

# Design Analysis Cover Sheet

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| 8. Checker  | Sedat Goluoglu                          | <i>[Signature]</i>                                  | 12/15/97                         |
| 9. Lead Design Engineer   | Peter Gottlieb                          | <i>[Signature]</i>                                  | 12/15/97                         |
| 10. Department Manager  | Hugh A. Benton                          | Hugh A. Benton                                      | 12/15/97                         |
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# Design Analysis Revision Record

Complete only applicable items.

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**Table of Contents**

| <b><u>Item</u></b>  | <b><u>Page</u></b> |
|---|--------------------|
| 1. Purpose .....  | 4                  |
| 2. Quality Assurance .....  | 4                  |
| 3. Method .....   | 4                  |
| 4. Design Inputs .....  | 5                  |
| 4.1 Design Parameters .....   | 5                  |
| 4.1.1 Massachusetts Institute of Technology (MIT) SNF .....           | 5                  |
| 4.1.2 Oak Ridge Research (ORR) SNF .....                              | 6                  |
| 4.1.3 High Level Waste (HLW) Glass Pour Canisters .....               | 7                  |
| 4.1.4 Codisposal Canister .....                                       | 7                  |
| 4.1.5 Five-HLW Waste Package .....                                    | 8                  |
| 4.2 Criteria .....  | 11                 |
| 4.3 Assumptions .....   | 12                 |
| 4.4 Codes and Standards .....   | 13                 |
| 5. References .....   | 13                 |
| 6. Use of Computer Software .....                                     | 16                 |
| 7. Design Analysis .....  | 17                 |
| 7.1 Background .....  | 17                 |
| 7.2 Criticality Models .....  | 18                 |
| 7.2.1 Homogeneous Mixture of Degraded DOE-SNF in DOE-SNF Canister ... | 20                 |
| 7.2.2 Degraded DOE SNF on Top of Degraded HLW .....                   | 21                 |
| 7.2.3 Degraded DOE SNF Mixed With Degraded HLW .....                  | 22                 |
| 7.3 Criticality Results .....   | 23                 |
| 7.3.1 Degraded MIT SNF Criticality .....                              | 24                 |
| 7.3.2 Degraded ORR SNF Criticality .....                              | 41                 |
| 8. Conclusions .....  | 46                 |
| 9. Attachments .....  | 47                 |

## 1. Purpose

The objective of this analysis is to characterize the criticality safety aspects of a degraded Department of Energy spent nuclear fuel (DOE-SNF) canister containing Massachusetts Institute of Technology (MIT) or Oak Ridge Research (ORR) fuel in the Five-Pack defense high level waste (DHLW) waste package to demonstrate concept viability related to use in the Mined Geologic Disposal System (MGDS) environment for the postclosure time frame. The purpose of this analysis is to investigate the disposal criticality issues for the degraded high level waste (HLW) waste package containing a DOE-SNF canister and to establish DHLW waste package and DOE-SNF canister compatibility with the MGDS, and to provide criticality evaluations for the preliminary DOE-SNF canister design.

## 2. Quality Assurance

The Quality Assurance (QA) program applies to this analysis. The work reported in this document is part of the preliminary waste package (WP) design analysis that will eventually support the License Application Design phase. This activity, when appropriately confirmed, can impact the proper functioning of the MGDS waste package. The *Classification of Permanent Items* QAP-2-3 evaluation entitled *Classification of the Preliminary MGDS Repository Design* (Ref. 5.1) has identified the waste package as an MGDS item important to safety, waste isolation, and physical protection of materials (Ref. 5.1, TBV-228). The Waste Package Operations responsible manager has evaluated this activity in accordance with QAP-2-0, *Conduct of Activities*. The *DOE Spent Fuel Characterization* activity evaluation (Ref. 5.2) has determined that work associated with the aluminum-based DOE Spent Fuel task is subject to *Quality Assurance Requirements and Description* (Ref 5.3) requirements. As specified in NLP-3-18, *Documentation of QA Controls on Drawings, Specifications, Design Analyses, and Technical Documents*, this activity is subject to QA controls.

## 3. Method

The solution method is to use the Monte Carlo N-Particle Version 4A computer code (MCNP4A; CSCI: 30006 V4A) to calculate  $k_{\text{eff}}$  for criticality safety evaluations. All calculations are performed with the fresh fuel isotopics; i.e., there is no credit for fuel burnup (Assumption 4.3.1). Throughout the waste package breach and the waste form degradation process, however, some of the materials may be removed from the waste package.

## 4. Design Inputs

All design inputs which are identified in this document are for the preliminary stage of the waste package design process; some or all of these design inputs will require subsequent confirmation (or superseding inputs) as the waste package design proceeds. Consequently, use of any data from this analysis for input into documents supporting construction, fabrication, or procurement is required to be controlled and tracked as TBV in accordance with NLP-3-15, *To Be Verified (TBV) and To Be Determined (TBD) Monitoring System*, or other appropriate procedures.

### 4.1 Design Parameters

Criticality calculations of the degraded form of both Massachusetts Institute of Technology (MIT) spent nuclear fuel (SNF) and Oak Ridge Research (ORR) SNF are performed to evaluate fresh fuel enrichments of 93.5 weight percent and 20.56 weight percent. These enrichments are representative of the various enrichments which may be found in Al-based DOE-owned SNF as identified by Savannah River Site (SRS) (Ref. 5.4).

Based on the rationale that the conclusions derived by this analysis are for preliminary design and will not be used as input into documents supporting construction, fabrication, or procurement, a notation of TBV or TBD will not be carried to the conclusion of this analysis.

#### 4.1.1 Massachusetts Institute of Technology (MIT) SNF

The details of the MIT fuel assembly were obtained from the MIT fuel Appendix A data and the MIT plate/assembly drawings (R3F-3-2, R3F-1-4) provided by SRS (Ref. 5.4) (TBV). The MIT fuel assembly is constructed from a collection of 15 flat plates tilted at a sixty degree angle so that the resulting assembly has a parallelogram cross-section instead of the more common square or hexagon shape. The MIT fuel length values used in these analyses are shorter than the original as-built length of the MIT assembly because the top and bottom ends of the assembly, which do not contain uranium materials, have been removed by cutting. The fuel plates consist of an aluminum cladding over an aluminum/uranium alloy. The maximum fuel mass for the MIT assembly is 514.25 grams of <sup>235</sup>U with an enrichment of 93.5 weight percent and one weight percent of U-234 (assumption 4.3.2). The amount of aluminum present in the U-Al<sub>x</sub> alloy is 30.5 weight percent.

The conservative values of the burnup for the MIT fuel were derived from Appendix A data provided by SRS (Ref. 5.4). The maximum burnup for the MIT fuel was less than 8100 MWD/MTU. The shortest total time in reactor (including down time) to accumulate this burnup is 2517 days. The reactor power level is 9.68 MW/MTU.

**Fuel Plates**

The flat plates are 2.552 (+0.000, -0.002) inches wide, and 23.000 inches long. All 15 plates are the same and have a finned cladding surface with a thickness of 0.080  $\pm$ 0.003 inches and a fin height of 0.010  $\pm$ 0.002 inches. The fuel alloy is 0.030 (+0.000, -0.002) inches thick, 2.177 (+0.000, -0.1875) inches wide, and 22.375  $\pm$ 0.375 inches long.

**Fuel Element**

The aluminum outer shroud which encloses 15 fuel plates on 4 sides is a 2.405 inch outside dimension rhomboid with a 0.044 inch thick wall parallel with the fuel plates and a 0.188 inch thick comb plate at 60° to the fuel plates, and a nominal length (after cutting) of 23.368 inches. The fuel plates are centered within this rhomboid angled 60 degrees off the comb plate. The plates are fixed relative to each other by comb plates along two sides and the lip of the end fittings across the top and bottom. Drawing R3F-1-4 (Ref. 5.4) shows a fuel plate center-to-center spacing of 0.158 inches, which is the spacing of the notches on the comb plates.

**4.1.2 Oak Ridge Research (ORR) SNF**

Details of the construction of the ORR fuel element are contained in drawings M-11495-OR-001 ("19 Plate Fuel Element Assay & Finish Machining", Ref. 5.4) (TBV), M-11495-OR-003 ("Misc. Details for ORR Fuel Element", Ref. 5.4) (TBV), and M-11495-OR-004 ("Fuel Plate Details", Ref. 5.4) (TBV). The element is constructed from 19 curved fuel plates which are held within a square aluminum box by two opposing aluminum comb plates. The ORR fuel length values used in these analyses are shorter than the original as-built length of the ORR assembly because the top and bottom ends of the assembly, which do not contain uranium materials, have been removed by cutting. The ORR fuel Appendix A (Ref. 5.4) contains the material information. The fuel plates consist of an aluminum cladding over an U-Si-Al fuel material. The maximum fuel mass for the ORR assembly is 347 grams of <sup>235</sup>U with an enrichment of 20.56 weight percent. The uranium present in the U-Si-Al alloy is 77.5 weight percent. There are 2 atoms of Si per 3 atoms of U, and Al fills out the bulk of the fuel material.

**Fuel Plates**

The curved plates are 2.770 minimum (2.775 maximum) inches wide with a 5.5 inch inner radius of curvature. Seventeen of the plates are inner plates, with a thickness of 0.0494 to 0.0510 inches total with a 0.0105 inch minimum aluminum cladding on both sides of a 0.020 inch nominal fuel foil, which is assumed to have a tolerance of 0.005 inches since this is the default tolerance for the drawing. Two of the plates are outer plates, with a thickness of 0.063 to 0.066 inches, with a 0.018 inch minimum cladding on both sides of a 0.020 inch nominal fuel foil. The inner and outer fuel plates are manufactured as flat laminated sheets with a minimum width of 2.7925 inches (2.7955 maximum) that are formed to the 5.5 inch radius of curvature. The fuel foil is not as wide as the

aluminum cladding, and an aluminum strip is used to close each side of the finished fuel plate. For the inner fuel plates, the width of the fuel foil allows a 0.126 to 0.200 inch inset from the edge of the plate on both sides. The overall length of the inner fuel plate is 24.620 to 24.630 inches and the fuel foil is centered within the plate longitudinally, with an inset at each end of 0.318 to 0.775 inches. For the outer fuel plates, the width of the fuel foil allows a 0.126 to 0.198 inch inset from the edge of the plate on both sides. The overall length of the outer fuel plate is 27.120 to 27.130 inches and the fuel foil is centered within the plate longitudinally, with an inset at each end of 1.574 to 2.011 inches. The top and bottom ends of the inner and outer fuel foils are chamfered, but this trimming of the fuel alloy will be neglected. The plates are fixed relative to each other by comb plates along two sides and by a comb strap across the top and bottom. Note that the upper and lower ends of each fuel plate (for a short length) are rolled slightly - this feature is neglected in the MCNP geometry model since the spacing of the plates is unaffected.

### **Fuel Element**

The aluminum comb plates enclose the 19 fuel plates on 2 sides fixing the fuel plates and creating an approximately 3.25 inch by 3.00 inch outside dimension rectangle, with a nominal length (after cutting) of 27.125 inches. The fuel plates are centered within this box, and form a square fuel/water region with a 3.169 inch reference dimension (the longitudinal comb plate width). Drawing M-11495-OR-003 ("Misc. Details for ORR Fuel Element") shows a fuel plate edge-to-edge spacing of 0.166 inches, which is the spacing of the notches on the comb plates.

#### **4.1.3 High Level Waste (HLW) Glass Pour Canisters**

The Savannah River glass pour canister is a cylindrical stainless steel Type 304L can with a 609 mm outer diameter, a 9.525 mm wall thickness (Ref. 5.7, p. 3.3-4) (TBV), and a nominal length of 3 m. The canister inside volume is 0.736 m<sup>3</sup> and the glass weight is 1682 kg (Ref. 5.7, p. 3.3-6). HLW glass (Ref. 5.7, p. 3.3-1) is poured into the canisters until 85% of the volume is filled. The nominal dimensions of the pour canister are used for these analyses.

The degraded HLW glass composition is taken from a separate geochemistry analysis (Ref. 5.18). The program output which includes this composition is included in Attachment I.

#### **4.1.4 Codisposal Canister**

The preliminary design (TBV) for the DOE-SNF canister is taken from reference 5.21. The canister is composed of stainless steel Type XM-19 forming a right circular cylinder which contains a stainless steel Type 316L basket. DOE-owned SNF is to be loaded into the basket. The dimensions for the DOE-SNF canister are a 439.3 mm outer diameter and a 15 mm wall thickness. The separator plates are 10 mm thick. End plates are 15 mm thick except for the top and bottom plates which are 5 mm thick. The DOE-SNF canister contains 16 MIT or 10 ORR fuel basket locations in four layers. Stainless steel/boron alloy is used to separate each layer from the adjacent layer within the canister.

In the MIT-SNF canister, stainless steel/boron alloy is also used in the basket between each assembly. The length of the canister is defined for this analysis as the length of four stacked fuel assemblies plus tolerances between-layer (axial) separator plates, the thicknesses of the axial separator plates, and the thicknesses of the top and bottom lids. The MIT-SNF canister is 2628 mm long and the ORR-SNF canister is 2901 mm long.

As a result of the difference in assembly size, uranium enrichment and uranium loading, the amount of U-235 per package is significantly different. The MIT-SNF canister with 64 fuel elements has a U-235 loading of 32.9 kg (35.2 kg of U). The ORR-SNF canister with 40 fuel elements has a U-235 loading of 13.9 kg (67.5 kg of U).

The composition of Type XM-19 stainless steel (Ref. 5.22) is shown in Table 4.1.4-1. The balance of the material is iron. Niobium and vanadium are neglected due to their insignificant chemical and neutronic contribution to the results.

Table 4.1.4-1. Type XM-19 Stainless Steel Composition

| Element    | Composition, Weight Percent |
|------------|-----------------------------|
| Carbon     | 0.06 Max                    |
| Manganese  | 4.00-6.00                   |
| Phosphorus | 0.040 Max                   |
| Sulfur     | 0.030 Max                   |
| Silicon    | 0.75 Max                    |
| Chromium   | 20.50-23.50                 |
| Nickel     | 11.50-13.50                 |
| Molybdenum | 1.50-3.00                   |
| Nitrogen   | 0.20-0.40                   |
| Copper     | 0.0                         |

#### 4.1.5 Five-HLW Waste Package

The HLW Five-Pack waste package (TBV) consists of a double-walled waste package which can accept five canisters in a pentagonal array. The central region of the pentagonal array is an empty space, which can accept the DOE-SNF canister, as shown in Figure 4.1.5-1. The figure represents



a probable horizontal configuration in the time frame that the waste packages would be penetrated and filled with water and the canisters are shifted to the bottom and supported on the walls of the waste package and/or other canisters. Dimensions for the HLW Five-Pack waste package are provided by the sketches available in reference 5.16. The materials of construction selected for the HLW waste package are: corrosion allowance barrier - ASTM A 516 Gr 55, corrosion resistant barrier - ASTM B 443 ("Alloy 625") (Ref. 5.12). The densities and isotopic contents of the A 516 Gr 55 are given in reference 5.11.

The composition of Alloy 625 (Ref. 5.23) is shown in Table 4.1.5-1. The density of Alloy 625 is 8.4425 g/cm<sup>3</sup> (Ref. 5.23, p. 1).

Table 4.1.5-1. Alloy 625 Composition

| Element            | Composition, Weight Percent |
|--------------------|-----------------------------|
| Carbon             | 0.1 Max                     |
| Manganese          | 0.5 Max                     |
| Phosphorus         | 0.015 Max                   |
| Sulfur             | 0.015 Max                   |
| Silicon            | 0.50 Max                    |
| Aluminum           | 0.40 Max                    |
| Titanium           | 0.40 Max                    |
| Chromium           | 20-23                       |
| Nickel             | 58 Min                      |
| Molybdenum         | 8-10                        |
| Niobium + Tantalum | 3.15-4.15                   |
| Iron               | 5.0 Max                     |
| Cobalt             | 1.0 Max                     |

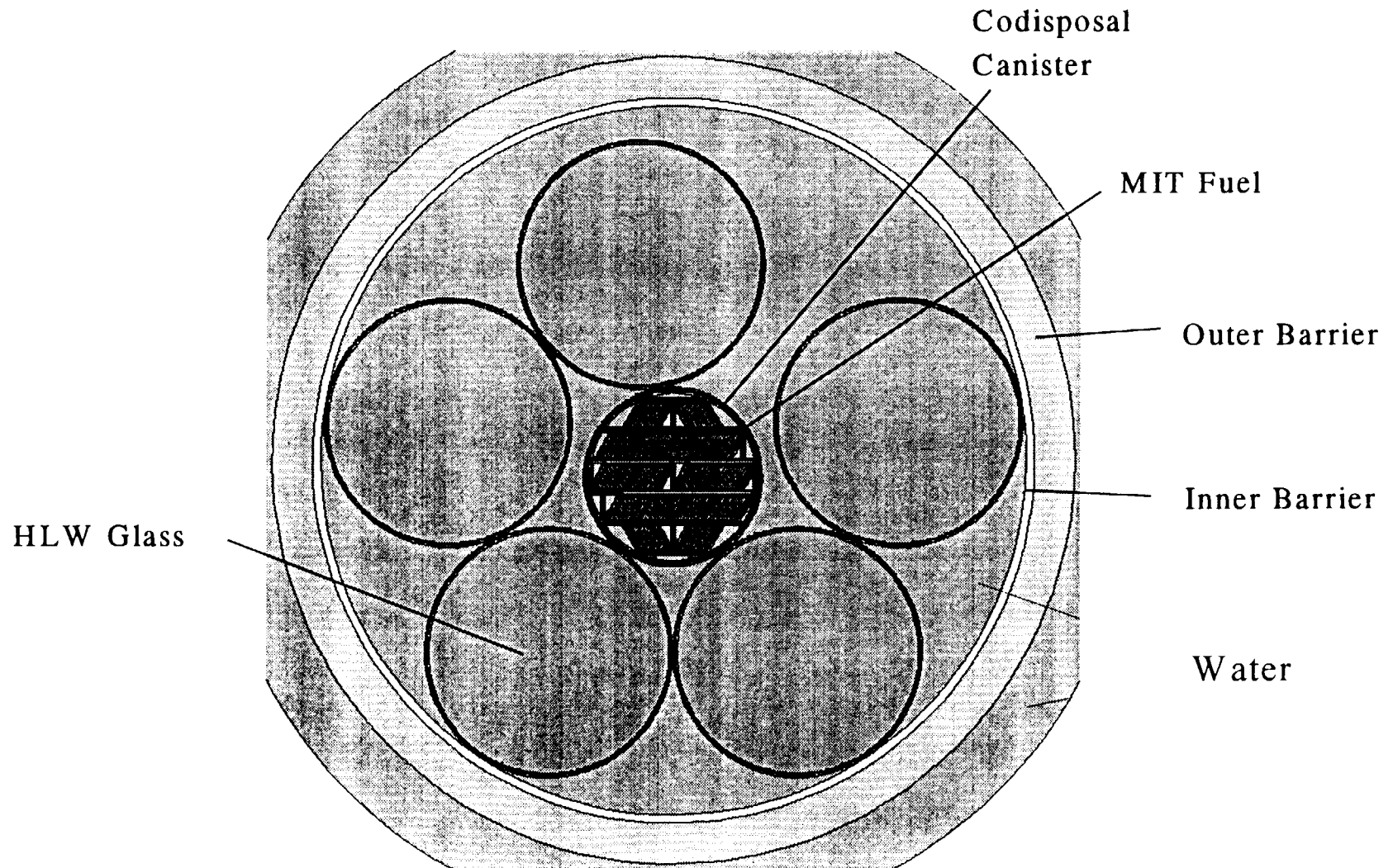


Figure 4.1.5-1. Five-ILW Waste Package with Codisposal Canister

## 4.2 Criteria

The *Engineered Barrier Design Requirements Document* (EBDRD; Ref. 5.5) contains several criteria which relate to criticality control. The "TBD" (to be determined) items identified in these criteria will not be carried to the conclusions of this analysis based on the rationale that the conclusions are for preliminary design, and will not be used as input to design documents supporting construction, fabrication, or procurement. A review of the EBDRD identified the following relevant requirements:

The EBDRD requirements 3.2.2.6 and 3.7.1.3.A both indicate that a WP criticality shall not be possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. These requirements also indicate that the design must provide for criticality safety under normal and accident conditions, and, that the calculated effective multiplication factor ( $k_{eff}$ ) must be sufficiently below unity to show at least a five percent margin after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the methods of calculation. The latter requirement contains a "TBD" at the end.

Controlled Design Assumptions document (CDA) assumption EBDRD 3.7.1.3.A (Ref. 5.6, p. 4-32) clarifies that the above requirement is applicable to only the preclosure phase of the MGDS, in accordance with the current DOE position on postclosure criticality. This assumption also indicates that for postclosure, the probability and consequences of a criticality provide reasonable assurance that the performance objective of 10CFR60.112 is met. While the Nuclear Regulatory Commission (NRC) has not yet endorsed any specific change for postclosure, they have indicated that they agree that one is necessary.

This analysis contributes to satisfying the above requirements by providing  $k_{eff}$  of degraded configurations of MIT and ORR fuel. This analysis provides information which will be used in probabilistic analyses of postclosure criticality as part of Total System Performance Assessment (TSPA)-Viability Assessment (VA) to demonstrate compliance with the performance objective of §60.112 (or, as appropriate, other applicable performance objectives in effect or proposed by the NRC at the time the TSPA-VA analysis is performed). The analysis also provides information on any potential design changes needed to allow the  $k_{eff}$  of various degraded configurations to also meet the 5% margin after allowance for bias and uncertainty.

### 4.3 Assumptions

- 4.3.1 It is assumed that all fuel is fresh and unburned for criticality analyses; i.e., there is no credit for burnup (the portion of CDA Key 079 relating to use of burnup credit does not apply to this analysis). The basis for this assumption is that it is conservative, because fresh fuel is more neutronically reactive than spent fuel. Additionally, the benefit would not be that significant as the burnup of the fuel is low compared to its enrichment, and the burnup records are unverified. This assumption is used throughout Section 7.
- 4.3.2 It is assumed that the MIT fuel contains one weight percent U-234. The basis for this assumption is comparison to published information on other research reactor fuel of similar enrichment (Ref. 5.10, p. 6). This assumption is used in Section 4.1.1.
- 4.3.3 No credit is taken for any boron neutron absorber contained in borated stainless steel in severely degraded cases. The basis for this assumption is that the boride particles contained in the borated stainless steel may corrode and dissolve following degradation of the stainless steel, since they have a large surface-to-volume ratio (average particle surface area of  $\approx 30 \mu\text{m}^2$ ; Ref. 5.27) and preliminary research indicates that they have corrosion rates similar to that of the stainless steel matrix (Ref. 5.26, p. VII-22). If the borides dissolve, they are likely to be transported out of the waste package as water flows out. This assumption is used throughout Section 7.
- 4.3.4 The Savannah River pour canister is assumed to be representative for HLW canisters. Reference 5.7 specifies the geometry and materials of construction. The basis for this assumption is that the specified reference is the best information available concerning the pour canister design. This assumption is used throughout Section 7.
- 4.3.5 CDA assumption EBD RD 3.7.1.3.A has been used to replace TBVs in requirements applicable to this document. Furthermore, the bases for these assumptions are given in the CDA (Ref. 5.6). These assumptions are used in Section 4.2.
- 4.3.6 The initial degraded form of the MIT fuel is assumed to be  $\text{UO}_2$  and  $\text{Al}_2\text{O}_3$  mixtures. The basis for this assumption is that oxides are the conservative form of degradation products since they can hydrate. This assumption is used throughout Section 7.
- 4.3.7 The initial degraded form of the ORR fuel is assumed to be soddyite  $\{(\text{UO}_2)_2(\text{SiO}_4):2\text{H}_2\text{O}\}$  and the aluminum will be incorporated into clay minerals. The basis for this assumption is that these forms are the most thermodynamically stable under the conditions in the degrading waste package and the conversion of U and Al oxides to these forms was found to be limited primarily by the available Si (Ref. 5.18). This assumption is used throughout Section 7.

- 4.3.8 It is assumed that only 50% of the iron oxides from corrosion of the stainless steel will contribute to moderator displacement in the degraded fuel. The other components in stainless steel are not accounted for. The basis for this assumption is that stainless steel typically undergoes localized attack (pitting, crevice corrosion, stress corrosion cracking, etc.) (Ref. 5.20, p. 362) that is likely to leave some small pieces of uncorroded material which are free to settle to the bottom of the canister and not become uniformly mixed with the degraded fuel. This assumption is used throughout Section 7.
- 4.3.9 It is assumed that all degraded configurations considered credible in the geochemistry and degradation mode analysis (Ref. 5.18) will require criticality analysis even if they require more than 10,000 years to develop. The basis for this assumption is CDA Key 039 (Ref. 5.6) which indicates that the time period over which criticality control must be maintained is not defined, but is expected to be greater than 10,000 years. This assumption is used throughout Section 7.
- 4.3.10 It is assumed that various amounts of mixing of HLW clayey material and degraded DOE-SNF, and various degrees of hydration (i.e., water fraction) of the resulting mixtures, are possible up to the point that the available volume is filled (DOE-SNF canister or entire WP depending on the configuration being evaluated). The basis for this assumption is that there is a great deal of uncertainty in these parameters, and therefore, it is conservative to evaluate the entire range to find the set of parameters which produce the peak  $k_{\text{eff}}$  for a given configuration.

#### 4.4 Codes and Standards

Not Applicable. Neutronic design of the waste package is not controlled by codes and standards.

#### 5. References

- 5.1 *Classification of the Preliminary MGDS Repository Design*, Document Identifier (DI) Number: B00000000-01717-0200-00134 REV 00, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O).
- 5.2 *QAP-2-0 Activity Evaluations*, ID No. WP-30, Perform Criticality, Thermal, Structural, and Shielding Analyses as Required for DOE Spent Fuel Characterization, Dated 8/3/97, CRWMS M&O.
- 5.3 *Quality Assurance Requirements and Description*, DOE/RW-0333P REV 7, U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM).
- 5.4 *Data Package from Savannah River Criticality Analysis of MIT and ORR SNF*, (includes

**Title:** Disposal Criticality Analysis for Aluminum Based Fuel in a Codisposal Waste Package - ORR and MIT SNF - Phase II

**Document Identifier:** BBA000000-01717-0200-00060 REV 00

**Page 14 of 51**

- WSRC-TR-95-0302 Appendix A data sheets 59 and 217 for MIT and ORR fuel, as well as drawings R3F-3-2, R3F-1-4, M-11495-OR-001, 003, and 004), Records Batch # MOY-970605-02, CRWMS M&O.
- 5.5 *Engineered Barrier Design Requirements Document*, YMP/CM-0024, REV 0, ICN 1, Yucca Mountain Site Characterization Project.
  - 5.6 *Controlled Design Assumptions Document*, D) Number: B00000000-01717-4600-00032 REV 04, ICN 03, CRWMS M&O.
  - 5.7 *Characteristics of Potential Repository Wastes*, DOE/RW-0184-R1; Volume 1, U.S. DOE OCRWM.
  - 5.8 *Software Qualification Report for MCNP4A*, CSCI: 30006 V4A, DI Number: 30006-2003 REV 02, CRWMS M&O.
  - 5.9 *10 CFR Part 60; Disposal of High-Level Radioactive Wastes in Geologic Repositories; Design Basis Events; Final Rule*, U.S. Nuclear Regulatory Commission, Federal Register, Volume 61, Number 234, pp. 64257-64270, December 4, 1996.
  - 5.10 *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, NEA/NSC/DOC(95)03/I, Volume II.b, HEU-SOL-THERM-001, Nuclear Energy Agency, Organization for Economic Co-operation and Development, November 4, 1996 update.
  - 5.11 *Material Compositions and Number Densities For Neutronics Calculations*, DI Number: BBA000000-01717-0200-00002 REV 00, CRWMS M&O.
  - 5.12 *Waste Package Materials Selection Analysis*, DI Number: BBA000000-01717-0200-00020 REV 00, CRWMS M&O.
  - 5.13 Weiss, N. L., ed., *SME Mineral Processing Handbook*, Volume I, Society of Mining Engineers, American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, 1985.
  - 5.14 *Summary of Information Exchange*, Interoffice Correspondence from Peter Gottlieb to File, LV.WP.PG.08/97-172, CRWMS M&O.
  - 5.15 *Handbook of Chemistry and Physics*, 66th Edition, CRC Press, 1985.
  - 5.16 *Criticality Safety and Shielding Evaluations of the Codisposal Canister in the Five-Pack DHLW Waste Package*, DI Number: BBA000000-01717-0200-00052 REV 01, CRWMS M&O.

Title: Disposal Criticality Analysis for Aluminum Based Fuel in a Codisposal Waste Package - ORR and MIT SNF - Phase II

Document Identifier: BBA000000-01717-0200-00060 REV 00

Page 15 of 51

- 5.17 *MCNP Evaluations of Laboratory Critical Experiments: Homogeneous Mixture Criticals*, DI Number: BBA000000-01717-0200-00045 REV 00, CRWMS M&O.
- 5.18 *Geochemical Analysis of Degradation Modes of HEU SNF in a Codisposal Waste Package with HLW Canisters*, DI Number: BBA000000-01717-0200-00059 REV 00, CRWMS M&O.
- 5.19 *Nuclear Criticality Safety Guide*, LA12808, Los Alamos National Laboratory.
- 5.20 Sedriks, A. John, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., 1996.
- 5.21 *Evaluation of Codisposal Viability for Aluminum-Clad DOE-Owned Spent Fuel: Phase I, Intact Codisposal Canister*, DI Number: BBA000000-01717-5705-00011 REV 01, CRWMS M&O.
- 5.22 *Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels*, ASTM A240/A240M - 95a, American Society for Testing and Materials, West Conshohoken, PA.
- 5.23 *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip*, ASTM B443-93<sup>e1</sup>, American Society for Testing and Materials, Philadelphia, PA.
- 5.24 Lamarsh, John R., *Introduction to Nuclear Engineering*, Addison Wesley Publishing Company, Reading, MA, 1983.
- 5.25 *Standard Mathematical Tables*, CRC Press, Cleveland, OH, 1974.
- 5.26 *Criticality Abstraction/Testing Workshop Results*, DI Number: B00000000-01717-2200-00187 REV 00, CRWMS M&O.
- 5.27 Stephens, J. J., Sorenson, K. B., McConnell, P., *Elevated Temperature Tensile Properties of Borated 304 Stainless Steel: Effect of Boride Dispersion on Strength and Ductility*, white paper, Sandia National Laboratories, performed under DOE contract DE-AC04-76DP00789.
- 5.28 Benedict, M., Pigford, T.H., and Levi, H.W., *Nuclear Chemical Engineering*, McGraw-Hill Book Company, New York, 1981.
- 5.29 *UCF WP Static Loads, Thermal Expansion Loads, and Internal Pressure Analysis*, DI Number: BBAAA0000-01717-0200-00001 REV 00, CRWMS M&O.
- 5.30 *Electronic Attachments for: BBA000000-01717-0200-00060 REV 00, Disposal Criticality Analysis for Aluminum Based Fuel in a Codisposal Waste Package - ORR and MIT SNF -*

*Phase II, Colorado BackupTape, RPC Batch Number MOY-971215-06, CRWMS M&O.*

## **6. Use of Computer Software**

The calculation of nuclear reactivity of degraded configurations was performed with the MCNP4A computer code, CSCI: 30006 V4A. MCNP4A calculates  $k_{\text{eff}}$  for a variety of geometric configurations with neutron cross sections for elements and isotopes described in the Evaluated Nuclear Data File version B-V (ENDF-B/V). MCNP4A is appropriate for the fuel geometries and materials required for these analyses. The calculations using the MCNP4A software were executed on a Hewlett-Packard 9000 Series 735 workstation. The software qualification of the MCNP4A software, including problems related to calculation of  $k_{\text{eff}}$  for fissile systems, is summarized in the Software Qualification Report for the Monte Carlo N-Particle code (Ref. 5.8). The MCNP4A evaluations performed for this design are fully within the range of the validation for the MCNP4A software used. Access to and use of the MCNP4A software for this analysis was granted by Software Configuration Management and performed in accordance with the QAP-SI series procedures. Inputs and outputs for the MCNP4A software are included as attachments as described in the following design analysis.

The computation of number densities of intact and degraded states and the heights of the cylinder segments of degraded material were performed with Microsoft Excel 97 spreadsheets (considered "Software Routines" under the QAP-SI series procedures). Microsoft Excel 97 was executed on an IBM PC compatible personal computer. Each spreadsheet is described in Section 7.2. Initial equations used in these spreadsheets are checked by hand and the copies are visually inspected for correctness. The number density equations are appropriate for all elements and isotopes. Cylinder segment calculations are appropriate for any cylinder. The spreadsheet files are located in the attached tape, and are indicated in Section 9 with an "xls" extension. The purpose of each spreadsheet along with major equations is provided in Section 7.2. Definitions and other data manipulations are provided in the spreadsheets.



## 7. Design Analysis

### 7.1 Background

As part of an engineered barrier system for the containment of radionuclides, the codisposal waste package containing degraded waste forms must not exceed  $k_{\text{eff}}$  of 0.95 after allowance for bias and uncertainty in the method of calculation (see Section 4.2). Development of detailed degradation scenarios for the codisposal DOE-SNF canister, the HLW glass, and the codisposal waste package is discussed in a separate analysis (Ref. 5.18). A summary is provided here to explain the models developed for this analysis. The likely sequence of degradation would be as indicated below:

Corrosion of WP Barriers

Corrosion of Stainless Steel Containers

Degradation of HLW Glass to Clayey Material

Degradation of DOE Al-based Fuel Concurrent with or after HLW Glass

Degradation of SNF Canister Basket Materials including Criticality Control Material

The HLW canisters would likely be breached long before the DOE-SNF canister (>50% thicker) which hasn't been thermally stressed like the HLW pour canister. In the unlikely event that the DOE-SNF canister is breached first, the resulting configurations within the canister will be the same as those for a breach after the HLW canisters, with the exception of the reflector conditions within the waste package.

The MIT and ORR fuel would be expected to degrade through oxidation within a few decades of breach of the DOE-SNF canister. If the DOE-SNF canister is penetrated while the HLW glass is degrading, the chemistry of the mixture (primarily pH > 10.0) will be such that most of the uranium will dissolve. The uranium concentration could be as high as 10 g/liter but over 2 g/liter of boron would be present from the degradation of the HLW glass. The minimum critical concentration of high enriched uranium (HEU) is 11.6 g/liter (Ref. 5.19, p. 38) under ideal conditions; therefore, this solution would not be a criticality concern inside the waste package.

If the DOE-SNF canister is penetrated after the HLW glass is degraded, then the fuel would remain in the canister or waste package in one of 3 configurations based on level of degradation of the other components and the location of the canister as it degrades: 1) degraded (oxidized) homogenized fuel material in intact or degraded basket in the DOE-SNF canister; 2) layer of hydrated aluminum, uranium, and iron oxides from the degraded DOE-SNF canister above the degraded HLW glass in the waste package; or 3) degraded products from the fuel mixed with various fractions of the degraded HLW glass in the waste package. The volume fraction of water in the degraded HLW and

SNF is variable as is the mass of iron oxide from the degraded canisters and basket. The boride particles contained in the borated stainless steel may corrode and dissolve following degradation of the stainless steel, since they have a large surface-to-volume ratio (average particle surface area of  $\approx 30 \mu\text{m}^2$ ; Ref. 5.27) and preliminary research indicates that they have corrosion rates similar to that of the stainless steel matrix (Ref. 5.26, p. VII-22). Therefore, credit will only be taken for the boron in the integrated borated stainless, since the boron from the degraded stainless steel may be carried away in solution. A significant fraction of relatively insoluble absorbers such as Gd will remain with the degradation products from the fuel. The amounts of Gd required to prevent criticality are determined in the following analysis

Uranium and aluminum oxides in water have been observed to form hydrates with a gel-like appearance and an effective solid density of as low as 10% (Ref. 5.13, p. 9-13). Both flocculent and gel-like forms of aluminum have been observed in association with test coupons at SRS (Ref. 5.14). The rate of formation of these hydrated oxides has not been quantified and is not well understood. Because of this limitation, the Al-based fuel forms will conservatively be assumed to initially degrade to a mix of hydrated Al and U oxides in water within the limits of the available volume as a bounding condition. The U oxides will likely be converted to soddyite  $\{(\text{UO}_2)_2(\text{SiO}_4) \cdot 2\text{H}_2\text{O}\}$  and the aluminum will be incorporated into clay minerals with time (Ref. 5.18). The ORR U-Si-Al fuel form will likely be converted directly to soddyite and the aluminum will be incorporated into clay minerals.

## 7.2 Criticality Models

Material volumes and densities used to generate the number densities for the constituents of the MCNP4A models are provided for degraded MIT SNF in Attachment II, for degraded ORR SNF in Attachment III, and for other materials in Reference 5.11. The values for various degraded MIT fuel configurations are incorporated into spreadsheets named mitclay-2.xls, mithomo.xls, homogen.xls, fe-gd.xls, inverse.xls and sl15.xls. The mitclay-2.xls spreadsheet calculates the HLW clayey material atomic density using the masses and volumes of the chemical forms determined by the EQ3/6 mass balance code in a separate analysis (Ref. 5.18). The mithomo.xls spreadsheet calculates the number densities for the homogeneous mixture scenario inside the DOE-SNF canister. Number density and cylinder segment calculations for the settled cases in the DOE-SNF canister are provided in the Excel spreadsheet "mitcol.xls". The fe\_gd.xls spreadsheet calculates the atomic densities and geometries for the scenario of the degraded MIT fuel layer on top of the HLW clayey material. The inverse.xls spreadsheet calculates the atomic densities and geometries for the scenario of the degraded MIT fuel at the bottom. The sl15.xls spreadsheet calculates the atomic densities and geometries for the scenario of the degraded MIT fuel layer on top of the HLW clayey material with 15% of HLW mixed with MIT fuel. The homogen.xls spreadsheet calculates the atomic number for the homogeneous mixture scenario inside the waste package. The number density and material volume calculations for the ORR cases were performed in several worksheets within the spreadsheet file orrphaz2.xlw. The "Incan" worksheet contains volumes and number densities for the homogenous mixture scenario inside the DOE-SNF. The "ORRontop" worksheet contains volume and number density calculations

for the scenario of the degraded ORR fuel layer on top of the HLW clayey material. The "ORRbot" worksheet contains volume and number density calculations for mixtures of clay and degraded ORR fuel at the bottom of the waste package. The geometries of the MCNP4A models are described below. In all cases, the WP is modeled as lying on a flat surface. While it is expected that the carbon steel supports would have failed long before the time frame considered in this analysis, at least two of the concrete piers (maximum 1.5 m spacing per Ref. 5.29), and the crushed tuff or other media placed between the piers would likely still provide a relatively flat surface for the WP. Even if the WP were inclined at a small angle due to the presence of some rubble under the WP, this would not significantly affect the  $k_{\text{eff}}$  of the geometries evaluated.

