E-04 | 13 46 | 26 92 | 0 00E+00 | 1 73E-03 | 3 46E-03 |
| Cl-36 | 2 8120E-06 | 13 46 | 26 92 | 0 00E+00 | 3 78E-05 | 7 57E-05 |
| Cm-243 | 1 7940E-07 | 13 46 | 26 92 | 0 00E+00 | 2 41E-06 | 4 83E-06 |
| Cm-244 | 1 6962E-06 | 13 46 | 26 92 | 0 00E+00 | 2.28E-05 | 4 57E-05 |
| Co-60 | 1.2839E+00 | 13 46 | 26 92 | 0 00E+00 | 1 73E+01 | 3 46E+01 |
| Cs-134 | 9 0541E-02 | 13 46 | 26 92 | 0 00E+00 | 1 22E+00 | 2 44E+00 |
| Cs-135 | 3.2195E-05 | 13 46 | 26 92 | 0 00E+00 | 4 33E-04 | 8 67E-04 |
| Cs-137 | 2.7564E+00 | 13.46 | 26 92 | 0 00E+00 | 3 71E+01 | 7 42E+01 |
| Eu-154 | 1 5368E-02 | 13.46 | 26 92 | 0 00E+00 | 2 07E-01 | 4 14E-01 |
| Eu-155 | 2 9293E-02 | 13.46 | 26 92 | 0 00E+00 | 3 94E-01 | 7 89E-01 |
| Fe-55 | 7.7158E-01 | 13 46 | 26 92 | 0 00E+00 | 1 04E+01 | 2 08E+01 |
| H-3 | 1 1111E-02 | 13 46 | 26 92 | 0 00E+00 | 1.50E-01 | 2 99E-01 |
| I-129 | 7 3684E-07 | 13 46 | 26 92 | 0 00E+00 | 9 92E-06 | 1 98E-05 |
| Kr-85 | 2 5263E-01 | 13 46 | 26 92 | 0 00E+00 | 3 40E+00 | 6 80E+00 |
| Np-237 | 1 2427E-06 | 13 46 | 26 92 | 0 00E+00 | 1.67E-05 | 3.35E-05 |
| Pa-231 | 3 8511E-09 | 13 46 | 26 92 | 0 00E+00 | 5 18E-08 | 1.04E-07 |
| Pb-210 | 7 3880E-15 | 13 46 | 26.92 | 0 00E+00 | 9 94E-14 | 1.99E-13 |
| Pm-147 | 2 1023E+00 | 13 46 | 26.92 | 0 00E+00 | 2 83E+01 | 5 66E+01 |
| Pu-238 | 1 0383E-03 | 13 46 | 26.92 | 0 00E+00 | 1 40E-02 | 2 80E-02 |
| Pu-239 | 5 5293E-03 | 13 46 | 26 92 | 0.00E+00 | 7 44E-02 | 1 49E-01 |
| Pu-240 | 2 1278E-03 | 13 46 | 26 92 | 0.00E+00 | 2 86E-02 | 5 73E-02 |
| Pu-241 | 1 0195E-01 | 13 46 | 26 92 | 0 00E+00 | 1.37E+00 | 2.74E+00 |
| Pu-242 | 2 3128E-07 | 13 46 | 26 92 | 0 00E+00 | 3 11E-06 | 6.23E-06 |
| Ra-226 | 5 2782E-14 | 13 46 | 26 92 | 0 00E+00 | 7 10E-13 | 1 42E-12 |
| Ra-228 | 1 9338E-10 | 13 46 | 26 92 | 0 00E+00 | 2 60E-09 | 5.21E-09 |
| Ru-106 | 9 1684E-02 | 13 46 | 26 92 | 0 00E+00 | 1.23E+00 | 2.47E+00 |
| Se-79 | 1 3018E-05 | 13 46 | 26 92 | 0 00E+00 | 1 75E-04 | 3 50E-04 |
| Sn-126 | 1 2167E-05 | 13 46 | 26 92 | 0 00E+00 | 1 64E-04 | 3.28E-04 |
| Sr-90 | 2 6045E+00 | 13 46 | 26 92 | 0 00E+00 | 3 51E+01 | 7 01E+01 |
| Tc-99 | 4 4241E-04 | 13 46 | 26 92 | 0 00E+00 | 5 95E-03 | 1.19E-02 |
| Th-229 | 1 3713E-10 | 13 46 | 26 92 | 0 00E+00 | 1 85E-09 | 3 69E-09 |
| Th-230 | 1 8090E-11 | 13 46 | 26 92 | 0 00E+00 | 2 43E-10 | 4 87E-10 |
| Th-232 | 2 5278E-10 | 13 46 | 26 92 | 0 00E+00 | 3 40E-09 | 6 80E-09 |
| Tl-208 | 1 6947E-08 | 13 46 | 26 92 | 0 00E+00 | 2 28E-07 | 4 56E-07 |
| U-232 | 4 8737E-08 | 13 46 | 26 92 | 0 00E+00 | 6 56E-07 | 1 31E-06 |
| U-233 | 1.2203E-07 | 13 46 | 26 92 | 0 00E+00 | 1 64E-06 | 3 29E-06 |
| U-234 | 1 5925E-07 | 13 46 | 26 92 | 0 00E+00 | 2 14E-06 | 4.29E-06 |
| U-235 | -2 6194E-06 | 13 46 | 0 00 | 8 43E-05 | 4 90E-05 | 8 43E-05 |
| U-236 | 1.2693E-05 | 13 46 | 26 92 | 0 00E+00 | 1 71E-04 | 3 42E-04 |
| U-238 | -3 6331E-08 | 13 46 | 0 00 | 5 24E-05 | 5 19E-05 | 5.24E-05 |
| Y-90 | 2 6060E+00 | 13 46 | 26 92 | 0 00E+00 | 3 51E+01 | 7 02E+01 |
| Other Radionuclides | | | | | 4 85E+01 | 9 71E+01 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 351E+12 |
| 0 0250 | 9 574E+11 |
| 0 0375 | 8 153E+11 |
| 0 0575 | 8 368E+11 |
| 0 0850 | 5 184E+11 |
| 0 1250 | 3 765E+11 |
| 0.2250 | 4 398E+11 |
| 0.3750 | 2.232E+11 |
| 0 5750 | 2 967E+12 |
| 0 8500 | 1.273E+11 |
| 1.2500 | 2.586E+12 |
| 1 7500 | 1 724E+09 |
| 2.2500 | 2.779E+09 |
| 2.7500 | 2.205E+07 |
| 3.5000 | 2.566E+06 |
| 5 0000 | 1 423E+01 |
| 7 0000 | 1 611E+00 |
| 11 0000 | 1 835E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 7.83E-01 | 1 57E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 2.85 | 13 46 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 26.92 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 2 02 | 4 72 | 1 00 |
| Bounding | 4 05 | | |

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: TRIGA (FLIP LEU 45/20) (DAMAGED) SO KOREA
SNF ID #: 819
Fuel Units & Descr: 4 - ELEMENT
Heavy Metal Mass: BOL=0 583kg, EOL=0 556kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1996
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20% U)
[2]Template Burnup(MWd): 6.65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 10 years

Estimated Canister usage
18"x10'
0 04

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1.3731E-09 | 25.58 | 51 17 | 0 00E+00 | 3 51E-08 | 7 03E-08 |
| Am-241 | 2.3865E-03 | 25 58 | 51 17 | 0 00E+00 | 6 11E-02 | 1 22E-01 |
| Am-242m | 1.3812E-06 | 25 58 | 51 17 | 0 00E+00 | 3 53E-05 | 7 07E-05 |
| Am-243 | 1 4767E-07 | 25 58 | 51 17 | 0 00E+00 | 3 78E-06 | 7 56E-06 |
| C-14 | 1.2863E-04 | 25 58 | 51 17 | 0 00E+00 | 3 29E-03 | 6 58E-03 |
| Cl-36 | 2 8120E-06 | 25 58 | 51 17 | 0 00E+00 | 7.19E-05 | 1 44E-04 |
| Cm-243 | 1 5895E-07 | 25 58 | 51 17 | 0 00E+00 | 4 07E-06 | 8.13E-06 |
| Cm-244 | 1 4008E-06 | 25 58 | 51 17 | 0 00E+00 | 3 58E-05 | 7.17E-05 |
| Co-60 | 6 6541E-01 | 25 58 | 51.17 | 0 00E+00 | 1 70E+01 | 3 40E+01 |
| Cs-134 | 1 6887E-02 | 25 58 | 51.17 | 0 00E+00 | 4.32E-01 | 8 64E-01 |
| Cs-135 | 3 2195E-05 | 25 58 | 51.17 | 0 00E+00 | 8.24E-04 | 1 65E-03 |
| Cs-137 | 2 4556E+00 | 25.58 | 51 17 | 0 00E+00 | 6.28E+01 | 1.26E+02 |
| Eu-154 | 1 0268E-02 | 25.58 | 51 17 | 0 00E+00 | 2 63E-01 | 5 25E-01 |
| Eu-155 | 1 4570E-02 | 25.58 | 51 17 | 0 00E+00 | 3 73E-01 | 7 45E-01 |
| Fe-55 | 2 0361E-01 | 25 58 | 51.17 | 0 00E+00 | 5.21E+00 | 1 04E+01 |
| H-3 | 8.3940E-03 | 25 58 | 51 17 | 0 00E+00 | 2 15E-01 | 4 29E-01 |
| I-129 | 7.3684E-07 | 25 58 | 51 17 | 0 00E+00 | 1 89E-05 | 3 77E-05 |
| Kr-85 | 1 8286E-01 | 25 58 | 51 17 | 0 00E+00 | 4 68E+00 | 9 36E+00 |
| Np-237 | 1.2462E-06 | 25 58 | 51 17 | 0 00E+00 | 3 19E-05 | 6.38E-05 |
| Pa-231 | 4 9143E-09 | 25 58 | 51 17 | 0 00E+00 | 1 26E-07 | 2 51E-07 |
| Pb-210 | 1 7173E-14 | 25 58 | 51.17 | 0 00E+00 | 4 39E-13 | 8.79E-13 |
| Pm-147 | 5 6165E-01 | 25 58 | 51.17 | 0 00E+00 | 1 44E+01 | 2 87E+01 |
| Pu-238 | 9 9820E-04 | 25 58 | 51.17 | 0 00E+00 | 2 55E-02 | 5 11E-02 |
| Pu-239 | 5 5293E-03 | 25 58 | 51.17 | 0 00E+00 | 1 41E-01 | 2.83E-01 |
| Pu-240 | 2 1263E-03 | 25.58 | 51.17 | 0 00E+00 | 5 44E-02 | 1 09E-01 |
| Pu-241 | 8 0165E-02 | 25.58 | 51 17 | 0 00E+00 | 2 05E+00 | 4.10E+00 |
| Pu-242 | 2 3128E-07 | 25 58 | 51 17 | 0 00E+00 | 5 92E-06 | 1 18E-05 |
| Ra-226 | 9 9774E-14 | 25 58 | 51 17 | 0 00E+00 | 2 55E-12 | 5 11E-12 |
| Ra-228 | 2.1729E-10 | 25 58 | 51 17 | 0 00E+00 | 5 56E-09 | 1 11E-08 |
| Ru-106 | 2 9519E-03 | 25 58 | 51 17 | 0 00E+00 | 7 55E-02 | 1 51E-01 |
| Se-79 | 1.3017E-05 | 25 58 | 51 17 | 0 00E+00 | 3 33E-04 | 6 66E-04 |
| Sn-126 | 1.2167E-05 | 25 58 | 51 17 | 0 00E+00 | 3 11E-04 | 6.23E-04 |
| Sr-90 | 2.3128E+00 | 25 58 | 51 17 | 0 00E+00 | 5 92E+01 | 1.18E+02 |
| Tc-99 | 4 4241E-04 | 25 58 | 51 17 | 0 00E+00 | 1 13E-02 | 2.26E-02 |
| Th-229 | 1 9459E-10 | 25 58 | 51.17 | 0.00E+00 | 4 98E-09 | 9 96E-09 |
| Th-230 | 2 5564E-11 | 25 58 | 51.17 | 0 00E+00 | 6 54E-10 | 1.31E-09 |
| Th-232 | 2 5278E-10 | 25 58 | 51.17 | 0 00E+00 | 6 47E-09 | 1.29E-08 |
| Tl-208 | 1 6947E-08 | 25.58 | 51.17 | 0 00E+00 | 4 34E-07 | 8 67E-07 |
| U-232 | 4 6812E-08 | 25.58 | 51.17 | 0 00E+00 | 1.20E-06 | 2 40E-06 |
| U-233 | 1.2206E-07 | 25 58 | 51.17 | 0 00E+00 | 3 12E-06 | 6 25E-06 |
| U-234 | 1.7323E-07 | 25 58 | 51 17 | 0 00E+00 | 4 43E-06 | 8 86E-06 |
| U-235 | -2 6194E-06 | 25 58 | 0 00 | 5 81E-04 | 5 14E-04 | 5 81E-04 |
| U-236 | 1.2693E-05 | 25 58 | 51 17 | 0 00E+00 | 3.25E-04 | 6 49E-04 |
| U-238 | -3 6331E-08 | 25 58 | 0 00 | 1 06E-04 | 1 05E-04 | 1 06E-04 |
| Y-90 | 2.3128E+00 | 25 58 | 51.17 | 0 00E+00 | 5 92E+01 | 1 18E+02 |
| Other Radionuclides | | | | | 6 27E+01 | 1.25E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 610E+12 |
| 0 0250 | 1 400E+12 |
| 0 0375 | 1 196E+12 |
| 0 0575 | 1.275E+12 |
| 0 0850 | 7 734E+11 |
| 0 1250 | 5 084E+11 |
| 0.2250 | 6.596E+11 |
| 0.3750 | 3 030E+11 |
| 0.5750 | 4 747E+12 |
| 0.8500 | 8 474E+10 |
| 1.2500 | 2.548E+12 |
| 1 7500 | 1 533E+09 |
| 2.2500 | 8 009E+07 |
| 2 7500 | 1 326E+06 |
| 3.5000 | 1 571E+05 |
| 5 0000 | 2.695E+01 |
| 7 0000 | 3 048E+00 |
| 11 0000 | 3 470E-01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.00E+00 | 2.00E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 46.09053498 | 10 to 20 1 |

**Basis for Parameter Differences:**

This Template was used for the following reasons:
This fuel matches on all parameters except enrichment.

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 14.21 | 25.58 |
| Bounding | | 51.17 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.29 | 1.80 |
| Bounding | 2.57 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

Fuel Name: TRIGA (FLIP LEU-I 20/20) MALAYSIA
SNF ID #: 497
Fuel Units & Descr: 94 - ELEMENT
Heavy Metal Mass: BOL=47 376kg; EOL=46 53kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0.000195
Template Decay Time: 5 years

Estimated Canister usage: 18"x10" 0 85

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 807 60 | 1,615.20 | 0 00E+00 | 6 88E-07 | 1 38E-06 |
| Am-241 | 1 8331E-03 | 807 60 | 1,615 20 | 0 00E+00 | 1 48E+00 | 2 96E+00 |
| Am-242m | 1.4129E-06 | 807 60 | 1,615 20 | 0 00E+00 | 1.14E-03 | 2 28E-03 |
| Am-243 | 1 4774E-07 | 807 60 | 1,615.20 | 0 00E+00 | 1.19E-04 | 2 39E-04 |
| C-14 | 1.2871E-04 | 807 60 | 1,615 20 | 0 00E+00 | 1.04E-01 | 2 08E-01 |
| Cl-36 | 2.8120E-06 | 807 60 | 1,615 20 | 0 00E+00 | 2.27E-03 | 4 54E-03 |
| Cm-243 | 1.7940E-07 | 807.60 | 1,615 20 | 0 00E+00 | 1.45E-04 | 2 90E-04 |
| Cm-244 | 1 6962E-06 | 807 60 | 1,615 20 | 0 00E+00 | 1.37E-03 | 2 74E-03 |
| Co-60 | 1.2839E+00 | 807 60 | 1,615 20 | 0 00E+00 | 1 04E+03 | 2 07E+03 |
| Cs-134 | 9 0541E-02 | 807 60 | 1,615 20 | 0 00E+00 | 7 31E+01 | 1 46E+02 |
| Cs-135 | 3.2195E-05 | 807 60 | 1,615 20 | 0 00E+00 | 2 60E-02 | 5 20E-02 |
| Cs-137 | 2.7564E+00 | 807 60 | 1,615 20 | 0 00E+00 | 2.23E+03 | 4 45E+03 |
| Eu-154 | 1 5368E-02 | 807 60 | 1,615 20 | 0 00E+00 | 1 24E+01 | 2.48E+01 |
| Eu-155 | 2 9293E-02 | 807 60 | 1,615 20 | 0 00E+00 | 2 37E+01 | 4 73E+01 |
| Fe-55 | 7 7158E-01 | 807 60 | 1,615 20 | 0 00E+00 | 6 23E+02 | 1.25E+03 |
| H-3 | 1 1111E-02 | 807 60 | 1,615 20 | 0 00E+00 | 8 97E+00 | 1.79E+01 |
| I-129 | 7 3684E-07 | 807 60 | 1,615.20 | 0 00E+00 | 5 95E-04 | 1.19E-03 |
| Kr-85 | 2 5263E-01 | 807 60 | 1,615.20 | 0 00E+00 | 2 04E+02 | 4 08E+02 |
| Np-237 | 1.2427E-06 | 807 60 | 1,615 20 | 0 00E+00 | 1 00E-03 | 2 01E-03 |
| Pa-231 | 3 8511E-09 | 807 60 | 1,615.20 | 0 00E+00 | 3 11E-06 | 6.22E-06 |
| Pb-210 | 7 3880E-15 | 807 60 | 1,615.20 | 0 00E+00 | 5 97E-12 | 1.19E-11 |
| Pm-147 | 2 1023E+00 | 807 60 | 1,615.20 | 0 00E+00 | 1 70E+03 | 3 40E+03 |
| Pu-238 | 1 0383E-03 | 807 60 | 1,615.20 | 0 00E+00 | 8 39E-01 | 1 68E+00 |
| Pu-239 | 5 5293E-03 | 807 60 | 1,615.20 | 0 00E+00 | 4 47E+00 | 8 93E+00 |
| Pu-240 | 2 1278E-03 | 807 60 | 1,615.20 | 0 00E+00 | 1 72E+00 | 3 44E+00 |
| Pu-241 | 1 0195E-01 | 807 60 | 1,615.20 | 0 00E+00 | 8 23E+01 | 1 65E+02 |
| Pu-242 | 2 3128E-07 | 807 60 | 1,615.20 | 0 00E+00 | 1 87E-04 | 3.74E-04 |
| Ra-226 | 5 2782E-14 | 807 60 | 1,615.20 | 0 00E+00 | 4 26E-11 | 8 53E-11 |
| Ra-228 | 1 9338E-10 | 807 60 | 1,615.20 | 0 00E+00 | 1 56E-07 | 3 12E-07 |
| Ru-106 | 9 1684E-02 | 807 60 | 1,615.20 | 0 00E+00 | 7.40E+01 | 1 48E+02 |
| Se-79 | 1.3018E-05 | 807 60 | 1,615.20 | 0 00E+00 | 1 05E-02 | 2 10E-02 |
| Sn-126 | 1 2167E-05 | 807 60 | 1,615 20 | 0 00E+00 | 9 83E-03 | 1 97E-02 |
| Sr-90 | 2 6045E+00 | 807 60 | 1,615.20 | 0 00E+00 | 2.10E+03 | 4 21E+03 |
| Tc-99 | 4 4241E-04 | 807 60 | 1,615.20 | 0 00E+00 | 3 57E-01 | 7 15E-01 |
| Th-229 | 1 3713E-10 | 807 60 | 1,615.20 | 0 00E+00 | 1.11E-07 | 2 21E-07 |
| Th-230 | 1 8090E-11 | 807 60 | 1,615 20 | 0.00E+00 | 1 46E-08 | 2 92E-08 |
| Th-232 | 2.5278E-10 | 807 60 | 1,615.20 | 0.00E+00 | 2.04E-07 | 4 08E-07 |
| Tl-208 | 1 6947E-08 | 807 60 | 1,615 20 | 0.00E+00 | 1.37E-05 | 2 74E-05 |
| U-232 | 4 8737E-08 | 807 60 | 1,615 20 | 0 00E+00 | 3 94E-05 | 7 87E-05 |
| U-233 | 1.2203E-07 | 807.60 | 1,615 20 | 0 00E+00 | 9.86E-05 | 1 97E-04 |
| U-234 | 1.5925E-07 | 807.60 | 1,615 20 | 0 00E+00 | 1.29E-04 | 2 57E-04 |
| U-235 | -2 6194E-06 | 807.60 | 0 00 | 2 05E-02 | 1 84E-02 | 2 05E-02 |
| U-236 | 1.2693E-05 | 807.60 | 1,615 20 | 0 00E+00 | 1 03E-02 | 2 05E-02 |
| U-238 | -3 6331E-08 | 807 60 | 0 00 | 1.27E-02 | 1.27E-02 | 1.27E-02 |
| Y-90 | 2 6060E+00 | 807 60 | 1,615 20 | 0 00E+00 | 2 10E+03 | 4.21E+03 |
| Other Radionuclides | | | | | 2 91E+03 | 5.82E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.611E+14 |
| 0 0250 | 5.744E+13 |
| 0 0375 | 4 892E+13 |
| 0 0575 | 5 021E+13 |
| 0 0850 | 3 111E+13 |
| 0 1250 | 2.259E+13 |
| 0 2250 | 2 639E+13 |
| 0 3750 | 1 339E+13 |
| 0 5750 | 1 780E+14 |
| 0 8500 | 7 641E+12 |
| 1.2500 | 1 552E+14 |
| 1 7500 | 1 034E+11 |
| 2.2500 | 1 667E+11 |
| 2 7500 | 1 323E+09 |
| 3 5000 | 1 540E+08 |
| 5 0000 | 8 759E+02 |
| 7 0000 | 9 919E+01 |
| 11 0000 | 1 130E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 70E+01 | 9.40E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 03968254 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 446 61 | 807 60 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 1 615.20 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 50 | 1 81 |
| Bounding | 1 00 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name TRIGA (FLIP LEU-I 20/20) THAILAND
SNF ID #· 496
Fuel Units & Descr· 36 - ELEMENT
Heavy Metal Mass BOL=18 144kg, EOL=15 649kg
ROD Storage Site· INEEL