Number densities for compounds, elements, or isotopes are routinely calculated in the spreadsheets listed above. The equation for number density is shown below (Ref. 5.24, p. 34).

$$N = (m/V) * N_A / M$$

where  $m$  is mass in grams

$V$  is volume

$N_A$  is Avogadro's Number ( 0.602252E+24 atoms/mole, Ref. 5.28, p. 933)

$M$  is the gram atomic weight (Sum for Compound)

The volume of a cylinder segment is also routinely calculated in the spreadsheets. The equation for the volume of a cylinder segment is shown below (Ref. 5.25, p. 11).

$$\text{Cylinder Segment Volume} = L \{ R^2 \text{Cos}^{-1}(R-h / R) - (R-h)(2Rh-h^2)^{1/2} \}$$

where  $L$  is the cylinder length

$R$  is the cylinder radius

$h$  is the height of the segment

The waste package outer structural wall was modeled as 10 cm thick A516 carbon steel and the inner structural wall as 2 cm thick Alloy 625. Also, 15 cm of water surrounding the waste package is modeled in order to provide a conservative boundary condition for criticality calculations (15 cm of water is effectively an infinite thickness). This boundary condition is for criticality calculations only and does not imply a flooded drift.

An allowance for calculational bias and experimental uncertainties in benchmark calculations must be made per the requirements listed in Section 4.2. Forty seven benchmark calculations representative for intact MIT and ORR research reactor fuel were run (Ref. 5.16) based on reviewed experiments (Ref. 5.10). The sum of bias and uncertainty is less than 0.02 in  $k_{\text{eff}}$  for all cases. One hundred nineteen HEU nitrate solution experiments in various configurations including no reflection, water (polyethylene) reflection, concrete reflection, boron absorber, gadolinium absorber, aluminum containers, stainless steel containers, single units, and arrays were run (Ref. 5.17). The average  $k_{\text{eff}}$

for these cases minus the average statistical uncertainty is over 1.0 although the values for a few cases fall below 1.0. The worst experimental uncertainty is 1.5% and is for a set utilizing gadolinium. The bias and uncertainty value was conservatively rounded up to 0.02  $k_{\text{eff}}$  for all homogeneous cases to account for geometry variations and material combinations not explicitly covered in the available criticality benchmark cases. Adding this to the 5% safety margin discussed in Section 4.2 yields a  $k_{\text{eff}}$  limit of 0.93 for the degraded DOE-SNF configurations.

Concentrations of  $^{235}\text{U}$  and absorbers are considered when evaluating whether benchmarks are similar to or bound the cases documented in this report. In addition, two spectrum indexes are used in evaluating whether benchmarks are similar to or bound the cases documented in this report in regards to the neutron spectrum. These two indexes are the  $\text{H}/^{235}\text{U}$  ratio and the average energy of the neutron causing fission (AENCF). The  $\text{H}/^{235}\text{U}$  ratio is simply the number density for hydrogen divided by that for  $^{235}\text{U}$  in the region containing  $^{235}\text{U}$ . The AENCF is the energy per source particle lost to fission divided by the weight per source neutron lost to fission from the “problem summary section” of an MCNP output. The  $\text{H}/^{235}\text{U}$  ratio and AENCF determined for cases documented in this report were compared to those values for benchmark cases (Ref. 5.17); the values for the benchmark cases were found to bound those for the cases in this report.

### **7.2.1 Homogeneous Mixture of Degraded DOE-SNF in DOE-SNF Canister**

This model consists of a DOE-SNF canister situated among 5 HLW canisters or against the inner barrier of the waste package surrounded by the degraded remnants of the HLW glass (clayey material). These models are shown in Figures 4.1.5-1 and 7.2.1-1. The degraded DOE-SNF is homogenized within a basket position or within the canister depending on the degree of degradation of the basket.

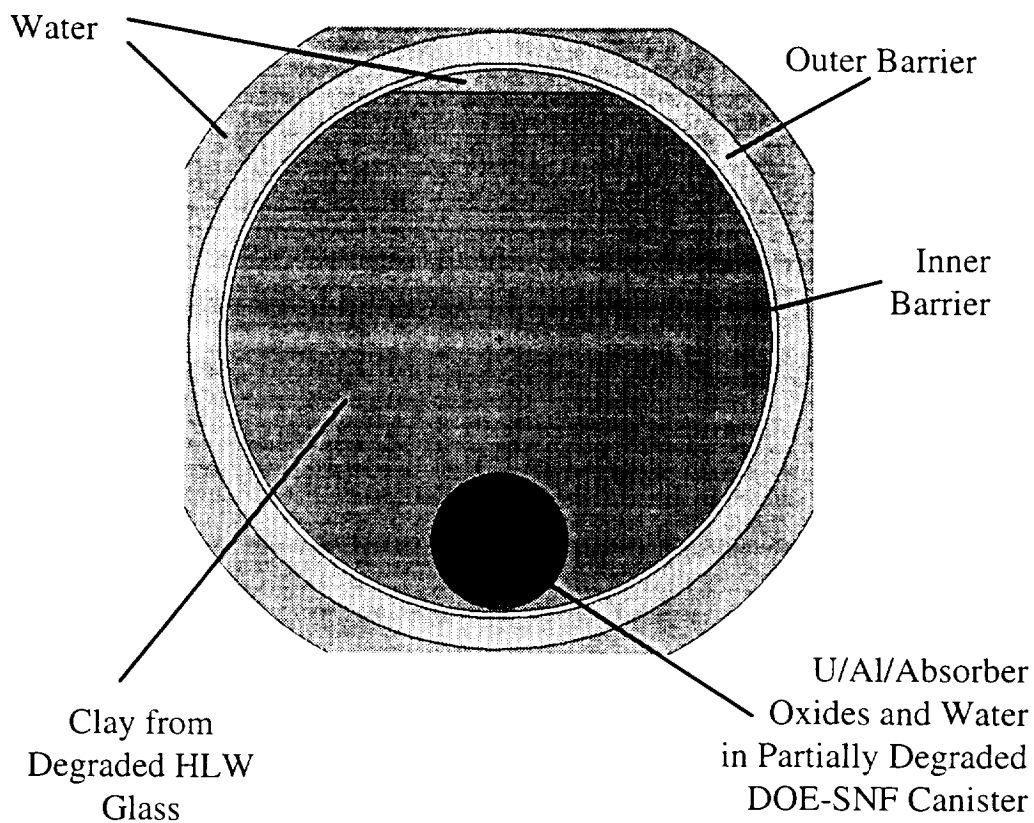


Figure 7.2.1-1. Homogeneous Mixture of Degraded DOE-SNF in DOE-SNF Canister

### 7.2.2 Degraded DOE SNF on Top of Degraded HLW

This model consists of a layer of hydrated oxides representing the degraded remnants of the DOE-SNF canister and contents above a volume of clayey material from the degradation of HLW glass. This model is shown in Figure 7.2.2-1. This configuration is based on the degradation of the DOE-SNF canister while resting on the surface of the clayey material. This configuration is judged unlikely, but was investigated in order for the most reactive configuration to be identified.

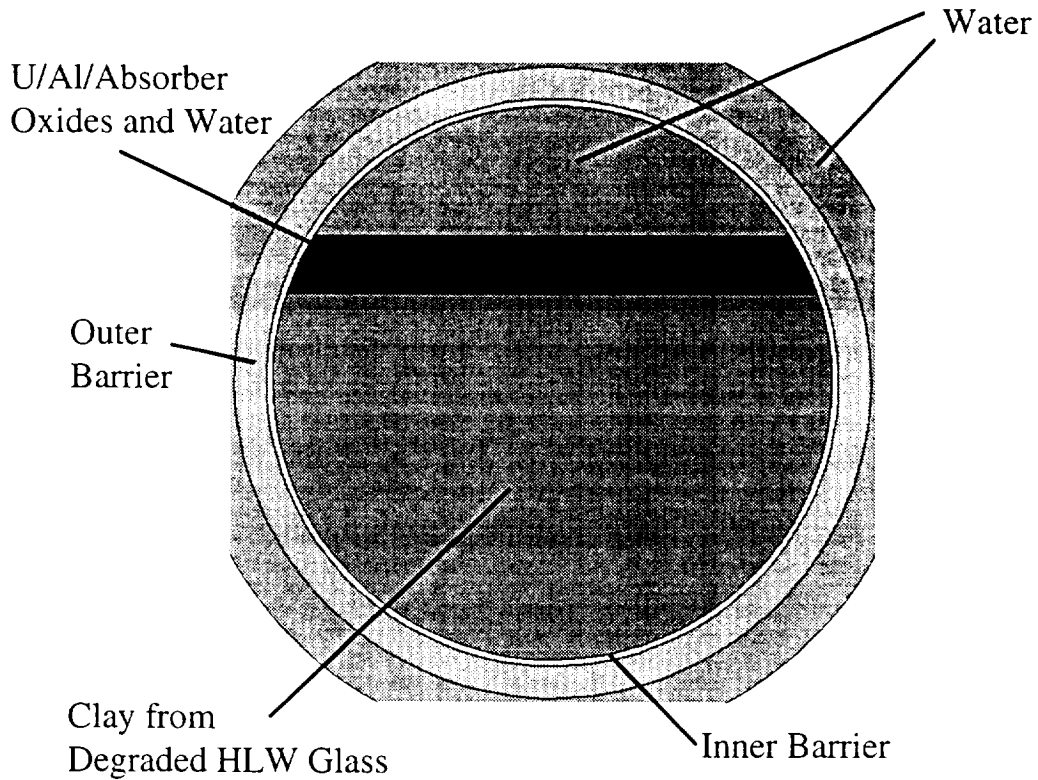


Figure 7.2.2-1. Degraded DOE-SNF on Top of Degraded HLW Glass Clay

**7.2.3 Degraded DOE SNF Mixed With Degraded HLW**

This model consists of various fractions of the HLW clayey material mixed with the degraded DOE-SNF accumulated starting in a layer below the unmixed fraction of HLW and proceeding until the DOE-SNF and all the HLW clayey material are homogeneously mixed. This configuration is shown in Figure 7.2.3-1. This configuration is based on the degradation of the DOE-SNF canister surrounded by the HLW clayey material.

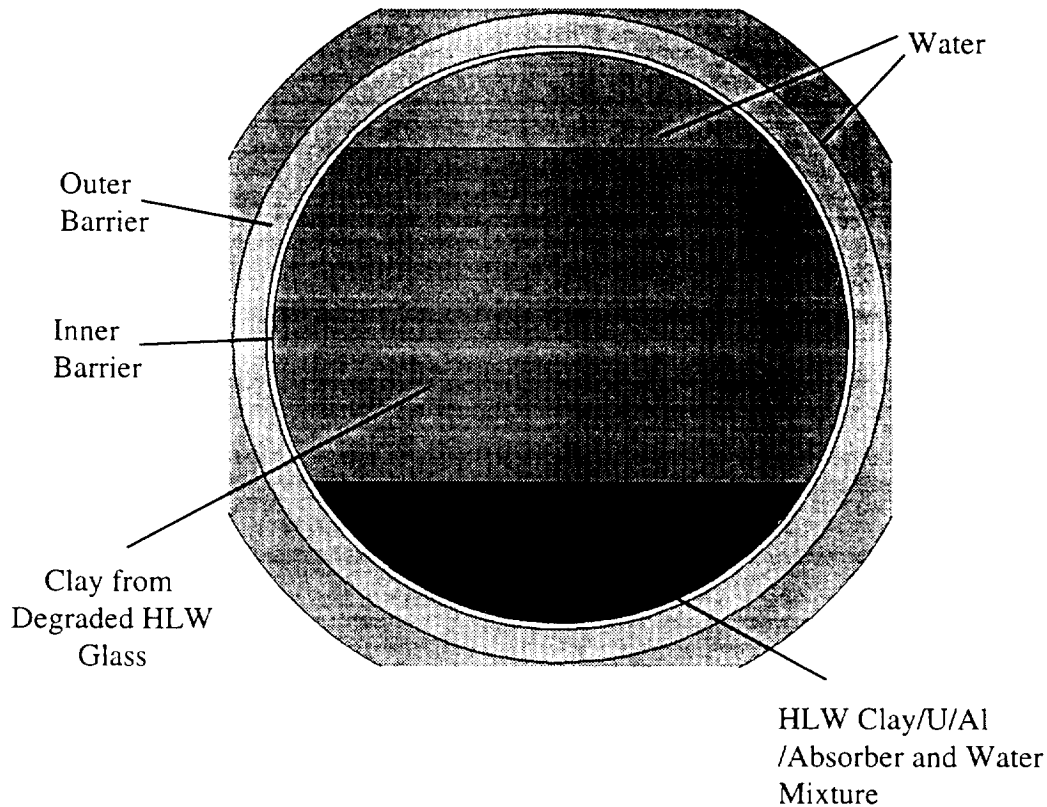


Figure 7.2.3-1. Degraded DOE-SNF Mixed with HLW Glass Clay at Bottom of WP

### 7.3 Criticality Results

Criticality calculations based on the waste package models described in Section 7.2 are presented in this section. The  $k_{\text{eff}}$  value and two sigma (approximate 95% confidence interval) are listed for each MCNP calculation. In addition, two spectrum indexes, namely the AENCF and  $H/^{235}\text{U}$ , are listed for each MCNP calculation.

The scenario development, geochemistry analysis, and configuration identification provide general guidance for the criticality analysis. The mass of material, but not its volume distribution or location, is identified. Parameters such as the amount of water mixed with solids, the density and volume of fissile or absorber material in clay, etc. are not fixed. The criticality analysis involves parametric analyses of several factors in addition to the general geometry configurations described in the previous section. These parameters include water content, U-235 volume distributions, absorber and  $\text{Fe}_2\text{O}_3$  distribution, material and reflector effects, and U-235 mass available.

### 7.3.1 Degraded MIT SNF Criticality

#### 7.3.1.1 Homogeneous MIT SNF Mixture inside DOE-SNF Canister

This scenario is based on the DOE-SNF canister degrading before or after the HLW canister. There are 2 configurations within the DOE-SNF canister for this scenario: 1) degraded MIT SNF in an intact basket, and 2) degraded MIT SNF and basket. The first configuration is modeled primarily among the HLW canisters. The degraded DOE-SNF canister in the second configuration is modeled at the bottom of the degraded HLW mass against the inner barrier of the waste package. Variations of the conditions outside the DOE-SNF canister are run to demonstrate conservatism. The basket is modeled at various stages of degradation and with stainless steel or carbon steel as the material of fabrication.

The first set of calculations is based on an intact basket where the boron in borated stainless steel only has been replaced by various amounts of Gd. The results are listed in Table 7.3.1.1-1. The configuration with degraded fuel filling the basket cells in an intact basket was identified as the most reactive configuration considered in the Phase I report (Ref. 5.16).

Table 7.3.1.1-1. Degraded MIT SNF in an Intact Stainless Steel Basket with Gd Absorber

| Case Name | Mass Gd (kg) | H/ <sup>235</sup> U | AENCF (MeV) | $k_{\text{eff}} \pm 2\sigma$ |
|-----------|--------------|---------------------|-------------|------------------------------|
| mitoz3g   | 0.25         | 113                 | 0.0210      | 0.9763 $\pm$ 0.0027          |
| mitoz4g   | 0.50         | 113                 | 0.0217      | 0.9458 $\pm$ 0.0032          |
| mitoz2g   | 0.75         | 113                 | 0.0220      | 0.9294 $\pm$ 0.0027          |
| mitoz5g   | 1.00         | 113                 | 0.0221      | 0.9195 $\pm$ 0.0030          |
| mitoz6g   | 1.50         | 113                 | 0.0231      | 0.9020 $\pm$ 0.0024          |

As indicated in Table 7.3.1.1-1, less than 1 kg of Gd is required in the intact basket where it is least effective (self-shielded). This DOE-SNF canister configuration was rerun with the canister positioned at the bottom of the degraded HLW mass against the inner barrier of the waste package to demonstrate reflector effects. The result is a  $k_{\text{eff}}$  of  $0.9187 \pm 0.0028$  (m5ghom) which statistically is the same result as that for the configuration among the HLW canisters (mitoz5g).

A case with intact MIT SNF and basket corresponding to case mitbz3 in the Phase I criticality report (Ref. 5.16) was run with 1.00 kg of Gd rather than B in the absorber plates to demonstrate the significant subcritical margin for intact fuel. The result is a  $k_{\text{eff}}$  of  $0.8148 \pm 0.0034$  (mitbzg1). The case with borated stainless steel (mitbz3, Ref. 5.16) has a value of  $k_{\text{eff}}$  of  $0.8101 \pm 0.0029$ .



In order to demonstrate the effects of replacing stainless steel with carbon steel, four cases were run as listed in Table 7.3.1.1-2. Note that  $k_{\text{eff}}$  increases only slightly for these cases indicating that carbon steel would be an acceptable alternative to stainless steel from a neutronics perspective.

Table 7.3.1.1-2. Check Cases - Carbon Steel Substitution for Stainless Steel in an Intact Basket

| Case Name | Case Descriptions  | H/ <sup>235</sup> U | AENCF (MeV) | $k_{\text{eff}} \pm 2\sigma$ |
|-----------|--|---------------------|-------------|------------------------------|
| mitoz8g   | A516 Absorber Plates, 1.5 kg Gd                          | 113                 | 0.0226      | 0.9062 $\pm$ 0.0031          |
| mitoz9g   | A516 replacing all stainless steel in basket, 1.5 kg Gd  | 113                 | 0.0230      | 0.9126 $\pm$ 0.0029          |
| mitozyg   | A516 replacing all stainless steel in basket, 1.25 kg Gd | 113                 | 0.0226      | 0.9216 $\pm$ 0.0029          |
| mitozxg   | A516 replacing all stainless steel in basket, 1.0 kg Gd  | 113                 | 0.0219      | 0.9317 $\pm$ 0.0032          |

The focus of the calculations in the remaining subsections of Section 7.3.1 will be to determine how much Gd is required to remain homogeneously mixed with the degraded fuel in order to prevent criticality in the configurations attained after the basket degrades.

The second set of calculations is based on a degraded basket configuration where the MIT SNF is homogenized into the canister volume with various amounts of iron oxide (from the basket) and Gd. The homogenized number densities are calculated in the mithomo.xls spreadsheet. The canister wall is modeled as being thinned down to 0.5 cm thick from the initial thickness of 1.5 cm to represent a severely degraded state. The HLW clayey material is modeled with 25% free water fraction which nearly fills the waste package. The results for the degraded basket cases are provided in Table 7.3.1.1-3. 590.51 kg of iron oxide corresponds to the mass of iron oxide produced from the complete oxidation of the stainless steel basket structure in the baseline design. As discussed in Section 7.1, stainless steel would likely degrade to a mix of stainless steel pieces and iron oxide, with the ratio of pieces to oxide decreasing with time. The basket would likely collapse long before all of the iron had oxidized to provide moderator displacement. As stated in Assumption 4.3.8, a maximum of half of the iron in stainless steel (295 kg Fe<sub>2</sub>O<sub>3</sub>) will be accounted for in a severely degraded configuration because of this potential segregation mechanism. If carbon steel were used for basket fabrication then essentially all of the iron could be accounted for because it experiences general corrosion as discussed in Section 7.1. In addition, approximately 30% more iron would be available in the same volume of basket material. Therefore, for severely degraded configurations, carbon steel

(uncoated, or zinc, nickel, or chromium plated) offers advantages over stainless steel. Note that with no credit for iron, approximately 0.5 kg of Gd is required to remain mixed with the degraded fuel in the canister. With half the iron as oxide, 0.25 kg of Gd is sufficient and with all the iron as oxide accounted for, only about 0.11 kg of Gd must remain. If carbon steel is used for the basket material (767.66 kg Fe<sub>2</sub>O<sub>3</sub>), almost all of the Gd could be removed.

Table 7.3.1.1-3. Degraded MIT SNF Homogenized with Iron Oxide and Gd

| Case Name | Mass Fe Oxide (kg) | Mass Gd (kg) | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|--------------------|--------------|---------------------|-------------|-----------------------|
| mithomi   | 767.66             | 0.00         | 103                 | 0.0172      | 0.9307 ± 0.0019       |
| mithomf   | 590.51             | 0.10         | 145                 | 0.0159      | 0.9395 ± 0.0020       |
| mithomg   | 590.51             | 0.12         | 145                 | 0.0159      | 0.9178 ± 0.0020       |
| mithom1   | 295.25             | 0.00         | 190                 | 0.0116      | 1.2265 ± 0.0024       |
| mithomh   | 295.25             | 0.15         | 190                 | 0.0141      | 0.9933 ± 0.0022       |
| mithom4   | 295.25             | 0.25         | 190                 | 0.0157      | 0.8964 ± 0.0022       |
| mithom3   | 295.25             | 0.50         | 190                 | 0.0190      | 0.7379 ± 0.0020       |
| mithom2   | 295.25             | 1.00         | 190                 | 0.0236      | 0.5791 ± 0.0014       |
| mithom5   | 0.0                | 0.0          | 235                 | 0.0090      | 1.4689 ± 0.0025       |
| mithom6   | 0.0                | 0.25         | 235                 | 0.0137      | 1.0043 ± 0.0022       |
| mithom0   | 0.0                | 0.50         | 235                 | 0.0164      | 0.7942 ± 0.0027       |

Three check cases to demonstrate that the homogeneous model is conservative were run as listed in Table 7.3.1.1-4. These cases correspond to case mithom4 in Table 7.3.1.1-3 with the modifications indicated. Note that all three cases are equivalent to (within 95% confidence interval) or are less reactive than the base model.

Table 7.3.1.1-4. Check Cases - Degraded MIT SNF Homogenized with Iron Oxide and Gd

| Case Name | Case Descriptions  | H/ <sup>235</sup> U | AENCF<br>(MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|--|---------------------|----------------|-----------------------|
| mithom7   | 1 cm thick degraded canister shell                             | 190                 | 0.0157         | 0.8982 $\pm$ 0.0024   |
| mithom8   | 80% Fill of the Canister - Total mass of components maintained | 132                 | 0.0198         | 0.8825 $\pm$ 0.0025   |
| mithom9   | DOE-SNF Canister Centered in Waste Package                     | 190                 | 0.0158         | 0.8948 $\pm$ 0.0023   |

Finally, cases were run to demonstrate that scenarios involving extreme settling of most of the degraded fuel and some portion of the integrated to the bottom of the WP are bounded by the homogeneous distribution previously evaluated. The most severe case of settling which might be possible is for a DOE-SNF canister with a carbon steel basket (see Ref. 5.18, Table 7.4-2). In this case, a maximum of 78% of the degraded fuel (U and Al oxides) and a minimum of 14% of the integrated basket (with Gd) may collect in a layer at the bottom of the canister, with the degradation products of the remaining portions of the basket and fuel in an upper layer. To evaluate this configuration, two cases were run with 10% and 30% bottom layer water fractions, respectively, with no credit for Gd. In these cases, the bottom layer consists only of U and Al oxides, Fe from the integrated basket, and water. Water fractions above 30% are not considered because the bottom layer would begin to occupy a significant portion of the canister, and thus would be expected to contain some of the oxides from the basket degradation as well. The results for these cases in the first two rows of Table 7.3.1.1-5 demonstrate that the various possible settled configurations are all well below 0.93, even without considering the effect of the Gd trapped in the integrated portions of the basket. They also show that  $k_{eff}$  is lowered with further settling. To evaluate the more realistic effect of having some of the basket oxides in the bottom layer, a final case was run. In this case, the height of the bottom layer was fixed at 12.5 cm (25% of the canister volume). The bottom layer consisted of a homogenous mixture of which,  $\approx$ 68 vol% was the 78% degraded fuel/14% integrated basket mixture, and the remaining  $\approx$ 32 vol% was the same composition water/oxide mixture as the top layer. The composition of the water/oxide mixture was determined by adding sufficient water to the remaining 22% degraded fuel/86% basket oxide mixture such that its volume would be equal to that of the codisposal canister internal volume minus the volume occupied by the 78% degraded fuel/14% basket mixture. The resulting mixture was  $\approx$ 46 vol% water and 54 vol% oxides. As expected, the results indicate that the presence of the basket degradation products further reduces  $k_{eff}$  in the settled configuration.

Table 7.3.1.1-5. Degraded MIT SNF and Integrated Basket Pieces Homogenized and Settled to Bottom of DOE-SNF Canister

| Case Name | Bottom Layer Water Fraction | Height of Bottom Layer (cm) [% of Can Volume] | Bottom Layer H/ <sup>235</sup> U | Top Layer H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-----------------------------|---|----------------------------------|-------------------------------|-------------|-----------------------|
| mitcol2   | 0.1                         | 10.2 [18%]                                    | 6.83                             | 475.73                        | 0.0417      | 0.6989 ± 0.0020       |
| mitcol1   | 0.3                         | 12.2 [24%]                                    | 26.34                            | 406.56                        | 0.0366      | 0.8335 ± 0.0023       |
| mitcol4   | 0.32*                       | 12.5 [25%]                                    | 13.45                            | 499.94                        | 0.0362      | 0.7304 ± 0.0018       |

\* - Water/Oxide Mixture

**7.3.1.2 Stratified Layers with the Degraded MIT Fuel on Top**

This scenario is based on the HLW canister degrading before the DOE-SNF canister. The degraded HLW clayey material will first be collected at the bottom of the waste package, and then the degraded MIT fuel will form a layer on top of that if the DOE-SNF canister rests on the surface of the degrading HLW canisters and glass. The HLW clayey material is modeled with no free water fraction (it, however, contains hydrogen in the form of hydrates) in order to maximize the potential volume (moderation) of the degraded MIT fuel in the layer above the clayey material. Various uranium loadings are used to represent removal of U over time or to represent a partial inventory from the DOE-SNF canister.

**Full Uranium Loading**

Criticality results for this scenario with the full uranium loading (35.2 kg) are provided in Table 7.3.1.2-1. The maximum k<sub>eff</sub> is observed for the water fraction of 0.8 (clay density of 20%). Note that the cases listed in Table 7.3.1.2-1 do not meet the criticality control target (k<sub>eff</sub> < 0.93) as is.

Table 7.3.1.2-1. Stratified Layers with Degraded MIT Fuel on Top

| Case Name | Water Fraction | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|----------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| mit060    | 0.60           | 27.4765                          | 37.8004                          | 237                 | 0.0086      | 0.9594 ± 0.0022       |
| mit070    | 0.70           | 27.4765                          | 41.3824                          | 369                 | 0.0063      | 1.0756 ± 0.0026       |
| mit075    | 0.75           | 27.4765                          | 44.3152                          | 475                 | 0.0055      | 1.1251 ± 0.0026       |
| mit080    | 0.80           | 27.4765                          | 48.8513                          | 633                 | 0.0044      | 1.1551 ± 0.0024       |
| mit085    | 0.85           | 27.4765                          | 56.9060                          | 897                 | 0.0033      | 1.1520 ± 0.0019       |
| mit090    | 0.90           | 27.4765                          | 77.4470                          | 1424                | 0.0025      | 1.0682 ± 0.0014       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Based on a checker comment, additional cases were run to better define the peak  $k_{eff}$  for this configuration. The peak is identified at a water fraction of 0.83 with a  $k_{eff}$  value up to 0.005 higher than that identified for 0.83. This minor variance will have no effect on the results and conclusions in the remainder of the report.

Table 7.3.1.2-1A. Stratified Layers with Degraded MIT Fuel on Top - Refinement of Peak  $k_{eff}$

| Case Name | Water Fraction | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|----------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| mit079    | 0.79           | 27.4765                 | 47.7544                 | 595                 | 0.0042      | 1.1499±0.0023         |
| mit081    | 0.81           | 27.4765                 | 50.0770                 | 675                 | 0.0040      | 1.1581±0.0022         |
| mit082    | 0.82           | 27.4765                 | 51.4570                 | 721                 | 0.0038      | 1.1610±0.0017         |
| mit083    | 0.83           | 27.4765                 | 53.0238                 | 773                 | 0.0038      | 1.1617±0.0023         |
| mit084    | 0.84           | 27.4765                 | 54.8205                 | 831                 | 0.0036      | 1.1568±0.0019         |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

It is of interest to determine the minimum amount of uranium needed to obtain criticality assuming the near optimum condition observed in Table 7.3.1.2-1 (water fraction of 0.80) and the absence of neutron absorbers. Table 7.3.1.2-2 lists the criticality results obtained by decreasing the length of the top layer. This case could conceivably occur if one end of the canister fails and releases a portion of the degraded SNF. It takes less than 10% of the original uranium loading (35.2 kg U) to pose a criticality concern if the optimum moderation condition can be maintained. These cases are intended to demonstrate that even for a fraction of the MIT SNF canister loading, absorber or moderator displacement is necessary to prevent a potential criticality.

Table 7.3.1.2-2. Stratified Layers with Degraded MIT Fuel on Top with Reduced Axial Lengths

| Case Name | Length (cm) | Mass of U (kg) | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|-------------|----------------|---------------------|-------------|-----------------------|
| mits200   | 200         | 23.16          | 633                 | 0.0042      | 1.1505 ± 0.0022       |
| mits100   | 100         | 11.58          | 633                 | 0.0044      | 1.1253 ± 0.0020       |
| mits74    | 74          | 8.57           | 633                 | 0.0043      | 1.1063 ± 0.0025       |
| mits50    | 50          | 5.79           | 633                 | 0.0044      | 1.0613 ± 0.0023       |
| mits36    | 36          | 4.17           | 633                 | 0.0044      | 1.0069 ± 0.0026       |
| mits30    | 30          | 3.47           | 633                 | 0.0043      | 0.9675 ± 0.0023       |

|        |    |      |     |        |                 |
|--------|----|------|-----|--------|-----------------|
| mits25 | 25 | 2.89 | 633 | 0.0044 | 0.9287 ± 0.0024 |
|--------|----|------|-----|--------|-----------------|

One possible way of mitigating this criticality concern is to insert Gd neutron absorber in the original, intact DOE-SNF canister. As the DOE-SNF canister degrades, the Gd neutron absorber is likely to stay with the degraded MIT fuel forms. Table 7.3.1.2-3 lists  $k_{\text{eff}}$  corresponding to various Gd loadings in the degraded MIT fuel layer. It would take less than 0.2 kg of Gd to maintain the waste package sufficiently subcritical.

Table 7.3.1.2-3. Stratified Layers with Degraded MIT Fuel on Top with Different Gd Loadings

| Case Name | Mass of Gd (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{\text{eff}} \pm 2\sigma$ |
|-----------|-----------------|-------------------------|-------------------------|---------------------|-------------|------------------------------|
| mitt20    | 0.20            | 27.4765                 | 48.8547                 | 633                 | 0.0056      | 0.8566 ± 0.0021              |
| mitt10    | 0.10            | 27.4765                 | 48.8530                 | 633                 | 0.0049      | 0.9792 ± 0.0020              |
| mitt05    | 0.05            | 27.4765                 | 48.8524                 | 633                 | 0.0047      | 1.0597 ± 0.0023              |
| mitt02    | 0.02            | 27.4765                 | 48.8520                 | 633                 | 0.0046      | 1.1121 ± 0.0020              |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

The case with 0.2 kg of Gd (degraded DHLW at the bottom, MIT fuel on top, no free water in DHLW clayey material, no Fe<sub>2</sub>O<sub>3</sub>) gives slightly higher  $k_{\text{eff}}$  with 83% water content ( $k_{\text{eff}} = 0.8617 \pm 0.0021$  as opposed to  $k_{\text{eff}} = 0.8566 \pm 0.0021$ ) (mitt20). With the resolution of these calculations, this minor variation has no impact.

Another factor that helps to mitigate the criticality concern is the existence of steel basket structures within the DOE-SNF canister. The degraded form of this basket structure, assumed to be Fe<sub>2</sub>O<sub>3</sub>, is likely to remain with the degraded MIT fuel form and act as an additional neutron absorber. Table 7.3.1.2-4 lists  $k_{\text{eff}}$  corresponding to various Gd loadings assuming half of the steel (295 kg of Fe<sub>2</sub>O<sub>3</sub>) stays with the degraded MIT fuel form. The amount of Gd to maintain the waste package sufficiently subcritical is reduced to about 0.1 kg by taking credit for half of the basket structure.

Table 7.3.1.2-4. Stratified Layers with Degraded MIT Fuel on Top with Different Gd Loadings  
(295 kg of Fe<sub>2</sub>O<sub>3</sub> in Top Layer)

| Case Name | Mass of Gd (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{\text{eff}} \pm 2\sigma$ |
|-----------|-----------------|-------------------------|-------------------------|---------------------|-------------|------------------------------|
| mittf20   | 0.2             | 27.4765                 | 55.5747                 | 810                 | 0.0049      | 0.8265 ± 0.0018              |
| mittf10   | 0.1             | 27.4765                 | 55.5730                 | 810                 | 0.0043      | 0.9388 ± 0.0019              |
| mittf05   | 0.05            | 27.4765                 | 55.5723                 | 810                 | 0.0041      | 1.0087 ± 0.0019              |

|         |      |         |         |     |        |                 |
|---------|------|---------|---------|-----|--------|-----------------|
| mittf02 | 0.02 | 27.4765 | 55.5718 | 810 | 0.0037 | 1.0569 ± 0.0018 |
|---------|------|---------|---------|-----|--------|-----------------|

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.2-5 lists the  $k_{eff}$  of the waste forms as a function of  $Fe_2O_3$  mass. No Gd is present in the degraded MIT fuel form and the water fraction is assumed to be 0.8. It takes more than 900 kg of  $Fe_2O_3$  to make the waste package subcritical, which is more than what is available in the DOE-SNF canister basket structure .

Table 7.3.1.2-5. Stratified Layers with Degraded MIT Fuel on Top with Different  $Fe_2O_3$  Loadings

| Case Name | Mass of $Fe_2O_3$ (kg) | Mass of Gd (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|------------------------|-----------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| mitfe1k   | 150                    | 0.0             | 27.4765                 | 52.2053                 | 723                 | 0.0039      | 1.1235 ± 0.0020       |
| mitfe3k   | 300                    | 0.0             | 27.4765                 | 55.6875                 | 813                 | 0.0039      | 1.0892 ± 0.0019       |
| mitfe6k   | 600                    | 0.0             | 27.4765                 | 63.1877                 | 993                 | 0.0035      | 1.0155 ± 0.0016       |
| mitf6g5   | 600                    | 0.050           | 27.4765                 | 63.1877                 | 993                 | 0.0038      | 0.9333 ± 0.0008       |
| mitf6g6   | 600                    | 0.060           | 27.4765                 | 63.1877                 | 993                 | 0.0038      | 0.9166 ± 0.0009       |
| mitfe8k   | 800                    | 0.0             | 27.4765                 | 68.8067                 | 1114                | 0.0033      | 0.9697 ± 0.0014       |
| mitfe850  | 850                    | 0.0             | 27.4765                 | 70.3335                 | 1144                | 0.0033      | 0.9581 ± 0.0016       |
| mitfe9k   | 900                    | 0.0             | 27.4765                 | 71.9280                 | 1174                | 0.0031      | 0.9460 ± 0.0014       |
| mitf9g1   | 900                    | 0.010           | 27.4765                 | 71.9280                 | 1174                | 0.0034      | 0.9277 ± 0.0009       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Amounts in excess of 590.51 kg  $Fe_2O_3$  are obtained by assuming that part of the XM-19 fuel canister wall is also degraded. In order to achieve 900 kg  $Fe_2O_3$ , approximately 80% of XM-19 has to degrade with a stainless steel basket. However, if the stainless steel is replaced by carbon steel, 35% degradation in XM-19 would account for 900 kg  $Fe_2O_3$ .

**75% Uranium Loading**

Results presented in Tables 7.3.1.2-1 through 7.3.1.2-5 assume that the original MIT uranium loading (35.2 kg) remains within the waste package. However, it is possible that some of the uranium will be transported out of the waste package during the degradation process. The criticality results presented in this section assume 75% of original uranium loading remaining in the degraded waste form.

Table 7.3.1.2-6 lists the  $k_{eff}$  as a function of the water fraction in the degraded MIT fuel form. It is assumed that the HLW clayey material has no free water in it (it, however, contains hydrogen in the form of hydrates). The maximum  $k_{eff}$  is observed for the water fraction of 0.8. Also, most of the cases listed in Table 7.3.1.2-6 do not meet the criticality control requirement as is even with 25% reduction in the uranium loading.

Table 7.3.1.2-6. Stratified Layers with Degraded MIT Fuel on Top (75% Uranium Loading)

| Case Name | Water Frac. | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|-------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| m75t070   | 0.70        | 27.4765                 | 41.3598                 | 490                 | 0.0051      | 0.9973 $\pm$ 0.0027   |
| m75t075   | 0.75        | 27.4765                 | 44.2344                 | 630                 | 0.0042      | 1.0361 $\pm$ 0.0023   |
| m75t080   | 0.80        | 27.4765                 | 48.7462                 | 840                 | 0.0035      | 1.0522 $\pm$ 0.0020   |
| m75t085   | 0.85        | 27.4765                 | 56.7528                 | 1190                | 0.0029      | 1.0332 $\pm$ 0.0020   |
| m75t090   | 0.90        | 27.4765                 | 77.0610                 | 1890                | 0.0021      | 0.9349 $\pm$ 0.0013   |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

As in the full uranium loading cases, Gd is added to the degraded MIT fuel form. The results are listed in Table 7.3.1.2-7. The optimum water fraction of 0.8 (from Table 7.3.1.2-6) is assumed for all calculations. With 25% reduction in the uranium loading, it takes about 0.06 kg of Gd to keep the waste package sufficiently subcritical ( $k_{eff} < 0.93$ ).