[1]Fuel decay start date 2010
Estimates as of 2010
Template TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 000195
Template Decay Time: 5 years

Estimated Canister usage: 18"x10' 0 32

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 2,381 55 | 4,763.11 | 0 00E+00 | 2 03E-06 | 4 06E-06 |
| Am-241 | 1 8331E-03 | 2,381 55 | 4,763.11 | 0 00E+00 | 4 37E+00 | 8 73E+00 |
| Am-242m | 1 4129E-06 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 36E-03 | 6 73E-03 |
| Am-243 | 1 4774E-07 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 52E-04 | 7 04E-04 |
| C-14 | 1 2871E-04 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 07E-01 | 6.13E-01 |
| Cl-36 | 2 8120E-06 | 2,381 55 | 4,763 11 | 0 00E+00 | 6 70E-03 | 1.34E-02 |
| Cm-243 | 1 7940E-07 | 2,381 55 | 4,763 11 | 0 00E+00 | 4.27E-04 | 8 54E-04 |
| Cm-244 | 1 6962E-06 | 2,381 55 | 4,763 11 | 0 00E+00 | 4 04E-03 | 8 08E-03 |
| Co-60 | 1.2839E+00 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 06E+03 | 6 12E+03 |
| Cs-134 | 9 0541E-02 | 2,381 55 | 4,763 11 | 0 00E+00 | 2 16E+02 | 4 31E+02 |
| Cs-135 | 3.2195E-05 | 2,381 55 | 4,763 11 | 0 00E+00 | 7 67E-02 | 1.53E-01 |
| Cs-137 | 2.7564E+00 | 2,381.55 | 4,763 11 | 0 00E+00 | 6 56E+03 | 1.31E+04 |
| Eu-154 | 1.5368E-02 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 66E+01 | 7.32E+01 |
| Eu-155 | 2 9293E-02 | 2,381.55 | 4,763 11 | 0 00E+00 | 6 98E+01 | 1.40E+02 |
| Fe-55 | 7.7158E-01 | 2,381.55 | 4,763 11 | 0 00E+00 | 1 84E+03 | 3 68E+03 |
| H-3 | 1.1111E-02 | 2,381.55 | 4,763 11 | 0 00E+00 | 2 65E+01 | 5.29E+01 |
| I-129 | 7.3684E-07 | 2,381.55 | 4,763 11 | 0 00E+00 | 1.75E-03 | 3.51E-03 |
| Kr-85 | 2.5263E-01 | 2,381.55 | 4,763 11 | 0 00E+00 | 6 02E+02 | 1.20E+03 |
| Np-237 | 1.2427E-06 | 2,381.55 | 4,763 11 | 0 00E+00 | 2.96E-03 | 5 92E-03 |
| Pa-231 | 3 8511E-09 | 2,381.55 | 4,763 11 | 0 00E+00 | 9 17E-06 | 1 83E-05 |
| Pb-210 | 7.3880E-15 | 2,381.55 | 4,763 11 | 0 00E+00 | 1.76E-11 | 3 52E-11 |
| Pm-147 | 2 1023E+00 | 2,381.55 | 4,763 11 | 0 00E+00 | 5 01E+03 | 1.00E+04 |
| Pu-238 | 1 0383E-03 | 2,381.55 | 4,763 11 | 0 00E+00 | 2 47E+00 | 4 95E+00 |
| Pu-239 | 5 5293E-03 | 2,381.55 | 4,763 11 | 0 00E+00 | 1.32E+01 | 2.63E+01 |
| Pu-240 | 2 1278E-03 | 2,381 55 | 4,763 11 | 0 00E+00 | 5 07E+00 | 1 01E+01 |
| Pu-241 | 1 0195E-01 | 2,381.55 | 4,763 11 | 0 00E+00 | 2.43E+02 | 4 86E+02 |
| Pu-242 | 2 3128E-07 | 2,381.55 | 4,763 11 | 0 00E+00 | 5 51E-04 | 1.10E-03 |
| Ra-226 | 5 2782E-14 | 2,381.55 | 4,763 11 | 0 00E+00 | 1.26E-10 | 2 51E-10 |
| Ra-228 | 1 9338E-10 | 2,381.55 | 4,763 11 | 0 00E+00 | 4 61E-07 | 9 21E-07 |
| Ru-106 | 9 1684E-02 | 2,381 55 | 4,763 11 | 0 00E+00 | 2.18E+02 | 4 37E+02 |
| Se-79 | 1 3018E-05 | 2,381.55 | 4,763 11 | 0 00E+00 | 3 10E-02 | 6 20E-02 |
| Sn-126 | 1.2167E-05 | 2,381 55 | 4,763 11 | 0 00E+00 | 2 90E-02 | 5 80E-02 |
| Sr-90 | 2 6045E+00 | 2,381 55 | 4,763 11 | 0 00E+00 | 6.20E+03 | 1.24E+04 |
| Tc-99 | 4 4241E-04 | 2,381 55 | 4,763 11 | 0 00E+00 | 1.05E+00 | 2 11E+00 |
| Th-229 | 1 3713E-10 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 27E-07 | 6 53E-07 |
| Th-230 | 1 8090E-11 | 2,381 55 | 4,763 11 | 0 00E+00 | 4 31E-08 | 8 62E-08 |
| Th-232 | 2 5278E-10 | 2,381 55 | 4,763 11 | 0 00E+00 | 6 02E-07 | 1 20E-06 |
| Tl-208 | 1 6947E-08 | 2,381 55 | 4,763.11 | 0 00E+00 | 4 04E-05 | 8 07E-05 |
| U-232 | 4 8737E-08 | 2,381 55 | 4,763.11 | 0 00E+00 | 1 16E-04 | 2.32E-04 |
| U-233 | 1.2203E-07 | 2,381 55 | 4,763.11 | 0 00E+00 | 2 91E-04 | 5 81E-04 |
| U-234 | 1 5925E-07 | 2,381 55 | 4,763.11 | 0 00E+00 | 3 79E-04 | 7 59E-04 |
| U-235 | -2 6194E-06 | 2,381 55 | 0 00 | 7.86E-03 | 1 62E-03 | 7 86E-03 |
| U-236 | 1.2693E-05 | 2,381 55 | 4,763 11 | 0 00E+00 | 3 02E-02 | 6 05E-02 |
| U-238 | -3 6331E-08 | 2,381 55 | 0 00 | 4 88E-03 | 4 79E-03 | 4 88E-03 |
| Y-90 | 2 6060E+00 | 2,381 55 | 4,763 11 | 0 00E+00 | 6 21E+03 | 1.24E+04 |
| Other Radionuclides | | | | | 8 59E+03 | 1 72E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 7.698E+14 |
| 0 0250 | 1 694E+14 |
| 0 0375 | 1 443E+14 |
| 0.0575 | 1.481E+14 |
| 0 0850 | 9 173E+13 |
| 0 1250 | 6 661E+13 |
| 0.2250 | 7 781E+13 |
| 0.3750 | 3.949E+13 |
| 0.5750 | 5.250E+14 |
| 0 8500 | 2.253E+13 |
| 1.2500 | 4.576E+14 |
| 1 7500 | 3 050E+11 |
| 2.2500 | 4.916E+11 |
| 2 7500 | 3 901E+09 |
| 3.5000 | 4.540E+08 |
| 5 0000 | 2.507E+03 |
| 7 0000 | 2.838E+02 |
| 11 0000 | 3.233E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.39E+02 | 2 77E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences· |
|---|---|---|---|
| Reactor Moderator· | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE | |
| Fuel Cladding | SST | SST | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 20 03968254 | 10 to 20 1 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate· |
|---|---|---|---|
| Nominal | 855.20 | 2,381.55 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 4 763 11 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 3 85 | 2 78 | 1 00 |
| Bounding | 7 70 | | |

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP LEU-I) BANGLADESH
SNF ID #: 470
Fuel Units & Descr.: 100 - ELEMENT
Heavy Metal Mass: BOL=50 4kg, EOL=46.06kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 5 years

Estimated Canister usage: 18"x10' — 0 90

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 4,143 00 | 8 285 99 | 0 00E+00 | 3 53E-06 | 7 06E-06 |
| Am-241 | 1 8331E-03 | 4,143 00 | 8,285 99 | 0 00E+00 | 7 59E+00 | 1 52E+01 |
| Am-242m | 1 4129E-06 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 85E-03 | 1 17E-02 |
| Am-243 | 1 4774E-07 | 4,143 00 | 8,285 99 | 0 00E+00 | 6.12E-04 | 1 22E-03 |
| C-14 | 1.2871E-04 | 4,143 00 | 8,285 99 | 0 00E+00 | 5.33E-01 | 1 07E+00 |
| Cl-36 | 2 8120E-06 | 4,143.00 | 8,285 99 | 0 00E+00 | 1.17E-02 | 2 33E-02 |
| Cm-243 | 1 7940E-07 | 4,143.00 | 8,285 99 | 0 00E+00 | 7 43E-04 | 1 49E-03 |
| Cm-244 | 1 6962E-06 | 4,143.00 | 8,285 99 | 0 00E+00 | 7 03E-03 | 1 41E-02 |
| Co-60 | 1.2839E+00 | 4,143.00 | 8,285 99 | 0 00E+00 | 5.32E+03 | 1 06E+04 |
| Cs-134 | 9 0541E-02 | 4,143 00 | 8,285 99 | 0 00E+00 | 3.75E+02 | 7 50E+02 |
| Cs-135 | 3 2195E-05 | 4,143 00 | 8,285 99 | 0 00E+00 | 1.33E-01 | 2 67E-01 |
| Cs-137 | 2 7564E+00 | 4,143.00 | 8,285 99 | 0 00E+00 | 1 14E+04 | 2.28E+04 |
| Eu-154 | 1 5368E-02 | 4,143 00 | 8,285 99 | 0 00E+00 | 6.37E+01 | 1.27E+02 |
| Eu-155 | 2 9293E-02 | 4,143.00 | 8,285 99 | 0 00E+00 | 1.21E+02 | 2 43E+02 |
| Fe-55 | 7 7158E-01 | 4,143 00 | 8,285 99 | 0 00E+00 | 3.20E+03 | 6 39E+03 |
| H-3 | 1 1111E-02 | 4,143 00 | 8,285 99 | 0 00E+00 | 4 60E+01 | 9 21E+01 |
| I-129 | 7 3684E-07 | 4,143 00 | 8,285 99 | 0 00E+00 | 3 05E-03 | 6 11E-03 |
| Kr-85 | 2 5263E-01 | 4,143 00 | 8,285 99 | 0 00E+00 | 1.05E+03 | 2 09E+03 |
| Np-237 | 1 2427E-06 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 15E-03 | 1 03E-02 |
| Pa-231 | 3 8511E-09 | 4,143 00 | 8,285 99 | 0 00E+00 | 1 60E-05 | 3 19E-05 |
| Pb-210 | 7 3880E-15 | 4,143 00 | 8,285 99 | 0 00E+00 | 3 06E-11 | 6 12E-11 |
| Pm-147 | 2 1023E+00 | 4,143 00 | 8,285 99 | 0 00E+00 | 8.71E+03 | 1 74E+04 |
| Pu-238 | 1 0383E-03 | 4,143 00 | 8,285 99 | 0 00E+00 | 4.30E+00 | 8 60E+00 |
| Pu-239 | 5 5293E-03 | 4,143 00 | 8,285 99 | 0 00E+00 | 2.29E+01 | 4 58E+01 |
| Pu-240 | 2 1278E-03 | 4,143 00 | 8,285 99 | 0 00E+00 | 8 82E+00 | 1 76E+01 |
| Pu-241 | 1 0195E-01 | 4,143 00 | 8,285 99 | 0 00E+00 | 4.22E+02 | 8 45E+02 |
| Pu-242 | 2 3128E-07 | 4,143 00 | 8,285 99 | 0 00E+00 | 9 58E-04 | 1 92E-03 |
| Ra-226 | 5 2782E-14 | 4,143 00 | 8,285 99 | 0 00E+00 | 2 19E-10 | 4 37E-10 |
| Ra-228 | 1 9338E-10 | 4,143 00 | 8,285 99 | 0 00E+00 | 8 01E-07 | 1 60E-06 |
| Ru-106 | 9 1684E-02 | 4,143 00 | 8,285 99 | 0 00E+00 | 3 80E+02 | 7 60E+02 |
| Se-79 | 1 3018E-05 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 39E-02 | 1 08E-01 |
| Sn-126 | 1 2167E-05 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 04E-02 | 1 01E-01 |
| Sr-90 | 2 6045E+00 | 4,143 00 | 8,285 99 | 0 00E+00 | 1 08E+04 | 2 16E+04 |
| Tc-99 | 4 4241E-04 | 4,143 00 | 8,285 99 | 0 00E+00 | 1 83E+00 | 3 67E+00 |
| Th-229 | 1 3713E-10 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 68E-07 | 1 14E-06 |
| Th-230 | 1 8090E-11 | 4,143 00 | 8,285 99 | 0 00E+00 | 7 49E-08 | 1 50E-07 |
| Th-232 | 2 5278E-10 | 4,143 00 | 8,285 99 | 0 00E+00 | 1 05E-06 | 2 09E-06 |
| Tl-208 | 1 6947E-08 | 4,143 00 | 8,285 99 | 0 00E+00 | 7 02E-05 | 1 40E-04 |
| U-232 | 4 8737E-08 | 4,143 00 | 8,285 99 | 0 00E+00 | 2 02E-04 | 4 04E-04 |
| U-233 | 1 2203E-07 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 06E-04 | 1 01E-03 |
| U-234 | 1 5925E-07 | 4,143 00 | 8,285 99 | 0 00E+00 | 6 60E-04 | 1 32E-03 |
| U-235 | -2 6194E-06 | 4,143 00 | 0 00 | 2.18E-02 | 1 10E-02 | 2.18E-02 |
| U-236 | 1 2693E-05 | 4,143 00 | 8,285 99 | 0 00E+00 | 5 26E-02 | 1.05E-01 |
| U-238 | -3 6331E-08 | 4,143 00 | 0 00 | 1.35E-02 | 1 34E-02 | 1 35E-02 |
| Y-90 | 2 6060E+00 | 4,143 00 | 8,285 99 | 0 00E+00 | 1 08E+04 | 2 16E+04 |
| Other Radionuclides | | | | | 1 49E+04 | 2 99E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 339E+15 |
| 0 0250 | 2 947E+14 |
| 0 0375 | 2 509E+14 |
| 0 0575 | 2 576E+14 |
| 0 0850 | 1 596E+14 |
| 0 1250 | 1 159E+14 |
| 0.2250 | 1 354E+14 |
| 0 3750 | 6 870E+13 |
| 0 5750 | 9 133E+14 |
| 0 8500 | 3 920E+13 |
| 1.2500 | 7 960E+14 |
| 1 7500 | 5 306E+11 |
| 2.2500 | 8 553E+11 |
| 2.7500 | 6 787E+09 |
| 3.5000 | 7 899E+08 |
| 5.0000 | 4 374E+03 |
| 7 0000 | 4 951E+02 |
| 11.0000 | 5 639E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.41E+02 | 4.82E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 03968254 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 475 12 | 4 143.00 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 8 285 99 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 2.41 | 8 72 |
| Bounding | 4 82 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name TRIGA (FLIP LEU-II 20/30) PHILIPPINES
SNF ID # 499
Fuel Units & Descr. 128 - ELEMENT
Heavy Metal Mass BOL=105 472kg, EOL=105.344kg
ROD Storage Site: INEEL

[1]Fuel decay start date 2010
Estimates as of. 2010
Template TRIGA-SS (LW/U-Zrx, SST, 10 to 20% U)
[2]Template Burnup(MWd) 6 65
Template BOL Heavy Metal Mass (MT) 0 000195
Template Decay Time 5 years