Table 7.3.1.2-7. Stratified Layers with Degraded MIT Fuel on Top with Different Gd Loadings (75% Uranium Loading)

| Case Name | Mass of Gd (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|-----------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| m75tg12   | 0.12            | 27.4765                 | 48.7478                 | 840                 | 0.0044      | 0.8342 $\pm$ 0.0021   |
| m75tg10   | 0.10            | 27.4765                 | 48.7476                 | 840                 | 0.0043      | 0.8641 $\pm$ 0.0021   |
| m75tg08   | 0.08            | 27.4765                 | 48.7474                 | 840                 | 0.0040      | 0.8961 $\pm$ 0.0023   |
| m75tg06   | 0.06            | 27.4765                 | 48.7470                 | 840                 | 0.0040      | 0.9275 $\pm$ 0.0021   |
| m75tg04   | 0.04            | 27.4765                 | 48.7466                 | 840                 | 0.0038      | 0.9679 $\pm$ 0.0020   |
| m75tg02   | 0.02            | 27.4765                 | 48.7464                 | 840                 | 0.0036      | 1.0086 $\pm$ 0.0020   |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

If half of the degraded basket steel is assumed to remain with the degraded MIT fuel form, the



amount of Gd required to keep the waste package sufficiently subcritical decreases to about 0.02 kg as shown in Table 7.3.1.2-8.

Table 7.3.1.2-8. Stratified Layers with Degraded MIT Fuel on Top with Different Gd Loadings (295 kg of Fe<sub>2</sub>O<sub>3</sub> in Top Layer, 75% Uranium Loading)

| Case Name | Mass of Gd (kg) | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-----------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| m75tf12   | 0.12            | 27.4765                          | 55.4595                          | 1077                | 0.0039      | 0.7873 ± 0.0018       |
| m75tf10   | 0.10            | 27.4765                          | 55.4594                          | 1077                | 0.0038      | 0.8138 ± 0.0019       |
| m75tf08   | 0.08            | 27.4765                          | 55.4592                          | 1077                | 0.0038      | 0.8394 ± 0.0019       |
| m75tf06   | 0.06            | 27.4765                          | 55.4587                          | 1077                | 0.0034      | 0.8684 ± 0.0019       |
| m75tf04   | 0.04            | 27.4765                          | 55.4584                          | 1077                | 0.0035      | 0.9001 ± 0.0016       |
| m75tf02   | 0.02            | 27.4765                          | 55.4582                          | 1077                | 0.0033      | 0.9351 ± 0.0017       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

**50% Uranium Loading**

Table 7.3.1.2-9 lists the k<sub>eff</sub> of the degraded waste form as a function of water fraction assuming 50% of the initial uranium remains in the waste package. Without taking credit for either Gd or degraded steel basket, the waste package remains sufficiently subcritical.

Table 7.3.1.2-9. Stratified Layers with Degraded MIT Fuel on Top (50% Uranium Loading)

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| m50t070   | 0.70        | 27.4765                          | 41.2507                          | 731                 | 0.0040      | 0.8728 ± 0.0022       |
| m50t075   | 0.75        | 27.4765                          | 44.1536                          | 941                 | 0.0033      | 0.8945 ± 0.0017       |
| m50t080   | 0.80        | 27.4765                          | 48.6412                          | 1254                | 0.0029      | 0.8949 ± 0.0017       |
| m50t085   | 0.85        | 27.4765                          | 56.5997                          | 1777                | 0.0023      | 0.8571 ± 0.0016       |
| m50t090   | 0.90        | 27.4765                          | 76.6830                          | 2822                | 0.0016      | 0.7468 ± 0.0009       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

**7.3.1.3 Stratified Layers with the Degraded MIT Fuel at the Bottom**

**Full Uranium Loading**

This scenario is based on the fact that the DOE-SNF canister sinks to the bottom of the degraded HLW clayey material during the degradation process. As the DOE-SNF canister degrades there will be some mixing of the HLW clayey material and the degraded MIT fuel forms. It is assumed that the water fraction is constant in the bottom mixture as well as the HLW clayey material on the top. It is unlikely to have a less dense mixture at the bottom. Criticality results for this scenario are provided in Tables 7.3.1.3-1 through 7.3.1.3-7. The water fraction and the amount of the HLW clayey material mixed with the degraded MIT fuel form are the two parameters varied in this configuration. Note that the fragments of stainless steel or Fe<sub>2</sub>O<sub>3</sub> likely present from the degradation of the HLW canisters are not accounted for in these calculations.

Table 7.3.1.3-1. 0% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|--------------------|-------------|-----------------------|
| mitb415   | 0.15        | -73.7805                         | 51.4845                          | 28                 | 0.039       | 0.6322 ± 0.0026       |
| mitb420   | 0.20        | -73.2477                         | 61.0600                          | 40                 | 0.032       | 0.7231 ± 0.0025       |
| mitb425   | 0.25        | -72.6550                         | 74.3800                          | 53                 | 0.026       | 0.8100 ± 0.0030       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-2. 10% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|--------------------|-------------|-----------------------|
| mitb515   | 0.15        | -56.6270                         | 51.4845                          | 119                | 0.015       | 0.8571 ± 0.0028       |
| mitb520   | 0.20        | -55.3425                         | 61.0600                          | 160                | 0.012       | 0.9454 ± 0.0029       |
| mitb525   | 0.25        | -53.9115                         | 74.3800                          | 206                | 0.0097      | 1.0170 ± 0.0030       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-3. 15% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|--------------------|-------------|-----------------------|
| mitb615   | 0.15        | -49.5490                         | 51.4845                          | 165                | 0.012       | 0.8890 ± 0.0026       |

|         |       |          |         |     |        |                 |
|---------|-------|----------|---------|-----|--------|-----------------|
| mitb620 | 0.20  | -47.9400 | 61.0600 | 220 | 0.0089 | 0.9671 ± 0.0027 |
| mitb625 | 0.25  | -46.1470 | 74.3800 | 283 | 0.0077 | 1.0262 ± 0.0025 |
| mitb627 | 0.272 | -45.2900 | 84.8900 | 313 | 0.0070 | 1.0464 ± 0.0025 |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-4. 20% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| mitb715   | 0.15        | -42.9370                         | 51.4845                          | 210                 | 0.0098      | 0.9057 ± 0.0026       |
| mitb720   | 0.20        | -41.0180                         | 61.0600                          | 280                 | 0.0076      | 0.9727 ± 0.0027       |
| mitb725   | 0.25        | -38.8750                         | 74.3800                          | 359                 | 0.0064      | 1.0177 ± 0.0025       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-5. 25% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| mitb115   | 0.15        | -36.6440                         | 51.4845                          | 256                 | 0.0089      | 0.9042 ± 0.0026       |
| mitb120   | 0.20        | -34.4230                         | 61.0600                          | 340                 | 0.0070      | 0.9641 ± 0.0028       |
| mitb125   | 0.25        | -31.9350                         | 74.3800                          | 436                 | 0.0059      | 0.9982 ± 0.0021       |
| mitb127   | 0.272       | -30.7430                         | 84.8900                          | 482                 | 0.0053      | 1.0068 ± 0.0022       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-6. 50% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| mitb215   | 0.15        | -7.6010                          | 51.4845                          | 483                 | 0.0057      | 0.8415 ± 0.0020       |
| mitb220   | 0.20        | -3.8220                          | 61.0600                          | 640                 | 0.0046      | 0.8627 ± 0.0016       |
| mitb225   | 0.25        | 0.4540                           | 74.3800                          | 818                 | 0.0040      | 0.8659 ± 0.0017       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-7. 75% of HLW Mixed With Degraded MIT Fuel

| Case Name | Water Frac. | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|-------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| mitb315   | 0.15        | 20.527                  | 51.4845                 | 710                 | 0.0046      | 0.7603 ± 0.0016       |
| mitb320   | 0.20        | 26.258                  | 61.0600                 | 940                 | 0.0038      | 0.7605 ± 0.0014       |
| mitb325   | 0.25        | 32.915                  | 74.3800                 | 1201                | 0.0034      | 0.7459 ± 0.0014       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Results for the degraded MIT fuel homogeneously mixed with 100% of the degraded HLW clayey material are provided below in Table 7.3.1.3-8. The water fraction is varied from 0.0 to 0.25. Water fractions above 0.28 are not possible because the waste package volume is limited. If some of the mixture is assumed to be transported out of the waste package, higher water fractions are possible. However, this would further reduce the  $k_{eff}$  since the optimum moderation is reached when the water fraction is about 0.2 as shown in Table 7.3.1.3-8. In fact, the homogeneous mixture of the degraded MIT fuel and the degraded HLW clayey material does not pose any criticality concern at any water fraction.

Table 7.3.1.3-8. Homogeneous Mixture of Degraded Waste Forms

| Case Name | Water Fraction | y (cm) <sup>1</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|----------------|---------------------|---------------------|-------------|-----------------------|
| mith00    | 0.0            | 31.5421             | 211                 | 0.0094      | 0.5327 ± 0.0018       |
| mith01    | 0.1            | 43.7463             | 668                 | 0.0049      | 0.6701 ± 0.0013       |
| mith02    | 0.2            | 61.0608             | 1241                | 0.0034      | 0.6774 ± 0.0016       |
| mith025   | 0.25           | 74.3790             | 1584                | 0.0030      | 0.6507 ± 0.0013       |

<sup>1</sup> Distance from the waste package centerline to the top of the mixture.

The most reactive condition occurs when about 15% of the HLW clayey material is mixed with the degraded MIT fuel forms. As the volume of the HLW mixed with the degraded MIT fuel forms becomes more than 15%,  $k_{eff}$  of the waste package starts to decrease. Also, for a given amount of mixing, the higher the water fraction the more reactive the waste package becomes. A water fraction greater than about 0.272 is not possible as the waste package volume is limited. Regardless, for the most reactive condition identified for the scenario, additional criticality control is required to maintain the waste package sufficiently subcritical.

The next two tables provide results for cases with Gd or Fe<sub>2</sub>O<sub>3</sub>. These cases were run to provide an indication of the margin for the likely configuration. The presence of the Gd or Fe<sub>2</sub>O<sub>3</sub> could cause minor shifts in the water fraction or clay percent which is most reactive for a given mixture. These minor variations would have no effect on the conclusions drawn from these results.

As in the previous scenario described in Section 7.3.1.2, one way of mitigating this criticality concern is to insert Gd neutron absorber in the original, intact DOE-SNF canister. As the DOE-SNF canister degrades, the Gd neutron absorber is likely to stay with the degraded MIT fuel forms. Table 7.3.1.3-9 lists  $k_{eff}$  corresponding to various Gd loadings in the mixture of the degraded MIT fuel forms and the HLW clayey material. The water fraction is assumed to be 0.272 and 25% of HLW clayey material is in the mixture. It would take less than 0.1 kg of Gd to maintain the waste package sufficiently subcritical.

Table 7.3.1.3-9. Stratified Layers with Degraded MIT Fuel Mixed with 25% of HLW Glass Clay at Bottom with Different Gd Loadings

| Case Name | Gd Mass (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|--------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| mitgd2    | 0.20         | -30.743                 | 84.89                   | 482                 | 0.0066      | 0.7736 ± 0.0021       |
| mitgd1    | 0.10         | -30.743                 | 84.89                   | 482                 | 0.0062      | 0.8735 ± 0.0019       |
| mitgd05   | 0.05         | -30.743                 | 84.89                   | 482                 | 0.0057      | 0.9345 ± 0.0022       |
| mitgd02   | 0.02         | -30.743                 | 84.89                   | 482                 | 0.0055      | 0.9780 ± 0.0018       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Even considering the fact that 15% HLW clayey mixture represents the more reactive waste package condition (by about 4% in  $k_{eff}$ ) than the cases considered in Table 7.3.1.3-9, 0.1 kg of Gd should be sufficient for criticality control. Two cases with degraded MIT fuel mixed with 15% HLW glass clay are run to verify this conclusion. The results indicate that 0.1 kg Gd is sufficient to maintain subcriticality as shown in Table 7.3.1.3-10.

Table 7.3.1.3-10. Stratified Layers with Degraded MIT Fuel Mixed with 15% of HLW Glass Clay at bottom with Different Gd Loadings

| Case Name | Gd Mass (kg) | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|--------------|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| mitxgd5   | 0.05         | -45.29                  | 84.89                   | 313                 | 0.0078      | 0.9621 ± 0.0025       |
| mitxgd1   | 0.10         | -45.29                  | 84.89                   | 313                 | 0.0082      | 0.8959 ± 0.0025       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

The addition of Fe<sub>2</sub>O<sub>3</sub> from the degraded DOE-SNF canister basket structure will further reduce the amount of Gd required for the criticality control. Table 7.3.1.3-11 lists k<sub>eff</sub> corresponding to various Gd loadings assuming half of the steel (295.105 kg of Fe<sub>2</sub>O<sub>3</sub>) stays with the degraded MIT fuel form mixed with 25% HLW clayey material with a water fraction of 0.26. The amount of Gd to maintain the waste package sufficiently subcritical is reduced to about 0.02 kg by taking credit for half of the basket structure.

Table 7.3.1.3-11. Stratified Layers with Degraded MIT Fuel Mixed with 25% HLW Clay at Bottom with Different Gd Loadings (295.105 kg of Fe<sub>2</sub>O<sub>3</sub> in the Mixture, 0.26 Water Fraction)

| Case Name | Gd Mass (kg) | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|--------------|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| mitfg00   | 0.0          | -29.8550                         | 82.0000                          | 472                 | 0.0054      | 0.9492 ± 0.0019       |
| mitfg02   | 0.02         | -29.8550                         | 82.0000                          | 472                 | 0.0058      | 0.9226 ± 0.0022       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Again, even considering the fact that 15% HLW clayey mixture represents more reactive (by about 4% in k<sub>eff</sub>) waste package condition than the cases considered in Table 7.3.1.3-11, 0.04 kg of Gd should be sufficient for criticality control. This is also verified by running several cases with MIT fuel mixed with 15% HLW glass clayey material. The results show that 0.04 kg Gd is sufficient to maintain the waste package subcritical as shown in Table 7.3.1.3-12. If all of the steel (590.21 kg of Fe<sub>2</sub>O<sub>3</sub>) stays with the degraded MIT fuel form mixed with 15% HLW clayey material with a water fraction of 0.255 (this is the highest possible water fraction to accommodate all of the steel), then the system is subcritical with a k<sub>eff</sub> of 0.9265 ± 0.0022, AENCF of 0.0074, and H/<sup>235</sup>U of 320 (mtxf6g0). As Fe<sub>2</sub>O<sub>3</sub> is added to the system the mixture volume increases. Total number of H in the mixture is the sum of H from HLW that is mixed with SNF and H from free water. However, total number of <sup>235</sup>U is only a function of mixture volume. Therefore, as mixture volume increases total number of H decreases slower than total number of <sup>235</sup>U, which results in higher H/<sup>235</sup>U ratios. To make up for the effect of mixture volume, volume fraction of the free water must be adjusted. If the water fraction of the case mtyf6g0 is adjusted so that H/<sup>235</sup>U is the same as case mitxfg0, then the new k<sub>eff</sub> of the system is 0.9249 ± 0.0023 with AENCF of 0.0077 (mtyf6g0) which shows that the system is subcritical.

Table 7.3.1.3-12. Stratified Layers with Degraded MIT Fuel Mixed with 15% of HLW Glass Clay at bottom with Different Gd Loadings (295.105 kg of Fe<sub>2</sub>O<sub>3</sub> in the Mixture, 0.26 Water Fraction)

| Case Name | Gd Mass (kg) | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ±2σ |
|-----------|--------------|----------------------------------|----------------------------------|---------------------|-------------|----------------------|
| mitxfg0   | 0.0          | -44.0692                         | 82.0000                          | 312                 | 0.0073      | 0.9820 ± 0.0023      |
| mitxfg2   | 0.02         | -44.0692                         | 82.0000                          | 312                 | 0.0075      | 0.9537 ± 0.0022      |
| mitxfg4   | 0.04         | -44.0692                         | 82.0000                          | 312                 | 0.0077      | 0.9257 ± 0.0023      |
| mitxfg5   | 0.05         | -44.0692                         | 82.0000                          | 312                 | 0.0081      | 0.9084 ± 0.0023      |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

**75% Uranium Loading**

Table 7.3.1.3-13 lists the k<sub>eff</sub> as a function of the amount of HLW volume mixed with the degraded MIT fuel forms. The water fraction is assumed to be 0.272. The maximum k<sub>eff</sub> is observed for 10% of HLW clayey material mixed with 75% of the original uranium loading. Even for the most reactive condition, it is only about 3.5% higher in k<sub>eff</sub> than the required 0.93.

Table 7.3.1.3-13. Stratified Layers with Degraded MIT Fuel at Bottom (75% Uranium Loading)

| Case Name | HLW Volume Fraction Mixed with MIT Fuel | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|---|----------------------------------|----------------------------------|---------------------|-------------|-----------------------|
| m75b000   | 0.00                                    | -72.4160                         | 84.76                            | 79                  | 0.0190      | 0.8078 ± 0.0033       |
| m75b005   | 0.05                                    | -62.0159                         | 84.76                            | 191                 | 0.0100      | 0.9369 ± 0.0027       |
| m75b010   | 0.10                                    | -53.2585                         | 84.76                            | 304                 | 0.0073      | 0.9654 ± 0.0025       |
| m75b015   | 0.15                                    | -45.3190                         | 84.76                            | 417                 | 0.0058      | 0.9503 ± 0.0023       |
| m75b020   | 0.20                                    | -37.8750                         | 84.76                            | 530                 | 0.0050      | 0.9297 ± 0.0021       |
| m75b025   | 0.25                                    | -30.7700                         | 84.76                            | 642                 | 0.0045      | 0.8981 ± 0.0023       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-14 lists the waste package k<sub>eff</sub> as a function of a Gd loading assuming 75% of the original uranium loading remaining. The water fraction is assumed to be 0.26. Ten percent of the HLW clayey material (maximum from Table 7.3.1.3-13) is assumed to be mixed with the degraded MIT fuel form. Even considering that the water fraction is not the most optimum

condition, 0.02 kg of Gd should be sufficient for criticality control.

Table 7.3.1.3-14. Stratified Layers with Degraded MIT Fuel at Bottom with Different Gd Loadings (75% Uranium Loading)

| Case Name | Mass of Gd (kg) | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-----------------|----------------------------------|----------------------------------|--------------------|-------------|-----------------------|
| m75bg08   | 0.08            | -53.6348                         | 78.1050                          | 288                | 0.0088      | 0.8124 ± 0.0024       |
| m75bg06   | 0.06            | -53.6350                         | 78.1050                          | 288                | 0.0084      | 0.8455 ± 0.0026       |
| m75bg04   | 0.04            | -53.6350                         | 78.1050                          | 288                | 0.0082      | 0.8753 ± 0.0023       |
| m75bg02   | 0.02            | -53.6350                         | 78.1010                          | 288                | 0.0077      | 0.9134 ± 0.0028       |
| m75bg00   | 0.00            | -53.6352                         | 78.1000                          | 288                | 0.0076      | 0.9525 ± 0.0024       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

If half of the degraded basket steel (295.105 kg of Fe<sub>2</sub>O<sub>3</sub>) is assumed to remain in the mixture, Gd is not required for criticality control. The criticality results are listed in Table 7.3.1.3-15.

Table 7.3.1.3-15. Stratified Layers with Degraded MIT Fuel at Bottom with Different Gd Loadings (295.105 kg of Fe<sub>2</sub>O<sub>3</sub>, 75% Uranium Loading)

| Case Name | Mass of Gd (kg) | y <sub>1</sub> (cm) <sup>1</sup> | y <sub>2</sub> (cm) <sup>2</sup> | H <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ |
|-----------|-----------------|----------------------------------|----------------------------------|--------------------|-------------|-----------------------|
| m75bf08   | 0.08            | -51.8100                         | 81.9300                          | 309                | 0.0087      | 0.7704 ± 0.0022       |
| m75bf06   | 0.06            | -51.8100                         | 81.9300                          | 309                | 0.0084      | 0.7974 ± 0.0022       |
| m75bf04   | 0.04            | -51.8100                         | 81.9300                          | 309                | 0.0080      | 0.8267 ± 0.0021       |
| m75bf02   | 0.02            | -51.8100                         | 81.9300                          | 309                | 0.0079      | 0.8564 ± 0.0023       |
| m75bf00   | 0.00            | -51.8100                         | 81.9250                          | 309                | 0.0076      | 0.8901 ± 0.0023       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

**50% Uranium Loading**

Table 7.3.1.3-16 lists the k<sub>eff</sub> of the degraded waste form as a function of the fraction of HLW clayey material mixed assuming that 50% of the initial uranium remains in the waste package. The water fraction is assumed to be 0.272. Without taking credit for either Gd or degraded steel basket, the waste package remains sufficiently subcritical.



Table 7.3.1.3-16. Stratified Layers with Degraded MIT Fuel at Bottom (50% Uranium Loading)

| Case Name | HLW Volume Fraction Mixed with MIT Fuel | $y_1$ (cm) <sup>1</sup> | $y_2$ (cm) <sup>2</sup> | H/ <sup>235</sup> U | AENCF (MeV) | $k_{eff} \pm 2\sigma$ |
|-----------|---|-------------------------|-------------------------|---------------------|-------------|-----------------------|
| m50b000   | 0.00                                    | -72.4600                | 84.65                   | 118                 | 0.0138      | 0.7465 ± 0.0029       |
| m50b005   | 0.05                                    | -62.0500                | 84.65                   | 287                 | 0.0076      | 0.8401 ± 0.0033       |
| m50b010   | 0.10                                    | -53.2886                | 84.65                   | 456                 | 0.0056      | 0.8432 ± 0.0023       |
| m50b015   | 0.15                                    | -45.3450                | 84.65                   | 625                 | 0.0045      | 0.8125 ± 0.0022       |
| m50b020   | 0.20                                    | -37.9030                | 84.65                   | 794                 | 0.0041      | 0.7766 ± 0.0023       |
| m50b025   | 0.25                                    | -30.7940                | 84.65                   | 963                 | 0.0036      | 0.7382 ± 0.0021       |

<sup>1</sup> Distance from the waste package centerline to the top of the bottom layer.

<sup>2</sup> Distance from the waste package centerline to the top of the top layer.

## 7.3.2 Degraded ORR SNF Criticality

### 7.3.2.1 Homogeneous ORR SNF Mixture inside DOE-SNF Canister

The Phase I analysis (Ref. 5.16) performed criticality evaluations for various configurations of degraded ORR fuel and basket material with the borated stainless steel axial separator plates intact, and showed that all configurations had values of  $k_{eff}$  below 0.93.

This analysis begins with an evaluation of the scenario where the fuel, basket, and separator plates have completely degraded and are homogenized together with water such that they completely fill the DOE-SNF canister. The boron from the axial separator plates has been flushed out of the DOE-SNF canister and is not considered (Assumption 4.3.3). Amounts of iron oxide corresponding to that available from 50% and 100% of the stainless steel basket material were homogenized into the degraded ORR/water mixture. As with the MIT analysis, the DOE-SNF canister is modelled at the bottom of the mass of degraded HLW glass clayey material to maximize neutron reflection into the DOE-SNF canister. The HLW clayey material is modelled with 25% free water fraction, and nearly fills the waste package. The results from this first set of calculations are provided in Table 7.3.2.1-1 and indicate that even 100% of the oxide from the degraded basket is insufficient to keep  $k_{eff}$  below 0.93.

However, Table 7.3.2.1-1 also shows that adding additional iron to the basket initially is a viable means of reducing  $k_{eff}$  to an acceptable value. A total of 380 kg of oxide would be sufficient to reduce  $k_{eff}$  below 0.93. This extra oxide can be obtained by increasing the thickness of the basket members from 5 mm to 13 mm (accounts for 50% loss associated with stainless steel from Assumption 4.3.8), or by simply changing the basket material to carbon steel. Unfortunately, space limitations inside the DOE-SNF canister make the former option impractical. Use of the

latter option would provide a better way to uniformly distribute the resulting oxide due to the general corrosion of the carbon steel, which occurs at a rate not much lower than that of the aluminum. Stainless steel typically undergoes localized attack (pitting, crevice corrosion, stress corrosion cracking, etc.) that is likely to leave some small pieces of uncorroded material which are free to settle to the bottom of the canister and not become uniformly mixed with the degraded fuel. However, changing to a carbon steel basket requires reevaluation of the worst degraded case from Phase I (Ref. 5.16, MCNP case "orroz3a") where the ORR fuel is homogenized with water and uniformly distributed throughout the basket cell, because intact stainless steel is a better neutron absorber than intact carbon steel. In addition to changing the basket material from Type 316 stainless steel to A516 carbon steel, the ORR fuel was also more realistically degraded to a mixture of soddyite ( $[\text{UO}_2]_2[\text{SiO}_4]:2\text{H}_2\text{O}$ ),  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ , and water, rather than just homogenizing it throughout the cell as was done in the Phase I analysis. The results of the criticality evaluation indicate that the  $k_{\text{eff}}$  in this degraded configuration is  $0.8861 \pm 0.0030$  (MCNP case "orroz4a"; AENCF = 0.0249 MeV), thus demonstrating the viability of the carbon steel basket option.

If a switch to a carbon steel structural basket is not desired for other reasons, uniformly adding 0.1 kg of Gd to the DOE-SNF canister is a third option which will reduce  $k_{\text{eff}}$  well below 0.93 in this degraded configuration, as is shown in Table 7.3.2.1-1. A simple method for adding Gd to the basket in a manner which would promote its uniform distribution throughout the degraded ORR fuel and basket is to deposit it on carbon steel basket inserts placed in the empty basket cells immediately adjacent to the ORR fuel cells, as is shown in Figure 7.3.2.1-1. This concept also represents an effective alternative to the borated stainless steel axial separator plates for reducing  $k_{\text{eff}}$  in the worst degraded case from Phase I discussed above. To demonstrate this, a criticality evaluation was performed which replaced the borated stainless steel axial separator plates with 316 stainless steel, and included 5 mm thick carbon steel basket inserts with a total of 0.25 kg of Gd, as shown in Figure 7.3.2.1-1. The results indicate that the  $k_{\text{eff}}$  in this degraded configuration is  $0.8390 \pm 0.0027$  (MCNP case "orroz4c"; AENCF = 0.0268 MeV), thus demonstrating the viability of the carbon steel/Gd basket insert concept.

Table 7.3.2.1-1. Degraded ORR Fuel Homogenized In DOE-SNF Canister with Iron Oxide From Degraded Basket (No Boron Remaining; Canister Surrounded by Clay)

| Mass of Fe <sub>2</sub> O <sub>3</sub> Remaining from Basket (kg) | Mass of Gd (kg) | Water Fraction | H/ <sup>235</sup> U | AENCF (MeV) | k <sub>eff</sub> ± 2σ | Case Name |
|---|-----------------|----------------|---------------------|-------------|-----------------------|-----------|
| 163.3   | 0               | 0.7058         | 535.8               | 0.01242     | 1.0440 ± 0.0022       | orrhom3   |
| 326.6   | 0               | 0.6272         | 477.2               | 0.01379     | 0.9521 ± 0.0022       | orrhom2   |
| 380   | 0               | 0.6015         | 458.0               | 0.01428     | 0.9262 ± 0.0021       | orrhom6   |
| 489.9   | 0               | 0.5486         | 418.6               | 0.01539     | 0.8673 ± 0.0023       | orrhom1   |
| 163.3   | 0.25            | 0.7058         | 535.8               | 0.02292     | 0.5513 ± 0.0015       | orrhom4   |
| 163.3   | 0.1             | 0.7058         | 535.8               | 0.01660     | 0.7550 ± 0.0020       | orrhom5   |
| 0   | 0.1             | 0.7844         | 594.4               | 0.01563     | 0.8060 ± 0.0022       | orrhom7   |

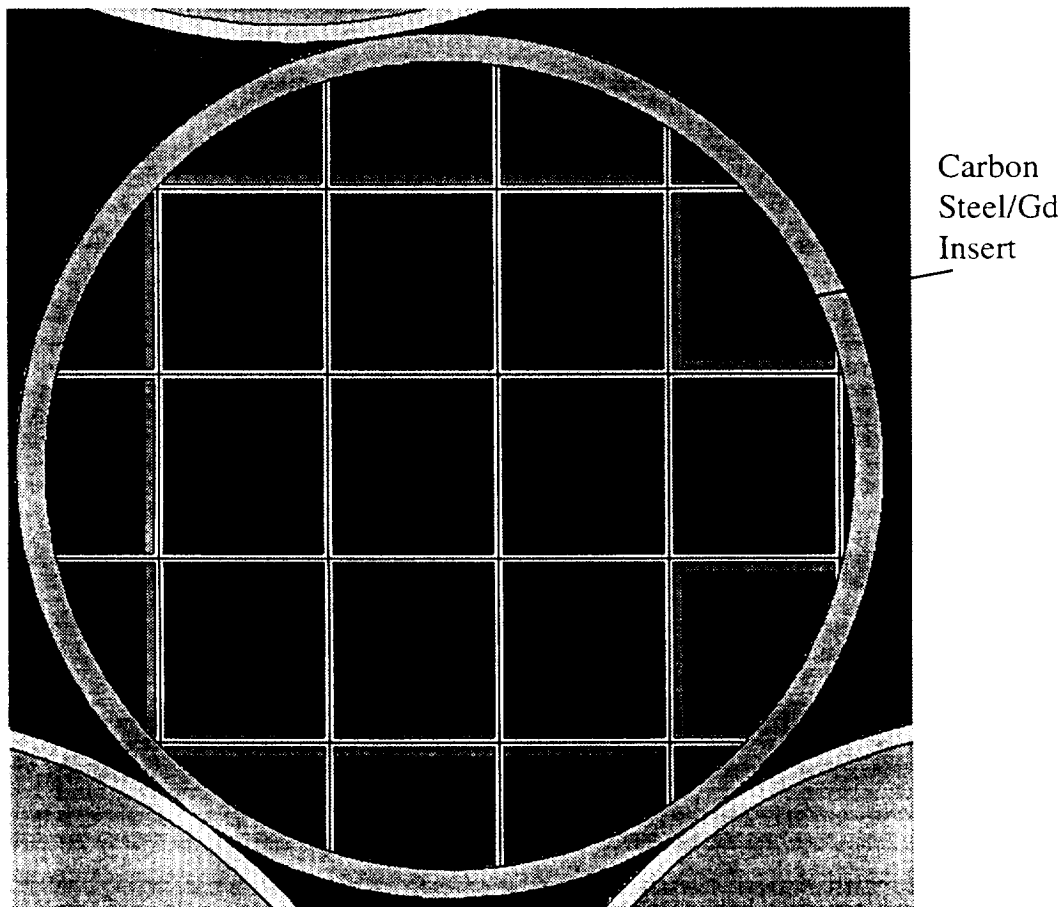


Figure 7.3.2.1-1. Conceptual ORR Basket with Carbon Steel/Gd Inserts

### 7.3.2.2 Stratified Layers with the Degraded ORR Fuel on Top

This scenario is based on the HLW canister degrading before the codisposal canister, which is the expected order, as they are fabricated from a thinner and less corrosion resistant type of stainless steel than the DOE-SNF canister, and the material may have been sensitized during the glass pour. For this scenario the HLW glass will settle to the bottom of the WP as it degrades to clay. The degraded ORR fuel will then form a layer on top of the clay if the DOE-SNF canister rests on the surface of the degrading HLW canisters and glass. Criticality calculations have been performed for this degraded configuration, with various water fractions in the degraded ORR layer, and above the layer for configurations which do not completely fill the waste package. For conservatism, no  $\text{Fe}_2\text{O}_3$  from degradation of the canisters or the ORR basket has been included. The degraded HLW clay at the bottom of the WP is modeled with no free water. The results are provided in Table 7.3.2.2-1 and indicate that the  $k_{\text{eff}}$  for this configuration is well below 0.93 for all amounts of water content, and therefore does not present a criticality concern.

Table 7.3.2.2-1. Layer of Degraded ORR Fuel on Top of Degraded HLW Glass Clayey Material

| ORR Water Fraction | Dist. from Top of Clay Layer to WP Center (cm) | Dist. from Top of ORR Layer to WP Center (cm) | $\text{H}^{235}\text{U}$ Ratio | AENCF (MeV) | $k_{\text{eff}} \pm 2\sigma$ | Case Name |
|--------------------|--|---|--------------------------------|-------------|------------------------------|-----------|
| 0.6                | 27.4765  | 31.8017                                       | 250.7                          | 0.02099     | $0.5770 \pm 0.0025$          | orr060    |
| 0.7                | 27.4765  | 33.2633                                       | 384.7                          | 0.01616     | $0.6564 \pm 0.0022$          | orr070    |
| 0.75               | 27.4765  | 34.4407                                       | 491.8                          | 0.01383     | $0.7004 \pm 0.0022$          | orr075    |
| 0.8                | 27.4765  | 36.2211                                       | 652.5                          | 0.01079     | $0.7526 \pm 0.0025$          | orr080    |
| 0.85               | 27.4765  | 39.2313                                       | 920.4                          | 0.00841     | $0.8018 \pm 0.0020$          | orr085    |
| 0.9                | 27.4765  | 45.4458                                       | 1456.1                         | 0.00622     | $0.8172 \pm 0.0019$          | orr090    |

### 7.3.2.3 Stratified Layers with Degraded ORR Fuel at the Bottom

This scenario is based on the fact that the codisposal canister sinks to the bottom of the degraded HLW clayey material during the degradation process. As the codisposal canister degrades, there will be some mixing of the HLW clayey material and the degraded ORR fuel forms. This will result in a mixed layer of degraded ORR fuel and HLW clay at the bottom of the WP, covered by a layer of the remaining HLW clay. To evaluate this scenario, criticality calculations have been performed for various mixtures of degraded ORR fuel and HLW clay at the bottom of the WP, with various water fractions in both the mixed and unmixed layers (same fraction in both layers). For conservatism, no  $\text{Fe}_2\text{O}_3$  from degradation of the canisters or the ORR basket has been included. As with the previous cases, the region above the clayey material (in cases where the clay does not completely fill the WP) and outside of the WP is modeled as being filled with water to conservatively maximize neutron reflection. The results are provided in Table 7.3.2.3-1 and indicate that this configuration is well below  $k_{\text{eff}}$  of 0.93 for all water contents and combinations of HLW clay and ORR mix, and therefore does not present a criticality concern.

Table 7.3.2.3-1. Degraded ORR Fuel at the Bottom of Waste Package  
Mixed With Various Amounts of Clay From Degraded HLW Glass

| Fraction of Clay Mixed with ORR | Clay and ORR/Clay Water Fraction | Dist. from Top of ORR/Clay Layer to WP Center (cm) | Dist. from Top of Clay Layer to WP Center (cm) | H/ <sup>235</sup> U Ratio | AENCF (MeV) | k <sub>eff</sub> ± 2σ | Case Name |
|---------------------------------|----------------------------------|--|--|---------------------------|-------------|-----------------------|-----------|
| 0.10                            | 0.200                            | -59.0016   | 57.2957  | 334.5                     | 0.01802     | 0.6671 ± 0.0021       | ob10v20   |
| 0.15                            | 0.200                            | -51.2921   | 57.2957  | 476.9                     | 0.01441     | 0.6706 ± 0.0023       | ob15v20   |
| 0.20                            | 0.200                            | -44.1725   | 57.2957  | 619.2                     | 0.01197     | 0.6553 ± 0.0020       | ob20v20   |
| 0.25                            | 0.200                            | -37.4398   | 57.2957  | 761.6                     | 0.01056     | 0.6343 ± 0.0018       | ob25v20   |
| 0.25                            | 0.250                            | -35.1116   | 69.1276  | 970.6                     | 0.00922     | 0.6549 ± 0.0019       | ob25v25   |
| 0.25                            | 0.289                            | -33.0784   | full WP  | 1155.4                    | 0.00786     | 0.6611 ± 0.0017       | ob25v29   |

Results for the degraded ORR fuel homogeneously mixed with 100% of the degraded HLW clayey material are provided in Table 7.3.2.3-2. The water fraction is varied from 0 to 0.289, which is the maximum possible without transporting some of the material out of the WP. The results indicate that k<sub>eff</sub> peaks within the range of water fractions evaluated for this configuration (without removing material), and is well below 0.93 for all cases. Therefore, this configuration does not present a criticality concern.

Table 7.3.2.3-2. Degraded ORR Fuel Completely Homogenized With Clay From Degraded HLW Glass

| Water Fraction | Distance from Top of ORR/Clay Mixture to WP Center (cm) | H/ <sup>235</sup> U Ratio | AENCF (MeV) | k <sub>eff</sub> ± 2σ | Case Name |
|----------------|---|---------------------------|-------------|-----------------------|-----------|
| 0.289          | Full WP   | 4396.5                    | 0.005222    | 0.3307 ± 0.0006       | orrh29    |
| 0.250          | 69.1276   | 3692.8                    | 0.005025    | 0.3457 ± 0.0007       | orrh25    |
| 0.200          | 57.2957   | 2896.9                    | 0.006199    | 0.3597 ± 0.0009       | orrh20    |
| 0.150          | 48.3202   | 2194.7                    | 0.007354    | 0.3684 ± 0.0008       | orrh15    |
| 0.100          | 40.9476   | 1570.5                    | 0.008407    | 0.3664 ± 0.0010       | orrh10    |
| 0.000          | 29.1966   | 509.3                     | 0.016440    | 0.2880 ± 0.0010       | orrh00    |

## 8. Conclusions

Based on the rationale that the conclusions derived by this analysis are for preliminary design and will not be used as input into documents supporting construction, fabrication, or procurement, a notation of TBV or TBD has not been carried to the conclusions of this analysis. Therefore, outputs of this analysis used as inputs into documents supporting construction, fabrication or procurement are required to be controlled and tracked as TBV or TBD in accordance with NLP-3-15, *To Be Verified (TBV) and To Be Determined (TBD) Monitoring System*, or other appropriate procedures.

This analysis examined the degradation scenarios for the DOE-SNF canister and the HLW glass canisters and performed criticality analyses for the range of potential configurations which could occur inside of the waste package. The criticality analyses indicate that an insoluble neutron absorber material is needed to maintain criticality control for several of the degraded configurations evaluated for both the HEU (MIT) and MEU (ORR) aluminum based fuel types. Without the presence of a fairly insoluble neutron absorber, the long-term action of infiltrating water can lead to a small, but significant, probability of criticality for both the HEU and MEU fuels.

The borated stainless steel initially used as the neutron absorber for the intact configuration becomes ineffective as the canister degrades. Preliminary corrosion testing indicates that the borides in the stainless steel matrix have a corrosion rate similar to that of the matrix, and are expected to degrade to a soluble form shortly after they are released from the stainless steel matrix (Ref. 5.26). The resulting boric acid is likely to be transported out of the waste package during the degradation process (Ref. 5.18). However, the criticality analyses have demonstrated that the degraded configurations will meet the criticality control requirements for long-term disposal if the borated stainless steel is replaced with relatively insoluble Gd oxide or phosphate. Utilization of carbon steel for basket fabrication is also shown to have advantages over the use of stainless steel by maximizing the water displacement potential of iron oxide and maximizing the mixing potential of the fuel with the degraded basket materials.

For the MIT canister containing 35.2 kg of 93.5% enriched uranium in the intact basket configuration, approximately 1 kg of Gd is required to be distributed in the basket in the locations originally designated for borated stainless steel if the basket is constructed of stainless steel and 1.25 kg of Gd is required if the basket is constructed of carbon steel. Lesser amounts of Gd were required to maintain criticality control in the degraded configurations. The configuration involving stratified layers of the degraded MIT fuel and the HLW clayey material would be of criticality concern in the absence of absorbers, even with less than 10% (2.9 kg) of the total uranium. If Gd neutron absorbers are assumed to be mixed with the degraded MIT fuel forms, it will require  $\approx 0.200$  kg of Gd to keep the waste package sufficiently subcritical even for the most reactive configuration. If partial credit is taken for the degradation products from the stainless steel basket (half of the iron present as oxide) the amount of Gd required is reduced to

about 0.12 kg. These requirements on the Gd neutron absorber are based on the fact that none of the original uranium loading is lost during the degradation process. If some of the uranium loading is transported out of the waste package, the amount of Gd required is reduced further.

For the ORR canister containing 67.5 kg of 20.56% enriched uranium, only a degraded internal configuration with degraded fuel and basket within the codisposal canister, and the with boron from the axial separator plates removed, presents a criticality concern. However, the criticality analysis has shown that this concern can easily be alleviated by adding iron to the basket structure to provide additional amounts of iron oxide upon basket degradation. This can easily be accomplished without changing the basket dimensions by switching the basket material to carbon steel (possibly a coated carbon steel if it is to be placed in a pool). The iron oxide is insoluble, and would be expected to remain mixed with the degraded fuel. Alternatively, if switching to a carbon steel structural basket is not desired, Gd deposited on carbon steel basket inserts placed in the spaces adjacent to the fuel cells can also be used. In the intact basket with degraded fuel configuration from Phase I, 0.25 kg of Gd in the inserts is sufficient to meet criticality requirements and allow the use of unborated stainless steel in the axial separator plates. In the completely degraded codisposal basket configuration, ≈0.1 kg of Gd is sufficient to maintain criticality control. All other degraded configurations involving degraded ORR fuel in, above, or below the clay formed from the degradation of the HLW glass were below the threshold of concern for criticality without requiring additional measures such as credit for iron oxides or the addition of Gd.

**9. Attachments**

Attachments to this document are listed in Table 9-1 below.

Table 9-1. List of Attachments

| Attachment Number | Description                                  | Pages | Date     |
|-------------------|--|-------|----------|
| I                 | EQ3/6 Output for Degraded DHLW Waste Package | 6     | 10/24/97 |
| II                | MIT Spreadsheet calculations                 | 235   | 10/31/97 |
| III               | ORR Spreadsheet calculations                 | 29    | 11/7/97  |
| IV                | MIT Spreadsheet "mitcol.xls" and "sl15.xls"  | 24    | 12/11/97 |

The following supporting documents are in electronic form on a Colorado Trakker<sup>®</sup> tape. Each file is identified by it's name, size (in bytes), and the date and time of last access.

```

FE_GD      XLS      414,208  10-20-97  4:08p  Fe_gd.xls
ORRPHAZ2  XLW      86,528   10-24-97  8:11a  ORRPHAZ2.XLW
OB10V20   O        209,669  10-24-97  9:33a  OB10V20.O
MITHOMO   XLS      54,784   10-22-97  6:35p  MITHOMO.XLS
    
```

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| OB15V20  | O   | 209,582 | 10-24-97 | 9:33a | OB15V20.O     |
| OB20V20  | O   | 209,788 | 10-24-97 | 9:33a | OB20V20.O     |
| OB25V20  | O   | 209,917 | 10-24-97 | 9:33a | OB25V20.O     |
| OB25V25  | O   | 209,980 | 10-24-97 | 9:33a | OB25V25.O     |
| OB25V29  | O   | 209,020 | 10-24-97 | 9:33a | OB25V29.O     |
| HOMOGEN  | XLS | 87,040  | 10-20-97 | 4:10p | Homogen.xls   |
| ORR060   | O   | 205,686 | 10-24-97 | 9:33a | orr060.O      |
| INVERSE  | XLS | 827,904 | 10-20-97 | 4:10p | Inverse.xls   |
| ORR070   | O   | 205,598 | 10-24-97 | 9:33a | orr070.O      |
| MITCLA~1 | XLS | 101,888 | 10-17-97 | 4:43p | mitclay-2.xls |
| ORR075   | O   | 205,686 | 10-24-97 | 9:33a | orr075.O      |
| ORR080   | O   | 205,598 | 10-24-97 | 9:33a | orr080.O      |
| ORR085   | O   | 205,448 | 10-24-97 | 9:33a | orr085.O      |
| ORR090   | O   | 205,997 | 10-24-97 | 9:33a | orr090.O      |
| ORRH00   | O   | 204,729 | 10-24-97 | 9:33a | orrrh00.O     |
| ORRH10   | O   | 204,792 | 10-24-97 | 9:33a | orrrh10.O     |
| ORRH15   | O   | 204,977 | 10-24-97 | 9:33a | orrrh15.O     |
| ORRH20   | O   | 205,040 | 10-24-97 | 9:33a | orrrh20.O     |
| ORRH25   | O   | 205,281 | 10-24-97 | 9:33a | orrrh25.O     |
| ORRH29   | O   | 204,239 | 10-24-97 | 9:33a | orrrh29.O     |
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| ORRHOM2  | O   | 229,086 | 10-24-97 | 9:33a | orrrhom2.O    |
| ORRHOM3  | O   | 227,922 | 10-24-97 | 9:33a | orrrhom3.O    |
| ORRHOM4  | O   | 232,746 | 10-24-97 | 9:33a | orrrhom4.O    |
| ORRHOM5  | O   | 231,390 | 10-24-97 | 9:33a | orrrhom5.O    |
| ORROZ4A  | O   | 289,601 | 10-24-97 | 9:33a | orroz4a.O     |
| M50B0000 |     | 206,593 | 10-24-97 | 9:37a | m50b000o      |
| M50B0050 |     | 210,358 | 10-24-97 | 9:37a | m50b005o      |
| M50B0100 |     | 210,697 | 10-24-97 | 9:37a | m50b010o      |
| M50B0150 |     | 210,156 | 10-24-97 | 9:37a | m50b015o      |
| M50B0200 |     | 210,219 | 10-24-97 | 9:37a | m50b020o      |
| M50B0250 |     | 210,404 | 10-24-97 | 9:37a | m50b025o      |
| M50T0700 |     | 205,051 | 10-24-97 | 9:37a | m50t070o      |
| M50T0750 |     | 205,292 | 10-24-97 | 9:37a | m50t075o      |
| M50T0800 |     | 205,968 | 10-24-97 | 9:37a | m50t080o      |
| M50T0850 |     | 205,952 | 10-24-97 | 9:37a | m50t085o      |
| M50T0900 |     | 207,282 | 10-24-97 | 9:37a | m50t090o      |
| M75B0000 |     | 206,418 | 10-24-97 | 9:37a | m75b000o      |
| M75B0050 |     | 209,336 | 10-24-97 | 9:37a | m75b005o      |
| M75B0100 |     | 208,453 | 10-24-97 | 9:37a | m75b010o      |
| M75B0150 |     | 210,243 | 10-24-97 | 9:37a | m75b015o      |
| M75B0200 |     | 210,212 | 10-24-97 | 9:37a | m75b020o      |
| M75B0250 |     | 209,100 | 10-24-97 | 9:37a | m75b025o      |
| M75BF000 |     | 209,428 | 10-24-97 | 9:37a | m75bf00o      |
| M75BF020 |     | 213,635 | 10-24-97 | 9:37a | m75bf02o      |
| M75BF040 |     | 212,828 | 10-24-97 | 9:37a | m75bf04o      |
| M75BF060 |     | 212,828 | 10-24-97 | 9:37a | m75bf06o      |
| M75BF080 |     | 213,797 | 10-24-97 | 9:37a | m75bf08o      |
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| M75T0750 |     | 205,834 | 10-24-97 | 9:37a | m75t075o      |
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| M75T0850 |     | 205,047 | 10-24-97 | 9:38a | m75t085o      |



# Waste Package Operations

# Design Analysis

Title: Disposal Criticality Analysis for Aluminum Based Fuel in a Codisposal Waste Package  
- ORR and MIT SNF - Phase II

Document Identifier: BBA000000-01717-0200-00060 REV 00

Page 49 of 51

|          |         |          |       |          |
|----------|---------|----------|-------|----------|
| M75T0900 | 205,114 | 10-24-97 | 9:38a | m75t090o |
| M75TF020 | 210,094 | 10-24-97 | 9:38a | m75tf02o |
| M75TF040 | 210,887 | 10-24-97 | 9:38a | m75tf04o |
| M75TF060 | 210,974 | 10-24-97 | 9:38a | m75tf06o |
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| M75TF100 | 209,918 | 10-24-97 | 9:38a | m75tf10o |
| M75TF120 | 211,089 | 10-24-97 | 9:38a | m75tf12o |
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| MIT0700  | 205,158 | 10-24-97 | 9:38a | mit070o  |
| MIT0750  | 205,246 | 10-24-97 | 9:38a | mit075o  |
| MIT0800  | 205,183 | 10-24-97 | 9:38a | mit080o  |
| MIT0850  | 205,984 | 10-24-97 | 9:38a | mit085o  |
| MIT0900  | 205,896 | 10-24-97 | 9:38a | mit090o  |
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| MITB1200 | 208,945 | 10-24-97 | 9:38a | mitb120o |
| MITB1250 | 210,236 | 10-24-97 | 9:38a | mitb125o |
| MITB1270 | 210,016 | 10-24-97 | 9:38a | mitb127o |
| MITB2150 | 209,963 | 10-24-97 | 9:38a | mitb215o |
| MITB2200 | 210,156 | 10-24-97 | 9:38a | mitb220o |
| MITB2250 | 210,306 | 10-24-97 | 9:38a | mitb225o |
| MITB3150 | 209,373 | 10-24-97 | 9:38a | mitb315o |
| MITB3200 | 210,368 | 10-24-97 | 9:38a | mitb320o |
| MITB3250 | 209,152 | 10-24-97 | 9:38a | mitb325o |
| MITB4150 | 206,115 | 10-24-97 | 9:38a | mitb415o |
| MITB4200 | 206,114 | 10-24-97 | 9:38a | mitb420o |
| MITB4250 | 206,178 | 10-24-97 | 9:38a | mitb425o |
| MITB5150 | 208,858 | 10-24-97 | 9:38a | mitb515o |
| MITB5200 | 208,945 | 10-24-97 | 9:38a | mitb520o |
| MITB5250 | 208,833 | 10-24-97 | 9:38a | mitb525o |
| MITB6150 | 208,858 | 10-24-97 | 9:38a | mitb615o |
| MITB6200 | 210,243 | 10-24-97 | 9:38a | mitb620o |
| MITB6250 | 207,952 | 10-24-97 | 9:38a | mitb625o |
| MITB6270 | 208,841 | 10-24-97 | 9:38a | mitb627o |
| MITB7150 | 208,945 | 10-24-97 | 9:38a | mitb715o |
| MITB7200 | 208,857 | 10-24-97 | 9:38a | mitb720o |
| MITB7250 | 207,952 | 10-24-97 | 9:38a | mitb725o |
| MITFE120 | 206,232 | 10-24-97 | 9:38a | mitfe12o |
| MITFE1KO | 206,162 | 10-24-97 | 9:38a | mitfe1ko |
| MITFE3KO | 206,145 | 10-24-97 | 9:38a | mitfe3ko |
| MITFE6KO | 205,037 | 10-24-97 | 9:38a | mitfe6ko |
| MITFE850 | 206,232 | 10-24-97 | 9:38a | mitfe85o |
| MITFE8KO | 206,232 | 10-24-97 | 9:38a | mitfe8ko |
| MITFE9KO | 206,232 | 10-24-97 | 9:38a | mitfe9ko |
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| MITGD020 | 213,619 | 10-24-97 | 9:38a | mitgd02o |
| MITGD050 | 212,666 | 10-24-97 | 9:38a | mitgd05o |
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| MITGD20  | 213,722 | 10-24-97 | 9:38a | mitgd2o  |
| MITH000  | 205,303 | 10-24-97 | 9:38a | mith00o  |
| MITH010  | 205,366 | 10-24-97 | 9:38a | mith01o  |

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| MIT1000  | 207,222 | 10-24-97 | 9:38a | mits100o |
| MIT2000  | 208,068 | 10-24-97 | 9:38a | mits200o |
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| MIT300   | 206,632 | 10-24-97 | 9:38a | mits30o  |
| MIT360   | 208,558 | 10-24-97 | 9:38a | mits36o  |
| MIT500   | 208,471 | 10-24-97 | 9:38a | mits50o  |
| MIT740   | 208,208 | 10-24-97 | 9:38a | mits74o  |
| MITT020  | 209,404 | 10-24-97 | 9:38a | mitt02o  |
| MITT050  | 209,403 | 10-24-97 | 9:38a | mitt05o  |
| MITT100  | 209,491 | 10-24-97 | 9:38a | mitt10o  |
| MITT200  | 209,491 | 10-24-97 | 9:38a | mitt20o  |
| MITTF020 | 211,037 | 10-24-97 | 9:38a | mittf02o |
| MITTF050 | 209,334 | 10-24-97 | 9:38a | mittf05o |
| MITTF100 | 209,636 | 10-24-97 | 9:38a | mittf10o |
| MITTF200 | 209,739 | 10-24-97 | 9:38a | mittf20o |
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| MITOZ4GO | 444,008 | 10-24-97 | 9:45a | mitoz4g0 |
| MITOZ5GO | 443,938 | 10-24-97 | 9:45a | mitoz5g0 |
| MITOZ6GO | 443,841 | 10-24-97 | 9:45a | mitoz6g0 |
| MITOZ3GO | 443,158 | 10-24-97 | 9:45a | mitoz3g0 |
| MITOZ8GO | 438,999 | 10-24-97 | 9:46a | mitoz8g0 |
| MITOZ9GO | 423,012 | 10-24-97 | 9:46a | mitoz9g0 |
| MITHOM80 | 232,865 | 10-24-97 | 9:46a | mithom80 |
| MITHOM40 | 232,804 | 10-24-97 | 9:46a | mithom40 |
| MITHOMFO | 232,416 | 10-24-97 | 9:46a | mithomf0 |
| MITHOM30 | 232,162 | 10-24-97 | 9:46a | mithom30 |
| MITHOM20 | 232,162 | 10-24-97 | 9:46a | mithom20 |
| MITHOM90 | 231,960 | 10-24-97 | 9:46a | mithom90 |
| MITHOM70 | 231,689 | 10-24-97 | 9:46a | mithom70 |
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| MITHOM60 | 229,150 | 10-24-97 | 9:46a | mithom60 |
| MITHOM50 | 227,291 | 10-24-97 | 9:46a | mithom50 |

**Files added for Rev 00B:**

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| MITOZ2GO | 443,728 | 11-10-97 | 4:28p    | mitoz2g0        |
| MITBZG10 | 474,499 | 11-10-97 | 4:28p    | mitbzg10        |
| MITHOMGO | 231,446 | 11-10-97 | 4:28p    | mithomg0        |
| MITHOMHO | 231,856 | 11-10-97 | 4:28p    | mithomh0        |
| MITHOMIO | 228,754 | 11-10-97 | 4:28p    | mithomi0        |
| MIT0790  | 205,246 | 11-10-97 | 4:30p    | mit079o         |
| MIT0810  | 205,984 | 11-10-97 | 4:30p    | mit081o         |
| MIT0820  | 205,431 | 11-10-97 | 4:30p    | mit082o         |
| MIT0830  | 204,928 | 11-10-97 | 4:30p    | mit083o         |
| MIT0840  | 205,547 | 11-10-97 | 4:30p    | mit084o         |
| ORRHOM7  | 0       | 232,090  | 11-11-97 | 7:46a orrhom7.0 |
| ORROZ4C  | 0       | 343,477  | 11-11-97 | 7:47a orroz4c.0 |
| ORRHOM6  | 0       | 227,730  | 11-11-97 | 7:59a orrhom6.0 |

**Files added for Rev 00C:**

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| MTYF6G00 | 208,541 | 12-09-97 | 9:34a | mtyf6g0o |
| MITXFG00 | 209,015 | 12-04-97 | 2:43p | mitxfg0o |

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| MTXF6G00 |     | 209,431 | 12-08-97 | 12:31p | mtxf6g0o   |
| MITXFG20 |     | 213,884 | 12-04-97 | 2:43p  | mitxfg2o   |
| MITXFG40 |     | 212,828 | 12-04-97 | 2:43p  | mitxfg4o   |
| MITXFG50 |     | 213,797 | 12-04-97 | 2:43p  | mitxfg5o   |
| MITXGD10 |     | 212,755 | 12-04-97 | 2:43p  | mitxgd1o   |
| MITXGD50 |     | 213,057 | 12-04-97 | 2:43p  | mitxgd5o   |
| M5GHOMO  |     | 430,227 | 12-04-97 | 3:42p  | m5ghomo    |
| MITOZXGO |     | 418,767 | 12-05-97 | 8:13a  | MITOZXGO   |
| MITOZYGO |     | 423,222 | 12-05-97 | 8:13a  | MITOZYGO   |
| MITF9G10 |     | 210,245 | 12-06-97 | 4:30p  | mitf9g1o   |
| MITF6G60 |     | 210,982 | 12-06-97 | 4:30p  | mitf6g6o   |
| MITF6G50 |     | 210,013 | 12-06-97 | 4:30p  | mitf6g5o   |
| MITCOL   | XLS | 45,056  | 12-11-97 | 2:05p  | mitcol.xls |
| MITCOL1  | O   | 231,874 | 12-11-97 | 3:08p  | mitcol1.O  |
| MITCOL2  | O   | 230,814 | 12-11-97 | 3:08p  | mitcol2.O  |
| MITCOL4  | O   | 231,784 | 12-11-97 | 3:08p  | mitcol4.O  |

SUMMARY OF DEGRADATION OF THE DHLW AND ASSOCIATED METALS PRIOR TO BREACH OF THE MIT FUEL CO-DISPOSAL CANISTER

Run UALL1b5mm, last printout

Steps completed = 15, iter = 3, ncorr = 0  
 Most rapidly changing is zvc1g1(Pu+++ ) = -37.1988

-----  
 Reaction progress = 7.960000000000000E+03  
 Log of reaction progress = 3.9009131

Time = 1.816E+11 sec  
 = 2.102E+06 days  
 = 5.756E+03 years

Log sec = 11.259  
 Log days = 6.323  
 Log years = 3.760

Temperature = 25.000 degrees C  
 total pressure = 1.013 bars

Step size is limited by the print requirement

Maximum value of time

--- Reactant Summary ---

| Reactant    | Moles      | Delta moles | Mass, g    | Delta Mass, g |
|-------------|------------|-------------|------------|---------------|
| XM-19 steel | 1.2151E+00 | 1.4996E-01  | 6.6287E+01 | 8.1808E+00    |
| 304L steel  | 1.6148E+01 | 1.9515E+00  | 8.8233E+02 | 1.0663E+02    |
| Alloy 625   | 1.9530E+01 | 5.2624E-02  | 1.1549E+03 | 3.1120E+00    |
| DHLW Glass  | .0000E+00  | 1.1178E+02  | .0000E+00  | 2.2337E+03    |
| J-13 water  | 2.0571E+01 | 1.9995E+01  | 1.2355E+02 | 1.2009E+02    |

Current total mass = 2.22710E+03 grams  
 Delta total mass = 2.47175E+03 grams  
 Delta total volume = .00000 cc

|                       | pH     | Eh    | pe         |
|-----------------------|--------|-------|------------|
| modified NBS pH scale | 7.7523 | .7604 | 1.2855E+01 |
| rational pH scale     | 7.6893 | .7642 | 1.2918E+01 |

pHCl = 11.5215

Oxygen fugacity = 2.09991E-01  
 Log oxygen fugacity = -.67780

Activity of water = .99941  
 Log activity of water = -.00025

Ionic strength = 3.224514E-02 molal  
 Sum of molalities = .0357702527525

Osmotic coefficient = .91060

Mass of solution = 1.122168 kg  
 Mass of solutes = .002143 kg  
 Conc. of solutes = .191005 per cent (w/w)

Moles of solvent H2O = 6.21708E+01  
 Mass of solvent H2O = 1.12002E+00 kg

| Product            | Log moles | Moles      | Mass, g    | Volume, cc |
|--------------------|-----------|------------|------------|------------|
| Celadonite         | -.3834    | 4.1358E-01 | 1.6408E+02 | 6.4973E+01 |
| Chalcedony         | .7596     | 5.7485E+00 | 3.4539E+02 | 1.3042E+02 |
| Dolomite-ord       | -.5209    | 3.0139E-01 | 5.5577E+01 | 1.9391E+01 |
| Fluorapatite       | -2.7829   | 1.6486E-03 | 8.3140E-01 | 8.2431E-01 |
| Maximum_Microcline | -.1672    | 6.8051E-01 | 1.8941E+02 | 7.3999E+01 |
| Ni2SiO4            | -.5778    | 2.6436E-01 | 5.5375E+01 | 1.1265E+01 |
| PuO2               | -5.5313   | 2.9427E-06 | 8.1219E-04 | 7.0125E-05 |
| Pyrolusite         | -.1476    | 7.1186E-01 | 6.1887E+01 | 3.5593E+02 |
| fix CO2(g)         | 4.9009    | 7.9595E+04 | 3.5030E+06 | .0000E+00  |
| fix O2(g)          | 4.9009    | 7.9599E+04 | 2.5471E+06 | .0000E+00  |
| Smectite-di        | .3507     | 2.2424E+00 | 9.5521E+02 | 2.9684E+02 |
| Beidellite-Ca      | -11.5217  | 3.0079E-12 | 1.1026E-09 | 3.8962E-10 |
| Beidellite-K       | -11.3930  | 4.0455E-12 | 1.5084E-09 | 5.4088E-10 |
| Beidellite-Mg      | -11.5557  | 2.7817E-12 | 1.0124E-09 | 3.4268E-10 |
| Beidellite-Na      | -11.6296  | 2.3462E-12 | 8.6230E-10 | 3.0627E-10 |
| Montmor-Ca         | -5.9220   | 1.1967E-06 | 4.3803E-04 | 5.9833E-04 |
| Montmor-K          | -5.5803   | 2.6285E-06 | 9.7867E-04 | 1.3142E-03 |
| Montmor-Mg         | -5.7451   | 1.7986E-06 | 6.5367E-04 | 8.9928E-04 |
| Montmor-Na         | -5.8278   | 1.4866E-06 | 5.4559E-04 | 7.4328E-04 |
| Nontronite-Ca      | -.2568    | 5.5363E-01 | 2.3490E+02 | 7.2581E+01 |
| Nontronite-K       | -.1281    | 7.4460E-01 | 3.2061E+02 | 1.0072E+02 |
| Nontronite-Mg      | -.2904    | 5.1235E-01 | 2.1606E+02 | 6.6483E+01 |
| Nontronite-Na      | -.3647    | 4.3183E-01 | 1.8364E+02 | 5.7049E+01 |
| Rhabdophane-ss     | -2.2946   | 5.0751E-03 | 1.3120E+00 | .0000E+00  |
| LaPO4:H2O          | -14.0000  | 9.9997E-15 | 2.5189E-12 | .0000E+00  |
| CePO4:H2O          | -24.0001  | 9.9984E-25 | 2.5306E-22 | .0000E+00  |
| NdPO4:H2O          | -2.3973   | 4.0062E-03 | 1.0305E+00 | .0000E+00  |
| GdPO4:H2O          | -14.0005  | 9.9877E-15 | 2.6990E-12 | .0000E+00  |
| SmPO4:H2O          | -2.9710   | 1.0690E-03 | 2.8151E-01 | .0000E+00  |

Mass, grams                      Volume, cc

|           |              |              |
|-----------|--------------|--------------|
| Created   | 6.051870E+06 | 9.536411E+02 |
| Destroyed | 2.471755E+03 | .000000E+00  |
| Net       | 6.049399E+06 | 9.536411E+02 |

Warning-- these volume totals may be incomplete because of missing partial molar volume data in the data base

N.B. They will in this case also be incomplete because they don't include rhabdophane.

Also, note that the masses include the gases, O2 and CO2. Thus the mass totals differ greatly from the actual total of solids produced.

Density of rhabdophane is about 4 g/cm<sup>3</sup>. This can be used to get volumes.

-----  
 SUMMARY OF DEGRADATION AFTER THE CO-DISPOSAL CANISTER HAS BEEN ADDED AND PARTIALLY DEGRADED

Run UAlIIB5mm, last printout of results

Differences from the above reflect additions of metal corrosion products. The run assumes complete equilibrium between the previous products and the new ones. In actuality this is unlikely to occur, but at least the data provide

an approximation to expected results.

Steps completed = 17, iter = 3, ncorr = 0

Most rapidly changing is zvc1g1(Gd+++ ) = -20.7674

-----

Reaction progress = 9.03750000000000E+03  
 Log of reaction progress = 3.9560483

Time = 2.065E+11 sec  
 = 2.391E+06 days  
 = 6.545E+03 years

Log sec = 11.315  
 Log days = 6.379  
 Log years = 3.816

Temperature = 25.000 degrees C  
 total pressure = 1.013 bars

Maximum value of time

--- Reactant Summary ---

| Reactant      | Moles      | Delta moles | Mass, g    | Delta Mass, g |
|---------------|------------|-------------|------------|---------------|
| MIT fuel meat | .0000E+00  | 2.5000E-01  | .0000E+00  | 1.7683E+01    |
| Aluminum      | .0000E+00  | 1.3880E+00  | .0000E+00  | 3.7450E+01    |
| 316L steel    | 3.2597E+00 | 6.3629E-02  | 1.8041E+02 | 3.5215E+00    |
| XM-19 steel   | 2.7908E+00 | 1.9090E-01  | 1.5225E+02 | 1.0414E+01    |
| 304L steel    | 1.5878E+01 | 2.2197E+00  | 8.6758E+02 | 1.2128E+02    |
| Borated steel | 4.8117E-01 | 2.1688E-01  | 2.5294E+01 | 1.1401E+01    |
| Alloy 625     | 1.9530E+01 | 5.9836E-02  | 1.1549E+03 | 3.5385E+00    |
| J-13 water    | 2.9243E+03 | 1.9830E+01  | 1.7563E+04 | 1.1910E+02    |

Current total mass = 1.99436E+04 grams  
 Delta total mass = 3.24391E+02 grams  
 Delta total volume = 13.87861 cc

|                       | pH     | Eh    | pe         |
|-----------------------|--------|-------|------------|
| modified NBS pH scale | 6.9024 | .8107 | 1.3705E+01 |
| rational pH scale     | 6.8242 | .8153 | 1.3783E+01 |

pHCl = 10.6938

Oxygen fugacity = 2.09991E-01  
 Log oxygen fugacity = -.67780

Activity of water = .99931  
 Log activity of water = -.00030

Ionic strength = 6.314517E-02 molal  
 Sum of molalities = .0461725949005  
 Osmotic coefficient = .83343

Mass of solution = 1.122575 kg

Mass of solutes = .003471 kg  
 Conc. of solutes = .309173 per cent (w/w)

Moles of solvent H2O = 6.21197E+01  
 Mass of solvent H2O = 1.11910E+00 kg

| Product            | Log moles | Moles      | Mass, g    | Volume, cc |
|--------------------|-----------|------------|------------|------------|
| Celadonite         | -.5549    | 2.7869E-01 | 1.1057E+02 | 4.3783E+01 |
| Chalcedony         | -.0061    | 9.8612E-01 | 5.9250E+01 | 2.2373E+01 |
| Fluorapatite       | -2.7687   | 1.7034E-03 | 8.5903E-01 | 8.5170E-01 |
| Maximum_Microcline | -.0164    | 9.6287E-01 | 2.6800E+02 | 1.0470E+02 |
| Ni2SiO4            | -.5256    | 2.9812E-01 | 6.2446E+01 | 1.2703E+01 |
| PuO2               | -5.5313   | 2.9427E-06 | 8.1219E-04 | 7.0125E-05 |
| Pyrolusite         | -.1399    | 7.2460E-01 | 6.2994E+01 | 3.6230E+02 |
| Soddyite           | -1.5865   | 2.5912E-02 | 1.7314E+01 | 3.4015E+00 |
| Stilbite           | -.5697    | 2.6934E-01 | 1.9247E+02 | 8.9824E+01 |
| fix CO2(g)         | 4.9561    | 9.0396E+04 | 3.9783E+06 | .0000E+00  |
| fix O2(g)          | 4.9562    | 9.0397E+04 | 2.8926E+06 | .0000E+00  |
| Smectite-di        | .4623     | 2.8993E+00 | 1.1994E+03 | 5.5372E+02 |
| Beidellite-Ca      | -4.6819   | 2.0800E-05 | 7.6246E-03 | 2.6943E-03 |
| Beidellite-K       | -5.1078   | 7.8019E-06 | 2.9090E-03 | 1.0431E-03 |
| Beidellite-Mg      | -4.2518   | 5.6007E-05 | 2.0384E-02 | 6.8996E-03 |
| Beidellite-Na      | -5.4898   | 3.2371E-06 | 1.1897E-03 | 4.2257E-04 |
| Montmor-Ca         | -1.1195   | 7.5939E-02 | 2.7797E+01 | 3.7969E+01 |
| Montmor-K          | -1.3324   | 4.6519E-02 | 1.7320E+01 | 2.3259E+01 |
| Montmor-Mg         | -.4784    | 3.3232E-01 | 1.2078E+02 | 1.6616E+02 |
| Montmor-Na         | -1.7253   | 1.8822E-02 | 6.9081E+00 | 9.4111E+00 |
| Nontronite-Ca      | -.2410    | 5.7407E-01 | 2.4357E+02 | 7.5261E+01 |
| Nontronite-K       | -.6669    | 2.1533E-01 | 9.2716E+01 | 2.9127E+01 |
| Nontronite-Mg      | .1894     | 1.5468E+00 | 6.5229E+02 | 2.0072E+02 |
| Nontronite-Na      | -1.0489   | 8.9341E-02 | 3.7994E+01 | 1.1803E+01 |
| Rhabdophane-ss     | -2.2946   | 5.0751E-03 | 1.3120E+00 | .0000E+00  |
| LaPO4:H2O          | -14.0000  | 9.9997E-15 | 2.5189E-12 | .0000E+00  |
| CePO4:H2O          | -24.0001  | 9.9984E-25 | 2.5306E-22 | .0000E+00  |
| NdPO4:H2O          | -2.3973   | 4.0062E-03 | 1.0305E+00 | .0000E+00  |
| GdPO4:H2O          | -14.0005  | 9.9877E-15 | 2.6990E-12 | .0000E+00  |
| SmPO4:H2O          | -2.9710   | 1.0690E-03 | 2.8151E-01 | .0000E+00  |

--- Grand Summary of Solid Phases (E.S.+P.R.S.+reactants) ---

| Phase/End-member   | Log moles | Moles      | Mass, g    | Volume, cc |
|--------------------|-----------|------------|------------|------------|
| Aluminum           | -999.0000 | .0000E+00  | .0000E+00  | .0000E+00  |
| Celadonite         | -.5549    | 2.7869E-01 | 1.1057E+02 | 4.3783E+01 |
| Chalcedony         | -.0061    | 9.8612E-01 | 5.9250E+01 | 2.2373E+01 |
| Fluorapatite       | -2.7687   | 1.7034E-03 | 8.5903E-01 | 8.5170E-01 |
| Maximum_Microcline | -.0164    | 9.6287E-01 | 2.6800E+02 | 1.0470E+02 |
| Ni2SiO4            | -.5256    | 2.9812E-01 | 6.2446E+01 | 1.2703E+01 |
| PuO2               | -5.5313   | 2.9427E-06 | 8.1219E-04 | 7.0125E-05 |
| Pyrolusite         | -.1399    | 7.2460E-01 | 6.2994E+01 | 3.6230E+02 |
| Soddyite           | -1.5865   | 2.5912E-02 | 1.7314E+01 | 3.4015E+00 |
| Stilbite           | -.5697    | 2.6934E-01 | 1.9247E+02 | 8.9824E+01 |
| fix CO2(g)         | 4.9561    | 9.0396E+04 | 3.9783E+06 | .0000E+00  |
| fix O2(g)          | 4.9562    | 9.0397E+04 | 2.8926E+06 | .0000E+00  |
| Smectite-di        | .4623     | 2.8993E+00 |            |            |
| Beidellite-Ca      | -4.6819   | 2.0800E-05 | 7.6246E-03 | 2.6943E-03 |
| Beidellite-K       | -5.1078   | 7.8019E-06 | 2.9090E-03 | 1.0431E-03 |
| Beidellite-Mg      | -4.2518   | 5.6007E-05 | 2.0384E-02 | 6.8996E-03 |
| Beidellite-Na      | -5.4898   | 3.2371E-06 | 1.1897E-03 | 4.2257E-04 |
| Montmor-Ca         | -1.1195   | 7.5939E-02 | 2.7797E+01 | 3.7969E+01 |
| Montmor-K          | -1.3324   | 4.6519E-02 | 1.7320E+01 | 2.3259E+01 |
| Montmor-Mg         | -.4784    | 3.3232E-01 | 1.2078E+02 | 1.6616E+02 |
| Montmor-Na         | -1.7253   | 1.8822E-02 | 6.9081E+00 | 9.4111E+00 |
| Nontronite-Ca      | -.2410    | 5.7407E-01 | 2.4357E+02 | 7.5261E+01 |
| Nontronite-K       | -.6669    | 2.1533E-01 | 9.2716E+01 | 2.9127E+01 |

|                |          |            |            |            |
|----------------|----------|------------|------------|------------|
| Nontronite-Mg  | .1894    | 1.5468E+00 | 6.5229E+02 | 2.0072E+02 |
| Nontronite-Na  | -1.0489  | 8.9341E-02 | 3.7994E+01 | 1.1803E+01 |
| Rhabdophane-ss | -2.2946  | 5.0751E-03 |            |            |
| LaPO4:H2O      | -14.0000 | 9.9997E-15 | 2.5189E-12 | .0000E+00  |
| CePO4:H2O      | -24.0001 | 9.9984E-25 | 2.5306E-22 | .0000E+00  |
| NdPO4:H2O      | -2.3973  | 4.0062E-03 | 1.0305E+00 | .0000E+00  |
| GdPO4:H2O      | -14.0005 | 9.9877E-15 | 2.6990E-12 | .0000E+00  |
| SmPO4:H2O      | -2.9710  | 1.0690E-03 | 2.8151E-01 | .0000E+00  |

|           | Mass, grams  | Volume, cc   |
|-----------|--------------|--------------|
| Created   | 6.872878E+06 | 1.193656E+03 |
| Destroyed | 3.243909E+02 | 1.387861E+01 |
| Net       | 6.872554E+06 | 1.179778E+03 |

Warning-- these volume totals may be incomplete because of missing partial molar volume data in the data base

N.B. See additional comments above following this part of the printout

-----  
 SUMMARY OF DEGRADATION OF THE CO-DISPOSAL CANISTER ONLY IN J-13 WATER

Last printout of run UAlIc5mm

Steps completed = 20, iter = 1, ncorr = 0  
 Most rapidly changing is zvc1g(Al+++ ) = -10.4738

-----  
 Reaction progress = 2.287500000000000E+03  
 Log of reaction progress = 3.3593611

Time = 5.290E+10 sec  
 = 6.122E+05 days  
 = 1.676E+03 years

Log sec = 10.723  
 Log days = 5.787  
 Log years = 3.224

Temperature = 25.000 degrees C  
 total pressure = 1.013 bars

Maximum value of time

--- Reactant Summary ---

| Reactant      | Moles      | Delta moles | Mass, g    | Delta Mass, g |
|---------------|------------|-------------|------------|---------------|
| MIT fuel meat | .0000E+00  | 2.5000E-01  | .0000E+00  | 1.7683E+01    |
| Aluminum      | .0000E+00  | 1.3880E+00  | .0000E+00  | 3.7450E+01    |
| 316L steel    | 3.1873E+00 | 1.3514E-01  | 1.7640E+02 | 7.4789E+00    |
| XM-19 steel   | 1.4007E+00 | 8.7216E-02  | 7.6412E+01 | 4.7578E+00    |
| Borated steel | 2.3730E-01 | 4.6077E-01  | 1.2474E+01 | 2.4222E+01    |
| Alloy 625     | 1.9530E+01 | 1.5346E-02  | 1.1549E+03 | 9.0749E-01    |
| J-13 water    | 1.7141E+03 | 1.7495E+01  | 1.0295E+04 | 1.0507E+02    |

Current total mass = 1.17149E+04 grams  
 Delta total mass = 1.97569E+02 grams



Delta total volume = 13.87861 cc

|                       |        |       |            |
|-----------------------|--------|-------|------------|
|                       | pH     | Eh    | pe         |
| modified NBS pH scale | 6.0655 | .8602 | 1.4541E+01 |
| rational pH scale     | 6.0063 | .8637 | 1.4601E+01 |

pHCl = 9.8290

Oxygen fugacity = 2.09991E-01  
 Log oxygen fugacity = -.67780

Activity of water = .99965  
 Log activity of water = -.00015

Ionic strength = 2.693815E-02 molal  
 Sum of molalities = .0217650696682  
 Osmotic coefficient = .88454

Mass of solution = 1.107143 kg  
 Mass of solutes = .002099 kg  
 Conc. of solutes = .189626 per cent (w/w)

Moles of solvent H2O = 6.13392E+01  
 Mass of solvent H2O = 1.10504E+00 kg

| Product           | Log moles | Moles      | Mass, g    | Volume, cc |
|-------------------|-----------|------------|------------|------------|
| (UO2)3(P04)2:4H2O | -3.7594   | 1.7403E-04 | 1.8657E-01 | 8.7013E-02 |
| Diaspore          | .2003     | 1.5862E+00 | 9.5151E+01 | 2.8170E+01 |
| Hematite          | -.7037    | 1.9785E-01 | 3.1595E+01 | 5.9897E+00 |
| Pyrolusite        | -1.8010   | 1.5812E-02 | 1.3746E+00 | 7.9059E+00 |
| Soddyite          | -1.9308   | 1.1726E-02 | 7.8350E+00 | 1.5393E+00 |
| Trevorite         | -2.5344   | 2.9217E-03 | 6.8479E-01 | 1.4609E+00 |
| UO3:2H2O          | -1.5573   | 2.7715E-02 | 8.9258E+00 | 1.3857E+01 |
| fix CO2(g)        | 4.3617    | 2.3000E+04 | 1.0122E+06 | .0000E+00  |
| fix O2(g)         | 4.3617    | 2.2998E+04 | 7.3591E+05 | .0000E+00  |