Estimated Canister usage: 18"x10' 1 15

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 994.28 | 1,988 57 | 0 00E+00 | 8 47E-07 | 1.69E-06 |
| Am-241 | 1 8331E-03 | 994.28 | 1,988 57 | 0 00E+00 | 1 82E+00 | 3 65E+00 |
| Am-242m | 1 4129E-06 | 994.28 | 1,988 57 | 0 00E+00 | 1 40E-03 | 2 81E-03 |
| Am-243 | 1 4774E-07 | 994.28 | 1,988 57 | 0 00E+00 | 1 47E-04 | 2 94E-04 |
| C-14 | 1.2871E-04 | 994 28 | 1,988 57 | 0 00E+00 | 1.28E-01 | 2 56E-01 |
| Cl-36 | 2.8120E-06 | 994 28 | 1,988 57 | 0 00E+00 | 2 80E-03 | 5 59E-03 |
| Cm-243 | 1 7940E-07 | 994 28 | 1,988 57 | 0 00E+00 | 1 78E-04 | 3 57E-04 |
| Cm-244 | 1 6962E-06 | 994 28 | 1,988 57 | 0 00E+00 | 1 69E-03 | 3 37E-03 |
| Co-60 | 1.2839E+00 | 994.28 | 1,988 57 | 0 00E+00 | 1 28E+03 | 2 55E+03 |
| Cs-134 | 9 0541E-02 | 994.28 | 1,988 57 | 0 00E+00 | 9 00E+01 | 1 80E+02 |
| Cs-135 | 3 2195E-05 | 994.28 | 1,988 57 | 0 00E+00 | 3.20E-02 | 6 40E-02 |
| Cs-137 | 2 7564E+00 | 994.28 | 1,988 57 | 0 00E+00 | 2 74E+03 | 5 48E+03 |
| Eu-154 | 1.5368E-02 | 994.28 | 1,988 57 | 0 00E+00 | 1.53E+01 | 3 06E+01 |
| Eu-155 | 2 9293E-02 | 994.28 | 1,988 57 | 0 00E+00 | 2.91E+01 | 5 83E+01 |
| Fe-55 | 7.7158E-01 | 994 28 | 1,988 57 | 0 00E+00 | 7.67E+02 | 1.53E+03 |
| H-3 | 1.1111E-02 | 994 28 | 1,988 57 | 0 00E+00 | 1 10E+01 | 2.21E+01 |
| I-129 | 7.3684E-07 | 994 28 | 1,988 57 | 0 00E+00 | 7.33E-04 | 1 47E-03 |
| Kr-85 | 2.5263E-01 | 994 28 | 1,988 57 | 0 00E+00 | 2 51E+02 | 5 02E+02 |
| Np-237 | 1.2427E-06 | 994.28 | 1,988.57 | 0 00E+00 | 1 24E-03 | 2 47E-03 |
| Pa-231 | 3 8511E-09 | 994.28 | 1,988 57 | 0 00E+00 | 3 83E-06 | 7 66E-06 |
| Pb-210 | 7 3880E-15 | 994.28 | 1,988 57 | 0 00E+00 | 7.35E-12 | 1 47E-11 |
| Pm-147 | 2 1023E+00 | 994.28 | 1,988 57 | 0 00E+00 | 2 09E+03 | 4 18E+03 |
| Pu-238 | 1 0383E-03 | 994.28 | 1,988 57 | 0 00E+00 | 1 03E+00 | 2 06E+00 |
| Pu-239 | 5 5293E-03 | 994.28 | 1,988 57 | 0 00E+00 | 5 50E+00 | 1.10E+01 |
| Pu-240 | 2.1278E-03 | 994.28 | 1,988 57 | 0 00E+00 | 2.12E+00 | 4.23E+00 |
| Pu-241 | 1.0195E-01 | 994 28 | 1,988 57 | 0 00E+00 | 1.01E+02 | 2.03E+02 |
| Pu-242 | 2.3128E-07 | 994 28 | 1,988 57 | 0 00E+00 | 2 30E-04 | 4 60E-04 |
| Ra-226 | 5.2782E-14 | 994 28 | 1,988 57 | 0 00E+00 | 5 25E-11 | 1 05E-10 |
| Ra-228 | 1 9338E-10 | 994.28 | 1,988.57 | 0 00E+00 | 1 92E-07 | 3 85E-07 |
| Ru-106 | 9 1684E-02 | 994 28 | 1,988.57 | 0 00E+00 | 9 12E+01 | 1 82E+02 |
| Se-79 | 1 3018E-05 | 994.28 | 1,988 57 | 0 00E+00 | 1.29E-02 | 2 59E-02 |
| Sn-126 | 1 2167E-05 | 994.28 | 1,988 57 | 0 00E+00 | 1.21E-02 | 2 42E-02 |
| Sr-90 | 2 6045E+00 | 994.28 | 1,988 57 | 0 00E+00 | 2 59E+03 | 5 18E+03 |
| Tc-99 | 4 4241E-04 | 994.28 | 1,988 57 | 0 00E+00 | 4.40E-01 | 8 80E-01 |
| Th-229 | 1.3713E-10 | 994.28 | 1,988 57 | 0 00E+00 | 1.36E-07 | 2.73E-07 |
| Th-230 | 1 8090E-11 | 994.28 | 1,988 57 | 0 00E+00 | 1 80E-08 | 3 60E-08 |
| Th-232 | 2.5278E-10 | 994.28 | 1,988 57 | 0 00E+00 | 2 51E-07 | 5 03E-07 |
| Tl-208 | 1 6947E-08 | 994 28 | 1,988 57 | 0 00E+00 | 1 69E-05 | 3.37E-05 |
| U-232 | 4 8737E-08 | 994 28 | 1,988.57 | 0 00E+00 | 4 85E-05 | 9 69E-05 |
| U-233 | 1.2203E-07 | 994 28 | 1,988.57 | 0.00E+00 | 1 21E-04 | 2 43E-04 |
| U-234 | 1 5925E-07 | 994.28 | 1,988 57 | 0 00E+00 | 1.58E-04 | 3 17E-04 |
| U-235 | -2.6194E-06 | 994.28 | 0 00 | 4 56E-02 | 4.30E-02 | 4 56E-02 |
| U-236 | 1.2693E-05 | 994.28 | 1,988 57 | 0 00E+00 | 1.26E-02 | 2.52E-02 |
| U-238 | -3 6331E-08 | 994.28 | 0 00 | 2 84E-02 | 2.83E-02 | 2 84E-02 |
| Y-90 | 2 6060E+00 | 994.28 | 1,988 57 | 0 00E+00 | 2 59E+03 | 5 18E+03 |
| Other Radionuclides | | | | | 3 58E+03 | 7 17E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3.214E+14 |
| 0 0250 | 7 072E+13 |
| 0 0375 | 6 023E+13 |
| 0 0575 | 6 182E+13 |
| 0 0850 | 3.830E+13 |
| 0 1250 | 2 781E+13 |
| 0.2250 | 3.249E+13 |
| 0.3750 | 1 649E+13 |
| 0.5750 | 2 192E+14 |
| 0.8500 | 9 407E+12 |
| 1.2500 | 1 910E+14 |
| 1 7500 | 1.273E+11 |
| 2.2500 | 2.053E+11 |
| 2 7500 | 1 629E+09 |
| 3 5000 | 1.896E+08 |
| 5 0000 | 1 108E+03 |
| 7 0000 | 1.255E+02 |
| 11.0000 | 1.430E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 5 79E+01 | 1.16E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 02427184 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 994.28 | 122 19 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 1,988 57 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.28 | 0 12 |
| Bounding | 0.55 | |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP LEU-II 20/30) TAIWAN
SNF ID #: 498
Fuel Units & Descr: 144 - ELEMENT
Heavy Metal Mass: BOL=118 656kg, EOL=118.512kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-SS (LW/U-Zrx, SST, 10 to 20%, U)
[2]Template Burnup(MWd): 6 65
Template BOL Heavy Metal Mass (MT): 0 000195
Template Decay Time: 5 years

Estimated Canister usage: 18"x10' 1 30

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 8 5173E-10 | 1,118 57 | 2,237 14 | 0 00E+00 | 9 53E-07 | 1 91E-06 |
| Am-241 | 1 8331E-03 | 1,118 57 | 2,237 14 | 0 00E+00 | 2 05E+00 | 4 10E+00 |
| Am-242m | 1 4129E-06 | 1,118 57 | 2,237 14 | 0 00E+00 | 1.58E-03 | 3 16E-03 |
| Am-243 | 1 4774E-07 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 65E-04 | 3 31E-04 |
| C-14 | 1 2871E-04 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 44E-01 | 2 88E-01 |
| Cl-36 | 2 8120E-06 | 1,118 57 | 2,237 14 | 0 00E+00 | 3.15E-03 | 6 29E-03 |
| Cm-243 | 1 7940E-07 | 1,118 57 | 2,237 14 | 0 00E+00 | 2 01E-04 | 4 01E-04 |
| Cm-244 | 1 6962E-06 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 90E-03 | 3 79E-03 |
| Co-60 | 1 2839E+00 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 44E+03 | 2 87E+03 |
| Cs-134 | 9 0541E-02 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 01E+02 | 2 03E+02 |
| Cs-135 | 3 2195E-05 | 1,118 57 | 2,237 14 | 0 00E+00 | 3 60E-02 | 7 20E-02 |
| Cs-137 | 2 7564E+00 | 1,118 57 | 2,237.14 | 0 00E+00 | 3 08E+03 | 6 17E+03 |
| Eu-154 | 1 5368E-02 | 1,118 57 | 2,237 14 | 0 00E+00 | 1 72E+01 | 3 44E+01 |
| Eu-155 | 2 9293E-02 | 1,118 57 | 2,237.14 | 0 00E+00 | 3 28E+01 | 6 55E+01 |
| Fe-55 | 7 7158E-01 | 1,118 57 | 2,237 14 | 0 00E+00 | 8 63E+02 | 1 73E+03 |
| H-3 | 1 1111E-02 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 24E+01 | 2 49E+01 |
| I-129 | 7 3684E-07 | 1,118 57 | 2,237 14 | 0 00E+00 | 8 24E-04 | 1 65E-03 |
| Kr-85 | 2 5263E-01 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 83E+02 | 5 65E+02 |
| Np-237 | 1 2427E-06 | 1,118 57 | 2,237 14 | 0 00E+00 | 1.39E-03 | 2 78E-03 |
| Pa-231 | 3 8511E-09 | 1,118 57 | 2,237.14 | 0 00E+00 | 4 31E-06 | 8 62E-06 |
| Pb-210 | 7 3880E-15 | 1,118 57 | 2,237 14 | 0 00E+00 | 8.26E-12 | 1 65E-11 |
| Pm-147 | 2 1023E+00 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 35E+03 | 4 70E+03 |
| Pu-238 | 1 0383E-03 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 16E+00 | 2 32E+00 |
| Pu-239 | 5 5293E-03 | 1,118 57 | 2,237.14 | 0 00E+00 | 6 18E+00 | 1.24E+01 |
| Pu-240 | 2 1278E-03 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 38E+00 | 4 76E+00 |
| Pu-241 | 1 0195E-01 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 14E+02 | 2.28E+02 |
| Pu-242 | 2 3128E-07 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 59E-04 | 5 17E-04 |
| Ra-226 | 5 2782E-14 | 1,118 57 | 2,237.14 | 0 00E+00 | 5 90E-11 | 1.18E-10 |
| Ra-228 | 1 9338E-10 | 1,118 57 | 2,237.14 | 0 00E+00 | 2.16E-07 | 4 33E-07 |
| Ru-106 | 9 1684E-02 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 03E+02 | 2 05E+02 |
| Se-79 | 1 3018E-05 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 46E-02 | 2 91E-02 |
| Sn-126 | 1 2167E-05 | 1,118 57 | 2,237.14 | 0 00E+00 | 1.36E-02 | 2 72E-02 |
| Sr-90 | 2 6045E+00 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 91E+03 | 5 83E+03 |
| Tc-99 | 4 4241E-04 | 1,118 57 | 2,237.14 | 0 00E+00 | 4 95E-01 | 9 90E-01 |
| Th-229 | 1 3713E-10 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 53E-07 | 3 07E-07 |
| Th-230 | 1 8090E-11 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 02E-08 | 4 05E-08 |
| Th-232 | 2 5278E-10 | 1,118 57 | 2,237.14 | 0 00E+00 | 2 83E-07 | 5 66E-07 |
| Tl-208 | 1 6947E-08 | 1,118.57 | 2,237.14 | 0 00E+00 | 1 90E-05 | 3 79E-05 |
| U-232 | 4 8737E-08 | 1,118.57 | 2,237.14 | 0 00E+00 | 5 45E-05 | 1 09E-04 |
| U-233 | 1 2203E-07 | 1,118.57 | 2,237.14 | 0 00E+00 | 1 36E-04 | 2 73E-04 |
| U-234 | 1 5925E-07 | 1,118 57 | 2,237.14 | 0 00E+00 | 1 78E-04 | 3 56E-04 |
| U-235 | -2 6194E-06 | 1,118 57 | 0 00 | 5 13E-02 | 4 84E-02 | 5 13E-02 |
| U-236 | 1 2693E-05 | 1,118.57 | 2,237.14 | 0 00E+00 | 1 42E-02 | 2 84E-02 |
| U-238 | -3 6331E-08 | 1,118.57 | 0 00 | 3.19E-02 | 3 19E-02 | 3 19E-02 |
| Y-90 | 2 6060E+00 | 1,118 57 | 2,237 14 | 0 00E+00 | 2 92E+03 | 5 83E+03 |
| Other Radionuclides | | | | | 4 03E+03 | 8 07E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 616E+14 |
| 0 0250 | 7 956E+13 |
| 0 0375 | 6 775E+13 |
| 0 0575 | 6 954E+13 |
| 0 0850 | 4.308E+13 |
| 0 1250 | 3 129E+13 |
| 0.2250 | 3 655E+13 |
| 0.3750 | 1 855E+13 |
| 0 5750 | 2 466E+14 |
| 0 8500 | 1 058E+13 |
| 1.2500 | 2 149E+14 |
| 1 7500 | 1 433E+11 |
| 2.2500 | 2 309E+11 |
| 2.7500 | 1.832E+09 |
| 3.5000 | 2 133E+08 |
| 5.0000 | 1.246E+03 |
| 7 0000 | 1 412E+02 |
| 11 0000 | 1 609E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 6 51E+01 | 1.30E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 20 024 | 10 to 20 1 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 1 118.57 | 137 46 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 2,237 14 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 28 | 0 12 |
| Bounding | 0 55 | |

Estimated EOL HM/Given EOL HM: 0 99

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) | [1]Fuel decay start date | 2035 |
| SNF ID # | 729 | Estimates as of | 2010 |
| Fuel Units & Descr | 111 - ELEMENT | Template | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=21.534kg EOL=16.35kg | [2]Template Burnup(MWd) | 66.52 |
| ROD Storage Site: | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000196 |
| | | Template Decay Time | 5 years |

Estimated Canister usage

| 18"x10' |
|---|
| 1 00 |

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 4,926 69 | 9,853 39 | 0 00E+00 | 1 40E-06 | 2 81E-06 |
| Am-241 | 7.5767E-03 | 4,926 69 | 9,853.39 | 0 00E+00 | 3 73E+01 | 7 47E+01 |
| Am-242m | 2 4459E-05 | 4,926 69 | 9,853 39 | 0 00E+00 | 1 21E-01 | 2 41E-01 |
| Am-243 | 3 0983E-05 | 4,926 69 | 9,853.39 | 0 00E+00 | 1 53E-01 | 3 05E-01 |
| C-14 | 1.2590E-04 | 4,926 69 | 9,853.39 | 0 00E+00 | 6 20E-01 | 1 24E+00 |
| Cl-36 | 2 6624E-06 | 4,926 69 | 9,853 39 | 0 00E+00 | 1 31E-02 | 2 62E-02 |
| Cm-243 | 3 8244E-05 | 4,926 69 | 9,853 39 | 0 00E+00 | 1 88E-01 | 3 77E-01 |
| Cm-244 | 4.1010E-03 | 4,926 69 | 9,853 39 | 0 00E+00 | 2 02E+01 | 4 04E+01 |
| Co-60 | 1.2410E+00 | 4,926 69 | 9,853 39 | 0 00E+00 | 6 11E+03 | 1 22E+04 |
| Cs-134 | 6.5454E-01 | 4,926 69 | 9,853.39 | 0 00E+00 | 3 22E+03 | 6 45E+03 |
| Cs-135 | 1.9753E-05 | 4,926 69 | 9,853.39 | 0 00E+00 | 9 73E-02 | 1 95E-01 |
| Cs-137 | 2 7375E+00 | 4,926 69 | 9,853 39 | 0 00E+00 | 1 35E+04 | 2 70E+04 |
| Eu-154 | 1.2324E-01 | 4,926 69 | 9,853 39 | 0 00E+00 | 6 07E+02 | 1.21E+03 |
| Eu-155 | 5 3037E-02 | 4,926 69 | 9,853 39 | 0 00E+00 | 2 61E+02 | 5 23E+02 |
| Fe-55 | 7.9555E-01 | 4,926 69 | 9,853 39 | 0 00E+00 | 3 92E+03 | 7.84E+03 |
| H-3 | 1.0531E-02 | 4,926 69 | 9,853 39 | 0.00E+00 | 5 19E+01 | 1 04E+02 |
| I-129 | 7.1287E-07 | 4,926 69 | 9 853 39 | 0 00E+00 | 3 51E-03 | 7.02E-03 |
| Kr-85 | 2 4955E-01 | 4,926 69 | 9,853 39 | 0.00E+00 | 1 23E+03 | 2 46E+03 |
| Np-237 | 1.2121E-05 | 4,926 69 | 9,853 39 | 0 00E+00 | 5 97E-02 | 1.19E-01 |
| Pa-231 | 1.1230E-09 | 4,926 69 | 9,853 39 | 0.00E+00 | 5 53E-06 | 1.11E-05 |
| Pb-210 | 6 1636E-14 | 4,926 69 | 9,853 39 | 0 00E+00 | 3 04E-10 | 6.07E-10 |
| Pm-147 | 1.1302E+00 | 4,926 69 | 9,853 39 | 0 00E+00 | 5 57E+03 | 1.11E+04 |
| Pu-238 | 5 4826E-02 | 4,926 69 | 9,853 39 | 0.00E+00 | 2 70E+02 | 5 40E+02 |
| Pu-239 | 1.4056E-03 | 4,926 69 | 9,853 39 | 0.00E+00 | 6 92E+00 | 1.38E+01 |
| Pu-240 | 1.1536E-03 | 4,926 69 | 9,853 39 | 0 00E+00 | 5 68E+00 | 1.14E+01 |
| Pu-241 | 4.2995E-01 | 4,926 69 | 9,853 39 | 0.00E+00 | 2 12E+03 | 4.24E+03 |
| Pu-242 | 4 9910E-06 | 4,926 69 | 9,853 39 | 0.00E+00 | 2 46E-02 | 4 92E-02 |
| Ra-226 | 2.4008E-13 | 4,926 69 | 9,853 39 | 0.00E+00 | 1.18E-09 | 2.37E-09 |
| Ra-228 | 1.8220E-11 | 4,926 69 | 9,853 39 | 0 00E+00 | 8 98E-08 | 1 80E-07 |
| Ru-106 | 1 0343E-01 | 4,926 69 | 9,853 39 | 0.00E+00 | 5 10E+02 | 1.02E+03 |
| Se-79 | 1.2832E-05 | 4,926 69 | 9,853 39 | 0.00E+00 | 6 32E-02 | 1.26E-01 |
| Sn-126 | 1.2090E-05 | 4,926 69 | 9,853 39 | 0.00E+00 | 5 96E-02 | 1 19E-01 |
| Sr-90 | 2.5646E+00 | 4,926 69 | 9,853 39 | 0.00E+00 | 1 26E+04 | 2.53E+04 |
| Tc-99 | 4 0319E-04 | 4,926 69 | 9,853 39 | 0.00E+00 | 1 99E+00 | 3.97E+00 |
| Th-229 | 7.7375E-11 | 4,926 69 | 9,853 39 | 0.00E+00 | 3 81E-07 | 7 62E-07 |
| Th-230 | 1.2211E-10 | 4,926 69 | 9,853 39 | 0.00E+00 | 6 02E-07 | 1.20E-06 |
| Th-232 | 2.3842E-11 | 4,926 69 | 9,853 39 | 0 00E+00 | 1.17E-07 | 2 35E-07 |
| Tl-208 | 1.4313E-07 | 4,926 69 | 9,853 39 | 0 00E+00 | 7.05E-04 | 1 41E-03 |
| U-232 | 4 1927E-07 | 4,926 69 | 9,853 39 | 0 00E+00 | 2.07E-03 | 4 13E-03 |
| U-233 | 6 8491E-08 | 4,926 69 | 9,853 39 | 0 00E+00 | 3.37E-04 | 6 75E-04 |
| U-234 | 2 0189E-06 | 4,926 69 | 9,853 39 | 0 00E+00 | 9.95E-03 | 1 99E-02 |
| U-235 | -2 6572E-06 | 4,926 69 | 0 00 | 3.26E-02 | 1.95E-02 | 3 26E-02 |
| U-236 | 1.3575E-05 | 4,926 69 | 9,853 39 | 0 00E+00 | 6 69E-02 | 1 34E-01 |
| U-238 | -2 2698E-08 | 4,926 69 | 0 00 | 2.17E-03 | 2.06E-03 | 2 17E-03 |
| Y-90 | 2.5646E+00 | 4,926 69 | 9,853 39 | 0 00E+00 | 1.26E+04 | 2 53E+04 |
| Other Radionuclides | | | | | 1 75E+04 | 3 51E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.590E+15 |
| 0 0250 | 3 489E+14 |
| 0 0375 | 3 086E+14 |
| 0 0575 | 3 080E+14 |
| 0 0850 | 1.917E+14 |
| 0 1250 | 1.539E+14 |
| 0 2250 | 1 629E+14 |
| 0 3750 | 8 127E+13 |
| 0 5750 | 1.345E+15 |
| 0.8500 | 2 468E+14 |
| 1.2500 | 9 478E+14 |
| 1 7500 | 1.268E+12 |
| 2.2500 | 9 937E+11 |
| 2 7500 | 9 009E+09 |
| 3.5000 | 1.060E+09 |
| 5 0000 | 2.540E+05 |
| 7 0000 | 2.923E+04 |
| 11 0000 | 3.354E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3.23E+02 | 6.46E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70 03211513 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 4,697 97 | 4 926 69 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 9,853 39 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 67 | 1 05 |
| Bounding | 1 35 | |

Estimated EOL HM/Given EOL HM: 1.00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name. TRIGA (FLIP) ANL-W
SNF ID #: 354
Fuel Units & Descr: 6 - ELEMENT
Heavy Metal Mass: BOL=1 068kg; EOL=0 979kg
ROD Storage Site. INEEL

[1]Fuel decay start date. 1994
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd). 66.52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 15 years