--- Grand Summary of Solid Phases (E.S.+P.R.S.+reactants) ---

| Phase/End-member  | Log moles | Moles      | Mass, g    | Volume, cc |
|-------------------|-----------|------------|------------|------------|
| (UO2)3(P04)2:4H2O | -3.7594   | 1.7403E-04 | 1.8657E-01 | 8.7013E-02 |
| Aluminum          | -999.0000 | .0000E+00  | .0000E+00  | .0000E+00  |
| Diaspore          | .2003     | 1.5862E+00 | 9.5151E+01 | 2.8170E+01 |
| Hematite          | -.7037    | 1.9785E-01 | 3.1595E+01 | 5.9897E+00 |
| Pyrolusite        | -1.8010   | 1.5812E-02 | 1.3746E+00 | 7.9059E+00 |
| Soddyite          | -1.9308   | 1.1726E-02 | 7.8350E+00 | 1.5393E+00 |
| Trevorite         | -2.5344   | 2.9217E-03 | 6.8479E-01 | 1.4609E+00 |
| UO3:2H2O          | -1.5573   | 2.7715E-02 | 8.9258E+00 | 1.3857E+01 |
| fix CO2(g)        | 4.3617    | 2.3000E+04 | 1.0122E+06 | .0000E+00  |
| fix O2(g)         | 4.3617    | 2.2998E+04 | 7.3591E+05 | .0000E+00  |

|           | Mass, grams  | Volume, cc   |
|-----------|--------------|--------------|
| Created   | 1.748284E+06 | 5.901043E+01 |
| Destroyed | 1.975694E+02 | 1.387861E+01 |
| Net       | 1.748087E+06 | 4.513182E+01 |

MITHOMO

|  |  |             |          |
|--|--|-------------|----------|
|  |  |             |          |
|  | Mass of U-235 = 514.25 g/Assembly  |             |          |
|  | Mass of U-234 = $514.25 \times 0.01 / 0.935 = 5.5$ g/Assembly  |             |          |
|  | Mass of U-238 = $514.25 \times 0.055 / 0.935 = 30.25$ g/Assembly   |             |          |
|  | Mass of Al in the Fuel = $550 \times 0.305 / 0.695 = 241.367$ g/Assembly   |             |          |
|  | Fuel Length = 22.75 in. = 57.785 cm  |             |          |
|  | Fuel Width = 2.177 in. = 5.52958 cm  |             |          |
|  | Fuel Thickness = 0.03 in. = 0.0762 cm  |             |          |
|  | Fuel Volume = $15 \times 57.785 \times 5.52958 \times 0.0762 = 365.22$ cm <sup>3</sup> /Assembly                             |             |          |
|  | Aluminum Clad Length = 23 in. = 58.42 cm   |             |          |
|  | Aluminum Clad Width = 2.552 in. = 6.48208 cm   |             |          |
|  | Aluminum Clad Thickness = 0.08 in = 0.2032 cm  |             |          |
|  | Clad Volume = $15 \times 2 \times 58.42 \times 6.48208 \times 0.2032 = 2308.452$ cm <sup>3</sup> /Assembly                   |             |          |
|  | Density of Al = 2.6989 g/cm <sup>3</sup> (Ref. 5.15)   |             |          |
|  | Mass of Al in the Clad = $2.6989 \times 2308.452 = 6230.281$ g/Assembly  |             |          |
|  | Total Mass of Al = $6230.281 + 241.367 = 6471.648$ g/Assembly  |             |          |
|  | Total U in the Codisposal Canister = $4 \times 16 \times 550 = 35200$ g  |             |          |
|  | Total Al in the Codisposal Canister = $4 \times 16 \times 6471.648 = 414190$ g   |             |          |
|  | Density of UO <sub>2</sub> = 10.96 g/cm <sup>3</sup> (Ref. 5.15)   |             |          |
|  | Density of Al <sub>2</sub> O <sub>3</sub> = 3.965 g/cm <sup>3</sup> (Ref. 5.15)  |             |          |
|  | Mass of UO <sub>2</sub> = $35200 \times 267 / 235 = 39993$ g   |             |          |
|  | Mass of Al <sub>2</sub> O <sub>3</sub> = $414190 \times 102 / 54 = 782360$ g   |             |          |
|  | Total Volume of UO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> = $782360 / 3.965 + 39993 / 10.96 = 200970$ cm <sup>3</sup> |             |          |
|  | Density of Fe <sub>2</sub> O <sub>3</sub> = 5.24 g/cm <sup>3</sup> (Ref. 5.15)   |             |          |
|  | Density of Gd = 7.9004 g/cm <sup>3</sup> (Ref. 5.15)   |             |          |
|  | The following Volumes and Masses are from Reference 5.18   |             |          |
|  | Material   | Volume (cc) | Mass (g) |
|  | 316 SS   | 66799.65    | 531257.6 |
|  | XM-19  | 60532.16    | 476993.4 |
|  | Borated SS   | 13685.71    | 105995.8 |
|  | Al   | 40448.79    | 109292.6 |
|  | U-Al   | 23406.23    | 51212.84 |
|  | 304L   | 366120.9    | 2892355  |
|  | DHLW glass   | 2417155     | 6888892  |

## Mithomo

|    | A | B                                   | C                           | D   | E                     | F        | G           |
|----|---|-------------------------------------|-----------------------------|---|-----------------------|----------|-------------|
| 1  |   |                                     |                             |   |                       |          |             |
| 2  |   |                                     |                             | Degraded DHLW Glass Clayey Material With Degraded C |                       |          |             |
| 3  |   | Total DHLW Vol.                     | 4993264.683 cm <sup>3</sup> | from MITCLAY-2.XLS                                  |                       |          |             |
| 4  |   |                                     |                             |   |                       |          | Degraded DH |
| 5  |   | Cylinder Segment Volume Calculation |                             |   |                       |          | 1001.50C    |
| 6  |   | (Degraded DHLW)                     |                             |   |                       |          | 8016.50C    |
| 7  |   |                                     |                             |   |                       |          | 9019.50C    |
| 8  |   | Geometry Calculations               |                             |   |                       |          | 11023.50C   |
| 9  |   | Cylinder Radius                     |                             | 86.5 cm   |                       |          | 12000.50C   |
| 10 |   | Cylinder Length                     |                             | 304 cm  |                       |          | 13027.50C   |
| 11 |   | Cylinder Volume                     |                             | 7.14588E+06 cm <sup>3</sup>                         |                       |          | 14000.50C   |
| 12 |   | 1/2 Cylinder Volume                 |                             | 3.57294E+06   |                       |          | 15031.50C   |
| 13 |   | DHLW Void Fraction                  |                             |   |                       |          | 19000.50C   |
| 14 |   | DHLW Volume                         |                             | 6.65769E+06 cm <sup>3</sup>                         |                       |          | 20000.50C   |
| 15 |   | Calculated Volume                   |                             | 6.65769E+06   |                       |          | 25055.50C   |
| 16 |   | Distance from Center                |                             | 7.90127E+01 cm                                      |                       |          | 26000.55C   |
| 17 |   | (DHLW)                              |                             |   |                       |          | 28000.50C   |
| 18 |   |                                     |                             |   |                       |          | 92239.55C   |
| 19 |   | Codisposal Canister Radius          |                             | 21.465 cm   |                       |          |             |
| 20 |   | Codisposal Canister Height          |                             | 262.8 cm  |                       |          | TOTAL       |
| 21 |   | Codisposal Canister Volume          |                             | 380396.9439 cm <sup>3</sup>                         |                       |          |             |
| 22 |   |                                     |                             |   |                       |          | Degraded DH |
| 23 |   | Total Volume of WP Contents         |                             | 7.03808E+06 cm <sup>3</sup>                         |                       |          | 1001.50C    |
| 24 |   |                                     |                             |   |                       |          | 8016.50C    |
| 25 |   |                                     |                             |   |                       |          | 9019.50C    |
| 26 |   |                                     |                             |   |                       |          | 11023.50C   |
| 27 |   |                                     |                             |   |                       |          | 12000.50C   |
| 28 |   |                                     |                             |   |                       |          | 13027.50C   |
| 29 |   |                                     |                             |   |                       |          | 14000.50C   |
| 30 |   |                                     |                             |   |                       |          | 15031.50C   |
| 31 |   |                                     |                             |   |                       |          | 19000.50C   |
| 32 |   |                                     |                             |   |                       |          | 20000.50C   |
| 33 |   |                                     |                             |   |                       |          | 25055.50C   |
| 34 |   |                                     |                             |   |                       |          | 26000.55C   |
| 35 |   |                                     |                             |   |                       |          | 28000.50C   |
| 36 |   |                                     |                             |   |                       |          | 92239.55C   |
| 37 |   |                                     |                             |   |                       |          |             |
| 38 |   |                                     | Avogadro's number =         |   | 6.02252E-01 atoms/mol |          | TOTAL       |
| 39 |   |                                     |                             |   |                       |          |             |
| 40 |   |                                     |                             | oxide mass X  | oxide mass            | density  | volume      |
| 41 |   | gm U-234                            | 3.520000E+02                | 1.136684782   | 4.001130E+02          | 10.79813 | 37.05392624 |
| 42 |   | gm U-235                            | 3.291200E+04                | 1.136101503   | 3.739137E+04          | 10.83884 | 3449.757744 |
| 43 |   | gm U-238                            | 1.936000E+03                | 1.134382384   | 2.196164E+03          | 10.96089 | 200.3637256 |
| 44 |   | Al in Fuel                          | 1.544748E+04                | 1.889214384   | 2.918361E+04          | 3.97     | 7351.034168 |
| 45 |   | Al Clad etc.                        | 1.092926E+05                | 1.889214384   | 2.064772E+05          | 3.97     | 52009.35819 |
| 46 |   | gm Fe BSS                           | 1.059958E+05                | 8.74563E-01   | 9.270004E+04          | 5.24     | 17690.84651 |
| 47 |   | gm Fe SS                            | 5.312576E+05                | 9.37037E-01   | 4.978081E+05          | 5.24     | 95001.55264 |
| 48 |   |                                     |                             |   |                       |          | 175739.9669 |
| 49 |   | volume of degraded canister =       |                             |   | 358739.1319           |          |             |
| 50 |   |                                     |                             |   |                       |          |             |

Mithomo

|    | A   | B  | C        | D | E           | F  | G       |                |
|----|---|--|----------|---|-------------|--|---------|----------------|
| 51 | Atom densities for water from BBA000000-01717-0200-00002 REV 00 |  |          |   |             |  |         |                |
| 52 |   | H  | 6.69E-02 |   |             |  |         |                |
| 53 |   | O  | 3.34E-02 |   |             |  |         |                |
| 54 |   |  |          |   |             | Water Density Multiplier for 100% basket c           |         |                |
| 55 |   |  |          |   |             | Multiplier=(358739.13-175740.0)/358739.1             |         |                |
| 56 |   |  |          |   |             | Water Density Multiplier for 50% basket ca           |         |                |
| 57 |   |  |          |   |             | Multiplier=(358739.13-119393.8)/358739.1             |         |                |
| 58 |   |  |          |   |             | Water Density Multiplier for 0% Basket Ca            |         |                |
| 59 |   |  |          |   |             | Multiplier=(358739.13-(37.0539+3449.758+200.364+7351 |         |                |
| 60 |   |  |          |   |             |  |         |                |
| 61 |   |  |          |   |             |  |         |                |
| 62 |   |  |          |   |             |  |         |                |
| 63 |   |  |          |   |             |  |         |                |
| 64 |   |  |          |   |             |  |         |                |
| 65 |   |  |          |   |             |  |         |                |
| 66 |   |  |          |   |             |  | Isotope |                |
| 67 |   | Number Density for 1 kg Gd               |          |   |             |  |         | Fraction *     |
| 68 |   | 1000 gm/canister volume * Av. #/157.25 = |          |   | 1.06760E-05 |  |         | 0.002          |
| 69 |   |  |          |   |             |  |         | 0.0218         |
| 70 |   |  |          |   |             |  |         | 0.148          |
| 71 |   |  |          |   |             |  |         | 0.2047         |
| 72 |   |  |          |   |             |  |         | 0.1565         |
| 73 |   |  |          |   |             |  |         | 0.2484         |
| 74 |   |  |          |   |             |  |         | 0.2186         |
| 75 |   |  |          |   |             |  |         | * Chart of the |
| 76 |   |  |          |   |             |  |         |                |
| 77 |   |  |          |   |             |  |         | 250 gm /canis  |
| 78 |   |  |          |   |             |  |         |                |
| 79 |   |  |          |   |             |  |         |                |
| 80 |   |  |          |   |             |  |         |                |
| 81 |   |  |          |   |             |  |         |                |
| 82 |   |  |          |   |             |  |         |                |
| 83 |   |  |          |   |             |  |         |                |
| 84 |   |  |          |   |             |  |         |                |
| 85 |   |  |          |   |             |  |         |                |
| 86 |   |  |          |   |             |  |         |                |
| 87 |   |  |          |   |             |  |         |                |
| 88 |   |  |          |   |             |  |         |                |
| 89 |   |  |          |   |             |  |         | 250 gm /80%    |
| 90 |   |  |          |   |             |  |         |                |
| 91 |   |  |          |   |             |  |         |                |
| 92 |   |  |          |   |             |  |         |                |
| 93 |   |  |          |   |             |  |         |                |
| 94 |   |  |          |   |             |  |         |                |
| 95 |   |  |          |   |             |  |         |                |
| 96 |   |  |          |   |             |  |         |                |
| 97 |   |  |          |   |             |  |         |                |
| 98 |   |  |          |   |             |  |         |                |

|    | H   | I                 | J | K                                | L          | M |
|----|---|-------------------|---|----------------------------------|------------|---|
| 1  |   |                   |   |                                  |            |   |
| 2  | W Glass Clayey Material Composition from MITCLAY-2.XLS (0 vol% water) |                   |   |                                  |            |   |
| 3  |   |                   |   |                                  |            |   |
| 4  | 3.5589E-03  |                   |   |                                  |            |   |
| 5  | 1.9788E-02  |                   |   |                                  |            |   |
| 6  | 5.8829E-07  |                   |   |                                  |            |   |
| 7  | 2.4980E-05  |                   |   |                                  |            |   |
| 8  | 2.5732E-04  |                   |   |                                  |            |   |
| 9  | 1.1813E-03  |                   |   |                                  |            |   |
| 10 | 6.1895E-03  |                   |   |                                  |            |   |
| 11 | 1.7649E-06  |                   |   |                                  |            |   |
| 12 | 4.5921E-04  |                   |   |                                  |            |   |
| 13 | 1.3478E-04  |                   |   |                                  |            |   |
| 14 | 2.5025E-04  |                   |   |                                  |            |   |
| 15 | 1.6755E-03  |                   |   |                                  |            |   |
| 16 | 2.0588E-04  |                   |   |                                  |            |   |
| 17 | 1.0348E-09  |                   |   |                                  |            |   |
| 18 |   |                   |   |                                  |            |   |
| 19 |   |                   |   |                                  |            |   |
| 20 | 3.3728E-02  |                   |   |                                  |            |   |
| 21 |   |                   |   |                                  |            |   |
| 22 | W Glass Clayey Material Composition                                   |                   |   | 25 % water                       |            |   |
| 23 | 1.9389E-02  |                   |   |                                  |            |   |
| 24 | 2.3201E-02  |                   |   |                                  |            |   |
| 25 | 4.4122E-07  |                   |   |                                  |            |   |
| 26 | 1.8735E-05  |                   |   |                                  |            |   |
| 27 | 1.9299E-04  |                   |   |                                  |            |   |
| 28 | 8.8597E-04  |                   |   |                                  |            |   |
| 29 | 4.6421E-03  |                   |   |                                  |            |   |
| 30 | 1.3237E-06  |                   |   |                                  |            |   |
| 31 | 3.4441E-04  |                   |   |                                  |            |   |
| 32 | 1.0108E-04  |                   |   |                                  |            |   |
| 33 | 1.8769E-04  |                   |   |                                  |            |   |
| 34 | 1.2566E-03  |                   |   |                                  |            |   |
| 35 | 1.5441E-04  |                   |   |                                  |            |   |
| 36 | 7.7610E-10  |                   |   |                                  |            |   |
| 37 |   |                   |   |                                  |            |   |
| 38 | 5.0375E-02  |                   |   | Atom Density for Homo 50% Basket |            |   |
| 39 | 50% Fe  |                   |   |                                  |            |   |
| 40 | multiplier  | molecular density |   | 1001.50C                         | 4.4620E-02 |   |
| 41 | 1   | 2.52494E-06       |   | 8016.50C                         | 5.3080E-02 |   |
| 42 | 1   | 0.000235074       |   | 13027.50C                        | 7.7614E-03 |   |
| 43 | 1   | 1.36532E-05       |   | 26000.55C                        | 1.2417E-02 |   |
| 44 | 1   | 0.000480574       |   | 92234.50C                        | 2.5249E-06 |   |
| 45 | 1   | 0.003400115       |   | 92235.50C                        | 2.3507E-04 |   |
| 46 | 0.5   | 0.000974613       |   | 92238.50C                        | 1.3653E-05 |   |
| 47 | 0.5   | 0.005233767       |   |                                  |            |   |
| 48 | 119393.7673   |                   |   | TOTAL                            | 1.1813E-01 |   |
| 49 |   |                   |   |                                  |            |   |
| 50 |   |                   |   |                                  |            |   |

Mithomo

|    | H                            | I           | J           | K                          | L        | M    |
|----|------------------------------|-------------|-------------|----------------------------|----------|------|
| 51 |                              |             |             |                            |          |      |
| 52 |                              |             |             |                            |          |      |
| 53 | ase                          |             |             |                            |          |      |
| 54 | 3=                           | 0.510117656 |             |                            |          |      |
| 55 | se                           |             |             |                            |          |      |
| 56 | 3=                           | 0.667184991 |             |                            |          |      |
| 57 |                              |             |             |                            |          |      |
| 58 | se                           |             |             |                            |          |      |
| 59 | .034+52009.358)))/358739.13= |             | 0.824252327 |                            |          |      |
| 60 |                              |             |             |                            |          |      |
| 61 |                              |             |             |                            |          |      |
| 62 |                              |             |             |                            |          |      |
| 63 |                              |             |             |                            |          |      |
| 64 |                              |             |             | Volume BSS                 | 13685.71 | cm^3 |
| 65 |                              |             |             |                            |          |      |
| 66 |                              | Number      |             | Number Density distributed |          |      |
| 67 | MCNP ID                      | Density     |             | in Borated Stainless Steel |          |      |
| 68 | 64152.50C                    | 2.1352E-08  |             | 5.59693E-07                |          |      |
| 69 | 64154.50C                    | 2.3274E-07  |             | 6.10066E-06                |          |      |
| 70 | 64155.50C                    | 1.5800E-06  |             | 4.14173E-05                |          |      |
| 71 | 64156.50C                    | 2.1854E-06  |             | 5.72846E-05                |          |      |
| 72 | 64157.50C                    | 1.6708E-06  |             | 4.37960E-05                |          |      |
| 73 | 64158.50C                    | 2.6519E-06  |             | 6.95139E-05                |          |      |
| 74 | 64160.50C                    | 2.3338E-06  |             | 6.11745E-05                |          |      |
| 75 | Nuclides, 14th Edition       |             | Total       | 2.79847E-04                |          |      |
| 76 |                              |             |             |                            |          |      |
| 77 | er divide above by 4         |             |             |                            |          |      |
| 78 |                              | Number      |             |                            |          |      |
| 79 | MCNP ID                      | Density     |             |                            |          |      |
| 80 | 64152.50C                    | 5.3380E-09  |             |                            |          |      |
| 81 | 64154.50C                    | 5.8185E-08  |             |                            |          |      |
| 82 | 64155.50C                    | 3.9500E-07  |             |                            |          |      |
| 83 | 64156.50C                    | 5.4635E-07  |             |                            |          |      |
| 84 | 64157.50C                    | 4.1770E-07  |             |                            |          |      |
| 85 | 64158.50C                    | 6.6298E-07  |             |                            |          |      |
| 86 | 64160.50C                    | 5.8345E-07  |             |                            |          |      |
| 87 |                              |             |             |                            |          |      |
| 88 |                              |             |             |                            |          |      |
| 89 | canister divide above by .8  |             |             |                            |          |      |
| 90 |                              | Number      |             |                            |          |      |
| 91 | MCNP ID                      | Density     |             |                            |          |      |
| 92 | 64152.50C                    | 6.6725E-09  |             |                            |          |      |
| 93 | 64154.50C                    | 7.2730E-08  |             |                            |          |      |
| 94 | 64155.50C                    | 4.9377E-07  |             |                            |          |      |
| 95 | 64156.50C                    | 6.8293E-07  |             |                            |          |      |
| 96 | 64157.50C                    | 5.2212E-07  |             |                            |          |      |
| 97 | 64158.50C                    | 8.2873E-07  |             |                            |          |      |
| 98 | 64160.50C                    | 7.2930E-07  |             |                            |          |      |

|    | N                                   | O          | P           | Q                               | R   |
|----|-------------------------------------|------------|-------------|---------------------------------|---|
| 1  |                                     |            |             |                                 |   |
| 2  |                                     |            |             |                                 |   |
| 3  |                                     |            |             |                                 |   |
| 4  |                                     |            |             |                                 |   |
| 5  |                                     |            |             |                                 |   |
| 6  |                                     |            |             |                                 |   |
| 7  |                                     |            |             |                                 |   |
| 8  |                                     |            |             |                                 |   |
| 9  |                                     |            |             |                                 |   |
| 10 |                                     |            |             |                                 |   |
| 11 |                                     |            |             |                                 |   |
| 12 |                                     |            |             |                                 |   |
| 13 |                                     |            |             |                                 |   |
| 14 |                                     |            |             |                                 |   |
| 15 |                                     |            |             |                                 |   |
| 16 |                                     |            |             |                                 |   |
| 17 |                                     |            |             |                                 |   |
| 18 |                                     |            |             |                                 |   |
| 19 | Cylinder Segment Volume Calculation |            |             |                                 |   |
| 20 | 80% Volume of DOE-SNF Canister      |            |             |                                 |   |
| 21 |                                     |            |             |                                 |   |
| 22 | Geometry Calculations               |            |             |                                 |   |
| 23 | Cylinder Radius                     |            | 21.465      | cm                              |   |
| 24 | Cylinder Length                     |            | 262.8       | cm                              |   |
| 25 | Cylinder Volume                     |            | 3.80397E+05 | cm <sup>3</sup>                 |   |
| 26 | 1/2 Cylinder Volume                 |            | 1.90198E+05 |                                 |   |
| 27 | Fill Fraction                       |            |             |                                 |   |
| 28 | Degraded Volume                     |            | 3.04318E+05 | cm <sup>3</sup>                 |   |
| 29 | Calculated Volume                   |            | 3.04318E+05 |                                 |   |
| 30 | Distance from Center                |            | 1.05578E+01 | cm                              |   |
| 31 | (DHLW)                              |            |             |                                 |   |
| 32 |                                     |            |             |                                 |   |
| 33 | Codisposal Canister Radius          |            |             | cm                              |   |
| 34 | Codisposal Canister Height          |            |             | cm                              |   |
| 35 | Codisposal Canister Volume          |            | 380396.9439 | cm <sup>3</sup>                 |   |
| 36 |                                     |            |             |                                 |   |
| 37 |                                     |            |             |                                 |   |
| 38 | Atom Density for Homo 50% Basket    |            |             | Atom Density for Homo 0% Basket |   |
| 39 | in 80% of Canister Volume           |            |             |                                 |   |
| 40 | 1001.50C                            | 3.9055E-02 |             | 1001.50C                        | 5.5124E-02                                |
| 41 | 8016.50C                            | 5.7990E-02 |             | 8016.50C                        | 5.8332E-02                                |
| 42 | 13027.50C                           | 9.7017E-03 |             | 13027.50C                       | 7.7614E-03                                |
| 43 | 26000.55C                           | 1.5521E-02 |             | 26000.55C                       | 0.0000E+00                                |
| 44 | 92234.50C                           | 3.1562E-06 |             | 92234.50C                       | 2.5249E-06                                |
| 45 | 92235.50C                           | 2.9384E-04 |             | 92235.50C                       | 2.3507E-04                                |
| 46 | 92238.50C                           | 1.7067E-05 |             | 92238.50C                       | 1.3653E-05                                |
| 47 |                                     |            |             |                                 |   |
| 48 | TOTAL                               | 1.2258E-01 |             | TOTAL                           | 1.2147E-01                                |
| 49 |                                     |            |             |                                 |   |
| 50 |                                     |            |             |                                 | equation of line for sides of parallelogr |

Mithomo

|    | N                  | O           | P | Q | R  |
|----|--------------------|-------------|---|---|--|
| 51 |                    |             |   |   |  |
| 52 |                    |             |   |   |  |
| 53 |                    |             |   |   | Volume of Fuel Cells = length of side p  |
| 54 |                    |             |   |   | length of side parallel to y axis=2x3.82 |
| 55 |                    |             |   |   | separation between sides parallel to y   |
| 56 | in 80% of Canister |             |   |   | Height=64 cm                             |
| 57 | 13*.8)=            | 0.583981239 |   |   |  |
| 58 |                    |             |   |   | Volume of Fuel Cells =                   |
| 59 |                    |             |   |   | Water Density Multiplie                  |
| 60 |                    |             |   |   | Multiplier=(358739.13-(37.0539+3449      |
| 61 |                    |             |   |   |  |
| 62 |                    |             |   |   |  |
| 63 |                    |             |   |   |  |
| 64 |                    |             |   |   |  |
| 65 |                    |             |   |   |  |
| 66 |                    |             |   |   |  |
| 67 |                    |             |   |   |  |
| 68 |                    |             |   |   |  |
| 69 |                    |             |   |   |  |
| 70 |                    |             |   |   |  |
| 71 |                    |             |   |   |  |
| 72 |                    |             |   |   |  |
| 73 |                    |             |   |   |  |
| 74 |                    |             |   |   |  |
| 75 |                    |             |   |   |  |
| 76 |                    |             |   |   |  |
| 77 |                    |             |   |   |  |
| 78 |                    |             |   |   |  |
| 79 |                    |             |   |   |  |
| 80 |                    |             |   |   |  |
| 81 |                    |             |   |   |  |
| 82 |                    |             |   |   |  |
| 83 |                    |             |   |   |  |
| 84 |                    |             |   |   |  |
| 85 |                    |             |   |   |  |
| 86 |                    |             |   |   |  |
| 87 |                    |             |   |   |  |
| 88 |                    |             |   |   |  |
| 89 |                    |             |   |   |  |
| 90 |                    |             |   |   |  |
| 91 |                    |             |   |   |  |
| 92 |                    |             |   |   |  |
| 93 |                    |             |   |   |  |
| 94 |                    |             |   |   |  |
| 95 |                    |             |   |   |  |
| 96 |                    |             |   |   |  |
| 97 |                    |             |   |   |  |
| 98 |                    |             |   |   |  |



Mithomo

|    | S             | T  | U          | V  | W                    |
|----|---------------|--|------------|----|----------------------|
| 1  |               |  |            |    |                      |
| 2  |               |  |            |    |                      |
| 3  |               |  |            |    |                      |
| 4  |               |  |            |    |                      |
| 5  |               |  |            |    |                      |
| 6  |               |  |            |    |                      |
| 7  |               |  |            |    |                      |
| 8  |               |  |            |    |                      |
| 9  |               |  |            |    |                      |
| 10 |               |  |            |    |                      |
| 11 |               |  |            |    |                      |
| 12 |               |  |            |    |                      |
| 13 |               |  |            |    |                      |
| 14 |               |  |            |    |                      |
| 15 |               |  |            |    |                      |
| 16 |               |  |            |    |                      |
| 17 |               |  |            |    |                      |
| 18 |               |  |            |    |                      |
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| 35 |               |  |            |    |                      |
| 36 |               |  |            |    |                      |
| 37 |               |  |            |    |                      |
| 38 |               | Atom Density for Homo SNF in Intact Basket |            |    | Atom Density for Hor |
| 39 |               |  |            |    |                      |
| 40 |               | 1001.50C                                   | 4.6352E-02 |    | 1001.50C             |
| 41 |               | 8016.50C                                   | 4.4385E-02 |    | 8016.50C             |
| 42 |               | 13027.50C                                  | 1.3554E-02 |    | 13027.50C            |
| 43 |               | 26000.55C                                  | 0.0000E+00 |    | 26000.55C            |
| 44 |               | 92234.50C                                  | 4.4094E-06 |    | 92234.50C            |
| 45 |               | 92235.50C                                  | 4.1052E-04 |    | 92235.50C            |
| 46 |               | 92238.50C                                  | 2.3843E-05 |    | 92238.50C            |
| 47 |               |  |            |    |                      |
| 48 |               | TOTAL                                      | 1.0473E-01 |    | TOTAL                |
| 49 |               |  |            |    |                      |
| 50 | lam from MCNP | -1.732051x + y -6.625=0                    | if y=0     | x= | 3.824945             |

Mithomo

|    | S   | T | U | V | W           |
|----|---|---|---|---|-------------|
| 51 |   |   |   |   |             |
| 52 | parallel to y axis X separation between sides parallel to y axis X height X 64 Positions/Canister |   |   |   |             |
| 53 | 4945  |   |   |   |             |
| 54 | axis =2x3.278   |   |   |   |             |
| 55 |   |   |   |   |             |
| 56 |   |   |   |   |             |
| 57 | 205425.3725   |   |   |   |             |
| 58 |   |   |   |   |             |
| 59 | r for Degraded SNF in Intact Basket Case  |   |   |   |             |
| 60 | 758+200.364+7351.034+52009.358)/358739.13=  |   |   |   | 0.693087728 |
| 61 |   |   |   |   |             |
| 62 |   |   |   |   |             |
| 63 |   |   |   |   |             |
| 64 |   |   |   |   |             |
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| 34 |                |
| 35 |                |
| 36 |                |
| 37 |                |
| 38 | no 100% Basket |
| 39 |                |
| 40 | 3.4116E-02     |
| 41 | 6.6453E-02     |
| 42 | 7.7614E-03     |
| 43 | 2.4834E-02     |
| 44 | 2.5249E-06     |
| 45 | 2.3507E-04     |
| 46 | 1.3653E-05     |
| 47 |                |
| 48 | 1.3341E-01     |
| 49 |                |
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|    | A   | B                                   | C | D   | E               | F | G                          | H           |  |
|----|---|-------------------------------------|---|---|-----------------|---|----------------------------|-------------|--|
| 1  |   |                                     |   |   |                 |   |                            |             |  |
| 2  | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay</b> |                                     |   |   |                 |   |                            |             |  |
| 3  |   |                                     |   |   |                 |   |                            |             |  |
| 4  |   |                                     |   |   |                 |   |                            |             |  |
| 5  |   | Cylinder Segment Volume Calculation |   |   |                 |   | Degraded MIT Fuel          |             |  |
| 6  |   | (Degraded DHLW)                     |   |   |                 |   |                            |             |  |
| 7  |   |                                     |   |   |                 |   |                            |             |  |
| 8  |   | Geometry Calculations               |   |   |                 |   | Fraction of UO2 Remaining  |             |  |
| 9  |   | Cylinder Radius (R)                 |   | 86.5  | cm              |   | Mass of Gd                 |             |  |
| 10 |   | Cylinder Length (lt)                |   | 304   | cm              |   | Density of Gd              |             |  |
| 11 |   | Cylinder Volume                     |   | 7.14588E+06   | cm <sup>3</sup> |   | Mass of Fe2O3              |             |  |
| 12 |   | Segment Volume                      |   | 4.99330E+06   | cm <sup>3</sup> |   | Nominal Den of UO2+Al2O3   |             |  |
| 13 |   | Target Cell                         |   | 4.99330E+06   |                 |   | Total Mas of UO2+Al2O3     |             |  |
| 14 |   | Dis. from Center (y1)               |   | 2.74765E+01   | cm              |   | Void Fraction              |             |  |
| 15 |   |                                     |   |   |                 |   | Den of UO2+Al2O3+Fe2O3     |             |  |
| 16 |   |                                     |   |   |                 |   | Vol. Occupied by UO2+Al2O3 |             |  |
| 17 |   |                                     |   |   |                 |   |                            |             |  |
| 18 |   | Layer of MIT Fuel and Others        |   |   |                 |   |                            |             |  |
| 19 |   |                                     |   |   |                 |   |                            |             |  |
| 20 |   | 1/2 Cylinder Volume                 |   | 3.57294E+06   | cm <sup>3</sup> |   |                            |             |  |
| 21 |   | Segment - 1/2 Cylin.                |   | 1.42036E+06   | cm <sup>3</sup> |   |                            |             |  |
| 22 |   | Layer Volume                        |   | 1.00486E+06   | cm <sup>3</sup> |   | Atomic Density Calculation |             |  |
| 23 |   | Target Cell                         |   | 1.00488E+06   |                 |   | Mass(g)                    |             |  |
| 24 |   | Dis from Center (y2)                |   | 1.00524E+01   | cm              |   | U-235                      | 32912       |  |
| 25 |   |                                     |   |   |                 |   | U-234                      | 352         |  |
| 26 |   |                                     |   |   |                 |   | U-238                      | 1936        |  |
| 27 |   |                                     |   |   |                 |   | Al                         | 4.14E+05    |  |
| 28 |   |                                     |   |   |                 |   | Fe                         | 0.00E+00    |  |
| 29 |   |                                     |   |   |                 |   | O                          | 1.09E+06    |  |
| 30 |   |                                     |   |   |                 |   | H                          | 8.93E+04    |  |
| 31 |   |                                     |   |   |                 |   | Gd-152                     |             |  |
| 32 |   |                                     |   |   |                 |   | Gd-154                     |             |  |
| 33 |   |                                     |   |   |                 |   | Gd-155                     |             |  |
| 34 |   |                                     |   |   |                 |   | Gd-156                     |             |  |
| 35 |   |                                     |   |   |                 |   | Gd-157                     |             |  |
| 36 |   |                                     |   |   |                 |   | Gd-158                     |             |  |
| 37 |   |                                     |   |   |                 |   | Gd-160                     |             |  |
| 38 |   |                                     |   |   |                 |   | den (g/cm <sup>3</sup> )   | 1.61843E+00 |  |
| 39 |   |                                     |   |   |                 |   |                            |             |  |
| 40 |   |                                     |   |   |                 |   | H/U-235 Ration             |             |  |
| 41 |   |                                     |   |   |                 |   |                            |             |  |
| 42 |   |                                     |   |   |                 |   |                            |             |  |
| 43 |   | DHLW Volume =                       |   | 1/2 Cyl. Volume + lt*(y1*sqrt(r <sup>2</sup> -y1 <sup>2</sup> ) + r <sup>2</sup> *arccos(sqrt(r <sup>2</sup> -y1 <sup>2</sup> )/r))           |                 |   |                            |             |  |
| 44 |   |                                     |   |   |                 |   |                            |             |  |
| 45 |   | MIT Fuel and Othes Volume =         |   | Cyl. Volume - DHLW Volume - lt*(y2*sqrt(r <sup>2</sup> -y2 <sup>2</sup> ) + r <sup>2</sup> *arccos(sqrt(r <sup>2</sup> -y2 <sup>2</sup> )/r)) |                 |   |                            |             |  |
| 46 |   |                                     |   |   |                 |   |                            |             |  |
| 47 |   | Den of UO2+Al2O3+Fe2O3+Void =       |   | Den of UO2+Al2O3+Fe2O3/(1 - Void Fraction)  |                 |   |                            |             |  |
| 48 |   |                                     |   |   |                 |   |                            |             |  |
| 49 |   | Atomic Num. Den. =                  |   | Mass of Isotope*Avogadro's Number / Molecular Weight / Volume   |                 |   |                            |             |  |
| 50 |   |                                     |   |   |                 |   |                            |             |  |
| 51 |   | Isotopic Abundance (%)              |   |   |                 |   |                            |             |  |

## Fe\_gd

|    | A | B      | C     | D | E | F | G | H |
|----|---|--------|-------|---|---|---|---|---|
| 52 |   | Gd-152 | 0.2   |   |   |   |   |   |
| 53 |   | Gd-154 | 2.18  |   |   |   |   |   |
| 54 |   | Gd-155 | 14.8  |   |   |   |   |   |
| 55 |   | Gd-156 | 20.47 |   |   |   |   |   |
| 56 |   | Gd-157 | 15.65 |   |   |   |   |   |
| 57 |   | Gd-158 | 24.84 |   |   |   |   |   |
| 58 |   | Gd-160 | 21.86 |   |   |   |   |   |

|    | I                        | J         | K                          | L      | M |
|----|--------------------------|-----------|----------------------------|--------|---|
| 1  |                          |           |                            |        |   |
| 2  |                          |           |                            |        |   |
| 3  |                          |           |                            |        |   |
| 4  |                          |           |                            |        |   |
| 5  |                          |           |                            |        |   |
| 6  |                          |           |                            |        |   |
| 7  |                          |           |                            |        |   |
| 8  | g                        |           | 7.9004E+00                 |        |   |
| 9  |                          |           |                            | g      |   |
| 10 |                          |           | 7.9004E+00                 | g/cm^3 |   |
| 11 |                          |           | 0.00E+00                   | g      |   |
| 12 | O3+Fe2O3                 |           | 4.09213E+00                | g/cm^3 |   |
| 13 | Fe2O3                    |           | 8.22403E+05                | g      |   |
| 14 |                          |           | 8.00000E-01                |        |   |
| 15 | O3+Void Used             |           | 8.18426E-01                | g/cm^3 |   |
| 16 | O3+Fe2O3+Void            |           | 1.00486E+06                | cm^3   |   |
| 17 |                          |           |                            |        |   |
| 18 |                          |           |                            |        |   |
| 19 |                          |           |                            |        |   |
| 20 |                          |           |                            |        |   |
| 21 |                          |           |                            |        |   |
| 22 | h (Degraded MIT Fuel)    |           |                            |        |   |
| 23 | WT                       | MCNP      | Atomic Density (#/barn cm) |        |   |
| 24 | 235.0439                 | 92235.50C | 8.3922E-05                 |        |   |
| 25 | 234.0409                 | 92234.50C | 9.0141E-07                 |        |   |
| 26 | 238.0508                 | 92238.50C | 4.8742E-06                 |        |   |
| 27 | 26.98154                 | 13027.50C | 9.2004E-03                 |        |   |
| 28 | 55.847                   | 26000.55C | 0.0000E+00                 |        |   |
| 29 | 15.99492                 | 8016.50C  | 4.0750E-02                 |        |   |
| 30 | 1.007825                 | 1001.50C  | 5.3118E-02                 |        |   |
| 31 |                          | 64152.50C | 3.8114E-10                 |        |   |
| 32 |                          | 64154.50C | 4.1544E-09                 |        |   |
| 33 |                          | 64155.50C | 2.8204E-08                 |        |   |
| 34 |                          | 64156.50C | 3.9009E-08                 |        |   |
| 35 |                          | 64157.50C | 2.9824E-08                 |        |   |
| 36 |                          | 64158.50C | 4.7337E-08                 |        |   |
| 37 |                          | 64160.50C | 4.1658E-08                 |        |   |
| 38 |                          |           | 1.0316E-01                 |        |   |
| 39 |                          |           |                            |        |   |
| 40 |                          |           | 632.939663                 |        |   |
| 41 |                          |           |                            |        |   |
| 42 |                          |           |                            |        |   |
| 43 | y1^2/r))                 |           |                            |        |   |
| 44 |                          |           |                            |        |   |
| 45 | 2^2) - r^2*arccos(y2/r)) |           |                            |        |   |
| 46 |                          |           |                            |        |   |
| 47 |                          |           |                            |        |   |
| 48 |                          |           |                            |        |   |
| 49 | Volume                   |           |                            |        |   |
| 50 |                          |           |                            |        |   |
| 51 |                          |           |                            |        |   |