Estimated Canister usage 18"x10'
0 05

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 5 6765E-10 | 84 97 | 169 94 | 0 00E+00 | 4 82E-08 | 9 65E-08 |
| Am-241 | 1 1720E-02 | 84.97 | 169 94 | 0 00E+00 | 9 96E-01 | 1 99E+00 |
| Am-242m | 2 3361E-05 | 84 97 | 169 94 | 0 00E+00 | 1.98E-03 | 3 97E-03 |
| Am-243 | 3 0953E-05 | 84 97 | 169 94 | 0 00E+00 | 2 63E-03 | 5 26E-03 |
| C-14 | 1.2574E-04 | 84 97 | 169 94 | 0 00E+00 | 1.07E-02 | 2 14E-02 |
| Cl-36 | 2 6624E-06 | 84 97 | 169 94 | 0 00E+00 | 2.26E-04 | 4 52E-04 |
| Cm-243 | 2 9991E-05 | 84 97 | 169 94 | 0 00E+00 | 2.55E-03 | 5 10E-03 |
| Cm-244 | 2.7977E-03 | 84 97 | 169 94 | 0 00E+00 | 2.38E-01 | 4 75E-01 |
| Co-60 | 3.3343E-01 | 84 97 | 169 94 | 0 00E+00 | 2 83E+01 | 5 67E+01 |
| Cs-134 | 2.2760E-02 | 84 97 | 169 94 | 0 00E+00 | 1 93E+00 | 3 87E+00 |
| Cs-135 | 1.9753E-05 | 84 97 | 169 94 | 0 00E+00 | 1 68E-03 | 3 36E-03 |
| Cs-137 | 2.1723E+00 | 84 97 | 169 94 | 0 00E+00 | 1 85E+02 | 3 69E+02 |
| Eu-154 | 5 5066E-02 | 84 97 | 169 94 | 0 00E+00 | 4 68E+00 | 9 36E+00 |
| Eu-155 | 1.3119E-02 | 84 97 | 169 94 | 0 00E+00 | 1.11E+00 | 2 23E+00 |
| Fe-55 | 5 5412E-02 | 84 97 | 169 94 | 0 00E+00 | 4.71E+00 | 9 42E+00 |
| H-3 | 6 0102E-03 | 84 97 | 169 94 | 0 00E+00 | 5 11E-01 | 1 02E+00 |
| I-129 | 7.1287E-07 | 84 97 | 169 94 | 0 00E+00 | 6 06E-05 | 1 21E-04 |
| Kr-85 | 1.3077E-01 | 84 97 | 169 94 | 0 00E+00 | 1.11E+01 | 2 22E+01 |
| Np-237 | 1.2153E-05 | 84 97 | 169 94 | 0 00E+00 | 1 03E-03 | 2 07E-03 |
| Pa-231 | 1 5021E-09 | 84 97 | 169 94 | 0 00E+00 | 1.28E-07 | 2.55E-07 |
| Pb-210 | 2.2760E-13 | 84 97 | 169 94 | 0 00E+00 | 1 93E-11 | 3 87E-11 |
| Pm-147 | 8 0622E-02 | 84 97 | 169 94 | 0 00E+00 | 6.85E+00 | 1 37E+01 |
| Pu-238 | 5 0676E-02 | 84 97 | 169 94 | 0 00E+00 | 4.31E+00 | 8 61E+00 |
| Pu-239 | 1 4051E-03 | 84 97 | 169 94 | 0 00E+00 | 1 19E-01 | 2 39E-01 |
| Pu-240 | 1 1553E-03 | 84 97 | 169 94 | 0 00E+00 | 9 82E-02 | 1 96E-01 |
| Pu-241 | 2 6578E-01 | 84 97 | 169 94 | 0.00E+00 | 2.26E+01 | 4 52E+01 |
| Pu-242 | 4 9910E-06 | 84 97 | 169 94 | 0 00E+00 | 4.24E-04 | 8 48E-04 |
| Ra-226 | 1.2541E-12 | 84 97 | 169 94 | 0 00E+00 | 1 07E-10 | 2 13E-10 |
| Ra-228 | 2 1843E-11 | 84 97 | 169 94 | 0 00E+00 | 1 86E-09 | 3.71E-09 |
| Ru-106 | 1 0722E-04 | 84 97 | 169 94 | 0 00E+00 | 9 11E-03 | 1 82E-02 |
| Se-79 | 1.2831E-05 | 84 97 | 169 94 | 0 00E+00 | 1 09E-03 | 2.18E-03 |
| Sn-126 | 1.2090E-05 | 84 97 | 169 94 | 0 00E+00 | 1 03E-03 | 2 05E-03 |
| Sr-90 | 2 0204E+00 | 84 97 | 169 94 | 0 00E+00 | 1 72E+02 | 3 43E+02 |
| Tc-99 | 4 0319E-04 | 84 97 | 169 94 | 0 00E+00 | 3 43E-02 | 6 85E-02 |
| Th-229 | 1 4217E-10 | 84 97 | 169 94 | 0 00E+00 | 1 21E-08 | 2.42E-08 |
| Th-230 | 3 6906E-10 | 84 97 | 169 94 | 0 00E+00 | 3 14E-08 | 6.27E-08 |
| Th-232 | 2 3857E-11 | 84 97 | 169 94 | 0 00E+00 | 2 03E-09 | 4 05E-09 |
| Tl-208 | 1 4857E-07 | 84 97 | 169 94 | 0 00E+00 | 1 26E-05 | 2.52E-05 |
| U-232 | 4 1251E-07 | 84 97 | 169 94 | 0 00E+00 | 3 50E-05 | 7.01E-05 |
| U-233 | 6 9017E-08 | 84 97 | 169 94 | 0 00E+00 | 5 86E-06 | 1.17E-05 |
| U-234 | 3 4546E-06 | 84 97 | 169 94 | 0 00E+00 | 2 94E-04 | 5 87E-04 |
| U-235 | -2 6572E-06 | 84 97 | 0 00 | 1 62E-03 | 1 39E-03 | 1.62E-03 |
| U-236 | 1 3575E-05 | 84 97 | 169 94 | 0 00E+00 | 1 15E-03 | 2.31E-03 |
| U-238 | -2 2698E-08 | 84 97 | 0 00 | 1 07E-04 | 1 05E-04 | 1 07E-04 |
| Y-90 | 2 0219E+00 | 84 97 | 169 94 | 0 00E+00 | 1 72E+02 | 3 44E+02 |
| Other Radionuclides | | | | | 1 81E+02 | 3 62E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1.910E+13 |
| 0 0250 | 3.978E+12 |
| 0 0375 | 3.514E+12 |
| 0 0575 | 3 718E+12 |
| 0 0850 | 2.239E+12 |
| 0 1250 | 1.585E+12 |
| 0 2250 | 1 928E+12 |
| 0 3750 | 8 464E+11 |
| 0 5750 | 1.398E+13 |
| 0 8500 | 4.252E+11 |
| 1.2500 | 4 428E+12 |
| 1 7500 | 8 922E+09 |
| 2.2500 | 2.580E+07 |
| 2.7500 | 1 110E+06 |
| 3 5000 | 2 606E+04 |
| 5 0000 | 3 036E+03 |
| 7 0000 | 3 490E+02 |
| 11 0000 | 4 003E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.76E+00 | 5.52E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70.2247191 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 77 67 | 84 97 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | 43 79 | 169 94 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.23 | 1 09 |
| Bounding | 0 47 | 3 88 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) ANL-W (NRAD)
SNF ID # 884
Fuel Units & Descr: 61 - ELEMENT
Heavy Metal Mass BOL=10.858kg, EOL=10.602kg
ROD Storage Site INEEL

[1]Fuel decay start date 1994
Estimates as of 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd) 66.52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 15 years

Estimated Canister usage: 18"x10' 0 55

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 5 6765E-10 | 263.21 | 445 18 | 0 00E+00 | 1.49E-07 | 2 53E-07 |
| Am-241 | 1 1720E-02 | 263.21 | 445 18 | 0 00E+00 | 3 08E+00 | 5.22E+00 |
| Am-242m | 2 3361E-05 | 263.21 | 445 18 | 0 00E+00 | 6 15E-03 | 1 04E-02 |
| Am-243 | 3 0953E-05 | 263.21 | 445 18 | 0 00E+00 | 8 15E-03 | 1 38E-02 |
| C-14 | 1 2574E-04 | 263.21 | 445 18 | 0 00E+00 | 3 31E-02 | 5 60E-02 |
| Cl-36 | 2 6624E-06 | 263 21 | 445 18 | 0 00E+00 | 7 01E-04 | 1 19E-03 |
| Cm-243 | 2 9991E-05 | 263 21 | 445 18 | 0 00E+00 | 7.89E-03 | 1 34E-02 |
| Cm-244 | 2 7977E-03 | 263 21 | 445 18 | 0 00E+00 | 7.36E-01 | 1.25E+00 |
| Co-60 | 3 3343E-01 | 263 21 | 445.18 | 0 00E+00 | 8 78E+01 | 1 48E+02 |
| Cs-134 | 2 2760E-02 | 263 21 | 445.18 | 0 00E+00 | 5 99E+00 | 1 01E+01 |
| Cs-135 | 1 9753E-05 | 263 21 | 445.18 | 0 00E+00 | 5.20E-03 | 8 79E-03 |
| Cs-137 | 2 1723E+00 | 263 21 | 445 18 | 0 00E+00 | 5 72E+02 | 9 67E+02 |
| Eu-154 | 5 5066E-02 | 263 21 | 445 18 | 0 00E+00 | 1.45E+01 | 2 45E+01 |
| Eu-155 | 1 3119E-02 | 263 21 | 445 18 | 0 00E+00 | 3 45E+00 | 5 84E+00 |
| Fe-55 | 5 5412E-02 | 263 21 | 445 18 | 0 00E+00 | 1.46E+01 | 2 47E+01 |
| H-3 | 6 0102E-03 | 263 21 | 445 18 | 0 00E+00 | 1.58E+00 | 2 68E+00 |
| I-129 | 7.1287E-07 | 263 21 | 445 18 | 0 00E+00 | 1 88E-04 | 3 17E-04 |
| Kr-85 | 1 3077E-01 | 263 21 | 445 18 | 0 00E+00 | 3 44E+01 | 5 82E+01 |
| Np-237 | 1.2153E-05 | 263 21 | 445 18 | 0 00E+00 | 3 20E-03 | 5 41E-03 |
| Pa-231 | 1.5021E-09 | 263.21 | 445 18 | 0 00E+00 | 3 95E-07 | 6 69E-07 |
| Pb-210 | 2.2760E-13 | 263 21 | 445 18 | 0 00E+00 | 5 99E-11 | 1.01E-10 |
| Pm-147 | 8 0622E-02 | 263 21 | 445 18 | 0 00E+00 | 2 12E+01 | 3 59E+01 |
| Pu-238 | 5 0676E-02 | 263.21 | 445 18 | 0 00E+00 | 1.33E+01 | 2.26E+01 |
| Pu-239 | 1 4051E-03 | 263.21 | 445 18 | 0 00E+00 | 3 70E-01 | 6.26E-01 |
| Pu-240 | 1.1553E-03 | 263.21 | 445 18 | 0 00E+00 | 3 04E-01 | 5.14E-01 |
| Pu-241 | 2 6578E-01 | 263.21 | 445 18 | 0 00E+00 | 7 00E+01 | 1.18E+02 |
| Pu-242 | 4 9910E-06 | 263.21 | 445 18 | 0 00E+00 | 1 31E-03 | 2.22E-03 |
| Ra-226 | 1.2541E-12 | 263.21 | 445 18 | 0 00E+00 | 3 30E-10 | 5.58E-10 |
| Ra-228 | 2.1843E-11 | 263.21 | 445 18 | 0 00E+00 | 5 75E-09 | 9 72E-09 |
| Ru-106 | 1.0722E-04 | 263.21 | 445 18 | 0 00E+00 | 2 82E-02 | 4 77E-02 |
| Se-79 | 1.2831E-05 | 263.21 | 445 18 | 0 00E+00 | 3 38E-03 | 5 71E-03 |
| Sn-126 | 1.2090E-05 | 263.21 | 445 18 | 0 00E+00 | 3 18E-03 | 5 38E-03 |
| Sr-90 | 2.0204E+00 | 263.21 | 445 18 | 0 00E+00 | 5 32E+02 | 8 99E+02 |
| Tc-99 | 4 0319E-04 | 263.21 | 445 18 | 0 00E+00 | 1 06E-01 | 1 79E-01 |
| Th-229 | 1.4217E-10 | 263.21 | 445 18 | 0 00E+00 | 3 74E-08 | 6 33E-08 |
| Th-230 | 3 6906E-10 | 263.21 | 445 18 | 0 00E+00 | 9 71E-08 | 1 64E-07 |
| Th-232 | 2.3857E-11 | 263.21 | 445 18 | 0 00E+00 | 6.28E-09 | 1 06E-08 |
| Tl-208 | 1.4857E-07 | 263.21 | 445 18 | 0 00E+00 | 3 91E-05 | 6 61E-05 |
| U-232 | 4 1251E-07 | 263.21 | 445 18 | 0 00E+00 | 1.09E-04 | 1 84E-04 |
| U-233 | 6 9017E-08 | 263.21 | 445 18 | 0 00E+00 | 1 82E-05 | 3 07E-05 |
| U-234 | 3 4546E-06 | 263.21 | 445 18 | 0.00E+00 | 9 09E-04 | 1 54E-03 |
| U-235 | -2 6572E-06 | 263.21 | 0 00 | 1.65E-02 | 1.58E-02 | 1 65E-02 |
| U-236 | 1.3575E-05 | 263.21 | 445.18 | 0 00E+00 | 3.57E-03 | 6 04E-03 |
| U-238 | -2 2698E-08 | 263 21 | 0 00 | 1.09E-03 | 1.08E-03 | 1 09E-03 |
| Y-90 | 2 0219E+00 | 263 21 | 445.18 | 0 00E+00 | 5 32E+02 | 9 00E+02 |
| Other Radionuclides | | | | | 5 61E+02 | 9 49E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 5.003E+13 |
| 0 0250 | 1.042E+13 |
| 0 0375 | 9.204E+12 |
| 0 0575 | 9 741E+12 |
| 0 0850 | 5.866E+12 |
| 0 1250 | 4 152E+12 |
| 0.2250 | 5.052E+12 |
| 0 3750 | 2.217E+12 |
| 0 5750 | 3 662E+13 |
| 0 8500 | 1 114E+12 |
| 1.2500 | 1 160E+13 |
| 1 7500 | 2.337E+10 |
| 2.2500 | 6 759E+07 |
| 2.7500 | 2.908E+06 |
| 3.5000 | 6.827E+04 |
| 5.0000 | 7.955E+03 |
| 7.0000 | 9 145E+02 |
| 11.0000 | 1.049E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8.56E+00 | 1.45E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70.2247191 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 263.21 | 243 50 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | 445 18 | 487 00 | Bounding burnup taken directly from SFD (converted to MWd) |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 07 | 0 93 |
| Bounding | 0 12 | 1 09 |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) AUSTRIA
SNF ID #: 492
Fuel Units & Descr: 10 - ELEMENT
Heavy Metal Mass: BOL=1 96kg; EOL=1 95kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 66 52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 5 years

Estimated Canister usage: 18"x10" 0 09

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 47 51 | 95 02 | 0 00E+00 | 1 35E-08 | 2.71E-08 |
| Am-241 | 7 5767E-03 | 47 51 | 95 02 | 0 00E+00 | 3 60E-01 | 7.20E-01 |
| Am-242m | 2 4459E-05 | 47 51 | 95 02 | 0 00E+00 | 1 16E-03 | 2.32E-03 |
| Am-243 | 3 0983E-05 | 47 51 | 95 02 | 0 00E+00 | 1 47E-03 | 2 94E-03 |
| C-14 | 1.2590E-04 | 47 51 | 95 02 | 0 00E+00 | 5 98E-03 | 1.20E-02 |
| Cl-36 | 2 6624E-06 | 47 51 | 95 02 | 0 00E+00 | 1 26E-04 | 2 53E-04 |
| Cm-243 | 3 8244E-05 | 47 51 | 95 02 | 0 00E+00 | 1 82E-03 | 3 63E-03 |
| Cm-244 | 4 1010E-03 | 47 51 | 95 02 | 0 00E+00 | 1 95E-01 | 3 90E-01 |
| Co-60 | 1.2410E+00 | 47 51 | 95 02 | 0 00E+00 | 5 90E+01 | 1 18E+02 |
| Cs-134 | 6.5454E-01 | 47 51 | 95 02 | 0 00E+00 | 3 11E+01 | 6.22E+01 |
| Cs-135 | 1.9753E-05 | 47 51 | 95 02 | 0 00E+00 | 9 39E-04 | 1 88E-03 |
| Cs-137 | 2.7375E+00 | 47 51 | 95 02 | 0 00E+00 | 1 30E+02 | 2 60E+02 |
| Eu-154 | 1.2324E-01 | 47 51 | 95 02 | 0 00E+00 | 5 86E+00 | 1 17E+01 |
| Eu-155 | 5.3037E-02 | 47 51 | 95 02 | 0 00E+00 | 2 52E+00 | 5 04E+00 |
| Fe-55 | 7 9555E-01 | 47 51 | 95 02 | 0 00E+00 | 3 78E+01 | 7 56E+01 |
| H-3 | 1 0531E-02 | 47 51 | 95 02 | 0 00E+00 | 5 00E-01 | 1 00E+00 |
| I-129 | 7.1287E-07 | 47 51 | 95 02 | 0 00E+00 | 3 39E-05 | 6 77E-05 |
| Kr-85 | 2 4955E-01 | 47 51 | 95 02 | 0 00E+00 | 1.19E+01 | 2.37E+01 |
| Np-237 | 1 2121E-05 | 47 51 | 95 02 | 0 00E+00 | 5 76E-04 | 1 15E-03 |
| Pa-231 | 1 1230E-09 | 47 51 | 95 02 | 0 00E+00 | 5 34E-08 | 1 07E-07 |
| Pb-210 | 6.1636E-14 | 47 51 | 95 02 | 0 00E+00 | 2 93E-12 | 5 86E-12 |
| Pm-147 | 1 1302E+00 | 47 51 | 95 02 | 0 00E+00 | 5 37E+01 | 1.07E+02 |
| Pu-238 | 5 4826E-02 | 47 51 | 95 02 | 0 00E+00 | 2 60E+00 | 5.21E+00 |
| Pu-239 | 1 4056E-03 | 47 51 | 95 02 | 0 00E+00 | 6 68E-02 | 1 34E-01 |
| Pu-240 | 1 1536E-03 | 47 51 | 95 02 | 0 00E+00 | 5 48E-02 | 1 10E-01 |
| Pu-241 | 4.2995E-01 | 47 51 | 95 02 | 0 00E+00 | 2 04E+01 | 4 09E+01 |
| Pu-242 | 4 9910E-06 | 47 51 | 95 02 | 0 00E+00 | 2 37E-04 | 4 74E-04 |
| Ra-226 | 2 4008E-13 | 47 51 | 95 02 | 0 00E+00 | 1 14E-11 | 2.28E-11 |
| Ra-228 | 1 8220E-11 | 47 51 | 95 02 | 0 00E+00 | 8 66E-10 | 1 73E-09 |
| Ru-106 | 1 0343E-01 | 47 51 | 95 02 | 0 00E+00 | 4 91E+00 | 9 83E+00 |
| Se-79 | 1 2832E-05 | 47 51 | 95 02 | 0 00E+00 | 6 10E-04 | 1.22E-03 |
| Sn-126 | 1.2090E-05 | 47 51 | 95 02 | 0 00E+00 | 5 74E-04 | 1 15E-03 |
| Sr-90 | 2 5646E+00 | 47 51 | 95 02 | 0 00E+00 | 1 22E+02 | 2 44E+02 |
| Tc-99 | 4 0319E-04 | 47 51 | 95 02 | 0 00E+00 | 1 92E-02 | 3 83E-02 |
| Th-229 | 7 7375E-11 | 47 51 | 95 02 | 0 00E+00 | 3 68E-09 | 7 35E-09 |
| Th-230 | 1.2211E-10 | 47 51 | 95 02 | 0 00E+00 | 5 80E-09 | 1 16E-08 |
| Th-232 | 2 3842E-11 | 47 51 | 95 02 | 0 00E+00 | 1.13E-09 | 2 27E-09 |
| Tl-208 | 1 4313E-07 | 47 51 | 95 02 | 0 00E+00 | 6 80E-06 | 1 36E-05 |
| U-232 | 4 1927E-07 | 47 51 | 95 02 | 0 00E+00 | 1.99E-05 | 3 98E-05 |
| U-233 | 6 8491E-08 | 47 51 | 95 02 | 0 00E+00 | 3.25E-06 | 6 51E-06 |
| U-234 | 2 0189E-06 | 47 51 | 95 02 | 0 00E+00 | 9 59E-05 | 1 92E-04 |
| U-235 | -2 6572E-06 | 47 51 | 0 00 | 2 96E-03 | 2.83E-03 | 2 96E-03 |
| U-236 | 1 3575E-05 | 47 51 | 95 02 | 0 00E+00 | 6 45E-04 | 1 29E-03 |
| U-238 | -2 2698E-08 | 47 51 | 0 00 | 1 98E-04 | 1.97E-04 | 1 98E-04 |
| Y-90 | 2 5646E+00 | 47 51 | 95 02 | 0 00E+00 | 1.22E+02 | 2 44E+02 |
| Other Radionuclides | | | | | 1 69E+02 | 3 38E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 1 533E+13 |
| 0 0250 | 3 364E+12 |
| 0 0375 | 2 976E+12 |
| 0 0575 | 2 970E+12 |
| 0.0850 | 1 848E+12 |
| 0 1250 | 1 484E+12 |
| 0.2250 | 1 571E+12 |
| 0.3750 | 7 838E+11 |
| 0.5750 | 1 297E+13 |
| 0.8500 | 2.380E+12 |
| 1.2500 | 9 141E+12 |
| 1 7500 | 1 223E+10 |
| 2.2500 | 9 583E+09 |
| 2 7500 | 8 688E+07 |
| 3.5000 | 1 022E+07 |
| 5 0000 | 2.450E+03 |
| 7 0000 | 2.819E+02 |
| 11 0000 | 3.235E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 12E+00 | 6.23E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 89795918 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 47 51 | 9 50 | Nominal burnup taken directly from SFD (converted to MWd) |
| Bounding | | 95 02 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 07 | 0 20 |
| Bounding | 0 14 | |