Fe\_gd

|    | I | J | K | L | M |
|----|---|---|---|---|---|
| 52 |   |   |   |   |   |
| 53 |   |   |   |   |   |
| 54 |   |   |   |   |   |
| 55 |   |   |   |   |   |
| 56 |   |   |   |   |   |
| 57 |   |   |   |   |   |
| 58 |   |   |   |   |   |



|    | A | B   | C | D                           | E | F | G  | H           |
|----|---|---|---|-----------------------------|---|---|--|-------------|
| 1  |   |   |   |                             |   |   |  |             |
| 2  |   | <b>Full Uranium Loading</b>   |   |                             |   |   |  |             |
| 3  |   |   |   |                             |   |   |  |             |
| 4  |   |   |   |                             |   |   |  |             |
| 5  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |                             |   |   |  |             |
| 6  |   |   |   |                             |   |   |  |             |
| 7  |   |   |   |                             |   |   |  |             |
| 8  |   | Cylinder Segment Volume Calculation                                       |   |                             |   |   | Degraded MIT Fuel  |             |
| 9  |   | (Degraded DHLW)   |   |                             |   |   |  |             |
| 10 |   |   |   |                             |   |   |  |             |
| 11 |   | Geometry Calculations   |   |                             |   |   | Fraction of UO2 Remaining  |             |
| 12 |   | Cylinder Radius (R)   |   | 86.5 cm                     |   |   | Mass of Gd   |             |
| 13 |   | Cylinder Length   |   | 304 cm                      |   |   | Density of Gd  |             |
| 14 |   | Cylinder Volume   |   | 7.14588E+06 cm <sup>3</sup> |   |   | Mass of Fe <sub>2</sub> O <sub>3</sub>   |             |
| 15 |   | Segment Volume  |   | 4.99330E+06 cm <sup>3</sup> |   |   | Nominal Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                         |             |
| 16 |   | Target Cell   |   | 4.99330E+06                 |   |   | Total Mas of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                           |             |
| 17 |   | Dis. from Center (y1)   |   | 2.74765E+01 cm              |   |   | Void Fraction  |             |
| 18 |   |   |   |                             |   |   | Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> |             |
| 19 |   |   |   |                             |   |   | Vol. Occupied by UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                       |             |
| 20 |   |   |   |                             |   |   |  |             |
| 21 |   | Layer of MIT Fuel and Others  |   |                             |   |   |  |             |
| 22 |   |   |   |                             |   |   |  |             |
| 23 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 cm <sup>3</sup> |   |   |  |             |
| 24 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 cm <sup>3</sup> |   |   |  |             |
| 25 |   | Layer Volume  |   | 5.02414E+05 cm <sup>3</sup> |   |   | Atomic Density Calculation   |             |
| 26 |   | Target Cell   |   | 5.02415E+05                 |   |   | Mass(g)  |             |
| 27 |   | Dis from Center (y2)  |   | 3.78004E+01 cm              |   |   | U-235  | 32912       |
| 28 |   |   |   |                             |   |   | U-234  | 352         |
| 29 |   |   |   |                             |   |   | U-238  | 1936        |
| 30 |   |   |   |                             |   |   | Al   | 4.14E+05    |
| 31 |   |   |   |                             |   |   | Fe   | 0.00E+00    |
| 32 |   |   |   |                             |   |   | O  | 6.41E+05    |
| 33 |   |   |   |                             |   |   | H  | 3.35E+04    |
| 34 |   |   |   |                             |   |   | Gd-152   |             |
| 35 |   |   |   |                             |   |   | Gd-154   |             |
| 36 |   |   |   |                             |   |   | Gd-155   |             |
| 37 |   |   |   |                             |   |   | Gd-156   |             |
| 38 |   |   |   |                             |   |   | Gd-157   |             |
| 39 |   |   |   |                             |   |   | Gd-158   |             |
| 40 |   |   |   |                             |   |   | Gd-160   |             |
| 41 |   |   |   |                             |   |   | den (g/cm <sup>3</sup> )   | 2.23680E+00 |
| 42 |   |   |   |                             |   |   |  |             |
| 43 |   |   |   |                             |   |   | H/U-235 Ration   |             |
| 44 |   |   |   |                             |   |   |  |             |
| 45 |   |   |   |                             |   |   |  |             |
| 46 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |                             |   |   |  |             |
| 47 |   |   |   |                             |   |   |  |             |
| 48 |   |   |   |                             |   |   |  |             |
| 49 |   | Cylinder Segment Volume Calculation                                       |   |                             |   |   | Degraded MIT Fuel  |             |
| 50 |   | (Degraded DHLW)   |   |                             |   |   |  |             |
| 51 |   |   |   |                             |   |   |  |             |

|     | A | B   | C | D           | E    | F | G                          | H           |
|-----|---|---|---|-------------|------|---|----------------------------|-------------|
| 52  |   | Geometry Calculations   |   |             |      |   | Fraction of UO2 Remainin   |             |
| 53  |   | Cylinder Radius (R)   |   | 86.5        | cm   |   | Mass of Gd                 |             |
| 54  |   | Cylinder Length   |   | 304         | cm   |   | Density of Gd              |             |
| 55  |   | Cylinder Volume   |   | 7.14588E+06 | cm^3 |   | Mass of Fe2O3              |             |
| 56  |   | Segment Volume  |   | 4.99330E+06 | cm^3 |   | Nominal Den of UO2+Al2O3   |             |
| 57  |   | Target Cell   |   | 4.99330E+06 |      |   | Total Mas of UO2+Al2O3-    |             |
| 58  |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm   |   | Void Fraction              |             |
| 59  |   |   |   |             |      |   | Den of UO2+Al2O3+Fe2O3     |             |
| 60  |   |   |   |             |      |   | Vol. Occupied by UO2+Al2O3 |             |
| 61  |   |   |   |             |      |   |                            |             |
| 62  |   | Layer of MIT Fuel and Others  |   |             |      |   |                            |             |
| 63  |   |   |   |             |      |   |                            |             |
| 64  |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm^3 |   |                            |             |
| 65  |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm^3 |   |                            |             |
| 66  |   | Layer Volume  |   | 6.69885E+05 | cm^3 |   | Atomic Density Calculation |             |
| 67  |   | Target Cell   |   | 6.69890E+05 |      |   | Mass(g)                    |             |
| 68  |   | Dis from Center (y2)  |   | 4.13824E+01 | cm   |   | U-235                      | 32912       |
| 69  |   |   |   |             |      |   | U-234                      | 352         |
| 70  |   |   |   |             |      |   | U-238                      | 1936        |
| 71  |   |   |   |             |      |   | Al                         | 4.14E+05    |
| 72  |   |   |   |             |      |   | Fe                         | 0.00E+00    |
| 73  |   |   |   |             |      |   | O                          | 7.90E+05    |
| 74  |   |   |   |             |      |   | H                          | 5.21E+04    |
| 75  |   |   |   |             |      |   | Gd-152                     |             |
| 76  |   |   |   |             |      |   | Gd-154                     |             |
| 77  |   |   |   |             |      |   | Gd-155                     |             |
| 78  |   |   |   |             |      |   | Gd-156                     |             |
| 79  |   |   |   |             |      |   | Gd-157                     |             |
| 80  |   |   |   |             |      |   | Gd-158                     |             |
| 81  |   |   |   |             |      |   | Gd-160                     |             |
| 82  |   |   |   |             |      |   | den (g/cm^3)               | 1.92760E+00 |
| 83  |   |   |   |             |      |   |                            |             |
| 84  |   |   |   |             |      |   | H/U-235 Ration             |             |
| 85  |   |   |   |             |      |   |                            |             |
| 86  |   |   |   |             |      |   |                            |             |
| 87  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |      |   |                            |             |
| 88  |   |   |   |             |      |   |                            |             |
| 89  |   |   |   |             |      |   |                            |             |
| 90  |   | Cylinder Segment Volume Calculation                                       |   |             |      |   | Degraded MIT Fuel          |             |
| 91  |   | (Degraded DHLW)   |   |             |      |   |                            |             |
| 92  |   |   |   |             |      |   |                            |             |
| 93  |   | Geometry Calculations   |   |             |      |   | Fraction of UO2 Remainin   |             |
| 94  |   | Cylinder Radius (R)   |   | 86.5        | cm   |   | Mass of Gd                 |             |
| 95  |   | Cylinder Length   |   | 304         | cm   |   | Density of Gd              |             |
| 96  |   | Cylinder Volume   |   | 7.14588E+06 | cm^3 |   | Mass of Fe2O3              |             |
| 97  |   | Segment Volume  |   | 4.99330E+06 | cm^3 |   | Nominal Den of UO2+Al2O3   |             |
| 98  |   | Target Cell   |   | 4.99330E+06 |      |   | Total Mas of UO2+Al2O3-    |             |
| 99  |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm   |   | Void Fraction              |             |
| 100 |   |   |   |             |      |   | Den of UO2+Al2O3+Fe2O3     |             |
| 101 |   |   |   |             |      |   | Vol. Occupied by UO2+Al2O3 |             |
| 102 |   |   |   |             |      |   |                            |             |

|     | A | B   | C | D                           | E | F | G  | H           |  |
|-----|---|---|---|-----------------------------|---|---|--|-------------|--|
| 103 |   | Layer of MIT Fuel and Others  |   |                             |   |   |  |             |  |
| 104 |   |   |   |                             |   |   |  |             |  |
| 105 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 cm <sup>3</sup> |   |   |  |             |  |
| 106 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 cm <sup>3</sup> |   |   |  |             |  |
| 107 |   | Layer Volume  |   | 8.03862E+05 cm <sup>3</sup> |   |   | Atomic Density Calculation   |             |  |
| 108 |   | Target Cell   |   | 8.03866E+05                 |   |   |  | Mass(g)     |  |
| 109 |   | Dis from Center (y2)  |   | 2.74765E+01 cm              |   |   | U-235  | 32912       |  |
| 110 |   |   |   |                             |   |   | U-234  | 352         |  |
| 111 |   |   |   |                             |   |   | U-238  | 1936        |  |
| 112 |   |   |   |                             |   |   | Al   | 4.14E+05    |  |
| 113 |   |   |   |                             |   |   | Fe   | 0.00E+00    |  |
| 114 |   |   |   |                             |   |   | O  | 9.09E+05    |  |
| 115 |   |   |   |                             |   |   | H  | 6.70E+04    |  |
| 116 |   |   |   |                             |   |   | Gd-152   |             |  |
| 117 |   |   |   |                             |   |   | Gd-154   |             |  |
| 118 |   |   |   |                             |   |   | Gd-155   |             |  |
| 119 |   |   |   |                             |   |   | Gd-156   |             |  |
| 120 |   |   |   |                             |   |   | Gd-157   |             |  |
| 121 |   |   |   |                             |   |   | Gd-158   |             |  |
| 122 |   |   |   |                             |   |   | Gd-160   |             |  |
| 123 |   |   |   |                             |   |   | den (g/cm <sup>3</sup> )   | 1.77300E+00 |  |
| 124 |   |   |   |                             |   |   |  |             |  |
| 125 |   |   |   |                             |   |   | H/U-235 Ratio  |             |  |
| 126 |   |   |   |                             |   |   |  |             |  |
| 127 |   |   |   |                             |   |   |  |             |  |
| 128 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |                             |   |   |  |             |  |
| 129 |   |   |   |                             |   |   |  |             |  |
| 130 |   |   |   |                             |   |   |  |             |  |
| 131 |   | Cylinder Segment Volume Calculation                                       |   |                             |   |   | Degraded MIT Fuel  |             |  |
| 132 |   | (Degraded DHLW)   |   |                             |   |   |  |             |  |
| 133 |   |   |   |                             |   |   |  |             |  |
| 134 |   | Geometry Calculations   |   |                             |   |   | Fraction of UO <sub>2</sub> Remaining  |             |  |
| 135 |   | Cylinder Radius (R)   |   | 86.5 cm                     |   |   | Mass of Gd   |             |  |
| 136 |   | Cylinder Length   |   | 304 cm                      |   |   | Density of Gd  |             |  |
| 137 |   | Cylinder Volume   |   | 7.14588E+06 cm <sup>3</sup> |   |   | Mass of Fe <sub>2</sub> O <sub>3</sub>   |             |  |
| 138 |   | Segment Volume  |   | 4.99330E+06 cm <sup>3</sup> |   |   | Nominal Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                         |             |  |
| 139 |   | Target Cell   |   | 4.99330E+06                 |   |   | Total Mas of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                           |             |  |
| 140 |   | Dis. from Center (y1)   |   | 2.74765E+01 cm              |   |   | Void Fraction  |             |  |
| 141 |   |   |   |                             |   |   | Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> |             |  |
| 142 |   |   |   |                             |   |   | Vol. Occupied by UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                       |             |  |
| 143 |   |   |   |                             |   |   |  |             |  |
| 144 |   | Layer of MIT Fuel and Others  |   |                             |   |   |  |             |  |
| 145 |   |   |   |                             |   |   |  |             |  |
| 146 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 cm <sup>3</sup> |   |   |  |             |  |
| 147 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 cm <sup>3</sup> |   |   |  |             |  |
| 148 |   | Layer Volume  |   | 1.00483E+06 cm <sup>3</sup> |   |   | Atomic Density Calculation   |             |  |
| 149 |   | Target Cell   |   | 1.00483E+06                 |   |   |  | Mass(g)     |  |
| 150 |   | Dis from Center (y2)  |   | 4.88513E+01 cm              |   |   | U-235  | 32912       |  |
| 151 |   |   |   |                             |   |   | U-234  | 352         |  |
| 152 |   |   |   |                             |   |   | U-238  | 1936        |  |
| 153 |   |   |   |                             |   |   | Al   | 4.14E+05    |  |

|     | A | B | C | D | E | F | G   | H                        |
|-----|---|---|---|---|---|---|---|--------------------------|
| 154 |   |   |   |   |   |   | Fe  | 0.00E+00                 |
| 155 |   |   |   |   |   |   | O   | 1.09E+06                 |
| 156 |   |   |   |   |   |   | H   | 8.93E+04                 |
| 157 |   |   |   |   |   |   | Gd-152  |                          |
| 158 |   |   |   |   |   |   | Gd-154  |                          |
| 159 |   |   |   |   |   |   | Gd-155  |                          |
| 160 |   |   |   |   |   |   | Gd-156  |                          |
| 161 |   |   |   |   |   |   | Gd-157  |                          |
| 162 |   |   |   |   |   |   | Gd-158  |                          |
| 163 |   |   |   |   |   |   | Gd-160  |                          |
| 164 |   |   |   |   |   |   | den (g/cm^  | 1.61840E+00              |
| 165 |   |   |   |   |   |   |   |                          |
| 166 |   |   |   |   |   |   | H/U-235 Ratio   |                          |
| 167 |   |   |   |   |   |   |   |                          |
| 168 |   |   |   |   |   |   |   |                          |
| 169 |   |   |   |   |   |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |                          |
| 170 |   |   |   |   |   |   |   |                          |
| 171 |   |   |   |   |   |   |   |                          |
| 172 |   |   |   |   |   |   | Cylinder Segment Volume Calculation                                       | Degraded MIT Fuel        |
| 173 |   |   |   |   |   |   | (Degraded DHLW)   |                          |
| 174 |   |   |   |   |   |   |   |                          |
| 175 |   |   |   |   |   |   | Geometry Calculations   | Fraction of UO2 Remainin |
| 176 |   |   |   |   |   |   | Cylinder Radius (R)   | 86.5 cm                  |
| 177 |   |   |   |   |   |   | Cylinder Length   | 304 cm                   |
| 178 |   |   |   |   |   |   | Cylinder Volume   | 7.14588E+06 cm^3         |
| 179 |   |   |   |   |   |   | Segment Volume  | 4.99330E+06 cm^3         |
| 180 |   |   |   |   |   |   | Target Cell   | 4.99330E+06              |
| 181 |   |   |   |   |   |   | Dis. from Center (y1)   | 2.74765E+01 cm           |
| 182 |   |   |   |   |   |   |   | Den of UO2+Al2O3+Fe2O    |
| 183 |   |   |   |   |   |   |   | Vol. Occupied by UO2+Al  |
| 184 |   |   |   |   |   |   |   |                          |
| 185 |   |   |   |   |   |   | Layer of MIT Fuel and Others  |                          |
| 186 |   |   |   |   |   |   |   |                          |
| 187 |   |   |   |   |   |   | 1/2 Cylinder Volume   | 3.57294E+06 cm^3         |
| 188 |   |   |   |   |   |   | Segment - 1/2 Cylin.  | 1.42036E+06 cm^3         |
| 189 |   |   |   |   |   |   | Layer Volume  | 1.33977E+06 cm^3         |
| 190 |   |   |   |   |   |   | Target Cell   | 1.33977E+06              |
| 191 |   |   |   |   |   |   | Dis from Center (y2)  | 5.69060E+01 cm           |
| 192 |   |   |   |   |   |   | U-235   | 32912                    |
| 193 |   |   |   |   |   |   | U-234   | 352                      |
| 194 |   |   |   |   |   |   | U-238   | 1936                     |
| 195 |   |   |   |   |   |   | Al  | 4.14E+05                 |
| 196 |   |   |   |   |   |   | Fe  | 0.00E+00                 |
| 197 |   |   |   |   |   |   | O   | 1.39E+06                 |
| 198 |   |   |   |   |   |   | H   | 1.27E+05                 |
| 199 |   |   |   |   |   |   | Gd-152  |                          |
| 200 |   |   |   |   |   |   | Gd-154  |                          |
| 201 |   |   |   |   |   |   | Gd-155  |                          |
| 202 |   |   |   |   |   |   | Gd-156  |                          |
| 203 |   |   |   |   |   |   | Gd-157  |                          |
| 204 |   |   |   |   |   |   | Gd-158  |                          |
|     |   |   |   |   |   |   | Gd-160  |                          |

|     | A | B                                   | C | D   | E               | F | G                          | H                        |  |
|-----|---|-------------------------------------|---|---|-----------------|---|----------------------------|--------------------------|--|
| 205 |   |                                     |   |   |                 |   | den (g/cm <sup>3</sup> )   | 1.46380E+00              |  |
| 206 |   |                                     |   |   |                 |   |                            |                          |  |
| 207 |   |                                     |   |   |                 |   | H/U-235 Ration             |                          |  |
| 208 |   |                                     |   |   |                 |   |                            |                          |  |
| 209 |   |                                     |   |   |                 |   |                            |                          |  |
| 210 |   |                                     |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |                 |   |                            |                          |  |
| 211 |   |                                     |   |   |                 |   |                            |                          |  |
| 212 |   |                                     |   |   |                 |   |                            |                          |  |
| 213 |   | Cylinder Segment Volume Calculation |   |   |                 |   |                            | Degraded MIT Fuel        |  |
| 214 |   | (Degraded DHLW)                     |   |   |                 |   |                            |                          |  |
| 215 |   |                                     |   |   |                 |   |                            |                          |  |
| 216 |   | Geometry Calculations               |   |   |                 |   |                            | Fraction of UO2 Remainin |  |
| 217 |   | Cylinder Radius (R)                 |   | 86.5  | cm              |   | Mass of Gd                 |                          |  |
| 218 |   | Cylinder Length                     |   | 304   | cm              |   | Density of Gd              |                          |  |
| 219 |   | Cylinder Volume                     |   | 7.14588E+06   | cm <sup>3</sup> |   | Mass of Fe2O3              |                          |  |
| 220 |   | Segment Volume                      |   | 4.99330E+06   | cm <sup>3</sup> |   | Nominal Den of UO2+Al2O    |                          |  |
| 221 |   | Target Cell                         |   | 4.99330E+06   |                 |   | Total Mas of UO2+Al2O3-    |                          |  |
| 222 |   | Dis. from Center (y1)               |   | 2.74765E+01   | cm              |   | Void Fraction              |                          |  |
| 223 |   |                                     |   |   |                 |   | Den of UO2+Al2O3+Fe2O      |                          |  |
| 224 |   |                                     |   |   |                 |   | Vol. Occupied by UO2+Al    |                          |  |
| 225 |   |                                     |   |   |                 |   |                            |                          |  |
| 226 |   | Layer of MIT Fuel and Others        |   |   |                 |   |                            |                          |  |
| 227 |   |                                     |   |   |                 |   |                            |                          |  |
| 228 |   | 1/2 Cylinder Volume                 |   | 3.57294E+06   | cm <sup>3</sup> |   |                            |                          |  |
| 229 |   | Segment - 1/2 Cylin.                |   | 1.42036E+06   | cm <sup>3</sup> |   |                            |                          |  |
| 230 |   | Layer Volume                        |   | 2.00966E+06   | cm <sup>3</sup> |   | Atomic Density Calculation |                          |  |
| 231 |   | Target Cell                         |   | 2.00966E+06   |                 |   | Mass(g)                    |                          |  |
| 232 |   | Dis from Center (y2)                |   | 7.74470E+01   | cm              |   | U-235                      | 32912                    |  |
| 233 |   |                                     |   |   |                 |   | U-234                      | 352                      |  |
| 234 |   |                                     |   |   |                 |   | U-238                      | 1936                     |  |
| 235 |   |                                     |   |   |                 |   | Al                         | 4.14E+05                 |  |
| 236 |   |                                     |   |   |                 |   | Fe                         | 0.00E+00                 |  |
| 237 |   |                                     |   |   |                 |   | O                          | 1.98E+06                 |  |
| 238 |   |                                     |   |   |                 |   | H                          | 2.01E+05                 |  |
| 239 |   |                                     |   |   |                 |   | Gd-152                     |                          |  |
| 240 |   |                                     |   |   |                 |   | Gd-154                     |                          |  |
| 241 |   |                                     |   |   |                 |   | Gd-155                     |                          |  |
| 242 |   |                                     |   |   |                 |   | Gd-156                     |                          |  |
| 243 |   |                                     |   |   |                 |   | Gd-157                     |                          |  |
| 244 |   |                                     |   |   |                 |   | Gd-158                     |                          |  |
| 245 |   |                                     |   |   |                 |   | Gd-160                     |                          |  |
| 246 |   |                                     |   |   |                 |   | den (g/cm <sup>3</sup> )   | 1.30920E+00              |  |
| 247 |   |                                     |   |   |                 |   |                            |                          |  |
| 248 |   |                                     |   |   |                 |   | H/U-235 Ration             |                          |  |
| 249 |   |                                     |   |   |                 |   |                            |                          |  |
| 250 |   |                                     |   |   |                 |   |                            |                          |  |
| 251 |   |                                     |   |   |                 |   |                            |                          |  |
| 252 |   |                                     |   |   |                 |   |                            |                          |  |
| 253 |   |                                     |   |   |                 |   |                            |                          |  |
| 254 |   |                                     |   |   |                 |   |                            |                          |  |
| 255 |   |                                     |   |   |                 |   |                            |                          |  |

Fe\_gd

|     | A | B | C | D | E | F | G | H |
|-----|---|---|---|---|---|---|---|---|
| 256 |   |   |   |   |   |   |   |   |
| 257 |   |   |   |   |   |   |   |   |
| 258 |   |   |   |   |   |   |   |   |
| 259 |   |   |   |   |   |   |   |   |
| 260 |   |   |   |   |   |   |   |   |
| 261 |   |   |   |   |   |   |   |   |
| 262 |   |   |   |   |   |   |   |   |
| 263 |   |   |   |   |   |   |   |   |
| 264 |   |   |   |   |   |   |   |   |
| 265 |   |   |   |   |   |   |   |   |
| 266 |   |   |   |   |   |   |   |   |
| 267 |   |   |   |   |   |   |   |   |
| 268 |   |   |   |   |   |   |   |   |
| 269 |   |   |   |   |   |   |   |   |
| 270 |   |   |   |   |   |   |   |   |
| 271 |   |   |   |   |   |   |   |   |
| 272 |   |   |   |   |   |   |   |   |
| 273 |   |   |   |   |   |   |   |   |
| 274 |   |   |   |   |   |   |   |   |
| 275 |   |   |   |   |   |   |   |   |
| 276 |   |   |   |   |   |   |   |   |
| 277 |   |   |   |   |   |   |   |   |
| 278 |   |   |   |   |   |   |   |   |
| 279 |   |   |   |   |   |   |   |   |
| 280 |   |   |   |   |   |   |   |   |
| 281 |   |   |   |   |   |   |   |   |
| 282 |   |   |   |   |   |   |   |   |
| 283 |   |   |   |   |   |   |   |   |
| 284 |   |   |   |   |   |   |   |   |
| 285 |   |   |   |   |   |   |   |   |
| 286 |   |   |   |   |   |   |   |   |
| 287 |   |   |   |   |   |   |   |   |
| 288 |   |   |   |   |   |   |   |   |
| 289 |   |   |   |   |   |   |   |   |

|    | I                         | J         | K                          | L      | M | N | O | P                       |              |
|----|---------------------------|-----------|----------------------------|--------|---|---|---|-------------------------|--------------|
| 1  |                           |           |                            |        |   |   |   |                         |              |
| 2  |                           |           |                            |        |   |   |   |                         |              |
| 3  |                           |           |                            |        |   |   |   |                         |              |
| 4  |                           |           |                            |        |   |   |   |                         |              |
| 5  | Fe2O3, Void Fraction 0.6) |           |                            |        |   |   |   |                         | Degraded     |
| 6  |                           |           |                            |        |   |   |   |                         |              |
| 7  |                           |           |                            |        |   |   |   |                         |              |
| 8  |                           |           |                            |        |   |   |   | Cylinder Segment Volume |              |
| 9  |                           |           |                            |        |   |   |   | (Degraded DHLW)         |              |
| 10 |                           |           |                            |        |   |   |   |                         |              |
| 11 | g                         |           | 1.00                       |        |   |   |   | Geometry Calculations   |              |
| 12 |                           |           |                            | g      |   |   |   | Cylinder Radius (R)     |              |
| 13 |                           |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length         |              |
| 14 |                           |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume         |              |
| 15 | O3+Fe2O3                  |           | 4.09201E+00                | g/cm^3 |   |   |   | Segment Volume          |              |
| 16 | Fe2O3                     |           | 8.22353E+05                | g      |   |   |   | Target Cell             |              |
| 17 |                           |           | 6.00000E-01                |        |   |   |   | Dis. from Center (y1)   |              |
| 18 | O3+Void Used              |           | 1.63680E+00                | g/cm^3 |   |   |   |                         |              |
| 19 | O3+Fe2O3+Void             |           | 5.02414E+05                | cm^3   |   |   |   |                         |              |
| 20 |                           |           |                            |        |   |   |   |                         |              |
| 21 |                           |           |                            |        |   |   |   | Layer of MIT Fuel and   |              |
| 22 |                           |           |                            |        |   |   |   |                         |              |
| 23 |                           |           |                            |        |   |   |   | 1/2 Cylinder Volume     |              |
| 24 |                           |           |                            |        |   |   |   | Segment - 1/2 Cylin.    |              |
| 25 | h (Degraded MIT Fuel)     |           |                            |        |   |   |   |                         | Layer Volume |
| 26 | WT                        | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell             |              |
| 27 | 235.0439                  | 92235.50C | 1.6785E-04                 |        |   |   |   | Dis from Center (y2)    |              |
| 28 | 234.0409                  | 92234.50C | 1.8029E-06                 |        |   |   |   |                         |              |
| 29 | 238.0508                  | 92238.50C | 9.7488E-06                 |        |   |   |   |                         |              |
| 30 | 26.98154                  | 13027.50C | 1.8401E-02                 |        |   |   |   |                         |              |
| 31 | 55.847                    | 26000.55C | 0.0000E+00                 |        |   |   |   |                         |              |
| 32 | 15.99492                  | 8016.50C  | 4.8032E-02                 |        |   |   |   |                         |              |
| 33 | 1.007825                  | 1001.50C  | 3.9838E-02                 |        |   |   |   |                         |              |
| 34 |                           | 64152.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 35 |                           | 64154.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 36 |                           | 64155.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 37 |                           | 64156.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 38 |                           | 64157.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 39 |                           | 64158.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 40 |                           | 64160.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 41 |                           |           | 1.0645E-01                 |        |   |   |   |                         |              |
| 42 |                           |           |                            |        |   |   |   |                         |              |
| 43 |                           |           | 237.3448992                |        |   |   |   |                         |              |
| 44 |                           |           |                            |        |   |   |   |                         |              |
| 45 |                           |           |                            |        |   |   |   |                         |              |
| 46 | Fe2O3, Void Fraction 0.7) |           |                            |        |   |   |   |                         | Degraded     |
| 47 |                           |           |                            |        |   |   |   |                         |              |
| 48 |                           |           |                            |        |   |   |   |                         |              |
| 49 |                           |           |                            |        |   |   |   | Cylinder Segment Volume |              |
| 50 |                           |           |                            |        |   |   |   | (Degraded DHLW)         |              |
| 51 |                           |           |                            |        |   |   |   |                         |              |

|     | I                          | J         | K                          | L      | M | N | O | P                     |
|-----|----------------------------|-----------|----------------------------|--------|---|---|---|-----------------------|
| 52  | g                          |           | 1.00                       |        |   |   |   | Geometry Calculations |
| 53  |                            |           |                            | g      |   |   |   | Cylinder Radius (R)   |
| 54  |                            |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length       |
| 55  |                            |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume       |
| 56  | D3+Fe2O3                   |           | 4.09201E+00                | g/cm^3 |   |   |   | Segment Volume        |
| 57  | Fe2O3                      |           | 8.22353E+05                | g      |   |   |   | Target Cell           |
| 58  |                            |           | 7.00000E-01                |        |   |   |   | Dis. from Center (y1) |
| 59  | D3+Void Used               |           | 1.22760E+00                | g/cm^3 |   |   |   |                       |
| 60  | D3O3+Fe2O3+Void            |           | 6.69885E+05                | cm^3   |   |   |   |                       |
| 61  |                            |           |                            |        |   |   |   |                       |
| 62  |                            |           |                            |        |   |   |   | Layer of MIT Fuel and |
| 63  |                            |           |                            |        |   |   |   |                       |
| 64  |                            |           |                            |        |   |   |   | 1/2 Cylinder Volume   |
| 65  |                            |           |                            |        |   |   |   | Segment - 1/2 Cylin.  |
| 66  | n (Degraded MIT Fuel)      |           |                            |        |   |   |   | Layer Volume          |
| 67  | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell           |
| 68  | 235.0439                   | 92235.50C | 1.2589E-04                 |        |   |   |   | Dis from Center (y2)  |
| 69  | 234.0409                   | 92234.50C | 1.3522E-06                 |        |   |   |   |                       |
| 70  | 238.0508                   | 92238.50C | 7.3116E-06                 |        |   |   |   |                       |
| 71  | 26.98154                   | 13027.50C | 1.3801E-02                 |        |   |   |   |                       |
| 72  | 55.847                     | 26000.55C | 0.0000E+00                 |        |   |   |   |                       |
| 73  | 15.99492                   | 8016.50C  | 4.4392E-02                 |        |   |   |   |                       |
| 74  | 1.007825                   | 1001.50C  | 4.6478E-02                 |        |   |   |   |                       |
| 75  |                            | 64152.50C | 0.0000E+00                 |        |   |   |   |                       |
| 76  |                            | 64154.50C | 0.0000E+00                 |        |   |   |   |                       |
| 77  |                            | 64155.50C | 0.0000E+00                 |        |   |   |   |                       |
| 78  |                            | 64156.50C | 0.0000E+00                 |        |   |   |   |                       |
| 79  |                            | 64157.50C | 0.0000E+00                 |        |   |   |   |                       |
| 80  |                            | 64158.50C | 0.0000E+00                 |        |   |   |   |                       |
| 81  |                            | 64160.50C | 0.0000E+00                 |        |   |   |   |                       |
| 82  |                            |           | 1.0481E-01                 |        |   |   |   |                       |
| 83  |                            |           |                            |        |   |   |   |                       |
| 84  |                            |           | 369.2031765                |        |   |   |   |                       |
| 85  |                            |           |                            |        |   |   |   |                       |
| 86  |                            |           |                            |        |   |   |   |                       |
| 87  | Fe2O3, Void Fraction 0.75) |           |                            |        |   |   |   | Degraded              |
| 88  |                            |           |                            |        |   |   |   |                       |
| 89  |                            |           |                            |        |   |   |   |                       |
| 90  |                            |           |                            |        |   |   |   | Cylinder Segment Volu |
| 91  |                            |           |                            |        |   |   |   | (Degraded DHLW)       |
| 92  |                            |           |                            |        |   |   |   |                       |
| 93  | g                          |           | 1.00                       |        |   |   |   | Geometry Calculations |
| 94  |                            |           |                            | g      |   |   |   | Cylinder Radius (R)   |
| 95  |                            |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length       |
| 96  |                            |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume       |
| 97  | D3+Fe2O3                   |           | 4.09201E+00                | g/cm^3 |   |   |   | Segment Volume        |
| 98  | Fe2O3                      |           | 8.22353E+05                | g      |   |   |   | Target Cell           |
| 99  |                            |           | 7.50000E-01                |        |   |   |   | Dis. from Center (y1) |
| 100 | D3+Void Used               |           | 1.02300E+00                | g/cm^3 |   |   |   |                       |
| 101 | D3O3+Fe2O3+Void            |           | 8.03862E+05                | cm^3   |   |   |   |                       |
| 102 |                            |           |                            |        |   |   |   |                       |



|      | I                                | J         | K                          | L      | M | N | O | P                     |                 |
|------|----------------------------------|-----------|----------------------------|--------|---|---|---|-----------------------|-----------------|
| 103  |                                  |           |                            |        |   |   |   |                       |                 |
| 104  |                                  |           |                            |        |   |   |   | Layer of MIT Fuel and |                 |
| 105  |                                  |           |                            |        |   |   |   |                       |                 |
| 106  |                                  |           |                            |        |   |   |   | 1/2 Cylinder Volume   |                 |
| 107  |                                  |           |                            |        |   |   |   | Segment - 1/2 Cylin.  |                 |
| 107h |                                  |           |                            |        |   |   |   | Layer Volume          |                 |
| 108  | WT                               | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell           |                 |
| 109  | 235.0439                         | 92235.50C | 1.0491E-04                 |        |   |   |   | Dis from Center (y2)  |                 |
| 110  | 234.0409                         | 92234.50C | 1.1268E-06                 |        |   |   |   |                       |                 |
| 111  | 238.0508                         | 92238.50C | 6.0930E-06                 |        |   |   |   |                       |                 |
| 112  | 26.98154                         | 13027.50C | 1.1501E-02                 |        |   |   |   |                       |                 |
| 113  | 55.847                           | 26000.55C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 114  | 15.99492                         | 8016.50C  | 4.2571E-02                 |        |   |   |   |                       |                 |
| 115  | 1.007825                         | 1001.50C  | 4.9798E-02                 |        |   |   |   |                       |                 |
| 116  |                                  | 64152.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 117  |                                  | 64154.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 118  |                                  | 64155.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 119  |                                  | 64156.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 120  |                                  | 64157.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 121  |                                  | 64158.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 122  |                                  | 64160.50C | 0.0000E+00                 |        |   |   |   |                       |                 |
| 123  |                                  |           | 1.0398E-01                 |        |   |   |   |                       |                 |
| 124  |                                  |           |                            |        |   |   |   |                       |                 |
| 125  |                                  |           | 474.6897984                |        |   |   |   |                       |                 |
| 126  |                                  |           |                            |        |   |   |   |                       |                 |
| 127  |                                  |           |                            |        |   |   |   |                       |                 |
| 128  | <b>Fe2O3, Void Fraction 0.8)</b> |           |                            |        |   |   |   |                       | <b>Degraded</b> |
| 129  |                                  |           |                            |        |   |   |   |                       |                 |
| 130  |                                  |           |                            |        |   |   |   |                       |                 |
| 131  |                                  |           |                            |        |   |   |   | Cylinder Segment Volu |                 |
| 132  |                                  |           |                            |        |   |   |   | (Degraded DHLW)       |                 |
| 133  |                                  |           |                            |        |   |   |   |                       |                 |
| 134  | g                                |           | 1.00                       |        |   |   |   | Geometry Calculations |                 |
| 135  |                                  |           |                            |        |   |   |   | Cylinder Radius (R)   |                 |
| 136  |                                  |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length       |                 |
| 137  |                                  |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume       |                 |
| 138  | D3+Fe2O3                         |           | 4.09201E+00                | g/cm^3 |   |   |   | Segment Volume        |                 |
| 139  | Fe2O3                            |           | 8.22353E+05                | g      |   |   |   | Target Cell           |                 |
| 140  |                                  |           | 8.00000E-01                |        |   |   |   | Dis. from Center (y1) |                 |
| 141  | D3+Void Used                     |           | 8.18402E-01                | g/cm^3 |   |   |   |                       |                 |
| 142  | D3+Fe2O3+Void                    |           | 1.00483E+06                | cm^3   |   |   |   |                       |                 |
| 143  |                                  |           |                            |        |   |   |   |                       |                 |
| 144  |                                  |           |                            |        |   |   |   | Layer of MIT Fuel and |                 |
| 145  |                                  |           |                            |        |   |   |   |                       |                 |
| 146  |                                  |           |                            |        |   |   |   | 1/2 Cylinder Volume   |                 |
| 147  |                                  |           |                            |        |   |   |   | Segment - 1/2 Cylin.  |                 |
| 148  |                                  |           |                            |        |   |   |   | Layer Volume          |                 |
| 149  | WT                               | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell           |                 |
| 150  | 235.0439                         | 92235.50C | 8.3925E-05                 |        |   |   |   | Dis from Center (y2)  |                 |
| 151  | 234.0409                         | 92234.50C | 9.0144E-07                 |        |   |   |   |                       |                 |
| 152  | 238.0508                         | 92238.50C | 4.8744E-06                 |        |   |   |   |                       |                 |
| 153  | 26.98154                         | 13027.50C | 9.2006E-03                 |        |   |   |   |                       |                 |

|     | I                          | J         | K                          | L | M | N | O | P      |
|-----|----------------------------|-----------|----------------------------|---|---|---|---|--------|
| 154 | 55.847                     | 26000.55C | 0.0000E+00                 |   |   |   |   |        |
| 155 | 15.99492                   | 8016.50C  | 4.0751E-02                 |   |   |   |   |        |
| 156 | 1.007825                   | 1001.50C  | 5.3118E-02                 |   |   |   |   |        |
| 157 |                            | 64152.50C | 0.0000E+00                 |   |   |   |   |        |
| 158 |                            | 64154.50C | 0.0000E+00                 |   |   |   |   |        |
| 159 |                            | 64155.50C | 0.0000E+00                 |   |   |   |   |        |
| 160 |                            | 64156.50C | 0.0000E+00                 |   |   |   |   |        |
| 161 |                            | 64157.50C | 0.0000E+00                 |   |   |   |   |        |
| 162 |                            | 64158.50C | 0.0000E+00                 |   |   |   |   |        |
| 163 |                            | 64160.50C | 0.0000E+00                 |   |   |   |   |        |
| 164 |                            |           | 1.0316E-01                 |   |   |   |   |        |
| 165 |                            |           |                            |   |   |   |   |        |
| 166 |                            |           | 632.9197311                |   |   |   |   |        |
| 167 |                            |           |                            |   |   |   |   |        |
| 168 |                            |           |                            |   |   |   |   |        |
| 169 | Fe2O3, Void Fraction 0.85) |           |                            |   |   |   |   |        |
| 170 |                            |           |                            |   |   |   |   |        |
| 171 |                            |           |                            |   |   |   |   |        |
| 172 |                            |           |                            |   |   |   |   |        |
| 173 |                            |           |                            |   |   |   |   |        |
| 174 |                            |           |                            |   |   |   |   |        |
| 175 | g                          |           | 1.00                       |   |   |   |   |        |
| 176 |                            |           |                            |   |   |   |   | g      |
| 177 |                            |           | 7.9004E+00                 |   |   |   |   | g/cm^3 |
| 178 |                            |           | 0.00E+00                   |   |   |   |   | g      |
| 179 | O3+Fe2O3                   |           | 4.09201E+00                |   |   |   |   | g/cm^3 |
| 180 | Fe2O3                      |           | 8.22353E+05                |   |   |   |   | g      |
| 181 |                            |           | 8.50000E-01                |   |   |   |   |        |
| 182 | O3+Void Used               |           | 6.13802E-01                |   |   |   |   | g/cm^3 |
| 183 | O3+Fe2O3+Void              |           | 1.33977E+06                |   |   |   |   | cm^3   |
| 184 |                            |           |                            |   |   |   |   |        |
| 185 |                            |           |                            |   |   |   |   |        |
| 186 |                            |           |                            |   |   |   |   |        |
| 187 |                            |           |                            |   |   |   |   |        |
| 188 |                            |           |                            |   |   |   |   |        |
| 189 | h (Degraded MIT Fuel)      |           |                            |   |   |   |   |        |
| 190 | WT                         | MCNP      | Atomic Density (#/barn cm) |   |   |   |   |        |
| 191 | 235.0439                   | 92235.50C | 6.2944E-05                 |   |   |   |   |        |
| 192 | 234.0409                   | 92234.50C | 6.7608E-07                 |   |   |   |   |        |
| 193 | 238.0508                   | 92238.50C | 3.6558E-06                 |   |   |   |   |        |
| 194 | 26.98154                   | 13027.50C | 6.9005E-03                 |   |   |   |   |        |
| 195 | 55.847                     | 26000.55C | 0.0000E+00                 |   |   |   |   |        |
| 196 | 15.99492                   | 8016.50C  | 3.8930E-02                 |   |   |   |   |        |
| 197 | 1.007825                   | 1001.50C  | 5.6438E-02                 |   |   |   |   |        |
| 198 |                            | 64152.50C | 0.0000E+00                 |   |   |   |   |        |
| 199 |                            | 64154.50C | 0.0000E+00                 |   |   |   |   |        |
| 200 |                            | 64155.50C | 0.0000E+00                 |   |   |   |   |        |
| 201 |                            | 64156.50C | 0.0000E+00                 |   |   |   |   |        |
| 202 |                            | 64157.50C | 0.0000E+00                 |   |   |   |   |        |
| 203 |                            | 64158.50C | 0.0000E+00                 |   |   |   |   |        |
| 204 |                            | 64160.50C | 0.0000E+00                 |   |   |   |   |        |