Estimated EOL HM/Given EOL HM: 0 98

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) FFCR | [1]Fuel decay start date | 2035 |
| SNF ID # | 996 | Estimates as of | 2010 |
| Fuel Units & Descr | 6 - ELEMENT | Template | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=0 965kg, EOL=0 607kg | [2]Template Burnup(MWd) | 66 52 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000196 |
| | | Template Decay Time | 5 years |

Estimated Canister usage: 18"x10' 0 08

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 339 87 | 679 74 | 0 00E+00 | 9 68E-08 | 1 94E-07 |
| Am-241 | 7 5767E-03 | 339 87 | 679 74 | 0 00E+00 | 2 58E+00 | 5 15E+00 |
| Am-242m | 2 4459E-05 | 339 87 | 679 74 | 0 00E+00 | 8 31E-03 | 1 66E-02 |
| Am-243 | 3 0983E-05 | 339 87 | 679 74 | 0 00E+00 | 1 05E-02 | 2 11E-02 |
| C-14 | 1.2590E-04 | 339 87 | 679 74 | 0 00E+00 | 4 28E-02 | 8 56E-02 |
| Cl-36 | 2 6624E-06 | 339 87 | 679 74 | 0 00E+00 | 9 05E-04 | 1 81E-03 |
| Cm-243 | 3 8244E-05 | 339 87 | 679 74 | 0 00E+00 | 1 30E-02 | 2 60E-02 |
| Cm-244 | 4 1010E-03 | 339 87 | 679 74 | 0 00E+00 | 1 39E+00 | 2 79E+00 |
| Co-60 | 1.2410E+00 | 339 87 | 679 74 | 0 00E+00 | 4 22E+02 | 8 44E+02 |
| Cs-134 | 6 5454E-01 | 339 87 | 679 74 | 0 00E+00 | 2 22E+02 | 4 45E+02 |
| Cs-135 | 1 9753E-05 | 339 87 | 679 74 | 0 00E+00 | 6 71E-03 | 1 34E-02 |
| Cs-137 | 2.7375E+00 | 339 87 | 679 74 | 0 00E+00 | 9 30E+02 | 1 86E+03 |
| Eu-154 | 1.2324E-01 | 339 87 | 679 74 | 0 00E+00 | 4 19E+01 | 8 38E+01 |
| Eu-155 | 5.3037E-02 | 339 87 | 679 74 | 0 00E+00 | 1 80E+01 | 3 61E+01 |
| Fe-55 | 7.9555E-01 | 339 87 | 679 74 | 0 00E+00 | 2 70E+02 | 5 41E+02 |
| H-3 | 1 0531E-02 | 339 87 | 679 74 | 0 00E+00 | 3 58E+00 | 7 16E+00 |
| I-129 | 7.1287E-07 | 339 87 | 679 74 | 0 00E+00 | 2 42E-04 | 4 85E-04 |
| Kr-85 | 2 4955E-01 | 339 87 | 679 74 | 0 00E+00 | 8 48E+01 | 1.70E+02 |
| Np-237 | 1.2121E-05 | 339 87 | 679 74 | 0 00E+00 | 4 12E-03 | 8 24E-03 |
| Pa-231 | 1 1230E-09 | 339 87 | 679 74 | 0 00E+00 | 3 82E-07 | 7 63E-07 |
| Pb-210 | 6 1636E-14 | 339 87 | 679 74 | 0 00E+00 | 2 09E-11 | 4 19E-11 |
| Pm-147 | 1.1302E+00 | 339 87 | 679 74 | 0 00E+00 | 3 84E+02 | 7 68E+02 |
| Pu-238 | 5 4826E-02 | 339 87 | 679 74 | 0 00E+00 | 1 86E+01 | 3 73E+01 |
| Pu-239 | 1.4056E-03 | 339 87 | 679 74 | 0 00E+00 | 4 78E-01 | 9 55E-01 |
| Pu-240 | 1.1536E-03 | 339 87 | 679 74 | 0 00E+00 | 3 92E-01 | 7 84E-01 |
| Pu-241 | 4.2995E-01 | 339 87 | 679 74 | 0 00E+00 | 1 46E+02 | 2 92E+02 |
| Pu-242 | 4 9910E-06 | 339 87 | 679 74 | 0 00E+00 | 1 70E-03 | 3 39E-03 |
| Ra-226 | 2 4008E-13 | 339 87 | 679 74 | 0 00E+00 | 8 16E-11 | 1 63E-10 |
| Ra-228 | 1.8220E-11 | 339 87 | 679 74 | 0 00E+00 | 6 19E-09 | 1.24E-08 |
| Ru-106 | 1.0343E-01 | 339 87 | 679 74 | 0 00E+00 | 3 52E+01 | 7 03E+01 |
| Se-79 | 1.2832E-05 | 339 87 | 679 74 | 0 00E+00 | 4 36E-03 | 8 72E-03 |
| Sn-126 | 1.2090E-05 | 339 87 | 679 74 | 0 00E+00 | 4 11E-03 | 8.22E-03 |
| Sr-90 | 2.5646E+00 | 339 87 | 679 74 | 0 00E+00 | 8 72E+02 | 1 74E+03 |
| Tc-99 | 4 0319E-04 | 339 87 | 679 74 | 0 00E+00 | 1.37E-01 | 2 74E-01 |
| Th-229 | 7 7375E-11 | 339 87 | 679 74 | 0 00E+00 | 2 63E-08 | 5.26E-08 |
| Th-230 | 1.2211E-10 | 339 87 | 679 74 | 0 00E+00 | 4.15E-08 | 8.30E-08 |
| Th-232 | 2.3842E-11 | 339 87 | 679 74 | 0 00E+00 | 8 10E-09 | 1 62E-08 |
| Tl-208 | 1.4313E-07 | 339 87 | 679 74 | 0 00E+00 | 4.86E-05 | 9.73E-05 |
| U-232 | 4 1927E-07 | 339 87 | 679 74 | 0 00E+00 | 1.42E-04 | 2 85E-04 |
| U-233 | 6 8491E-08 | 339 87 | 679 74 | 0 00E+00 | 2.33E-05 | 4.66E-05 |
| U-234 | 2 0189E-06 | 339 87 | 679 74 | 0 00E+00 | 6 86E-04 | 1.37E-03 |
| U-235 | -2 6572E-06 | 339 87 | 0 00 | 1 46E-03 | 5.57E-04 | 1.46E-03 |
| U-236 | 1.3575E-05 | 339 87 | 679 74 | 0 00E+00 | 4.61E-03 | 9.23E-03 |
| U-238 | -2 2698E-08 | 339 87 | 0 00 | 9 71E-05 | 8 94E-05 | 9.71E-05 |
| Y-90 | 2 5646E+00 | 339 87 | 679 74 | 0 00E+00 | 8 72E+02 | 1 74E+03 |
| Other Radionuclides | | | | | 1.21E+03 | 2 42E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 1 097E+14 |
| 0 0250 | 2 407E+13 |
| 0 0375 | 2 129E+13 |
| 0 0575 | 2 125E+13 |
| 0 0850 | 1.322E+13 |
| 0 1250 | 1 062E+13 |
| 0.2250 | 1 124E+13 |
| 0 3750 | 5 606E+12 |
| 0 5750 | 9.279E+13 |
| 0 8500 | 1 702E+13 |
| 1.2500 | 6.538E+13 |
| 1 7500 | 8 745E+10 |
| 2.2500 | 6 855E+10 |
| 2.7500 | 6.215E+08 |
| 3 5000 | 7.314E+07 |
| 5 0000 | 1 752E+04 |
| 7 0000 | 2 016E+03 |
| 11 0000 | 2.314E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 2.23E+01 | 4 46E+01 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70 05184872 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[1]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 327.42 | 339 87 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 679 74 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 1.04 | 1.04 |
| Bounding | 2 08 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name TRIGA (FLIP) FFCR OSU
SNF ID #: 702
Fuel Units & Descr: 4 - ELEMENT
Heavy Metal Mass: BOL=0 64kg, EOL=0 617kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2025
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 66.52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 5 years

Estimated Canister usage: 18"x10' 0 05

**II. Estimates**

| | m | $x_n$ | $x_b$ | b | $y_n$ | $y_b$ |
|---|---|---|---|---|---|---|
| Radionuclide | Ci/MWd From Template | Nominal Fuel Burnup (MWd)[2] | Bounding Fuel Burnup (MWd)[2] | Initial Activity (Ci) | Nominal Fuel Inventories(Ci) | Bounding Fuel Inventories(Ci) |
| Ac-227 | 2 8488E-10 | 21 67 | 43 34 | 0 00E+00 | 6 17E-09 | 1 23E-08 |
| Am-241 | 7 5767E-03 | 21 67 | 43 34 | 0 00E+00 | 1 64E-01 | 3 28E-01 |
| Am-242m | 2 4459E-05 | 21 67 | 43 34 | 0 00E+00 | 5 30E-04 | 1 06E-03 |
| Am-243 | 3 0983E-05 | 21 67 | 43 34 | 0 00E+00 | 6.71E-04 | 1 34E-03 |
| C-14 | 1 2590E-04 | 21 67 | 43 34 | 0 00E+00 | 2.73E-03 | 5 46E-03 |
| Cl-36 | 2.6624E-06 | 21 67 | 43 34 | 0 00E+00 | 5.77E-05 | 1 15E-04 |
| Cm-243 | 3.8244E-05 | 21 67 | 43 34 | 0 00E+00 | 8.29E-04 | 1 66E-03 |
| Cm-244 | 4 1010E-03 | 21 67 | 43 34 | 0 00E+00 | 8 89E-02 | 1 78E-01 |
| Co-60 | 1.2410E+00 | 21.67 | 43.34 | 0 00E+00 | 2 69E+01 | 5 38E+01 |
| Cs-134 | 6 5454E-01 | 21.67 | 43.34 | 0 00E+00 | 1 42E+01 | 2 84E+01 |
| Cs-135 | 1 9753E-05 | 21.67 | 43.34 | 0 00E+00 | 4.28E-04 | 8 56E-04 |
| Cs-137 | 2.7375E+00 | 21.67 | 43.34 | 0 00E+00 | 5 93E+01 | 1 19E+02 |
| Eu-154 | 1 2324E-01 | 21.67 | 43 34 | 0 00E+00 | 2 67E+00 | 5 34E+00 |
| Eu-155 | 5 3037E-02 | 21.67 | 43.34 | 0 00E+00 | 1.15E+00 | 2 30E+00 |
| Fe-55 | 7 9555E-01 | 21 67 | 43 34 | 0 00E+00 | 1.72E+01 | 3 45E+01 |
| H-3 | 1 0531E-02 | 21 67 | 43 34 | 0 00E+00 | 2.28E-01 | 4.56E-01 |
| I-129 | 7 1287E-07 | 21 67 | 43 34 | 0 00E+00 | 1 54E-05 | 3 09E-05 |
| Kr-85 | 2 4955E-01 | 21 67 | 43 34 | 0 00E+00 | 5 41E+00 | 1 08E+01 |
| Np-237 | 1.2121E-05 | 21 67 | 43 34 | 0 00E+00 | 2 63E-04 | 5.25E-04 |
| Pa-231 | 1 1230E-09 | 21 67 | 43 34 | 0 00E+00 | 2 43E-08 | 4 87E-08 |
| Pb-210 | 6 1636E-14 | 21 67 | 43 34 | 0 00E+00 | 1 34E-12 | 2 67E-12 |
| Pm-147 | 1 1302E+00 | 21 67 | 43 34 | 0 00E+00 | 2 45E+01 | 4.90E+01 |
| Pu-238 | 5 4826E-02 | 21 67 | 43 34 | 0 00E+00 | 1 19E+00 | 2.38E+00 |
| Pu-239 | 1 4056E-03 | 21 67 | 43 34 | 0 00E+00 | 3 05E-02 | 6 09E-02 |
| Pu-240 | 1 1536E-03 | 21 67 | 43 34 | 0 00E+00 | 2 50E-02 | 5 00E-02 |
| Pu-241 | 4 2995E-01 | 21 67 | 43 34 | 0 00E+00 | 9 32E+00 | 1 86E+01 |
| Pu-242 | 4 9910E-06 | 21 67 | 43 34 | 0 00E+00 | 1 08E-04 | 2 16E-04 |
| Ra-226 | 2 4008E-13 | 21 67 | 43 34 | 0 00E+00 | 5 20E-12 | 1 04E-11 |
| Ra-228 | 1 8220E-11 | 21 67 | 43 34 | 0 00E+00 | 3 95E-10 | 7 90E-10 |
| Ru-106 | 1 0343E-01 | 21 67 | 43 34 | 0 00E+00 | 2 24E+00 | 4 48E+00 |
| Se-79 | 1 2832E-05 | 21 67 | 43 34 | 0 00E+00 | 2 78E-04 | 5 56E-04 |
| Sn-126 | 1 2090E-05 | 21 67 | 43 34 | 0 00E+00 | 2 62E-04 | 5 24E-04 |
| Sr-90 | 2 5646E+00 | 21 67 | 43 34 | 0 00E+00 | 5 56E+01 | 1 11E+02 |
| Tc-99 | 4 0319E-04 | 21 67 | 43 34 | 0 00E+00 | 8 74E-03 | 1 75E-02 |
| Th-229 | 7 7375E-11 | 21 67 | 43 34 | 0 00E+00 | 1 68E-09 | 3 35E-09 |
| Th-230 | 1 2211E-10 | 21 67 | 43 34 | 0 00E+00 | 2 65E-09 | 5 29E-09 |
| Th-232 | 2 3842E-11 | 21 67 | 43 34 | 0 00E+00 | 5 17E-10 | 1 03E-09 |
| Tl-208 | 1 4313E-07 | 21 67 | 43 34 | 0 00E+00 | 3 10E-06 | 6.20E-06 |
| U-232 | 4 1927E-07 | 21 67 | 43 34 | 0 00E+00 | 9 09E-06 | 1 82E-05 |
| U-233 | 6 8491E-08 | 21 67 | 43 34 | 0 00E+00 | 1 48E-06 | 2 97E-06 |
| U-234 | 2 0189E-06 | 21 67 | 43 34 | 0 00E+00 | 4 37E-05 | 8 75E-05 |
| U-235 | -2 6572E-06 | 21 67 | 0 00 | 9 67E-04 | 9 09E-04 | 9 67E-04 |
| U-236 | 1.3575E-05 | 21 67 | 43 34 | 0.00E+00 | 2.94E-04 | 5 88E-04 |
| U-238 | -2.2698E-08 | 21 67 | 0 00 | 6 47E-05 | 6.43E-05 | 6 47E-05 |
| Y-90 | 2 5646E+00 | 21 67 | 43 34 | 0 00E+00 | 5 56E+01 | 1 11E+02 |
| Other Radionuclides | | | | | 7 72E+01 | 1 54E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 6 993E+12 |
| 0 0250 | 1 534E+12 |
| 0 0375 | 1 357E+12 |
| 0 0575 | 1 355E+12 |
| 0 0850 | 8 430E+11 |
| 0 1250 | 6 769E+11 |
| 0 2250 | 7.164E+11 |
| 0 3750 | 3.575E+11 |
| 0 5750 | 5.916E+12 |
| 0 8500 | 1.085E+12 |
| 1.2500 | 4 169E+12 |
| 1 7500 | 5.576E+09 |
| 2.2500 | 4.371E+09 |
| 2.7500 | 3 962E+07 |
| 3.5000 | 4 663E+06 |
| 5.0000 | 1 117E+03 |
| 7 0000 | 1.286E+02 |
| 11.0000 | 1 475E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.42E+00 | 2.84E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 9 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 6 03 | 21 67 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 43.34 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 10 | 3 59 |
| Bounding | 0.20 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) FFCR SO KOREA | [1]Fuel decay start date | 1997 |
| SNF ID # | 733 | Estimates as of | 2010 |
| Fuel Units & Descr | 4 - ELEMENT | Template | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=0 638kg EOL=0.561kg | [2]Template Burnup(MWd) | 66 52 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000196 |
| | | Template Decay Time | 10 years |

Estimated Canister usage 18"x10' 0 05

**II. Estimates**

| Radionuclide | m: C/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4.2243E-10 | 73 37 | 146.74 | 0 00E+00 | 3 10E-08 | 6.20E-08 |
| Am-241 | 9 9143E-03 | 73 37 | 146.74 | 0 00E+00 | 7 27E-01 | 1 45E+00 |
| Am-242m | 2 3903E-05 | 73 37 | 146.74 | 0 00E+00 | 1 75E-03 | 3 51E-03 |
| Am-243 | 3 0968E-05 | 73 37 | 146.74 | 0 00E+00 | 2 27E-03 | 4.54E-03 |
| C-14 | 1.2581E-04 | 73 37 | 146.74 | 0 00E+00 | 9 23E-03 | 1 85E-02 |
| Cl-36 | 2 6624E-06 | 73 37 | 146 74 | 0 00E+00 | 1 95E-04 | 3 91E-04 |
| Cm-243 | 3 3870E-05 | 73 37 | 146 74 | 0 00E+00 | 2 49E-03 | 4 97E-03 |
| Cm-244 | 3 3870E-03 | 73 37 | 146 74 | 0 00E+00 | 2 49E-01 | 4 97E-01 |
| Co-60 | 6 4311E-01 | 73.37 | 146 74 | 0 00E+00 | 4 72E+01 | 9 44E+01 |
| Cs-134 | 1 2201E-01 | 73 37 | 146 74 | 0 00E+00 | 8 95E+00 | 1.79E+01 |
| Cs-135 | 1 9753E-05 | 73.37 | 146 74 | 0 00E+00 | 1.45E-03 | 2 90E-03 |
| Cs-137 | 2 4384E+00 | 73.37 | 146 74 | 0 00E+00 | 1 79E+02 | 3 58E+02 |
| Eu-154 | 8 2396E-02 | 73.37 | 146 74 | 0 00E+00 | 6 05E+00 | 1.21E+01 |
| Eu-155 | 2 6383E-02 | 73.37 | 146 74 | 0 00E+00 | 1 94E+00 | 3 87E+00 |
| Fe-55 | 2 1001E-01 | 73.37 | 146 74 | 0 00E+00 | 1.54E+01 | 3 08E+01 |
| H-3 | 7 9555E-03 | 73 37 | 146 74 | 0 00E+00 | 5 84E-01 | 1 17E+00 |
| I-129 | 7 1287E-07 | 73.37 | 146 74 | 0 00E+00 | 5.23E-05 | 1 05E-04 |
| Kr-85 | 1 8070E-01 | 73 37 | 146 74 | 0 00E+00 | 1.33E+01 | 2 65E+01 |
| Np-237 | 1.2135E-05 | 73 37 | 146 74 | 0 00E+00 | 8 90E-04 | 1 78E-03 |
| Pa-231 | 1.3125E-09 | 73 37 | 146 74 | 0 00E+00 | 9 63E-08 | 1 93E-07 |
| Pb-210 | 1.1201E-13 | 73 37 | 146 74 | 0 00E+00 | 8.22E-12 | 1 64E-11 |
| Pm-147 | 3.0186E-01 | 73 37 | 146 74 | 0.00E+00 | 2.21E+01 | 4 43E+01 |
| Pu-238 | 5.2706E-02 | 73 37 | 146 74 | 0.00E+00 | 3 87E+00 | 7 73E+00 |
| Pu-239 | 1.4054E-03 | 73 37 | 146 74 | 0 00E+00 | 1 03E-01 | 2 06E-01 |
| Pu-240 | 1 1545E-03 | 73 37 | 146 74 | 0 00E+00 | 8 47E-02 | 1 69E-01 |
| Pu-241 | 3 3809E-01 | 73 37 | 146 74 | 0 00E+00 | 2 48E+01 | 4 96E+01 |
| Pu-242 | 4 9910E-06 | 73 37 | 146.74 | 0 00E+00 | 3 66E-04 | 7.32E-04 |
| Ra-226 | 6 1395E-13 | 73 37 | 146.74 | 0 00E+00 | 4 50E-11 | 9 01E-11 |
| Ra-228 | 2 0490E-11 | 73 37 | 146 74 | 0 00E+00 | 1 50E-09 | 3 01E-09 |
| Ru-106 | 3 3298E-03 | 73 37 | 146 74 | 0 00E+00 | 2 44E-01 | 4 89E-01 |
| Se-79 | 1.2831E-05 | 73 37 | 146 74 | 0 00E+00 | 9 41E-04 | 1 88E-03 |
| Sn-126 | 1.2090E-05 | 73 37 | 146 74 | 0 00E+00 | 8 87E-04 | 1.77E-03 |
| Sr-90 | 2.2760E+00 | 73 37 | 146 74 | 0 00E+00 | 1 67E+02 | 3 34E+02 |
| Tc-99 | 4 0319E-04 | 73 37 | 146 74 | 0 00E+00 | 2 96E-02 | 5.92E-02 |
| Th-229 | 1 0973E-10 | 73 37 | 146 74 | 0 00E+00 | 8 05E-09 | 1 61E-08 |
| Th-230 | 2 2940E-10 | 73.37 | 146 74 | 0 00E+00 | 1 68E-08 | 3.37E-08 |
| Th-232 | 2 3842E-11 | 73.37 | 146 74 | 0 00E+00 | 1 75E-09 | 3 50E-09 |
| Tl-208 | 1 4857E-07 | 73.37 | 146 74 | 0 00E+00 | 1 09E-05 | 2 18E-05 |
| U-232 | 4 1927E-07 | 73.37 | 146 74 | 0 00E+00 | 3 08E-05 | 6 15E-05 |
| U-233 | 6 8746E-08 | 73.37 | 146 74 | 0 00E+00 | 5 04E-06 | 1 01E-05 |
| U-234 | 2 7511E-06 | 73.37 | 146 74 | 0 00E+00 | 2.02E-04 | 4 04E-04 |
| U-235 | -2 6572E-06 | 73.37 | 0 00 | 9 65E-04 | 7.70E-04 | 9 65E-04 |
| U-236 | 1.3575E-05 | 73.37 | 146 74 | 0 00E+00 | 9 96E-04 | 1 99E-03 |
| U-238 | -2.2698E-08 | 73 37 | 0 00 | 6 44E-05 | 6.27E-05 | 6 44E-05 |
| Y-90 | 2.2775E+00 | 73 37 | 146 74 | 0 00E+00 | 1 67E+02 | 3 34E+02 |
| Other Radionuclides | | | | | 1 78E+02 | 3 55E+02 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 1 882E+13 |
| 0 0250 | 3 972E+12 |
| 0 0375 | 3 501E+12 |
| 0 0575 | 3 651E+12 |
| 0 0850 | 2.214E+12 |
| 0 1250 | 1 608E+12 |
| 0.2250 | 1 898E+12 |
| 0 3750 | 8 605E+11 |
| 0.5750 | 1.428E+13 |
| 0.8500 | 9.292E+11 |
| 1.2500 | 7.302E+12 |
| 1 7500 | 1 053E+10 |
| 2 2500 | 2.263E+08 |
| 2.7500 | 4 921E+06 |
| 3 5000 | 5 154E+05 |
| 5 0000 | 3 145E+03 |
| 7 0000 | 3 618E+02 |
| 11 0000 | 4 151E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 3 09E+00 | 6 17E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 98432602 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate |
|---|---|---|---|
| Nominal | 30 07 | 73.37 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 146 74 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.34 | 2 44 |
| Bounding | 0.68 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) MEXICO
SNF ID #: 493
Fuel Units & Descr: 35 - ELEMENT
Heavy Metal Mass: BOL=6 86kg EOL=6 825kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 2010
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 66.52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 5 years

Estimated Canister usage.
18"x10"
0.32

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 64 67 | 129 34 | 0 00E+00 | 1 84E-08 | 3 68E-08 |
| Am-241 | 7 5767E-03 | 64 67 | 129 34 | 0 00E+00 | 4 90E-01 | 9 80E-01 |
| Am-242m | 2.4459E-05 | 64 67 | 129 34 | 0 00E+00 | 1 58E-03 | 3 16E-03 |
| Am-243 | 3 0983E-05 | 64 67 | 129 34 | 0 00E+00 | 2 00E-03 | 4 01E-03 |
| C-14 | 1.2590E-04 | 64 67 | 129 34 | 0 00E+00 | 8 14E-03 | 1 63E-02 |
| Cl-36 | 2 6624E-06 | 64 67 | 129 34 | 0 00E+00 | 1 72E-04 | 3.44E-04 |
| Cm-243 | 3 8244E-05 | 64 67 | 129 34 | 0 00E+00 | 2 47E-03 | 4 95E-03 |
| Cm-244 | 4 1010E-03 | 64 67 | 129 34 | 0 00E+00 | 2 65E-01 | 5.30E-01 |
| Co-60 | 1 2410E+00 | 64 67 | 129 34 | 0 00E+00 | 8 03E+01 | 1 61E+02 |
| Cs-134 | 6 5454E-01 | 64 67 | 129 34 | 0 00E+00 | 4 23E+01 | 8.47E+01 |
| Cs-135 | 1 9753E-05 | 64 67 | 129 34 | 0 00E+00 | 1.28E-03 | 2 55E-03 |
| Cs-137 | 2 7375E+00 | 64 67 | 129 34 | 0 00E+00 | 1 77E+02 | 3.54E+02 |
| Eu-154 | 1 2324E-01 | 64 67 | 129 34 | 0 00E+00 | 7 97E+00 | 1.59E+01 |
| Eu-155 | 5 3037E-02 | 64 67 | 129 34 | 0 00E+00 | 3 43E+00 | 6 86E+00 |
| Fe-55 | 7 9555E-01 | 64 67 | 129 34 | 0 00E+00 | 5 14E+01 | 1.03E+02 |
| H-3 | 1 0531E-02 | 64 67 | 129 34 | 0 00E+00 | 6 81E-01 | 1.36E+00 |
| I-129 | 7 1287E-07 | 64 67 | 129 34 | 0 00E+00 | 4 61E-05 | 9.22E-05 |
| Kr-85 | 2 4955E-01 | 64 67 | 129 34 | 0 00E+00 | 1 61E+01 | 3.23E+01 |
| Np-237 | 1 2121E-05 | 64 67 | 129 34 | 0 00E+00 | 7 84E-04 | 1 57E-03 |
| Pa-231 | 1 1230E-09 | 64 67 | 129 34 | 0 00E+00 | 7.26E-08 | 1 45E-07 |
| Pb-210 | 6 1636E-14 | 64 67 | 129 34 | 0 00E+00 | 3 99E-12 | 7 97E-12 |
| Pm-147 | 1 1302E+00 | 64 67 | 129 34 | 0 00E+00 | 7.31E+01 | 1.46E+02 |
| Pu-238 | 5 4826E-02 | 64 67 | 129 34 | 0 00E+00 | 3.55E+00 | 7 09E+00 |
| Pu-239 | 1 4056E-03 | 64 67 | 129 34 | 0 00E+00 | 9 09E-02 | 1 82E-01 |
| Pu-240 | 1 1536E-03 | 64 67 | 129 34 | 0 00E+00 | 7 46E-02 | 1 49E-01 |
| Pu-241 | 4 2995E-01 | 64 67 | 129 34 | 0 00E+00 | 2.78E+01 | 5 56E+01 |
| Pu-242 | 4 9910E-06 | 64 67 | 129 34 | 0 00E+00 | 3.23E-04 | 6 46E-04 |
| Ra-226 | 2 4008E-13 | 64 67 | 129 34 | 0 00E+00 | 1 55E-11 | 3 11E-11 |
| Ra-228 | 1 8220E-11 | 64 67 | 129 34 | 0 00E+00 | 1 18E-09 | 2 36E-09 |
| Ru-106 | 1 0343E-01 | 64 67 | 129 34 | 0 00E+00 | 6 69E+00 | 1 34E+01 |
| Se-79 | 1 2832E-05 | 64 67 | 129 34 | 0 00E+00 | 8 30E-04 | 1 66E-03 |
| Sn-126 | 1 2090E-05 | 64 67 | 129 34 | 0 00E+00 | 7 82E-04 | 1 56E-03 |
| Sr-90 | 2 5646E+00 | 64 67 | 129.34 | 0 00E+00 | 1.66E+02 | 3.32E+02 |
| Tc-99 | 4 0319E-04 | 64 67 | 129 34 | 0 00E+00 | 2 61E-02 | 5 21E-02 |
| Th-229 | 7 7375E-11 | 64 67 | 129 34 | 0 00E+00 | 5 00E-09 | 1 00E-08 |
| Th-230 | 1 2211E-10 | 64 67 | 129 34 | 0 00E+00 | 7 90E-09 | 1 58E-08 |
| Th-232 | 2 3842E-11 | 64 67 | 129 34 | 0 00E+00 | 1 54E-09 | 3 08E-09 |
| Tl-208 | 1 4313E-07 | 64 67 | 129 34 | 0 00E+00 | 9 26E-06 | 1 85E-05 |
| U-232 | 4 1927E-07 | 64 67 | 129.34 | 0 00E+00 | 2 71E-05 | 5 42E-05 |
| U-233 | 6 8491E-08 | 64.67 | 129 34 | 0 00E+00 | 4 43E-06 | 8 86E-06 |
| U-234 | 2 0189E-06 | 64 67 | 129 34 | 0 00E+00 | 1 31E-04 | 2 61E-04 |
| U-235 | -2 6572E-06 | 64 67 | 0 00 | 1 04E-02 | 1 02E-02 | 1 04E-02 |
| U-236 | 1.3575E-05 | 64.67 | 129 34 | 0 00E+00 | 8 78E-04 | 1 76E-03 |
| U-238 | -2.2698E-08 | 64 67 | 0 00 | 6 94E-04 | 6 93E-04 | 6 94E-04 |
| Y-90 | 2 5646E+00 | 64 67 | 129 34 | 0 00E+00 | 1 66E+02 | 3 32E+02 |
| Other Radionuclides | | | | | 2 30E+02 | 4 61E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 2.087E+13 |
| 0 0250 | 4.579E+12 |
| 0 0375 | 4.051E+12 |
| 0 0575 | 4 043E+12 |
| 0 0850 | 2.516E+12 |
| 0 1250 | 2 020E+12 |
| 0.2250 | 2 138E+12 |
| 0 3750 | 1 067E+12 |
| 0 5750 | 1 766E+13 |
| 0.8500 | 3.239E+12 |
| 1.2500 | 1.244E+13 |
| 1 7500 | 1 664E+10 |
| 2.2500 | 1.304E+10 |
| 2.7500 | 1 182E+08 |
| 3.5000 | 1 392E+07 |
| 5.0000 | 3.336E+03 |
| 7 0000 | 3.839E+02 |
| 11 0000 | 4 405E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.24E+00 | 8 48E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 89795918 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 64 67 | 33.26 | Nominal burnup taken directly from SFD (converted to MWd). |
| Bounding | | 129.34 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 03 | 0.51 |
| Bounding | 0 06 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel.

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) OSU | [1]Fuel decay start date | 2025 |
| SNF ID # | 240 | Estimates as of | 2010 |
| Fuel Units & Descr | 87 - ELEMENT | Template | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U) |
| Heavy Metal Mass | BOL=17.052kg EOL=15 625kg | [2]Template Burnup(MWd) | 66 52 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000196 |
| | | Template Decay Time | 5 years |

Estimated Canister usage 18"x10' 0 78

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 1,356 06 | 2,712 12 | 0 00E+00 | 3 86E-07 | 7 73E-07 |
| Am-241 | 7.5767E-03 | 1,356 06 | 2,712.12 | 0 00E+00 | 1 03E+01 | 2 05E+01 |
| Am-242m | 2 4459E-05 | 1,356 06 | 2,712 12 | 0 00E+00 | 3 32E-02 | 6 63E-02 |
| Am-243 | 3 0983E-05 | 1,356 06 | 2,712 12 | 0 00E+00 | 4 20E-02 | 8 40E-02 |
| C-14 | 1 2590E-04 | 1,356 06 | 2,712.12 | 0 00E+00 | 1 71E-01 | 3 41E-01 |
| Cl-36 | 2 6624E-06 | 1,356 06 | 2,712.12 | 0 00E+00 | 3 61E-03 | 7 22E-03 |
| Cm-243 | 3 8244E-05 | 1,356 06 | 2,712.12 | 0 00E+00 | 5 19E-02 | 1 04E-01 |
| Cm-244 | 4 1010E-03 | 1,356 06 | 2,712.12 | 0 00E+00 | 5 56E+00 | 1 11E+01 |
| Co-60 | 1 2410E+00 | 1,356 06 | 2,712.12 | 0 00E+00 | 1 68E+03 | 3 37E+03 |
| Cs-134 | 6 5454E-01 | 1,356 06 | 2,712.12 | 0 00E+00 | 8 88E+02 | 1 78E+03 |
| Cs-135 | 1 9753E-05 | 1,356 06 | 2,712 12 | 0 00E+00 | 2 68E-02 | 5 36E-02 |
| Cs-137 | 2 7375E+00 | 1,356 06 | 2,712.12 | 0 00E+00 | 3 71E+03 | 7 42E+03 |
| Eu-154 | 1 2324E-01 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 67E+02 | 3 34E+02 |
| Eu-155 | 5 3037E-02 | 1,356 06 | 2,712 12 | 0 00E+00 | 7 19E+01 | 1 44E+02 |
| Fe-55 | 7 9555E-01 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 08E+03 | 2 16E+03 |
| H-3 | 1 0531E-02 | 1,356 06 | 2,712.12 | 0 00E+00 | 1 43E+01 | 2 86E+01 |
| I-129 | 7 1287E-07 | 1,356 06 | 2,712 12 | 0 00E+00 | 9 67E-04 | 1 93E-03 |
| Kr-85 | 2 4955E-01 | 1,356 06 | 2,712 12 | 0 00E+00 | 3 38E+02 | 6 77E+02 |
| Np-237 | 1.2121E-05 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 64E-02 | 3 29E-02 |
| Pa-231 | 1 1230E-09 | 1,356 06 | 2,712 12 | 0 00E+00 | 1.52E-06 | 3 05E-06 |
| Pb-210 | 6 1636E-14 | 1,356 06 | 2,712 12 | 0 00E+00 | 8 36E-11 | 1 67E-10 |
| Pm-147 | 1.1302E+00 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 53E+03 | 3 07E+03 |
| Pu-238 | 5 4826E-02 | 1,356 06 | 2,712 12 | 0 00E+00 | 7 43E+01 | 1 49E+02 |
| Pu-239 | 1 4056E-03 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 91E+00 | 3 81E+00 |
| Pu-240 | 1.1536E-03 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 56E+00 | 3 13E+00 |
| Pu-241 | 4.2995E-01 | 1,356 06 | 2,712 12 | 0 00E+00 | 5 83E+02 | 1 17E+03 |
| Pu-242 | 4 9910E-06 | 1,356.06 | 2,712 12 | 0 00E+00 | 6 77E-03 | 1.35E-02 |
| Ra-226 | 2 4008E-13 | 1,356 06 | 2,712 12 | 0 00E+00 | 3.26E-10 | 6.51E-10 |
| Ra-228 | 1.8220E-11 | 1,356 06 | 2,712 12 | 0 00E+00 | 2 47E-08 | 4 94E-08 |
| Ru-106 | 1 0343E-01 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 40E+02 | 2 81E+02 |
| Se-79 | 1.2832E-05 | 1,356.06 | 2,712 12 | 0 00E+00 | 1.74E-02 | 3 48E-02 |
| Sn-126 | 1.2090E-05 | 1,356.06 | 2,712 12 | 0 00E+00 | 1.64E-02 | 3.28E-02 |
| Sr-90 | 2.5646E+00 | 1,356 06 | 2,712 12 | 0 00E+00 | 3 48E+03 | 6 96E+03 |
| Tc-99 | 4 0319E-04 | 1,356.06 | 2,712 12 | 0 00E+00 | 5.47E-01 | 1.09E+00 |
| Th-229 | 7.7375E-11 | 1,356.06 | 2,712 12 | 0 00E+00 | 1.05E-07 | 2.10E-07 |
| Th-230 | 1.2211E-10 | 1,356.06 | 2,712 12 | 0 00E+00 | 1.66E-07 | 3.31E-07 |
| Th-232 | 2.3842E-11 | 1,356.06 | 2,712 12 | 0 00E+00 | 3.23E-08 | 6 47E-08 |
| Tl-208 | 1.4313E-07 | 1,356.06 | 2,712 12 | 0 00E+00 | 1.94E-04 | 3 88E-04 |
| U-232 | 4.1927E-07 | 1,356.06 | 2,712 12 | 0 00E+00 | 5 69E-04 | 1 14E-03 |
| U-233 | 6 8491E-08 | 1,356.06 | 2,712 12 | 0 00E+00 | 9.29E-05 | 1 86E-04 |
| U-234 | 2.0189E-06 | 1,356 06 | 2,712 12 | 0 00E+00 | 2.74E-03 | 5 48E-03 |
| U-235 | -2 6572E-06 | 1,356 06 | 0 00 | 2.58E-02 | 2.22E-02 | 2.58E-02 |
| U-236 | 1.3575E-05 | 1,356 06 | 2,712 12 | 0 00E+00 | 1 84E-02 | 3 68E-02 |
| U-238 | -2 2698E-08 | 1,356 06 | 0 00 | 1 73E-03 | 1 69E-03 | 1.73E-03 |
| Y-90 | 2 5646E+00 | 1,356 06 | 2,712 12 | 0 00E+00 | 3 48E+03 | 6 96E+03 |
| Other Radionuclides | | | | | 4 83E+03 | 9 66E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 4 376E+14 |
| 0 0250 | 9 603E+13 |
| 0 0375 | 8 494E+13 |
| 0 0575 | 8 478E+13 |
| 0 0850 | 5 275E+13 |
| 0 1250 | 4.236E+13 |
| 0.2250 | 4 483E+13 |
| 0.3750 | 2.237E+13 |
| 0.5750 | 3 702E+14 |
| 0.8500 | 6 792E+13 |
| 1.2500 | 2 609E+14 |
| 1 7500 | 3 489E+11 |
| 2.2500 | 2 735E+11 |
| 2 7500 | 2 480E+09 |
| 3 5000 | 2 918E+08 |
| 5 0000 | 6 991E+04 |
| 7.0000 | 8 045E+03 |
| 11 0000 | 9.233E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 8.89E+01 | 1 78E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used | Basis for Parameter Differences: |
|---|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE | |
| Fuel Cladding | SST | SST | |
| BOL HM Constituents | U | U | |
| BOL Enrichment % | 69 89795918 | 60 to 100 | |

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 482.25 | 1,356.06 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 2,712.12 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup | Estimated EOL HM/Given EOL HM |
|---|---|---|---|
| Nominal | 0.23 | 2.81 | 1 00 |
| Bounding | 0 47 | | |

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) SLOVENIA
SNF ID #: 495
Fuel Units & Descr: 26 - ELEMENT
Heavy Metal Mass: BOL=4 987kg, EOL=4 69kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1999
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 66 52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 10 years