Fe\_gd

|     | I                         | J         | K                          | L | M      | N | O | P |
|-----|---------------------------|-----------|----------------------------|---|--------|---|---|---|
| 205 |                           |           | 1.0234E-01                 |   |        |   |   |   |
| 206 |                           |           |                            |   |        |   |   |   |
| 207 |                           |           | 896.6362858                |   |        |   |   |   |
| 208 |                           |           |                            |   |        |   |   |   |
| 209 |                           |           |                            |   |        |   |   |   |
| 210 | Fe2O3, Void Fraction 0.9) |           |                            |   |        |   |   |   |
| 211 |                           |           |                            |   |        |   |   |   |
| 212 |                           |           |                            |   |        |   |   |   |
| 213 |                           |           |                            |   |        |   |   |   |
| 214 |                           |           |                            |   |        |   |   |   |
| 215 |                           |           |                            |   |        |   |   |   |
| 216 | g                         |           | 1.00                       |   |        |   |   |   |
| 217 |                           |           |                            |   | g      |   |   |   |
| 218 |                           |           | 7.9004E+00                 |   | g/cm^3 |   |   |   |
| 219 |                           |           | 0.00E+00                   |   | g      |   |   |   |
| 220 | O3+Fe2O3                  |           | 4.09201E+00                |   | g/cm^3 |   |   |   |
| 221 | Fe2O3                     |           | 8.22353E+05                |   | g      |   |   |   |
| 222 |                           |           | 9.00000E-01                |   |        |   |   |   |
| 223 | O3+Void Used              |           | 4.09201E-01                |   | g/cm^3 |   |   |   |
| 224 | O3+Fe2O3+Void             |           | 2.00966E+06                |   | cm^3   |   |   |   |
| 225 |                           |           |                            |   |        |   |   |   |
| 226 |                           |           |                            |   |        |   |   |   |
| 227 |                           |           |                            |   |        |   |   |   |
| 228 |                           |           |                            |   |        |   |   |   |
| 229 |                           |           |                            |   |        |   |   |   |
| 230 | h (Degraded MIT Fuel)     |           |                            |   |        |   |   |   |
| 231 | WT                        | MCNP      | Atomic Density (#/barn cm) |   |        |   |   |   |
| 232 | 235.0439                  | 92235.50C | 4.1962E-05                 |   |        |   |   |   |
| 233 | 234.0409                  | 92234.50C | 4.5072E-07                 |   |        |   |   |   |
| 234 | 238.0508                  | 92238.50C | 2.4372E-06                 |   |        |   |   |   |
| 235 | 26.98154                  | 13027.50C | 4.6003E-03                 |   |        |   |   |   |
| 236 | 55.847                    | 26000.55C | 0.0000E+00                 |   |        |   |   |   |
| 237 | 15.99492                  | 8016.50C  | 3.7110E-02                 |   |        |   |   |   |
| 238 | 1.007825                  | 1001.50C  | 5.9757E-02                 |   |        |   |   |   |
| 239 |                           | 64152.50C | 0.0000E+00                 |   |        |   |   |   |
| 240 |                           | 64154.50C | 0.0000E+00                 |   |        |   |   |   |
| 241 |                           | 64155.50C | 0.0000E+00                 |   |        |   |   |   |
| 242 |                           | 64156.50C | 0.0000E+00                 |   |        |   |   |   |
| 243 |                           | 64157.50C | 0.0000E+00                 |   |        |   |   |   |
| 244 |                           | 64158.50C | 0.0000E+00                 |   |        |   |   |   |
| 245 |                           | 64160.50C | 0.0000E+00                 |   |        |   |   |   |
| 246 |                           |           | 1.0151E-01                 |   |        |   |   |   |
| 247 |                           |           |                            |   |        |   |   |   |
| 248 |                           |           | 1424.069395                |   |        |   |   |   |
| 249 |                           |           |                            |   |        |   |   |   |
| 250 |                           |           |                            |   |        |   |   |   |
| 251 |                           |           |                            |   |        |   |   |   |
| 252 |                           |           |                            |   |        |   |   |   |
| 253 |                           |           |                            |   |        |   |   |   |
| 254 |                           |           |                            |   |        |   |   |   |
| 255 |                           |           |                            |   |        |   |   |   |

Fe\_gd

|     | I | J | K | L | M | N | O | P |
|-----|---|---|---|---|---|---|---|---|
| 256 |   |   |   |   |   |   |   |   |
| 257 |   |   |   |   |   |   |   |   |
| 258 |   |   |   |   |   |   |   |   |
| 259 |   |   |   |   |   |   |   |   |
| 260 |   |   |   |   |   |   |   |   |
| 261 |   |   |   |   |   |   |   |   |
| 262 |   |   |   |   |   |   |   |   |
| 263 |   |   |   |   |   |   |   |   |
| 264 |   |   |   |   |   |   |   |   |
| 265 |   |   |   |   |   |   |   |   |
| 266 |   |   |   |   |   |   |   |   |
| 267 |   |   |   |   |   |   |   |   |
| 268 |   |   |   |   |   |   |   |   |
| 269 |   |   |   |   |   |   |   |   |
| 270 |   |   |   |   |   |   |   |   |
| 271 |   |   |   |   |   |   |   |   |
| 272 |   |   |   |   |   |   |   |   |
| 273 |   |   |   |   |   |   |   |   |
| 274 |   |   |   |   |   |   |   |   |
| 275 |   |   |   |   |   |   |   |   |
| 276 |   |   |   |   |   |   |   |   |
| 277 |   |   |   |   |   |   |   |   |
| 278 |   |   |   |   |   |   |   |   |
| 279 |   |   |   |   |   |   |   |   |
| 280 |   |   |   |   |   |   |   |   |
| 281 |   |   |   |   |   |   |   |   |
| 282 |   |   |   |   |   |   |   |   |
| 283 |   |   |   |   |   |   |   |   |
| 284 |   |   |   |   |   |   |   |   |
| 285 |   |   |   |   |   |   |   |   |
| 286 |   |   |   |   |   |   |   |   |
| 287 |   |   |   |   |   |   |   |   |
| 288 |   |   |   |   |   |   |   |   |
| 289 |   |   |   |   |   |   |   |   |

Fe\_gd

|    | Q  | R    | S | T  | U        | V        | W              | X           |            |
|----|--|------|---|--|----------|----------|----------------|-------------|------------|
| 1  |  |      |   |  |          |          |                |             |            |
| 2  |  |      |   |  |          |          |                |             |            |
| 3  |  |      |   |  |          |          |                |             |            |
| 4  |  |      |   |  |          |          |                |             |            |
| 5  | <b>MIT Fuel On Top of Degraded DHLW Clay ( 200 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |  |          |          |                |             |            |
| 6  |  |      |   |  |          |          |                |             |            |
| 7  |  |      |   |  |          |          |                |             |            |
| 8  | Time Calculation   |      |   | Degraded MIT Fuel                              |          |          |                |             |            |
| 9  |  |      |   |  |          |          |                |             |            |
| 10 |  |      |   |  |          |          |                |             |            |
| 11 |  |      |   | Fraction of UO2 Remaining                      |          |          |                | 1.00        |            |
| 12 | 86.5   | cm   |   | Mass of Gd                                     |          |          |                | 200         |            |
| 13 | 304  | cm   |   | Density of Gd                                  |          |          |                | 7.9004E+00  |            |
| 14 | 7.14588E+06  | cm^3 |   | Mass of Fe2O3                                  |          |          |                | 0.00E+00    |            |
| 15 | 4.99330E+06  | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |          |          |                | 4.09249E+00 |            |
| 16 | 4.99330E+06  |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |          |          |                | 8.22553E+05 |            |
| 17 | 2.74765E+01  | cm   |   | Void Fraction                                  |          |          |                | 8.00000E-01 |            |
| 18 |  |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |          |          |                | 8.18498E-01 |            |
| 19 |  |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |          |          |                | 1.00495E+06 |            |
| 20 |  |      |   |  |          |          |                |             |            |
| 21 | Others   |      |   |  |          |          |                |             |            |
| 22 |  |      |   |  |          |          |                |             |            |
| 23 | 3.57294E+06  | cm^3 |   |  |          |          |                |             |            |
| 24 | 1.42036E+06  | cm^3 |   |  |          |          |                |             |            |
| 25 | 1.00495E+06  | cm^3 |   | Atomic Density Calculation (Degraded MIT Fuel) |          |          |                |             |            |
| 26 | 1.00498E+06  |      |   | Mass(g)  | WT       | MCNP     | Atomic Density |             |            |
| 27 | 4.68547E+01  | cm   |   | U-235  | 32912    | 235.0439 | 92235.50C      | 8.3914E-05  |            |
| 28 |  |      |   | U-234  | 352      | 234.0409 | 92234.50C      | 9.0133E-07  |            |
| 29 |  |      |   | U-238  | 1936     | 238.0508 | 92238.50C      | 4.8738E-06  |            |
| 30 |  |      |   | Al   | 4.14E+05 | 26.98154 | 13027.50C      | 9.1995E-03  |            |
| 31 |  |      |   | Fe   | 0.00E+00 | 55.847   | 26000.55C      | 0.0000E+00  |            |
| 32 |  |      |   | O  | 1.09E+06 | 15.99492 | 8016.50C       | 4.0749E-02  |            |
| 33 |  |      |   | H  | 8.93E+04 | 1.007825 | 1001.50C       | 5.3118E-02  |            |
| 34 |  |      |   | Gd-152   |          |          | 64152.50C      | 1.5244E-09  |            |
| 35 |  |      |   | Gd-154   |          |          | 64154.50C      | 1.6616E-08  |            |
| 36 |  |      |   | Gd-155   |          |          | 64155.50C      | 1.1281E-07  |            |
| 37 |  |      |   | Gd-156   |          |          | 64156.50C      | 1.5602E-07  |            |
| 38 |  |      |   | Gd-157   |          |          | 64157.50C      | 1.1928E-07  |            |
| 39 |  |      |   | Gd-158   |          |          | 64158.50C      | 1.8933E-07  |            |
| 40 |  |      |   | Gd-160   |          |          | 64160.50C      | 1.6662E-07  |            |
| 41 |  |      |   | den (g/cm^                                     |          |          |                | 1.61850E+00 | 1.0316E-01 |
| 42 |  |      |   |  |          |          |                |             |            |
| 43 |  |      |   | H/U-235 Ration                                 |          |          |                | 632.9994586 |            |
| 44 |  |      |   |  |          |          |                |             |            |
| 45 |  |      |   |  |          |          |                |             |            |
| 46 | <b>MIT Fuel On Top of Degraded DHLW Clay ( 100 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |  |          |          |                |             |            |
| 47 |  |      |   |  |          |          |                |             |            |
| 48 |  |      |   |  |          |          |                |             |            |
| 49 | Time Calculation   |      |   | Degraded MIT Fuel                              |          |          |                |             |            |
| 50 |  |      |   |  |          |          |                |             |            |
| 51 |  |      |   |  |          |          |                |             |            |

Fe\_gd

|     | Q   | R    | S | T  | U           | V        | W              | X           |
|-----|---|------|---|--|-------------|----------|----------------|-------------|
| 52  |   |      |   | Fraction of UO2 Remaining                      |             |          |                | 1.00        |
| 53  | 86.5  | cm   |   | Mass of Gd                                     |             |          |                | 50          |
| 54  | 304   | cm   |   | Density of Gd                                  |             |          |                | 7.9004E+00  |
| 55  | 7.14588E+06   | cm^3 |   | Mass of Fe2O3                                  |             |          |                | 0.00E+00    |
| 56  | 4.99330E+06   | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |                | 4.09225E+00 |
| 57  | 4.99330E+06   |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |                | 8.22453E+05 |
| 58  | 2.74765E+01   | cm   |   | Void Fraction                                  |             |          |                | 8.00000E-01 |
| 59  |   |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |                | 8.18450E-01 |
| 60  |   |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |                | 1.00489E+06 |
| 61  |   |      |   |  |             |          |                |             |
| 62  | Others  |      |   |  |             |          |                |             |
| 63  |   |      |   |  |             |          |                |             |
| 64  | 3.57294E+06   | cm^3 |   |  |             |          |                |             |
| 65  | 1.42036E+06   | cm^3 |   |  |             |          |                |             |
| 66  | 1.00489E+06   | cm^3 |   | Atomic Density Calculation (Degraded MIT Fuel) |             |          |                |             |
| 67  | 1.00491E+06   |      |   | Mass(g)  | WT          | MCNP     | Atomic Density |             |
| 68  | 4.88530E+01   | cm   |   | U-235  | 32912       | 235.0439 | 92235.50C      | 8.3920E-05  |
| 69  |   |      |   | U-234  | 352         | 234.0409 | 92234.50C      | 9.0138E-07  |
| 70  |   |      |   | U-238  | 1936        | 238.0508 | 92238.50C      | 4.8741E-06  |
| 71  |   |      |   | Al   | 4.14E+05    | 26.98154 | 13027.50C      | 9.2001E-03  |
| 72  |   |      |   | Fe   | 0.00E+00    | 55.847   | 26000.55C      | 0.0000E+00  |
| 73  |   |      |   | O  | 1.09E+06    | 15.99492 | 8016.50C       | 4.0750E-02  |
| 74  |   |      |   | H  | 8.93E+04    | 1.007825 | 1001.50C       | 5.3118E-02  |
| 75  |   |      |   | Gd-152   |             |          | 64152.50C      | 7.6225E-10  |
| 76  |   |      |   | Gd-154   |             |          | 64154.50C      | 8.3085E-09  |
| 77  |   |      |   | Gd-155   |             |          | 64155.50C      | 5.6407E-08  |
| 78  |   |      |   | Gd-156   |             |          | 64156.50C      | 7.8017E-08  |
| 79  |   |      |   | Gd-157   |             |          | 64157.50C      | 5.9646E-08  |
| 80  |   |      |   | Gd-158   |             |          | 64158.50C      | 9.4672E-08  |
| 81  |   |      |   | Gd-160   |             |          | 64160.50C      | 8.3314E-08  |
| 82  |   |      |   | den (g/cm^                                     | 1.61845E+00 |          |                | 1.0316E-01  |
| 83  |   |      |   |  |             |          |                |             |
| 84  |   |      |   | H/U-235 Ration                                 |             |          |                | 632.9595949 |
| 85  |   |      |   |  |             |          |                |             |
| 86  |   |      |   |  |             |          |                |             |
| 87  | <b>MIT Fuel On Top of Degraded DHLW Clay ( 50 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |  |             |          |                |             |
| 88  |   |      |   |  |             |          |                |             |
| 89  |   |      |   |  |             |          |                |             |
| 90  | me Calculation  |      |   | Degraded MIT Fuel                              |             |          |                |             |
| 91  |   |      |   |  |             |          |                |             |
| 92  |   |      |   |  |             |          |                |             |
| 93  |   |      |   | Fraction of UO2 Remaining                      |             |          |                | 1.00        |
| 94  | 86.5  | cm   |   | Mass of Gd                                     |             |          |                | 50          |
| 95  | 304   | cm   |   | Density of Gd                                  |             |          |                | 7.9004E+00  |
| 96  | 7.14588E+06   | cm^3 |   | Mass of Fe2O3                                  |             |          |                | 0.00E+00    |
| 97  | 4.99330E+06   | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |                | 4.09213E+00 |
| 98  | 4.99330E+06   |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |                | 8.22403E+05 |
| 99  | 2.74765E+01   | cm   |   | Void Fraction                                  |             |          |                | 8.00000E-01 |
| 100 |   |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |                | 8.18426E-01 |
| 101 |   |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |                | 1.00486E+06 |
| 102 |   |      |   |  |             |          |                |             |

|     | Q  | R    | S  | T           | U        | V         | W              | X |
|-----|--|------|--|-------------|----------|-----------|----------------|---|
| 103 | Others   |      |  |             |          |           |                |   |
| 104 |  |      |  |             |          |           |                |   |
| 105 | 3.57294E+06  | cm^3 |  |             |          |           |                |   |
| 106 | 1.42036E+06  | cm^3 |  |             |          |           |                |   |
| 107 | 1.00486E+06  | cm^3 | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |                |   |
| 108 | 1.00488E+06  |      |  | Mass(g)     | WT       | MCNP      | Atomic Density |   |
| 109 | 4.88524E+01  | cm   | U-235  | 32912       | 235.0439 | 92235.50C | 8.3922E-05     |   |
| 110 |  |      | U-234  | 352         | 234.0409 | 92234.50C | 9.0141E-07     |   |
| 111 |  |      | U-238  | 1936        | 238.0508 | 92238.50C | 4.8742E-06     |   |
| 112 |  |      | Al   | 4.14E+05    | 26.98154 | 13027.50C | 9.2004E-03     |   |
| 113 |  |      | Fe   | 0.00E+00    | 55.847   | 26000.55C | 0.0000E+00     |   |
| 114 |  |      | O  | 1.09E+06    | 15.99492 | 8016.50C  | 4.0750E-02     |   |
| 115 |  |      | H  | 8.93E+04    | 1.007825 | 1001.50C  | 5.3118E-02     |   |
| 116 |  |      | Gd-152   |             |          | 64152.50C | 3.8114E-10     |   |
| 117 |  |      | Gd-154   |             |          | 64154.50C | 4.1544E-09     |   |
| 118 |  |      | Gd-155   |             |          | 64155.50C | 2.8204E-08     |   |
| 119 |  |      | Gd-156   |             |          | 64156.50C | 3.9009E-08     |   |
| 120 |  |      | Gd-157   |             |          | 64157.50C | 2.9824E-08     |   |
| 121 |  |      | Gd-158   |             |          | 64158.50C | 4.7337E-08     |   |
| 122 |  |      | Gd-160   |             |          | 64160.50C | 4.1658E-08     |   |
| 123 |  |      | den (g/cm^                                     | 1.61843E+00 |          |           | 1.0316E-01     |   |
| 124 |  |      |  |             |          |           |                |   |
| 125 |  |      | H/U-235 Ration                                 |             |          |           | 632.939663     |   |
| 126 |  |      |  |             |          |           |                |   |
| 127 |  |      |  |             |          |           |                |   |
| 128 | MIT Fuel On Top of Degraded DHLW Clay ( 20 g of Gd, 0 g of Fe2O3, Void Fraction 0.8) |      |  |             |          |           |                |   |
| 129 |  |      |  |             |          |           |                |   |
| 130 |  |      |  |             |          |           |                |   |
| 131 | Time Calculation   |      | Degraded MIT Fuel                              |             |          |           |                |   |
| 132 |  |      |  |             |          |           |                |   |
| 133 |  |      |  |             |          |           |                |   |
| 134 |  |      | Fraction of UO2 Remaining                      |             |          |           | 1.00           |   |
| 135 | 86.5   | cm   | Mass of Gd                                     |             |          |           | 20             |   |
| 136 | 304  | cm   | Density of Gd                                  |             |          |           | 7.9004E+00     |   |
| 137 | 7.14588E+06  | cm^3 | Mass of Fe2O3                                  |             |          |           | 0.00E+00       |   |
| 138 | 4.99330E+06  | cm^3 | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           | 4.09206E+00    |   |
| 139 | 4.99330E+06  |      | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           | 8.22373E+05    |   |
| 140 | 2.74765E+01  | cm   | Void Fraction                                  |             |          |           | 8.00000E-01    |   |
| 141 |  |      | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           | 8.18412E-01    |   |
| 142 |  |      | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           | 1.00484E+06    |   |
| 143 |  |      |  |             |          |           |                |   |
| 144 | Others   |      |  |             |          |           |                |   |
| 145 |  |      |  |             |          |           |                |   |
| 146 | 3.57294E+06  | cm^3 |  |             |          |           |                |   |
| 147 | 1.42036E+06  | cm^3 |  |             |          |           |                |   |
| 148 | 1.00484E+06  | cm^3 | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |                |   |
| 149 | 1.00486E+06  |      |  | Mass(g)     | WT       | MCNP      | Atomic Density |   |
| 150 | 4.88520E+01  | cm   | U-235  | 32912       | 235.0439 | 92235.50C | 8.3924E-05     |   |
| 151 |  |      | U-234  | 352         | 234.0409 | 92234.50C | 9.0143E-07     |   |
| 152 |  |      | U-238  | 1936        | 238.0508 | 92238.50C | 4.8743E-06     |   |
| 153 |  |      | Al   | 4.14E+05    | 26.98154 | 13027.50C | 9.2005E-03     |   |

Fe\_gd

|     | Q | R | S | T              | U           | V        | W         | X           |
|-----|---|---|---|----------------|-------------|----------|-----------|-------------|
| 154 |   |   |   | Fe             | 0.00E+00    | 55.847   | 26000.55C | 0.0000E+00  |
| 155 |   |   |   | O              | 1.09E+06    | 15.99492 | 8016.50C  | 4.0751E-02  |
| 156 |   |   |   | H              | 8.93E+04    | 1.007825 | 1001.50C  | 5.3118E-02  |
| 157 |   |   |   | Gd-152         |             |          | 64152.50C | 1.5246E-10  |
| 158 |   |   |   | Gd-154         |             |          | 64154.50C | 1.6618E-09  |
| 159 |   |   |   | Gd-155         |             |          | 64155.50C | 1.1282E-08  |
| 160 |   |   |   | Gd-156         |             |          | 64156.50C | 1.5604E-08  |
| 161 |   |   |   | Gd-157         |             |          | 64157.50C | 1.1930E-08  |
| 162 |   |   |   | Gd-158         |             |          | 64158.50C | 1.8935E-08  |
| 163 |   |   |   | Gd-160         |             |          | 64160.50C | 1.6664E-08  |
| 164 |   |   |   | den (g/cm^     | 1.61841E+00 |          |           | 1.0316E-01  |
| 165 |   |   |   |                |             |          |           |             |
| 166 |   |   |   | H/U-235 Ration |             |          |           | 632.9277039 |
| 167 |   |   |   |                |             |          |           |             |
| 168 |   |   |   |                |             |          |           |             |
| 169 |   |   |   |                |             |          |           |             |
| 170 |   |   |   |                |             |          |           |             |
| 171 |   |   |   |                |             |          |           |             |
| 172 |   |   |   |                |             |          |           |             |
| 173 |   |   |   |                |             |          |           |             |
| 174 |   |   |   |                |             |          |           |             |
| 175 |   |   |   |                |             |          |           |             |
| 176 |   |   |   |                |             |          |           |             |
| 177 |   |   |   |                |             |          |           |             |
| 178 |   |   |   |                |             |          |           |             |
| 179 |   |   |   |                |             |          |           |             |
| 180 |   |   |   |                |             |          |           |             |
| 181 |   |   |   |                |             |          |           |             |
| 182 |   |   |   |                |             |          |           |             |
| 183 |   |   |   |                |             |          |           |             |
| 184 |   |   |   |                |             |          |           |             |
| 185 |   |   |   |                |             |          |           |             |
| 186 |   |   |   |                |             |          |           |             |
| 187 |   |   |   |                |             |          |           |             |
| 188 |   |   |   |                |             |          |           |             |
| 189 |   |   |   |                |             |          |           |             |
| 190 |   |   |   |                |             |          |           |             |
| 191 |   |   |   |                |             |          |           |             |
| 192 |   |   |   |                |             |          |           |             |
| 193 |   |   |   |                |             |          |           |             |
| 194 |   |   |   |                |             |          |           |             |
| 195 |   |   |   |                |             |          |           |             |
| 196 |   |   |   |                |             |          |           |             |
| 197 |   |   |   |                |             |          |           |             |
| 198 |   |   |   |                |             |          |           |             |
| 199 |   |   |   |                |             |          |           |             |
| 200 |   |   |   |                |             |          |           |             |
| 201 |   |   |   |                |             |          |           |             |
| 202 |   |   |   |                |             |          |           |             |
| 203 |   |   |   |                |             |          |           |             |
| 204 |   |   |   |                |             |          |           |             |



Fe\_gd

|     | Q | R | S | T | U | V | W | X |
|-----|---|---|---|---|---|---|---|---|
| 205 |   |   |   |   |   |   |   |   |
| 206 |   |   |   |   |   |   |   |   |
| 207 |   |   |   |   |   |   |   |   |
| 208 |   |   |   |   |   |   |   |   |
| 209 |   |   |   |   |   |   |   |   |
| 210 |   |   |   |   |   |   |   |   |
| 211 |   |   |   |   |   |   |   |   |
| 212 |   |   |   |   |   |   |   |   |
| 213 |   |   |   |   |   |   |   |   |
| 214 |   |   |   |   |   |   |   |   |
| 215 |   |   |   |   |   |   |   |   |
| 216 |   |   |   |   |   |   |   |   |
| 217 |   |   |   |   |   |   |   |   |
| 218 |   |   |   |   |   |   |   |   |
| 219 |   |   |   |   |   |   |   |   |
| 220 |   |   |   |   |   |   |   |   |
| 221 |   |   |   |   |   |   |   |   |
| 222 |   |   |   |   |   |   |   |   |
| 223 |   |   |   |   |   |   |   |   |
| 224 |   |   |   |   |   |   |   |   |
| 225 |   |   |   |   |   |   |   |   |
| 226 |   |   |   |   |   |   |   |   |
| 227 |   |   |   |   |   |   |   |   |
| 228 |   |   |   |   |   |   |   |   |
| 229 |   |   |   |   |   |   |   |   |
| 230 |   |   |   |   |   |   |   |   |
| 231 |   |   |   |   |   |   |   |   |
| 232 |   |   |   |   |   |   |   |   |
| 233 |   |   |   |   |   |   |   |   |
| 234 |   |   |   |   |   |   |   |   |
| 235 |   |   |   |   |   |   |   |   |
| 236 |   |   |   |   |   |   |   |   |
| 237 |   |   |   |   |   |   |   |   |
| 238 |   |   |   |   |   |   |   |   |
| 239 |   |   |   |   |   |   |   |   |
| 240 |   |   |   |   |   |   |   |   |
| 241 |   |   |   |   |   |   |   |   |
| 242 |   |   |   |   |   |   |   |   |
| 243 |   |   |   |   |   |   |   |   |
| 244 |   |   |   |   |   |   |   |   |
| 245 |   |   |   |   |   |   |   |   |
| 246 |   |   |   |   |   |   |   |   |
| 247 |   |   |   |   |   |   |   |   |
| 248 |   |   |   |   |   |   |   |   |
| 249 |   |   |   |   |   |   |   |   |
| 250 |   |   |   |   |   |   |   |   |
| 251 |   |   |   |   |   |   |   |   |
| 252 |   |   |   |   |   |   |   |   |
| 253 |   |   |   |   |   |   |   |   |
| 254 |   |   |   |   |   |   |   |   |
| 255 |   |   |   |   |   |   |   |   |

Fe\_gd

|     | Q | R | S | T | U | V | W | X |
|-----|---|---|---|---|---|---|---|---|
| 256 |   |   |   |   |   |   |   |   |
| 257 |   |   |   |   |   |   |   |   |
| 258 |   |   |   |   |   |   |   |   |
| 259 |   |   |   |   |   |   |   |   |
| 260 |   |   |   |   |   |   |   |   |
| 261 |   |   |   |   |   |   |   |   |
| 262 |   |   |   |   |   |   |   |   |
| 263 |   |   |   |   |   |   |   |   |
| 264 |   |   |   |   |   |   |   |   |
| 265 |   |   |   |   |   |   |   |   |
| 266 |   |   |   |   |   |   |   |   |
| 267 |   |   |   |   |   |   |   |   |
| 268 |   |   |   |   |   |   |   |   |
| 269 |   |   |   |   |   |   |   |   |
| 270 |   |   |   |   |   |   |   |   |
| 271 |   |   |   |   |   |   |   |   |
| 272 |   |   |   |   |   |   |   |   |
| 273 |   |   |   |   |   |   |   |   |
| 274 |   |   |   |   |   |   |   |   |
| 275 |   |   |   |   |   |   |   |   |
| 276 |   |   |   |   |   |   |   |   |
| 277 |   |   |   |   |   |   |   |   |
| 278 |   |   |   |   |   |   |   |   |
| 279 |   |   |   |   |   |   |   |   |
| 280 |   |   |   |   |   |   |   |   |
| 281 |   |   |   |   |   |   |   |   |
| 282 |   |   |   |   |   |   |   |   |
| 283 |   |   |   |   |   |   |   |   |
| 284 |   |   |   |   |   |   |   |   |
| 285 |   |   |   |   |   |   |   |   |
| 286 |   |   |   |   |   |   |   |   |
| 287 |   |   |   |   |   |   |   |   |
| 288 |   |   |   |   |   |   |   |   |
| 289 |   |   |   |   |   |   |   |   |

|    | Y           | Z | AA | AB | AC | AD          | AE   | AF | AG   |
|----|-------------|---|----|----|----|-------------|------|----|--|
| 1  |             |   |    |    |    |             |      |    |  |
| 2  |             |   |    |    |    |             |      |    |  |
| 3  |             |   |    |    |    |             |      |    |  |
| 4  |             |   |    |    |    |             |      |    |  |
| 5  |             |   |    |    |    |             |      |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 20</b> |
| 6  |             |   |    |    |    |             |      |    |  |
| 7  |             |   |    |    |    |             |      |    |  |
| 8  |             |   |    |    |    |             |      |    | Cylinder Segment Volume Calculation                        |
| 9  |             |   |    |    |    |             |      |    | (Degraded DHLW)  |
| 10 |             |   |    |    |    |             |      |    |  |
| 11 |             |   |    |    |    |             |      |    | Geometry Calculations                                      |
| 12 | g           |   |    |    |    | 86.5        | cm   |    | Mass of Gd   |
| 13 | g/cm^3      |   |    |    |    | 304         | cm   |    | Density of (   |
| 14 | g           |   |    |    |    | 7.14588E+06 | cm^3 |    | Mass of Fe   |
| 15 | g/cm^3      |   |    |    |    | 4.99330E+06 | cm^3 |    | Nominal D  |
| 16 | g           |   |    |    |    | 4.99330E+06 |      |    | Total Mas  |
| 17 |             |   |    |    |    | 2.74765E+01 | cm   |    | Void Fracti  |
| 18 | g/cm^3      |   |    |    |    |             |      |    | Den of UO  |
| 19 | cm^3        |   |    |    |    |             |      |    | Vol. Occup   |
| 20 |             |   |    |    |    |             |      |    |  |
| 21 |             |   |    |    |    |             |      |    | Layer of MIT Fuel and Others                               |
| 22 |             |   |    |    |    |             |      |    |  |
| 23 |             |   |    |    |    | 3.57294E+06 | cm^3 |    |  |
| 24 |             |   |    |    |    | 1.42036E+06 | cm^3 |    |  |
| 25 |             |   |    |    |    | 1.28654E+06 | cm^3 |    | Atomic Den   |
| 26 | (#/barn cm) |   |    |    |    | 1.28657E+06 |      |    |  |
| 27 |             |   |    |    |    | 5.55747E+01 | cm   |    | U-235  |
| 28 |             |   |    |    |    |             |      |    | U-234  |
| 29 |             |   |    |    |    |             |      |    | U-238  |
| 30 |             |   |    |    |    |             |      |    | Al   |
| 31 |             |   |    |    |    |             |      |    | Fe   |
| 32 |             |   |    |    |    |             |      |    | O  |
| 33 |             |   |    |    |    |             |      |    | H  |
| 34 |             |   |    |    |    |             |      |    | Gd-152   |
| 35 |             |   |    |    |    |             |      |    | Gd-154   |
| 36 |             |   |    |    |    |             |      |    | Gd-155   |
| 37 |             |   |    |    |    |             |      |    | Gd-156   |
| 38 |             |   |    |    |    |             |      |    | Gd-157   |
| 39 |             |   |    |    |    |             |      |    | Gd-158   |
| 40 |             |   |    |    |    |             |      |    | Gd-160   |
| 41 |             |   |    |    |    |             |      |    | den (g/cm^   |
| 42 |             |   |    |    |    |             |      |    |  |
| 43 |             |   |    |    |    |             |      |    | H/U-235 R  |
| 44 |             |   |    |    |    |             |      |    |  |
| 45 |             |   |    |    |    |             |      |    |  |
| 46 |             |   |    |    |    |             |      |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 10</b> |
| 47 |             |   |    |    |    |             |      |    |  |
| 48 |             |   |    |    |    |             |      |    |  |
| 49 |             |   |    |    |    |             |      |    | Cylinder Segment Volume Calculation                        |
| 50 |             |   |    |    |    |             |      |    | (Degraded DHLW)  |
| 51 |             |   |    |    |    |             |      |    |  |