Estimated Canister usage, 18"x10': 0.23

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4 2243E-10 | 281 70 | 563 41 | 0 00E+00 | 1 19E-07 | 2 38E-07 |
| Am-241 | 9 9143E-03 | 281 70 | 563 41 | 0 00E+00 | 2.79E+00 | 5 59E+00 |
| Am-242m | 2.3903E-05 | 281 70 | 563 41 | 0 00E+00 | 6 73E-03 | 1 35E-02 |
| Am-243 | 3 0968E-05 | 281 70 | 563 41 | 0 00E+00 | 8 72E-03 | 1 74E-02 |
| C-14 | 1.2581E-04 | 281 70 | 563.41 | 0 00E+00 | 3 54E-02 | 7 09E-02 |
| Cl-36 | 2 6624E-06 | 281 70 | 563.41 | 0 00E+00 | 7 50E-04 | 1 50E-03 |
| Cm-243 | 3.3870E-05 | 281 70 | 563.41 | 0 00E+00 | 9 54E-03 | 1 91E-02 |
| Cm-244 | 3.3870E-03 | 281 70 | 563 41 | 0 00E+00 | 9 54E-01 | 1 91E+00 |
| Co-60 | 6 4311E-01 | 281 70 | 563.41 | 0 00E+00 | 1 81E+02 | 3 62E+02 |
| Cs-134 | 1.2201E-01 | 281 70 | 563 41 | 0 00E+00 | 3.44E+01 | 6 87E+01 |
| Cs-135 | 1 9753E-05 | 281 70 | 563.41 | 0 00E+00 | 5 56E-03 | 1 11E-02 |
| Cs-137 | 2 4384E+00 | 281 70 | 563 41 | 0 00E+00 | 6 87E+02 | 1 37E+03 |
| Eu-154 | 8.2396E-02 | 281 70 | 563.41 | 0 00E+00 | 2 32E+01 | 4 64E+01 |
| Eu-155 | 2.6383E-02 | 281 70 | 563 41 | 0 00E+00 | 7 43E+00 | 1 49E+01 |
| Fe-55 | 2.1001E-01 | 281 70 | 563.41 | 0 00E+00 | 5 92E+01 | 1 18E+02 |
| H-3 | 7 9555E-03 | 281 70 | 563 41 | 0 00E+00 | 2.24E+00 | 4 48E+00 |
| I-129 | 7.1287E-07 | 281 70 | 563 41 | 0 00E+00 | 2 01E-04 | 4,02E-04 |
| Kr-85 | 1 8070E-01 | 281 70 | 563.41 | 0 00E+00 | 5 09E+01 | 1 02E+02 |
| Np-237 | 1.2135E-05 | 281 70 | 563 41 | 0 00E+00 | 3 42E-03 | 6 84E-03 |
| Pa-231 | 1.3125E-09 | 281 70 | 563 41 | 0 00E+00 | 3.70E-07 | 7 39E-07 |
| Pb-210 | 1.1201E-13 | 281 70 | 563 41 | 0 00E+00 | 3.16E-11 | 6 31E-11 |
| Pm-147 | 3 0186E-01 | 281 70 | 563 41 | 0.00E+00 | 8 50E+01 | 1 70E+02 |
| Pu-238 | 5.2706E-02 | 281 70 | 563.41 | 0 00E+00 | 1 48E+01 | 2 97E+01 |
| Pu-239 | 1 4054E-03 | 281 70 | 563 41 | 0 00E+00 | 3.96E-01 | 7.92E-01 |
| Pu-240 | 1 1545E-03 | 281 70 | 563 41 | 0 00E+00 | 3.25E-01 | 6 50E-01 |
| Pu-241 | 3 3809E-01 | 281 70 | 563 41 | 0 00E+00 | 9 52E+01 | 1 90E+02 |
| Pu-242 | 4 9910E-06 | 281 70 | 563 41 | 0 00E+00 | 1 41E-03 | 2 81E-03 |
| Ra-226 | 6 1395E-13 | 281 70 | 563 41 | 0 00E+00 | 1 73E-10 | 3 46E-10 |
| Ra-228 | 2 0490E-11 | 281 70 | 563 41 | 0 00E+00 | 5 77E-09 | 1 15E-08 |
| Ru-106 | 3 3298E-03 | 281 70 | 563 41 | 0 00E+00 | 9 38E-01 | 1 88E+00 |
| Se-79 | 1 2831E-05 | 281 70 | 563 41 | 0 00E+00 | 3 61E-03 | 7 23E-03 |
| Sn-126 | 1 2090E-05 | 281 70 | 563 41 | 0 00E+00 | 3 41E-03 | 6 81E-03 |
| Sr-90 | 2 2760E+00 | 281 70 | 563 41 | 0 00E+00 | 6 41E+02 | 1 28E+03 |
| Tc-99 | 4 0319E-04 | 281 70 | 563 41 | 0 00E+00 | 1 14E-01 | 2 27E-01 |
| Th-229 | 1 0973E-10 | 281 70 | 563 41 | 0 00E+00 | 3 09E-08 | 6 18E-08 |
| Th-230 | 2 2940E-10 | 281 70 | 563 41 | 0 00E+00 | 6 46E-08 | 1 29E-07 |
| Th-232 | 2 3842E-11 | 281 70 | 563 41 | 0 00E+00 | 6 72E-09 | 1 34E-08 |
| Tl-208 | 1 4857E-07 | 281 70 | 563 41 | 0 00E+00 | 4 19E-05 | 8 37E-05 |
| U-232 | 4 1927E-07 | 281 70 | 563 41 | 0 00E+00 | 1 18E-04 | 2 36E-04 |
| U-233 | 6 8746E-08 | 281 70 | 563 41 | 0 00E+00 | 1 94E-05 | 3 87E-05 |
| U-234 | 2 7511E-06 | 281 70 | 563 41 | 0 00E+00 | 7 75E-04 | 1 55E-03 |
| U-235 | -2 6572E-06 | 281.70 | 0.00 | 7 54E-03 | 6 79E-03 | 7 54E-03 |
| U-236 | 1 3575E-05 | 281.70 | 563 41 | 0 00E+00 | 3 82E-03 | 7 65E-03 |
| U-238 | -2.2698E-08 | 281.70 | 0 00 | 5 03E-04 | 4 97E-04 | 5 03E-04 |
| Y-90 | 2 2775E+00 | 281.70 | 563 41 | 0 00E+00 | 6 42E+02 | 1.28E+03 |
| Other Radionuclides | | | | | 6 82E+02 | 1 36E+03 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg. MeV | |
| 0 0150 | 7.224E+13 |
| 0 0250 | 1 525E+13 |
| 0 0375 | 1 344E+13 |
| 0 0575 | 1 402E+13 |
| 0 0850 | 8 500E+12 |
| 0 1250 | 6 174E+12 |
| 0.2250 | 7 288E+12 |
| 0 3750 | 3 304E+12 |
| 0 5750 | 5 483E+13 |
| 0 8500 | 3 568E+12 |
| 1.2500 | 2.804E+13 |
| 1 7500 | 4 043E+10 |
| 2.2500 | 8 688E+08 |
| 2 7500 | 1 889E+07 |
| 3 5000 | 1 979E+06 |
| 5 0000 | 1 208E+04 |
| 7 0000 | 1 389E+03 |
| 11 0000 | 1 594E+02 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 19E+01 | 2.37E+01 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 96306689 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 94 02 | 281 70 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 563 41 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 17 | 3 00 |
| Bounding | 0 33 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) SO KOREA | [1]Fuel decay start date | 1996 |
| SNF ID # | 494 | Estimates as of | 2010 |
| Fuel Units & Descr | 114 - ELEMENT | Template | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100% U) |
| Heavy Metal Mass | BOL=21 66kg, EOL=19 106kg | [2]Template Burnup(MWd) | 66 52 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT) | 0 000196 |
| | | Template Decay Time | 10 years |

Estimated Canister usage
18"x10'
1 03

### II. Estimates

| Radionuclide | m Ci/MWd From Template | $x_n$ Nominal Fuel Burnup (MWd)[2] | $x_b$ Bounding Fuel Burnup (MWd)[2] | b Initial Activity (Ci) | $y_n$ Nominal Fuel Inventories(Ci) | $y_b$ Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 4.2243E-10 | 2,426 99 | 4,853 99 | 0 00E+00 | 1 03E-06 | 2 05E-06 |
| Am-241 | 9 9143E-03 | 2,426 99 | 4,853 99 | 0 00E+00 | 2 41E+01 | 4 81E+01 |
| Am-242m | 2.3903E-05 | 2,426.99 | 4,853 99 | 0 00E+00 | 5 80E-02 | 1 16E-01 |
| Am-243 | 3 0968E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 7 52E-02 | 1.50E-01 |
| C-14 | 1.2581E-04 | 2,426 99 | 4,853 99 | 0 00E+00 | 3 05E-01 | 6 11E-01 |
| Cl-36 | 2 6624E-06 | 2,426 99 | 4,853 99 | 0.00E+00 | 6 46E-03 | 1.29E-02 |
| Cm-243 | 3.3870E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 8 22E-02 | 1 64E-01 |
| Cm-244 | 3.3870E-03 | 2,426 99 | 4,853 99 | 0 00E+00 | 8 22E+00 | 1 64E+01 |
| Co-60 | 6 4311E-01 | 2,426 99 | 4,853 99 | 0 00E+00 | 1 56E+03 | 3 12E+03 |
| Cs-134 | 1.2201E-01 | 2,426 99 | 4,853 99 | 0 00E+00 | 2 96E+02 | 5 92E+02 |
| Cs-135 | 1 9753E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 4 79E-02 | 9 59E-02 |
| Cs-137 | 2 4384E+00 | 2,426 99 | 4,853 99 | 0 00E+00 | 5 92E+03 | 1 18E+04 |
| Eu-154 | 8 2396E-02 | 2,426 99 | 4,853 99 | 0.00E+00 | 2 00E+02 | 4 00E+02 |
| Eu-155 | 2 6383E-02 | 2,426 99 | 4,853 99 | 0 00E+00 | 6 40E+01 | 1.28E+02 |
| Fe-55 | 2 1001E-01 | 2,426 99 | 4,853 99 | 0 00E+00 | 5 10E+02 | 1 02E+03 |
| H-3 | 7 9555E-03 | 2,426 99 | 4,853 99 | 0 00E+00 | 1 93E+01 | 3 86E+01 |
| I-129 | 7 1287E-07 | 2,426 99 | 4,853 99 | 0 00E+00 | 1.73E-03 | 3 46E-03 |
| Kr-85 | 1 8070E-01 | 2,426 99 | 4,853 99 | 0 00E+00 | 4 39E+02 | 8 77E+02 |
| Np-237 | 1 2135E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 2.95E-02 | 5 89E-02 |
| Pa-231 | 1 3125E-09 | 2,426 99 | 4,853 99 | 0 00E+00 | 3.19E-06 | 6.37E-06 |
| Pb-210 | 1 1201E-13 | 2,426 99 | 4,853 99 | 0 00E+00 | 2.72E-10 | 5 44E-10 |
| Pm-147 | 3 0186E-01 | 2,426 99 | 4,853.99 | 0 00E+00 | 7.33E+02 | 1 47E+03 |
| Pu-238 | 5 2706E-02 | 2,426 99 | 4,853 99 | 0 00E+00 | 1.28E+02 | 2.56E+02 |
| Pu-239 | 1 4054E-03 | 2,426 99 | 4,853.99 | 0 00E+00 | 3 41E+00 | 6 82E+00 |
| Pu-240 | 1 1545E-03 | 2,426 99 | 4,853 99 | 0 00E+00 | 2.80E+00 | 5 60E+00 |
| Pu-241 | 3 3809E-01 | 2,426 99 | 4,853.99 | 0 00E+00 | 8.21E+02 | 1 64E+03 |
| Pu-242 | 4 9910E-06 | 2,426 99 | 4,853 99 | 0 00E+00 | 1.21E-02 | 2 42E-02 |
| Ra-226 | 6 1395E-13 | 2,426 99 | 4,853 99 | 0 00E+00 | 1.49E-09 | 2 98E-09 |
| Ra-228 | 2 0490E-11 | 2,426 99 | 4,853.99 | 0 00E+00 | 4 97E-08 | 9 95E-08 |
| Ru-106 | 3 3298E-03 | 2,426 99 | 4,853 99 | 0 00E+00 | 8 08E+00 | 1 62E+01 |
| Se-79 | 1 2831E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 3 11E-02 | 6 23E-02 |
| Sn-126 | 1 2090E-05 | 2,426 99 | 4,853 99 | 0 00E+00 | 2 93E-02 | 5 87E-02 |
| Sr-90 | 2.2760E+00 | 2,426 99 | 4,853 99 | 0 00E+00 | 5.52E+03 | 1 10E+04 |
| Tc-99 | 4 0319E-04 | 2,426 99 | 4,853 99 | 0 00E+00 | 9 79E-01 | 1 96E+00 |
| Th-229 | 1 0973E-10 | 2,426 99 | 4,853 99 | 0 00E+00 | 2 66E-07 | 5 33E-07 |
| Th-230 | 2.2940E-10 | 2,426 99 | 4,853 99 | 0 00E+00 | 5 57E-07 | 1 11E-06 |
| Th-232 | 2.3842E-11 | 2,426 99 | 4,853 99 | 0 00E+00 | 5 79E-08 | 1 16E-07 |
| Tl-208 | 1 4857E-07 | 2,426 99 | 4,853 99 | 0 00E+00 | 3 61E-04 | 7.21E-04 |
| U-232 | 4 1927E-07 | 2,426 99 | 4,853 99 | 0 00E+00 | 1 02E-03 | 2 04E-03 |
| U-233 | 6 8746E-08 | 2,426.99 | 4,853 99 | 0 00E+00 | 1 67E-04 | 3 34E-04 |
| U-234 | 2.7511E-06 | 2,426 99 | 4,853 99 | 0 00E+00 | 6 68E-03 | 1.34E-02 |
| U-235 | -2 6572E-06 | 2,426.99 | 0 00 | 3.28E-02 | 2 63E-02 | 3.28E-02 |
| U-236 | 1.3575E-05 | 2,426.99 | 4,853 99 | 0 00E+00 | 3 29E-02 | 6.59E-02 |
| U-238 | -2.2698E-08 | 2,426 99 | 0 00 | 2.18E-03 | 2 13E-03 | 2.18E-03 |
| Y-90 | 2.2775E+00 | 2,426 99 | 4,853 99 | 0 00E+00 | 5 53E+03 | 1 11E+04 |
| Other Radionuclides | | | | | 5 87E+03 | 1.17E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6.224E+14 |
| 0 0250 | 1 314E+14 |
| 0 0375 | 1 158E+14 |
| 0 0575 | 1.208E+14 |
| 0 0850 | 7.323E+13 |
| 0 1250 | 5 319E+13 |
| 0.2250 | 6.279E+13 |
| 0.3750 | 2 846E+13 |
| 0.5750 | 4 724E+14 |
| 0.8500 | 3 074E+13 |
| 1.2500 | 2 415E+14 |
| 1 7500 | 3 483E+11 |
| 2.2500 | 7 485E+09 |
| 2 7500 | 1 628E+08 |
| 3 5000 | 1 705E+07 |
| 5 0000 | 1 040E+05 |
| 7 0000 | 1 197E+04 |
| 11 0000 | 1 373E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1 02E+02 | 2.04E+02 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 816 76 | 2,426 99 | Nominal burnup calculated from the heavy metal mass destroyed |
| Bounding | | 4 853 99 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.33 | 2.97 |
| Bounding | 0 66 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) TEXAS A&M
SNF ID #: 239
Fuel Units & Descr: 7 - ELEMENT
Heavy Metal Mass: BOL=1.372kg, EOL=1 182kg
ROD Storage Site: INEEL

[1]Fuel decay start date: 1976
Estimates as of: 2010
Template: TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd): 66 52
Template BOL Heavy Metal Mass (MT): 0 000196
Template Decay Time: 25 years

Estimated Canister usage 18"x10' 0 06

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 1 0386E-09 | 180 29 | 360.59 | 0 00E+00 | 1 87E-07 | 3 75E-07 |
| Am-241 | 1 4973E-02 | 180.29 | 360.59 | 0 00E+00 | 2 70E+00 | 5 40E+00 |
| Am-242m | 2 2324E-05 | 180.29 | 360.59 | 0 00E+00 | 4 02E-03 | 8 05E-03 |
| Am-243 | 3 0923E-05 | 180 29 | 360 59 | 0 00E+00 | 5 58E-03 | 1 12E-02 |
| C-14 | 1 2559E-04 | 180 29 | 360.59 | 0 00E+00 | 2 26E-02 | 4 53E-02 |
| Cl-36 | 2 6624E-06 | 180 29 | 360.59 | 0 00E+00 | 4 80E-04 | 9 60E-04 |
| Cm-243 | 2 3527E-05 | 180 29 | 360.59 | 0 00E+00 | 4 24E-03 | 8 48E-03 |
| Cm-244 | 1 9092E-03 | 180.29 | 360.59 | 0 00E+00 | 3 44E-01 | 6 88E-01 |
| Co-60 | 8 9552E-02 | 180 29 | 360 59 | 0 00E+00 | 1 61E+01 | 3 23E+01 |
| Cs-134 | 7 9074E-04 | 180 29 | 360.59 | 0 00E+00 | 1 43E-01 | 2 85E-01 |
| Cs-135 | 1 9753E-05 | 180.29 | 360 59 | 0 00E+00 | 3 56E-03 | 7 12E-03 |
| Cs-137 | 1 7243E+00 | 180.29 | 360 59 | 0 00E+00 | 3 11E+02 | 6 22E+02 |
| Eu-154 | 2 4609E-02 | 180 29 | 360.59 | 0 00E+00 | 4 44E+00 | 8 87E+00 |
| Eu-155 | 3 2456E-03 | 180.29 | 360.59 | 0 00E+00 | 5 85E-01 | 1 17E+00 |
| Fe-55 | 3 8605E-03 | 180.29 | 360 59 | 0 00E+00 | 6 96E-01 | 1 39E+00 |
| H-3 | 3 4305E-03 | 180.29 | 360.59 | 0 00E+00 | 6 19E-01 | 1 24E+00 |
| I-129 | 7 1287E-07 | 180.29 | 360.59 | 0 00E+00 | 1 29E-04 | 2 57E-04 |
| Kr-85 | 6 8536E-02 | 180.29 | 360 59 | 0 00E+00 | 1 24E+01 | 2 47E+01 |
| Np-237 | 1 2219E-05 | 180.29 | 360.59 | 0 00E+00 | 2 20E-03 | 4 41E-03 |
| Pa-231 | 2 0701E-09 | 180.29 | 360.59 | 0 00E+00 | 3 73E-07 | 7 46E-07 |
| Pb-210 | 1 3279E-12 | 180.29 | 360.59 | 0 00E+00 | 2 39E-10 | 4 79E-10 |
| Pm-147 | 5 7517E-03 | 180.29 | 360 59 | 0 00E+00 | 1 04E+00 | 2 07E+00 |
| Pu-238 | 4 6828E-02 | 180.29 | 360 59 | 0 00E+00 | 8 44E+00 | 1 69E+01 |
| Pu-239 | 1 4048E-03 | 180.29 | 360 59 | 0 00E+00 | 2 53E-01 | 5 07E-01 |
| Pu-240 | 1 1563E-03 | 180.29 | 360 59 | 0 00E+00 | 2 08E-01 | 4 17E-01 |
| Pu-241 | 1 6431E-01 | 180.29 | 360.59 | 0 00E+00 | 2 96E+01 | 5 92E+01 |
| Pu-242 | 4 9910E-06 | 180.29 | 360 59 | 0 00E+00 | 9 00E-04 | 1 80E-03 |
| Ra-226 | 5 4390E-12 | 180.29 | 360 59 | 0 00E+00 | 9 81E-10 | 1 96E-09 |
| Ra-228 | 2 3437E-11 | 180 29 | 360 59 | 0 00E+00 | 4 23E-09 | 8 45E-09 |
| Ru-106 | 1 1115E-07 | 180.29 | 360 59 | 0 00E+00 | 2 00E-05 | 4 01E-05 |
| Se-79 | 1.2829E-05 | 180.29 | 360 59 | 0 00E+00 | 2 31E-03 | 4 63E-03 |
| Sn-126 | 1 2088E-05 | 180.29 | 360 59 | 0 00E+00 | 2 18E-03 | 4 36E-03 |
| Sr-90 | 1 5935E+00 | 180.29 | 360 59 | 0 00E+00 | 2 87E+02 | 5 75E+02 |
| Tc-99 | 4 0319E-04 | 180 29 | 360 59 | 0.00E+00 | 7 27E-02 | 1 45E-01 |
| Th-229 | 2 4023E-10 | 180 29 | 360 59 | 0 00E+00 | 4 33E-08 | 8 66E-08 |
| Th-230 | 9 6948E-10 | 180 29 | 360 59 | 0 00E+00 | 1 75E-07 | 3 50E-07 |
| Th-232 | 2 3857E-11 | 180 29 | 360 59 | 0 00E+00 | 4 30E-09 | 8 60E-09 |
| Tl-208 | 1 3982E-07 | 180 29 | 360 59 | 0.00E+00 | 2 52E-05 | 5 04E-05 |
| U-232 | 3 7943E-07 | 180 29 | 360 59 | 0 00E+00 | 6 84E-05 | 1 37E-04 |
| U-233 | 6 9814E-08 | 180 29 | 360 59 | 0 00E+00 | 1 26E-05 | 2 52E-05 |
| U-234 | 5 4059E-06 | 180 29 | 360 59 | 0 00E+00 | 9 75E-04 | 1 95E-03 |
| U-235 | -2 6572E-06 | 180 29 | 0.00 | 2 07E-03 | 1 59E-03 | 2 07E-03 |
| U-236 | 1.3576E-05 | 180 29 | 360 59 | 0 00E+00 | 2 45E-03 | 4 90E-03 |
| U-238 | -2 2698E-08 | 180 29 | 0 00 | 1 39E-04 | 1 35E-04 | 1 39E-04 |
| Y-90 | 1.5935E+00 | 180 29 | 360 59 | 0 00E+00 | 2 87E+02 | 5 75E+02 |
| Other Radionuclides | | | | | 3 05E+02 | 6 11E+02 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 3 170E+13 |
| 0 0250 | 6 562E+12 |
| 0 0375 | 5 767E+12 |
| 0 0575 | 6 196E+12 |
| 0 0850 | 3 699E+12 |
| 0 1250 | 2.526E+12 |
| 0.2250 | 3 196E+12 |
| 0 3750 | 1.387E+12 |
| 0 5750 | 2.319E+13 |
| 0 8500 | 3.897E+11 |
| 1.2500 | 2 638E+12 |
| 1 7500 | 1 095E+10 |
| 2.2500 | 1.332E+07 |
| 2.7500 | 1.822E+06 |
| 3.5000 | 1.060E+04 |
| 5.0000 | 4 497E+03 |
| 7 0000 | 5 163E+02 |
| 11 0000 | 5 918E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4.14E+00 | 8.27E+00 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69.89795918 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal: | 38.80 | 180 29 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding: | | 360 59 | Bounding burnup assumed to be twice nominal burnup. |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0.39 | 4 65 |
| Bounding | 0 77 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT).

## Fuel Radionuclide Inventory Worksheet

**I. Fuel and Template Information**

Fuel Name: TRIGA (FLIP) TEXAS A&M
SNF ID # 241
Fuel Units & Descr 96 - ELEMENT
Heavy Metal Mass BOL=16 819kg; EOL=14 63kg
ROD Storage Site INEEL

[1]Fuel decay start date 2035
Estimates as of 2010
Template TRIGA FLIP (LW/U-Zrx, SST, 60 to 100%, U)
[2]Template Burnup(MWd) 66 52
Template BOL Heavy Metal Mass (MT) 0 000196
Template Decay Time 5 years

Estimated Canister usage
18"x10'
0 86

**II. Estimates**

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 2,080.28 | 4,160 56 | 0 00E+00 | 5 93E-07 | 1 19E-06 |
| Am-241 | 7.5767E-03 | 2,080.28 | 4,160 56 | 0 00E+00 | 1 58E+01 | 3.15E+01 |
| Am-242m | 2 4459E-05 | 2,080.28 | 4,160 56 | 0 00E+00 | 5 09E-02 | 1 02E-01 |
| Am-243 | 3 0983E-05 | 2,080 28 | 4,160 56 | 0 00E+00 | 6 45E-02 | 1 29E-01 |
| C-14 | 1 2590E-04 | 2,080 28 | 4,160 56 | 0 00E+00 | 2 62E-01 | 5 24E-01 |
| Cl-36 | 2 6624E-06 | 2,080 28 | 4,160 56 | 0 00E+00 | 5 54E-03 | 1 11E-02 |
| Cm-243 | 3 8244E-05 | 2,080 28 | 4,160.56 | 0 00E+00 | 7.96E-02 | 1 59E-01 |
| Cm-244 | 4.1010E-03 | 2,080.28 | 4,160.56 | 0 00E+00 | 8.53E+00 | 1 71E+01 |
| Co-60 | 1.2410E+00 | 2,080 28 | 4,160 56 | 0.00E+00 | 2.58E+03 | 5 16E+03 |
| Cs-134 | 6 5454E-01 | 2,080.28 | 4,160 56 | 0 00E+00 | 1.36E+03 | 2 72E+03 |
| Cs-135 | 1 9753E-05 | 2,080.28 | 4,160 56 | 0 00E+00 | 4 11E-02 | 8.22E-02 |
| Cs-137 | 2 7375E+00 | 2,080.28 | 4,160 56 | 0 00E+00 | 5 69E+03 | 1.14E+04 |
| Eu-154 | 1.2324E-01 | 2,080.28 | 4,160 56 | 0 00E+00 | 2 56E+02 | 5 13E+02 |
| Eu-155 | 5 3037E-02 | 2,080 28 | 4,160 56 | 0 00E+00 | 1 10E+02 | 2.21E+02 |
| Fe-55 | 7 9555E-01 | 2,080 28 | 4,160 56 | 0 00E+00 | 1 65E+03 | 3 31E+03 |
| H-3 | 1 0531E-02 | 2,080 28 | 4,160 56 | 0 00E+00 | 2 19E+01 | 4.38E+01 |
| I-129 | 7 1287E-07 | 2,080 28 | 4,160.56 | 0 00E+00 | 1.48E-03 | 2 97E-03 |
| Kr-85 | 2 4955E-01 | 2,080.28 | 4,160 56 | 0 00E+00 | 5 19E+02 | 1 04E+03 |
| Np-237 | 1.2121E-05 | 2,080.28 | 4,160 56 | 0.00E+00 | 2 52E-02 | 5 04E-02 |
| Pa-231 | 1 1230E-09 | 2,080.28 | 4,160 56 | 0 00E+00 | 2 34E-06 | 4 67E-06 |
| Pb-210 | 6 1636E-14 | 2,080.28 | 4,160 56 | 0 00E+00 | 1 28E-10 | 2.56E-10 |
| Pm-147 | 1 1302E+00 | 2,080 28 | 4,160 56 | 0 00E+00 | 2 35E+03 | 4 70E+03 |
| Pu-238 | 5 4826E-02 | 2,080 28 | 4,160 56 | 0 00E+00 | 1 14E+02 | 2.28E+02 |
| Pu-239 | 1 4056E-03 | 2,080 28 | 4,160 56 | 0 00E+00 | 2 92E+00 | 5 85E+00 |
| Pu-240 | 1 1536E-03 | 2,080 28 | 4,160.56 | 0 00E+00 | 2 40E+00 | 4 80E+00 |
| Pu-241 | 4.2995E-01 | 2,080 28 | 4,160.56 | 0 00E+00 | 8 94E+02 | 1 79E+03 |
| Pu-242 | 4 9910E-06 | 2,080.28 | 4,160 56 | 0 00E+00 | 1 04E-02 | 2 08E-02 |
| Ra-226 | 2 4008E-13 | 2,080.28 | 4,160 56 | 0 00E+00 | 4 99E-10 | 9 99E-10 |
| Ra-228 | 1 8220E-11 | 2,080.28 | 4,160 56 | 0 00E+00 | 3 79E-08 | 7.58E-08 |
| Ru-106 | 1 0343E-01 | 2,080.28 | 4,160 56 | 0.00E+00 | 2 15E+02 | 4.30E+02 |
| Se-79 | 1.2832E-05 | 2,080.28 | 4,160 56 | 0 00E+00 | 2 67E-02 | 5 34E-02 |
| Sn-126 | 1.2090E-05 | 2,080.28 | 4,160 56 | 0 00E+00 | 2 51E-02 | 5 03E-02 |
| Sr-90 | 2 5646E+00 | 2,080 28 | 4,160 56 | 0 00E+00 | 5 34E+03 | 1 07E+04 |
| Tc-99 | 4 0319E-04 | 2,080 28 | 4,160 56 | 0 00E+00 | 8.39E-01 | 1 68E+00 |
| Th-229 | 7 7375E-11 | 2,080 28 | 4,160.56 | 0 00E+00 | 1.61E-07 | 3.22E-07 |
| Th-230 | 1.2211E-10 | 2,080.28 | 4,160.56 | 0 00E+00 | 2.54E-07 | 5 08E-07 |
| Th-232 | 2.3842E-11 | 2,080.28 | 4,160 56 | 0 00E+00 | 4 96E-08 | 9 92E-08 |
| Tl-208 | 1.4313E-07 | 2,080.28 | 4,160 56 | 0 00E+00 | 2 98E-04 | 5 96E-04 |
| U-232 | 4 1927E-07 | 2,080.28 | 4,160 56 | 0 00E+00 | 8 72E-04 | 1 74E-03 |
| U-233 | 6 8491E-08 | 2,080.28 | 4,160 56 | 0 00E+00 | 1 42E-04 | 2 85E-04 |
| U-234 | 2 0189E-06 | 2,080.28 | 4,160 56 | 0 00E+00 | 4.20E-03 | 8 40E-03 |
| U-235 | -2 6572E-06 | 2,080 28 | 0 00 | 2 54E-02 | 1.99E-02 | 2 54E-02 |
| U-236 | 1 3575E-05 | 2,080 28 | 4,160 56 | 0 00E+00 | 2.82E-02 | 5 65E-02 |
| U-238 | -2.2698E-08 | 2,080 28 | 0 00 | 1 70E-03 | 1.65E-03 | 1.70E-03 |
| Y-90 | 2 5646E+00 | 2,080 28 | 4,160 56 | 0 00E+00 | 5.34E+03 | 1.07E+04 |
| Other Radionuclides | | | | | 7.41E+03 | 1.48E+04 |

**Gamma Sources**

| Photon Energy Group | Total Photons/sec (bounding) |
|---|---|
| Avg MeV | |
| 0 0150 | 6 713E+14 |
| 0 0250 | 1.473E+14 |
| 0 0375 | 1.303E+14 |
| 0 0575 | 1.301E+14 |
| 0.0850 | 8 093E+13 |
| 0 1250 | 6 498E+13 |
| 0.2250 | 6 877E+13 |
| 0.3750 | 3 432E+13 |
| 0 5750 | 5 680E+14 |
| 0 8500 | 1.042E+14 |
| 1 2500 | 4.002E+14 |
| 1 7500 | 5.353E+11 |
| 2.2500 | 4 196E+11 |
| 2 7500 | 3.804E+09 |
| 3.5000 | 4 477E+08 |
| 5.0000 | 1 072E+05 |
| 7.0000 | 1.234E+04 |
| 11 0000 | 1 416E+03 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 1.36E+02 | 2.73E+02 |
| Total | Total |

**III. Template Selection Summary, Burnup Summary, and Checks**

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 70 00179205 | 60 to 100 |

**Basis for Parameter Differences:**

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated |
|---|---|---|
| Nominal | 792.76 | 2,080.28 |
| Bounding | | 4,160 56 |

**Basis for burnup used in estimate:**

Nominal burnup calculated from the heavy metal mass destroyed
Bounding burnup assumed to be twice nominal burnup

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 36 | 2.62 |
| Bounding | 0 73 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)

## Fuel Radionuclide Inventory Worksheet

### I. Fuel and Template Information

| | | | |
|---|---|---|---|
| Fuel Name | TRIGA (FLIP) TEXAS A&M - DAMAGED | [1]Fuel decay start date: | 2035 |
| SNF ID #. | 844 | Estimates as of: | 2010 |
| Fuel Units & Descr: | 5 - ELEMENT | Template: | TRIGA-FLIP (LW/U-Zrx, SST, 60 to 100%. U) |
| Heavy Metal Mass | BOL=0 879kg; EOL=0.812kg | [2]Template Burnup(MWd): | 66.52 |
| ROD Storage Site | INEEL | Template BOL Heavy Metal Mass (MT): | 0 000196 |
| | | Template Decay Time: | 5 years |

Estimated Canister usage 18"x10' 0 05

### II. Estimates

| Radionuclide | m: Ci/MWd From Template | $x_n$: Nominal Fuel Burnup (MWd)[2] | $x_b$: Bounding Fuel Burnup (MWd)[2] | b: Initial Activity (Ci) | $y_n$: Nominal Fuel Inventories(Ci) | $y_b$: Bounding Fuel Inventories(Ci) |
|---|---|---|---|---|---|---|
| Ac-227 | 2 8488E-10 | 63 68 | 127 36 | 0 00E+00 | 1 81E-08 | 3 63E-08 |
| Am-241 | 7 5767E-03 | 63 68 | 127.36 | 0 00E+00 | 4 82E-01 | 9 65E-01 |
| Am-242m | 2 4459E-05 | 63 68 | 127.36 | 0 00E+00 | 1 56E-03 | 3 11E-03 |
| Am-243 | 3 0983E-05 | 63 68 | 127 36 | 0 00E+00 | 1 97E-03 | 3 95E-03 |
| C-14 | 1.2590E-04 | 63 68 | 127 36 | 0 00E+00 | 8 02E-03 | 1 60E-02 |
| Cl-36 | 2 6624E-06 | 63 68 | 127 36 | 0 00E+00 | 1 70E-04 | 3 39E-04 |
| Cm-243 | 3 8244E-05 | 63 68 | 127 36 | 0 00E+00 | 2 44E-03 | 4 87E-03 |
| Cm-244 | 4 1010E-03 | 63 68 | 127.36 | 0 00E+00 | 2 61E-01 | 5.22E-01 |
| Co-60 | 1.2410E+00 | 63 68 | 127.36 | 0 00E+00 | 7 90E+01 | 1 58E+02 |
| Cs-134 | 6.5454E-01 | 63 68 | 127.36 | 0 00E+00 | 4 17E+01 | 8.34E+01 |
| Cs-135 | 1 9753E-05 | 63 68 | 127.36 | 0 00E+00 | 1 26E-03 | 2.52E-03 |
| Cs-137 | 2 7375E+00 | 63.68 | 127.36 | 0 00E+00 | 1 74E+02 | 3 49E+02 |
| Eu-154 | 1 2324E-01 | 63 68 | 127 36 | 0 00E+00 | 7 85E+00 | 1.57E+01 |
| Eu-155 | 5 3037E-02 | 63 68 | 127 36 | 0 00E+00 | 3 38E+00 | 6 75E+00 |
| Fe-55 | 7 9555E-01 | 63 68 | 127 36 | 0 00E+00 | 5 07E+01 | 1 01E+02 |
| H-3 | 1 0531E-02 | 63 68 | 127 36 | 0 00E+00 | 6 71E-01 | 1.34E+00 |
| I-129 | 7 1287E-07 | 63 68 | 127 36 | 0 00E+00 | 4 54E-05 | 9 08E-05 |
| Kr-85 | 2 4955E-01 | 63 68 | 127 36 | 0 00E+00 | 1 59E+01 | 3 18E+01 |
| Np-237 | 1 2121E-05 | 63 68 | 127 36 | 0 00E+00 | 7 72E-04 | 1.54E-03 |
| Pa-231 | 1 1230E-09 | 63 68 | 127 36 | 0 00E+00 | 7.15E-08 | 1 43E-07 |
| Pb-210 | 6 1636E-14 | 63 68 | 127 36 | 0 00E+00 | 3 92E-12 | 7 85E-12 |
| Pm-147 | 1 1302E+00 | 63 68 | 127 36 | 0 00E+00 | 7.20E+01 | 1 44E+02 |
| Pu-238 | 5 4826E-02 | 63 68 | 127 36 | 0 00E+00 | 3.49E+00 | 6 98E+00 |
| Pu-239 | 1 4056E-03 | 63 68 | 127 36 | 0 00E+00 | 8 95E-02 | 1 79E-01 |
| Pu-240 | 1 1536E-03 | 63 68 | 127 36 | 0 00E+00 | 7.35E-02 | 1 47E-01 |
| Pu-241 | 4 2995E-01 | 63 68 | 127 36 | 0 00E+00 | 2 74E+01 | 5 48E+01 |
| Pu-242 | 4 9910E-06 | 63 68 | 127 36 | 0 00E+00 | 3.18E-04 | 6 36E-04 |
| Ra-226 | 2 4008E-13 | 63 68 | 127 36 | 0 00E+00 | 1.53E-11 | 3 06E-11 |
| Ra-228 | 1 8220E-11 | 63 68 | 127 36 | 0 00E+00 | 1 16E-09 | 2 32E-09 |
| Ru-106 | 1 0343E-01 | 63 68 | 127.36 | 0 00E+00 | 6 59E+00 | 1 32E+01 |
| Se-79 | 1.2832E-05 | 63 68 | 127.36 | 0 00E+00 | 8.17E-04 | 1 63E-03 |
| Sn-126 | 1.2090E-05 | 63 68 | 127.36 | 0 00E+00 | 7 70E-04 | 1 54E-03 |
| Sr-90 | 2 5646E+00 | 63 68 | 127.36 | 0 00E+00 | 1 63E+02 | 3.27E+02 |
| Tc-99 | 4 0319E-04 | 63 68 | 127.36 | 0 00E+00 | 2 57E-02 | 5 13E-02 |
| Th-229 | 7.7375E-11 | 63 68 | 127.36 | 0 00E+00 | 4 93E-09 | 9 85E-09 |
| Th-230 | 1.2211E-10 | 63.68 | 127.36 | 0 00E+00 | 7 78E-09 | 1 56E-08 |
| Th-232 | 2.3842E-11 | 63 68 | 127.36 | 0 00E+00 | 1 52E-09 | 3 04E-09 |
| Tl-208 | 1 4313E-07 | 63 68 | 127.36 | 0 00E+00 | 9 11E-06 | 1 82E-05 |
| U-232 | 4.1927E-07 | 63 68 | 127.36 | 0 00E+00 | 2 67E-05 | 5 34E-05 |
| U-233 | 6 8491E-08 | 63 68 | 127 36 | 0 00E+00 | 4 36E-06 | 8 72E-06 |
| U-234 | 2 0189E-06 | 63 68 | 127 36 | 0 00E+00 | 1 29E-04 | 2.57E-04 |
| U-235 | -2 6572E-06 | 63 68 | 0 00 | 1 33E-03 | 1 16E-03 | 1.33E-03 |
| U-236 | 1 3575E-05 | 63 68 | 127 36 | 0 00E+00 | 8 64E-04 | 1.73E-03 |
| U-238 | -2.2698E-08 | 63 68 | 0 00 | 8 87E-05 | 8 73E-05 | 8 87E-05 |
| Y-90 | 2 5646E+00 | 63 68 | 127 36 | 0 00E+00 | 1 63E+02 | 3.27E+02 |
| Other Radionuclides | | | | | 2.27E+02 | 4 54E+02 |

**Gamma Sources**

| Photon Energy Group (Avg MeV) | Total Photons/sec (bounding) |
|---|---|
| 0 0150 | 2 055E+13 |
| 0 0250 | 4 509E+12 |
| 0 0375 | 3 989E+12 |
| 0 0575 | 3 981E+12 |
| 0 0850 | 2 477E+12 |
| 0 1250 | 1 989E+12 |
| 0.2250 | 2 105E+12 |
| 0 3750 | 1 050E+12 |
| 0 5750 | 1 739E+13 |
| 0 8500 | 3 189E+12 |
| 1.2500 | 1.225E+13 |
| 1 7500 | 1 639E+10 |
| 2.2500 | 1.284E+10 |
| 2 7500 | 1 164E+08 |
| 3 5000 | 1.370E+07 |
| 5 0000 | 3.283E+03 |
| 7 0000 | 3 778E+02 |
| 11 0000 | 4.336E+01 |

**Thermal Power**

| Nominal Heat Output (Watts) | Bounding Heat Output (Watts) |
|---|---|
| 4 18E+00 | 8.35E+00 |
| Total | Total |

### III. Template Selection Summary, Burnup Summary, and Checks

**Template Selection Summary**

| | From SFD | Used |
|---|---|---|
| Reactor Moderator | LW AND U ZIRC HYDRIDE | LW AND U ZIRC HYDRIDE |
| Fuel Cladding | SST | SST |
| BOL HM Constituents | U | U |
| BOL Enrichment % | 69 96587031 | 60 to 100 |

Basis for Parameter Differences:

**Burnup Summary (MWd)[2]**

| | From SFD | Estimated | Basis for burnup used in estimate: |
|---|---|---|---|
| Nominal | 24 86 | 63 68 | Nominal burnup calculated from the heavy metal mass destroyed. |
| Bounding | | 127 36 | Bounding burnup assumed to be twice nominal burnup |

**Checks**

| | Burnup Multiplier | Estimated Burnup/ Given Burnup |
|---|---|---|
| Nominal | 0 21 | 2.56 |
| Bounding | 0 43 | |

Estimated EOL HM/Given EOL HM: 1 00

[1]Reactor shutdown, core removal, storage, shipping or other date confirming that irradiation ceased for fuel

[2]Total burnup for all fuel associated with this worksheet must be divided by BOL heavy metal mass to get specific burnup values (MWd/MT)