Fe\_gd

|     | Y           | Z | AA | AB  | AC | AD          | AE   | AF | AG           |             |
|-----|-------------|---|----|---|----|-------------|------|----|--------------|-------------|
| 52  |             |   |    | Geometry Calculations                               |    |             |      |    |              | Fraction of |
| 53  | g           |   |    | Cylinder Radius (R)                                 |    | 86.5        | cm   |    | Mass of Gd   |             |
| 54  | g/cm^3      |   |    | Cylinder Length                                     |    | 304         | cm   |    | Density of   |             |
| 55  | g           |   |    | Cylinder Volume                                     |    | 7.14588E+06 | cm^3 |    | Mass of Fe   |             |
| 56  | g/cm^3      |   |    | Segment Volume                                      |    | 4.99330E+06 | cm^3 |    | Nominal D    |             |
| 57  | g           |   |    | Target Cell   |    | 4.99330E+06 |      |    | Total Mas    |             |
| 58  |             |   |    | Dis. from Center (y1)                               |    | 2.74765E+01 | cm   |    | Void Fracti  |             |
| 59  | g/cm^3      |   |    |   |    |             |      |    | Den of UO    |             |
| 60  | cm^3        |   |    |   |    |             |      |    | Vol. Occup   |             |
| 61  |             |   |    |   |    |             |      |    |              |             |
| 62  |             |   |    | Layer of MIT Fuel and Others                        |    |             |      |    |              |             |
| 63  |             |   |    |   |    |             |      |    |              |             |
| 64  |             |   |    | 1/2 Cylinder Volume                                 |    | 3.57294E+06 | cm^3 |    |              |             |
| 65  |             |   |    | Segment - 1/2 Cylin.                                |    | 1.42036E+06 | cm^3 |    |              |             |
| 66  |             |   |    | Layer Volume  |    | 1.28648E+06 | cm^3 |    | Atomic Den   |             |
| 67  | (#/barn cm) |   |    | Target Cell   |    | 1.28650E+06 |      |    |              |             |
| 68  |             |   |    | Dis from Center (y2)                                |    | 5.55730E+01 | cm   |    | U-235        |             |
| 69  |             |   |    |   |    |             |      |    | U-234        |             |
| 70  |             |   |    |   |    |             |      |    | U-238        |             |
| 71  |             |   |    |   |    |             |      |    | Al           |             |
| 72  |             |   |    |   |    |             |      |    | Fe           |             |
| 73  |             |   |    |   |    |             |      |    | O            |             |
| 74  |             |   |    |   |    |             |      |    | H            |             |
| 75  |             |   |    |   |    |             |      |    | Gd-152       |             |
| 76  |             |   |    |   |    |             |      |    | Gd-154       |             |
| 77  |             |   |    |   |    |             |      |    | Gd-155       |             |
| 78  |             |   |    |   |    |             |      |    | Gd-156       |             |
| 79  |             |   |    |   |    |             |      |    | Gd-157       |             |
| 80  |             |   |    |   |    |             |      |    | Gd-158       |             |
| 81  |             |   |    |   |    |             |      |    | Gd-160       |             |
| 82  |             |   |    |   |    |             |      |    | den (g/cm^3) |             |
| 83  |             |   |    |   |    |             |      |    |              |             |
| 84  |             |   |    |   |    |             |      |    | H/U-235 R    |             |
| 85  |             |   |    |   |    |             |      |    |              |             |
| 86  |             |   |    |   |    |             |      |    |              |             |
| 87  |             |   |    | Degraded MIT Fuel On Top of Degraded DHLW Clay ( 50 |    |             |      |    |              |             |
| 88  |             |   |    |   |    |             |      |    |              |             |
| 89  |             |   |    |   |    |             |      |    |              |             |
| 90  |             |   |    | Cylinder Segment Volume Calculation                 |    |             |      |    |              | Degraded    |
| 91  |             |   |    | (Degraded DHLW)                                     |    |             |      |    |              |             |
| 92  |             |   |    |   |    |             |      |    |              |             |
| 93  |             |   |    | Geometry Calculations                               |    |             |      |    |              | Fraction of |
| 94  | g           |   |    | Cylinder Radius (R)                                 |    | 86.5        | cm   |    | Mass of Gd   |             |
| 95  | g/cm^3      |   |    | Cylinder Length                                     |    | 304         | cm   |    | Density of   |             |
| 96  | g           |   |    | Cylinder Volume                                     |    | 7.14588E+06 | cm^3 |    | Mass of Fe   |             |
| 97  | g/cm^3      |   |    | Segment Volume                                      |    | 4.99330E+06 | cm^3 |    | Nominal D    |             |
| 98  | g           |   |    | Target Cell   |    | 4.99330E+06 |      |    | Total Mas    |             |
| 99  |             |   |    | Dis. from Center (y1)                               |    | 2.74765E+01 | cm   |    | Void Fracti  |             |
| 100 | g/cm^3      |   |    |   |    |             |      |    | Den of UO    |             |
| 101 | cm^3        |   |    |   |    |             |      |    | Vol. Occup   |             |
| 102 |             |   |    |   |    |             |      |    |              |             |

Fe\_gd

|     | Y           | Z | AA | AB   | AC | AD          | AE   | AF | AG           |             |
|-----|-------------|---|----|--|----|-------------|------|----|--------------|-------------|
| 103 |             |   |    | Layer of MIT Fuel and Others                               |    |             |      |    |              |             |
| 104 |             |   |    |  |    |             |      |    |              |             |
| 105 |             |   |    | 1/2 Cylinder Volume  |    | 3.57294E+06 | cm^3 |    |              |             |
| 106 |             |   |    | Segment - 1/2 Cylin.                                       |    | 1.42036E+06 | cm^3 |    |              |             |
| 107 |             |   |    | Layer Volume   |    | 1.28645E+06 | cm^3 |    |              |             |
| 108 | (#/barn cm) |   |    | Target Cell  |    | 1.28647E+06 |      |    | Atomic Den   |             |
| 109 |             |   |    | Dis from Center (y2)                                       |    | 5.55723E+01 | cm   |    | U-235        |             |
| 110 |             |   |    |  |    |             |      |    | U-234        |             |
| 111 |             |   |    |  |    |             |      |    | U-238        |             |
| 112 |             |   |    |  |    |             |      |    | Al           |             |
| 113 |             |   |    |  |    |             |      |    | Fe           |             |
| 114 |             |   |    |  |    |             |      |    | O            |             |
| 115 |             |   |    |  |    |             |      |    | H            |             |
| 116 |             |   |    |  |    |             |      |    | Gd-152       |             |
| 117 |             |   |    |  |    |             |      |    | Gd-154       |             |
| 118 |             |   |    |  |    |             |      |    | Gd-155       |             |
| 119 |             |   |    |  |    |             |      |    | Gd-156       |             |
| 120 |             |   |    |  |    |             |      |    | Gd-157       |             |
| 121 |             |   |    |  |    |             |      |    | Gd-158       |             |
| 122 |             |   |    |  |    |             |      |    | Gd-160       |             |
| 123 |             |   |    |  |    |             |      |    | den (g/cm^3) |             |
| 124 |             |   |    |  |    |             |      |    |              |             |
| 125 |             |   |    |  |    |             |      |    | H/U-235 R    |             |
| 126 |             |   |    |  |    |             |      |    |              |             |
| 127 |             |   |    |  |    |             |      |    |              |             |
| 128 |             |   |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 20</b> |    |             |      |    |              |             |
| 129 |             |   |    |  |    |             |      |    |              |             |
| 130 |             |   |    |  |    |             |      |    |              |             |
| 131 |             |   |    | Cylinder Segment Volume Calculation                        |    |             |      |    |              | Degraded    |
| 132 |             |   |    | (Degraded DHLW)  |    |             |      |    |              |             |
| 133 |             |   |    |  |    |             |      |    |              |             |
| 134 |             |   |    | Geometry Calculations                                      |    |             |      |    |              | Fraction of |
| 135 | g           |   |    | Cylinder Radius (R)  |    | 86.5        | cm   |    | Mass of Gd   |             |
| 136 | g/cm^3      |   |    | Cylinder Length  |    | 304         | cm   |    | Density of   |             |
| 137 | g           |   |    | Cylinder Volume  |    | 7.14588E+06 | cm^3 |    | Mass of Fe   |             |
| 138 | g/cm^3      |   |    | Segment Volume   |    | 4.99330E+06 | cm^3 |    | Nominal D    |             |
| 139 | g           |   |    | Target Cell  |    | 4.99330E+06 |      |    | Total Mas    |             |
| 140 |             |   |    | Dis. from Center (y1)                                      |    | 2.74765E+01 | cm   |    | Void Fracti  |             |
| 141 | g/cm^3      |   |    |  |    |             |      |    | Den of UO    |             |
| 142 | cm^3        |   |    |  |    |             |      |    | Vol. Occup   |             |
| 143 |             |   |    |  |    |             |      |    |              |             |
| 144 |             |   |    | Layer of MIT Fuel and Others                               |    |             |      |    |              |             |
| 145 |             |   |    |  |    |             |      |    |              |             |
| 146 |             |   |    | 1/2 Cylinder Volume  |    | 3.57294E+06 | cm^3 |    |              |             |
| 147 |             |   |    | Segment - 1/2 Cylin.                                       |    | 1.42036E+06 | cm^3 |    |              |             |
| 148 |             |   |    | Layer Volume   |    | 1.28643E+06 | cm^3 |    |              |             |
| 149 | (#/barn cm) |   |    | Target Cell  |    | 1.28645E+06 |      |    | Atomic Den   |             |
| 150 |             |   |    | Dis from Center (y2)                                       |    | 5.55718E+01 | cm   |    | U-235        |             |
| 151 |             |   |    |  |    |             |      |    | U-234        |             |
| 152 |             |   |    |  |    |             |      |    | U-238        |             |
| 153 |             |   |    |  |    |             |      |    | Al           |             |

Fe\_gd

|     | Y | Z | AA | AB | AC | AD | AE | AF | AG                       |
|-----|---|---|----|----|----|----|----|----|--------------------------|
| 154 |   |   |    |    |    |    |    |    | Fe                       |
| 155 |   |   |    |    |    |    |    |    | O                        |
| 156 |   |   |    |    |    |    |    |    | H                        |
| 157 |   |   |    |    |    |    |    |    | Gd-152                   |
| 158 |   |   |    |    |    |    |    |    | Gd-154                   |
| 159 |   |   |    |    |    |    |    |    | Gd-155                   |
| 160 |   |   |    |    |    |    |    |    | Gd-156                   |
| 161 |   |   |    |    |    |    |    |    | Gd-157                   |
| 162 |   |   |    |    |    |    |    |    | Gd-158                   |
| 163 |   |   |    |    |    |    |    |    | Gd-160                   |
| 164 |   |   |    |    |    |    |    |    | den (g/cm <sup>3</sup> ) |
| 165 |   |   |    |    |    |    |    |    |                          |
| 166 |   |   |    |    |    |    |    |    | H/U-235 R                |
| 167 |   |   |    |    |    |    |    |    |                          |
| 168 |   |   |    |    |    |    |    |    |                          |
| 169 |   |   |    |    |    |    |    |    |                          |
| 170 |   |   |    |    |    |    |    |    |                          |
| 171 |   |   |    |    |    |    |    |    |                          |
| 172 |   |   |    |    |    |    |    |    |                          |
| 173 |   |   |    |    |    |    |    |    |                          |
| 174 |   |   |    |    |    |    |    |    |                          |
| 175 |   |   |    |    |    |    |    |    |                          |
| 176 |   |   |    |    |    |    |    |    |                          |
| 177 |   |   |    |    |    |    |    |    |                          |
| 178 |   |   |    |    |    |    |    |    |                          |
| 179 |   |   |    |    |    |    |    |    |                          |
| 180 |   |   |    |    |    |    |    |    |                          |
| 181 |   |   |    |    |    |    |    |    |                          |
| 182 |   |   |    |    |    |    |    |    |                          |
| 183 |   |   |    |    |    |    |    |    |                          |
| 184 |   |   |    |    |    |    |    |    |                          |
| 185 |   |   |    |    |    |    |    |    |                          |
| 186 |   |   |    |    |    |    |    |    |                          |
| 187 |   |   |    |    |    |    |    |    |                          |
| 188 |   |   |    |    |    |    |    |    |                          |
| 189 |   |   |    |    |    |    |    |    |                          |
| 190 |   |   |    |    |    |    |    |    |                          |
| 191 |   |   |    |    |    |    |    |    |                          |
| 192 |   |   |    |    |    |    |    |    |                          |
| 193 |   |   |    |    |    |    |    |    |                          |
| 194 |   |   |    |    |    |    |    |    |                          |
| 195 |   |   |    |    |    |    |    |    |                          |
| 196 |   |   |    |    |    |    |    |    |                          |
| 197 |   |   |    |    |    |    |    |    |                          |
| 198 |   |   |    |    |    |    |    |    |                          |
| 199 |   |   |    |    |    |    |    |    |                          |
| 200 |   |   |    |    |    |    |    |    |                          |
| 201 |   |   |    |    |    |    |    |    |                          |
| 202 |   |   |    |    |    |    |    |    |                          |
| 203 |   |   |    |    |    |    |    |    |                          |
| 204 |   |   |    |    |    |    |    |    |                          |

|     | Y | Z | AA | AB | AC | AD | AE | AF | AG |
|-----|---|---|----|----|----|----|----|----|----|
| 205 |   |   |    |    |    |    |    |    |    |
| 206 |   |   |    |    |    |    |    |    |    |
| 207 |   |   |    |    |    |    |    |    |    |
| 208 |   |   |    |    |    |    |    |    |    |
| 209 |   |   |    |    |    |    |    |    |    |
| 210 |   |   |    |    |    |    |    |    |    |
| 211 |   |   |    |    |    |    |    |    |    |
| 212 |   |   |    |    |    |    |    |    |    |
| 213 |   |   |    |    |    |    |    |    |    |
| 214 |   |   |    |    |    |    |    |    |    |
| 215 |   |   |    |    |    |    |    |    |    |
| 216 |   |   |    |    |    |    |    |    |    |
| 217 |   |   |    |    |    |    |    |    |    |
| 218 |   |   |    |    |    |    |    |    |    |
| 219 |   |   |    |    |    |    |    |    |    |
| 220 |   |   |    |    |    |    |    |    |    |
| 221 |   |   |    |    |    |    |    |    |    |
| 222 |   |   |    |    |    |    |    |    |    |
| 223 |   |   |    |    |    |    |    |    |    |
| 224 |   |   |    |    |    |    |    |    |    |
| 225 |   |   |    |    |    |    |    |    |    |
| 226 |   |   |    |    |    |    |    |    |    |
| 227 |   |   |    |    |    |    |    |    |    |
| 228 |   |   |    |    |    |    |    |    |    |
| 229 |   |   |    |    |    |    |    |    |    |
| 230 |   |   |    |    |    |    |    |    |    |
| 231 |   |   |    |    |    |    |    |    |    |
| 232 |   |   |    |    |    |    |    |    |    |
| 233 |   |   |    |    |    |    |    |    |    |
| 234 |   |   |    |    |    |    |    |    |    |
| 235 |   |   |    |    |    |    |    |    |    |
| 236 |   |   |    |    |    |    |    |    |    |
| 237 |   |   |    |    |    |    |    |    |    |
| 238 |   |   |    |    |    |    |    |    |    |
| 239 |   |   |    |    |    |    |    |    |    |
| 240 |   |   |    |    |    |    |    |    |    |
| 241 |   |   |    |    |    |    |    |    |    |
| 242 |   |   |    |    |    |    |    |    |    |
| 243 |   |   |    |    |    |    |    |    |    |
| 244 |   |   |    |    |    |    |    |    |    |
| 245 |   |   |    |    |    |    |    |    |    |
| 246 |   |   |    |    |    |    |    |    |    |
| 247 |   |   |    |    |    |    |    |    |    |
| 248 |   |   |    |    |    |    |    |    |    |
| 249 |   |   |    |    |    |    |    |    |    |
| 250 |   |   |    |    |    |    |    |    |    |
| 251 |   |   |    |    |    |    |    |    |    |
| 252 |   |   |    |    |    |    |    |    |    |
| 253 |   |   |    |    |    |    |    |    |    |
| 254 |   |   |    |    |    |    |    |    |    |
| 255 |   |   |    |    |    |    |    |    |    |

Fe\_gd

|     | Y | Z | AA | AB | AC | AD | AE | AF | AG |
|-----|---|---|----|----|----|----|----|----|----|
| 256 |   |   |    |    |    |    |    |    |    |
| 257 |   |   |    |    |    |    |    |    |    |
| 258 |   |   |    |    |    |    |    |    |    |
| 259 |   |   |    |    |    |    |    |    |    |
| 260 |   |   |    |    |    |    |    |    |    |
| 261 |   |   |    |    |    |    |    |    |    |
| 262 |   |   |    |    |    |    |    |    |    |
| 263 |   |   |    |    |    |    |    |    |    |
| 264 |   |   |    |    |    |    |    |    |    |
| 265 |   |   |    |    |    |    |    |    |    |
| 266 |   |   |    |    |    |    |    |    |    |
| 267 |   |   |    |    |    |    |    |    |    |
| 268 |   |   |    |    |    |    |    |    |    |
| 269 |   |   |    |    |    |    |    |    |    |
| 270 |   |   |    |    |    |    |    |    |    |
| 271 |   |   |    |    |    |    |    |    |    |
| 272 |   |   |    |    |    |    |    |    |    |
| 273 |   |   |    |    |    |    |    |    |    |
| 274 |   |   |    |    |    |    |    |    |    |
| 275 |   |   |    |    |    |    |    |    |    |
| 276 |   |   |    |    |    |    |    |    |    |
| 277 |   |   |    |    |    |    |    |    |    |
| 278 |   |   |    |    |    |    |    |    |    |
| 279 |   |   |    |    |    |    |    |    |    |
| 280 |   |   |    |    |    |    |    |    |    |
| 281 |   |   |    |    |    |    |    |    |    |
| 282 |   |   |    |    |    |    |    |    |    |
| 283 |   |   |    |    |    |    |    |    |    |
| 284 |   |   |    |    |    |    |    |    |    |
| 285 |   |   |    |    |    |    |    |    |    |
| 286 |   |   |    |    |    |    |    |    |    |
| 287 |   |   |    |    |    |    |    |    |    |
| 288 |   |   |    |    |    |    |    |    |    |
| 289 |   |   |    |    |    |    |    |    |    |



|    | AH   | AI       | AJ        | AK                         | AL     | AM | AN | AO          |
|----|--|----------|-----------|----------------------------|--------|----|----|-------------|
| 1  |  |          |           |                            |        |    |    |             |
| 2  |  |          |           |                            |        |    |    |             |
| 3  |  |          |           |                            |        |    |    |             |
| 4  |  |          |           |                            |        |    |    |             |
| 5  | 0 g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |    |             |
| 6  |  |          |           |                            |        |    |    |             |
| 7  |  |          |           |                            |        |    |    |             |
| 8  | MIT Fuel   |          |           |                            |        |    |    | Cylinder Se |
| 9  |  |          |           |                            |        |    |    | (Degraded   |
| 10 |  |          |           |                            |        |    |    |             |
| 11 | UO2 Remaining                                    |          |           | 1.00                       |        |    |    | Geometry C  |
| 12 |  |          |           |                            |        |    |    | Cylinder Ra |
| 13 | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |    | Cylinder Le |
| 14 | 2O3  |          |           | 2.95E+05                   | g      |    |    | Cylinder Vo |
| 15 | an of UO2+Al2O3+Fe2O3                            |          |           | 4.34365E+00                | g/cm^3 |    |    | Segment V   |
| 16 | of UO2+Al2O3+Fe2O3                               |          |           | 1.11766E+06                | g      |    |    | Target Cell |
| 17 | on   |          |           | 8.00000E-01                |        |    |    | Dis. from C |
| 18 | 2+Al2O3+Fe2O3+Void Used                          |          |           | 8.68730E-01                | g/cm^3 |    |    |             |
| 19 | ed by UO2+Al2O3+Fe2O3+Void                       |          |           | 1.28654E+06                | cm^3   |    |    |             |
| 20 |  |          |           |                            |        |    |    |             |
| 21 |  |          |           |                            |        |    |    | Layer of M  |
| 22 |  |          |           |                            |        |    |    |             |
| 23 |  |          |           |                            |        |    |    | 1/2 Cylinde |
| 24 |  |          |           |                            |        |    |    | Segment -   |
| 25 | ensity Calculation (Degraded MIT Fuel)           |          |           |                            |        |    |    | Layer Volu  |
| 26 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |    | Target Cell |
| 27 | 32912  | 235.0439 | 92235.50C | 6.5548E-05                 |        |    |    | Dis from C  |
| 28 | 352  | 234.0409 | 92234.50C | 7.0405E-07                 |        |    |    |             |
| 29 | 1936   | 238.0508 | 92238.50C | 3.8070E-06                 |        |    |    |             |
| 30 | 4.14E+05   | 26.98154 | 13027.50C | 7.1860E-03                 |        |    |    |             |
| 31 | 2.07E+05   | 55.847   | 26000.55C | 1.7315E-03                 |        |    |    |             |
| 32 | 1.38E+06   | 15.99492 | 8016.50C  | 4.0286E-02                 |        |    |    |             |
| 33 | 1.14E+05   | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |    |             |
| 34 |  |          | 64152.50C | 1.1908E-09                 |        |    |    |             |
| 35 |  |          | 64154.50C | 1.2979E-08                 |        |    |    |             |
| 36 |  |          | 64155.50C | 8.8116E-08                 |        |    |    |             |
| 37 |  |          | 64156.50C | 1.2187E-07                 |        |    |    |             |
| 38 |  |          | 64157.50C | 9.3177E-08                 |        |    |    |             |
| 39 |  |          | 64158.50C | 1.4789E-07                 |        |    |    |             |
| 40 |  |          | 64160.50C | 1.3015E-07                 |        |    |    |             |
| 41 | 1.66885E+00                                      |          |           | 1.0239E-01                 |        |    |    |             |
| 42 |  |          |           |                            |        |    |    |             |
| 43 | ation  |          |           | 810.3662761                |        |    |    |             |
| 44 |  |          |           |                            |        |    |    |             |
| 45 |  |          |           |                            |        |    |    |             |
| 46 | 0 g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |    |             |
| 47 |  |          |           |                            |        |    |    |             |
| 48 |  |          |           |                            |        |    |    |             |
| 49 | MIT Fuel   |          |           |                            |        |    |    | Cylinder Se |
| 50 |  |          |           |                            |        |    |    | (Degraded   |
| 51 |  |          |           |                            |        |    |    |             |

Fe\_gd

|     | AH  | AI       | AJ        | AK                         | AL     | AM | AN | AO          |
|-----|---|----------|-----------|----------------------------|--------|----|----|-------------|
| 52  | UO2 Remaining   |          |           | 1.00                       |        |    |    | Geometry    |
| 53  |   |          |           |                            |        |    |    | Cylinder R  |
| 54  | Gd  |          |           | 7.9004E+00                 | g/cm^3 |    |    | Cylinder Le |
| 55  | 2O3   |          |           | 2.95E+05                   | g      |    |    | Cylinder Vo |
| 56  | en of UO2+Al2O3+Fe2O3                                 |          |           | 4.34347E+00                | g/cm^3 |    |    | Segment V   |
| 57  | of UO2+Al2O3+Fe2O3                                    |          |           | 1.11756E+06                | g      |    |    | Target Cell |
| 58  | pn  |          |           | 8.00000E-01                |        |    |    | Dis. from C |
| 59  | 2+Al2O3+Fe2O3+Void Used                               |          |           | 8.68695E-01                | g/cm^3 |    |    |             |
| 60  | ed by UO2+Al2O3+Fe2O3+Void                            |          |           | 1.28648E+06                | cm^3   |    |    |             |
| 61  |   |          |           |                            |        |    |    |             |
| 62  |   |          |           |                            |        |    |    | Layer of M  |
| 63  |   |          |           |                            |        |    |    |             |
| 64  |   |          |           |                            |        |    |    | 1/2 Cylinde |
| 65  |   |          |           |                            |        |    |    | Segment -   |
| 66  | nsity Calculation (Degraded MIT Fuel)                 |          |           |                            |        |    |    | Layer Volu  |
| 67  | Mass(g)   | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |    | Target Cell |
| 68  | 32912   | 235.0439 | 92235.50C | 6.5551E-05                 |        |    |    | Dis from C  |
| 69  | 352   | 234.0409 | 92234.50C | 7.0408E-07                 |        |    |    |             |
| 70  | 1936  | 238.0508 | 92238.50C | 3.8072E-06                 |        |    |    |             |
| 71  | 4.14E+05  | 26.98154 | 13027.50C | 7.1863E-03                 |        |    |    |             |
| 72  | 2.07E+05  | 55.847   | 26000.55C | 1.7316E-03                 |        |    |    |             |
| 73  | 1.38E+06  | 15.99492 | 8016.50C  | 4.0287E-02                 |        |    |    |             |
| 74  | 1.14E+05  | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |    |             |
| 75  |   |          | 64152.50C | 5.9541E-10                 |        |    |    |             |
| 76  |   |          | 64154.50C | 6.4899E-09                 |        |    |    |             |
| 77  |   |          | 64155.50C | 4.4060E-08                 |        |    |    |             |
| 78  |   |          | 64156.50C | 6.0940E-08                 |        |    |    |             |
| 79  |   |          | 64157.50C | 4.6591E-08                 |        |    |    |             |
| 80  |   |          | 64158.50C | 7.3950E-08                 |        |    |    |             |
| 81  |   |          | 64160.50C | 6.5078E-08                 |        |    |    |             |
| 82  | 1.66881E+00   |          |           | 1.0239E-01                 |        |    |    |             |
| 83  |   |          |           |                            |        |    |    |             |
| 84  | ation   |          |           | 810.3264124                |        |    |    |             |
| 85  |   |          |           |                            |        |    |    |             |
| 86  |   |          |           |                            |        |    |    |             |
| 87  | <b>g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)</b> |          |           |                            |        |    |    |             |
| 88  |   |          |           |                            |        |    |    |             |
| 89  |   |          |           |                            |        |    |    |             |
| 90  | MIT Fuel  |          |           |                            |        |    |    | Cylinder Se |
| 91  |   |          |           |                            |        |    |    | (Degraded   |
| 92  |   |          |           |                            |        |    |    |             |
| 93  | UO2 Remaining   |          |           | 1.00                       |        |    |    | Geometry    |
| 94  |   |          |           |                            |        |    |    | Cylinder R  |
| 95  | Gd  |          |           | 7.9004E+00                 | g/cm^3 |    |    | Cylinder Le |
| 96  | 2O3   |          |           | 2.95E+05                   | g      |    |    | Cylinder Vo |
| 97  | en of UO2+Al2O3+Fe2O3                                 |          |           | 4.34339E+00                | g/cm^3 |    |    | Segment V   |
| 98  | of UO2+Al2O3+Fe2O3                                    |          |           | 1.11751E+06                | g      |    |    | Target Cell |
| 99  | pn  |          |           | 8.00000E-01                |        |    |    | Dis. from C |
| 100 | 2+Al2O3+Fe2O3+Void Used                               |          |           | 8.68677E-01                | g/cm^3 |    |    |             |
| 101 | ed by UO2+Al2O3+Fe2O3+Void                            |          |           | 1.28645E+06                | cm^3   |    |    |             |
| 102 |   |          |           |                            |        |    |    |             |

|     | AH   | AI       | AJ        | AK                         | AL | AM | AN | AO          |
|-----|--|----------|-----------|----------------------------|----|----|----|-------------|
| 103 |  |          |           |                            |    |    |    |             |
| 104 |  |          |           |                            |    |    |    | Layer of M  |
| 105 |  |          |           |                            |    |    |    |             |
| 106 |  |          |           |                            |    |    |    | 1/2 Cylinde |
| 107 | Density Calculation (Degraded MIT Fuel)        |          |           |                            |    |    |    |             |
| 108 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |    |    |    | Target Cell |
| 109 | 32912  | 235.0439 | 92235.50C | 6.5553E-05                 |    |    |    | Dis from C  |
| 110 | 352  | 234.0409 | 92234.50C | 7.0410E-07                 |    |    |    |             |
| 111 | 1936   | 238.0508 | 92238.50C | 3.8073E-06                 |    |    |    |             |
| 112 | 4.14E+05                                       | 26.98154 | 13027.50C | 7.1865E-03                 |    |    |    |             |
| 113 | 2.07E+05                                       | 55.847   | 26000.55C | 1.7316E-03                 |    |    |    |             |
| 114 | 1.38E+06                                       | 15.99492 | 8016.50C  | 4.0287E-02                 |    |    |    |             |
| 115 | 1.14E+05                                       | 1.007825 | 1001.50C  | 5.3118E-02                 |    |    |    |             |
| 116 |  |          | 64152.50C | 2.9771E-10                 |    |    |    |             |
| 117 |  |          | 64154.50C | 3.2451E-09                 |    |    |    |             |
| 118 |  |          | 64155.50C | 2.2031E-08                 |    |    |    |             |
| 119 |  |          | 64156.50C | 3.0471E-08                 |    |    |    |             |
| 120 |  |          | 64157.50C | 2.3296E-08                 |    |    |    |             |
| 121 |  |          | 64158.50C | 3.6976E-08                 |    |    |    |             |
| 122 |  |          | 64160.50C | 3.2540E-08                 |    |    |    |             |
| 123 | 1.66879E+00                                    |          |           | 1.0239E-01                 |    |    |    |             |
| 124 |  |          |           |                            |    |    |    |             |
| 125 | ation  |          |           | 810.3064805                |    |    |    |             |
| 126 |  |          |           |                            |    |    |    |             |
| 127 |  |          |           |                            |    |    |    |             |
| 128 | g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |    |    |    |             |
| 129 |  |          |           |                            |    |    |    |             |
| 130 |  |          |           |                            |    |    |    |             |
| 131 | MIT Fuel                                       |          |           |                            |    |    |    |             |
| 132 |  |          |           |                            |    |    |    | Cylinder Se |
| 133 |  |          |           |                            |    |    |    | (Degraded   |
| 134 | UO2 Remaining                                  |          |           | 1.00                       |    |    |    | Geometry (  |
| 135 |  |          |           | g                          |    |    |    | Cylinder Ra |
| 136 | Gd   |          |           | 7.9004E+00 g/cm^3          |    |    |    | Cylinder Le |
| 137 | 2O3  |          |           | 2.95E+05 g                 |    |    |    | Cylinder Vo |
| 138 | n of UO2+Al2O3+Fe2O3                           |          |           | 4.34333E+00 g/cm^3         |    |    |    | Segment V   |
| 139 | f UO2+Al2O3+Fe2O3                              |          |           | 1.11748E+06 g              |    |    |    | Target Cell |
| 140 | n  |          |           | 8.00000E-01                |    |    |    | Dis. from C |
| 141 | 2+Al2O3+Fe2O3+Void Used                        |          |           | 8.68667E-01 g/cm^3         |    |    |    |             |
| 142 | ied by UO2+Al2O3+Fe2O3+Void                    |          |           | 1.28643E+06 cm^3           |    |    |    |             |
| 143 |  |          |           |                            |    |    |    |             |
| 144 |  |          |           |                            |    |    |    |             |
| 145 |  |          |           |                            |    |    |    | Layer of M  |
| 146 |  |          |           |                            |    |    |    |             |
| 147 |  |          |           |                            |    |    |    | 1/2 Cylinde |
| 148 | Density Calculation (Degraded MIT Fuel)        |          |           |                            |    |    |    |             |
| 149 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |    |    |    | Target Cell |
| 150 | 32912  | 235.0439 | 92235.50C | 6.5554E-05                 |    |    |    | Dis from C  |
| 151 | 352  | 234.0409 | 92234.50C | 7.0411E-07                 |    |    |    |             |
| 152 | 1936   | 238.0508 | 92238.50C | 3.8074E-06                 |    |    |    |             |
| 153 | 4.14E+05                                       | 26.98154 | 13027.50C | 7.1866E-03                 |    |    |    |             |

Fe\_gd

|     | AH          | AI       | AJ        | AK          | AL | AM | AN | AO          |
|-----|-------------|----------|-----------|-------------|----|----|----|-------------|
| 154 | 2.07E+05    | 55.847   | 26000.55C | 1.7317E-03  |    |    |    |             |
| 155 | 1.38E+06    | 15.99492 | 8016.50C  | 4.0287E-02  |    |    |    |             |
| 156 | 1.14E+05    | 1.007825 | 1001.50C  | 5.3118E-02  |    |    |    |             |
| 157 |             |          | 64152.50C | 1.1909E-10  |    |    |    |             |
| 158 |             |          | 64154.50C | 1.2980E-09  |    |    |    |             |
| 159 |             |          | 64155.50C | 8.8124E-09  |    |    |    |             |
| 160 |             |          | 64156.50C | 1.2188E-08  |    |    |    |             |
| 161 |             |          | 64157.50C | 9.3185E-09  |    |    |    |             |
| 162 |             |          | 64158.50C | 1.4791E-08  |    |    |    |             |
| 163 |             |          | 64160.50C | 1.3016E-08  |    |    |    |             |
| 164 | 1.66878E+00 |          |           | 1.0239E-01  |    |    |    |             |
| 165 |             |          |           |             |    |    |    |             |
| 166 | ation       |          |           | 810.2945214 |    |    |    |             |
| 167 |             |          |           |             |    |    |    |             |
| 168 |             |          |           |             |    |    |    |             |
| 169 |             |          |           |             |    |    |    |             |
| 170 |             |          |           |             |    |    |    |             |
| 171 |             |          |           |             |    |    |    |             |
| 172 |             |          |           |             |    |    |    | Cylinder Se |
| 173 |             |          |           |             |    |    |    | (Degraded   |
| 174 |             |          |           |             |    |    |    |             |
| 175 |             |          |           |             |    |    |    | Geometry C  |
| 176 |             |          |           |             |    |    |    | Cylinder Ra |
| 177 |             |          |           |             |    |    |    | Cylinder Le |
| 178 |             |          |           |             |    |    |    | Cylinder Vo |
| 179 |             |          |           |             |    |    |    | Segment M   |
| 180 |             |          |           |             |    |    |    | Target Cell |
| 181 |             |          |           |             |    |    |    | Dis. from C |
| 182 |             |          |           |             |    |    |    |             |
| 183 |             |          |           |             |    |    |    |             |
| 184 |             |          |           |             |    |    |    |             |
| 185 |             |          |           |             |    |    |    | Layer of M  |
| 186 |             |          |           |             |    |    |    |             |
| 187 |             |          |           |             |    |    |    | 1/2 Cylinde |
| 188 |             |          |           |             |    |    |    | Segment -   |
| 189 |             |          |           |             |    |    |    | Layer Volu  |
| 190 |             |          |           |             |    |    |    | Target Cell |
| 191 |             |          |           |             |    |    |    | Dis from C  |
| 192 |             |          |           |             |    |    |    |             |
| 193 |             |          |           |             |    |    |    |             |
| 194 |             |          |           |             |    |    |    |             |
| 195 |             |          |           |             |    |    |    |             |
| 196 |             |          |           |             |    |    |    |             |
| 197 |             |          |           |             |    |    |    |             |
| 198 |             |          |           |             |    |    |    |             |
| 199 |             |          |           |             |    |    |    |             |
| 200 |             |          |           |             |    |    |    |             |
| 201 |             |          |           |             |    |    |    |             |
| 202 |             |          |           |             |    |    |    |             |
| 203 |             |          |           |             |    |    |    |             |
| 204 |             |          |           |             |    |    |    |             |

|     | AH | AI | AJ | AK | AL | AM | AN | AO          |
|-----|----|----|----|----|----|----|----|-------------|
| 205 |    |    |    |    |    |    |    |             |
| 206 |    |    |    |    |    |    |    |             |
| 207 |    |    |    |    |    |    |    |             |
| 208 |    |    |    |    |    |    |    |             |
| 209 |    |    |    |    |    |    |    |             |
| 210 |    |    |    |    |    |    |    |             |
| 211 |    |    |    |    |    |    |    |             |
| 212 |    |    |    |    |    |    |    |             |
| 213 |    |    |    |    |    |    |    | Cylinder Se |
| 214 |    |    |    |    |    |    |    | (Degraded   |
| 215 |    |    |    |    |    |    |    |             |
| 216 |    |    |    |    |    |    |    | Geometry    |
| 217 |    |    |    |    |    |    |    | Cylinder R  |
| 218 |    |    |    |    |    |    |    | Cylinder Le |
| 219 |    |    |    |    |    |    |    | Cylinder Vo |
| 220 |    |    |    |    |    |    |    | Segment V   |
| 221 |    |    |    |    |    |    |    | Target Cell |
| 222 |    |    |    |    |    |    |    | Dis. from C |
| 223 |    |    |    |    |    |    |    |             |
| 224 |    |    |    |    |    |    |    |             |
| 225 |    |    |    |    |    |    |    |             |
| 226 |    |    |    |    |    |    |    | Layer of M  |
| 227 |    |    |    |    |    |    |    |             |
| 228 |    |    |    |    |    |    |    | 1/2 Cylinde |
| 229 |    |    |    |    |    |    |    | Segment -   |
| 230 |    |    |    |    |    |    |    | Layer Volu  |
| 231 |    |    |    |    |    |    |    | Target Cell |
| 232 |    |    |    |    |    |    |    | Dis from C  |
| 233 |    |    |    |    |    |    |    |             |
| 234 |    |    |    |    |    |    |    |             |
| 235 |    |    |    |    |    |    |    |             |
| 236 |    |    |    |    |    |    |    |             |
| 237 |    |    |    |    |    |    |    |             |
| 238 |    |    |    |    |    |    |    |             |
| 239 |    |    |    |    |    |    |    |             |
| 240 |    |    |    |    |    |    |    |             |
| 241 |    |    |    |    |    |    |    |             |
| 242 |    |    |    |    |    |    |    |             |
| 243 |    |    |    |    |    |    |    |             |
| 244 |    |    |    |    |    |    |    |             |
| 245 |    |    |    |    |    |    |    |             |
| 246 |    |    |    |    |    |    |    |             |
| 247 |    |    |    |    |    |    |    |             |
| 248 |    |    |    |    |    |    |    |             |
| 249 |    |    |    |    |    |    |    |             |
| 250 |    |    |    |    |    |    |    |             |
| 251 |    |    |    |    |    |    |    |             |
| 252 |    |    |    |    |    |    |    |             |
| 253 |    |    |    |    |    |    |    |             |
| 254 |    |    |    |    |    |    |    | Cylinder Se |
| 255 |    |    |    |    |    |    |    | (Degraded   |

Fe\_gd

|     | AH | AI | AJ | AK | AL | AM | AN | AO          |
|-----|----|----|----|----|----|----|----|-------------|
| 256 |    |    |    |    |    |    |    |             |
| 257 |    |    |    |    |    |    |    | Geometry    |
| 258 |    |    |    |    |    |    |    | Cylinder R  |
| 259 |    |    |    |    |    |    |    | Cylinder Le |
| 260 |    |    |    |    |    |    |    | Cylinder Vo |
| 261 |    |    |    |    |    |    |    | Segment V   |
| 262 |    |    |    |    |    |    |    | Target Cell |
| 263 |    |    |    |    |    |    |    | Dis. from C |
| 264 |    |    |    |    |    |    |    |             |
| 265 |    |    |    |    |    |    |    |             |
| 266 |    |    |    |    |    |    |    |             |
| 267 |    |    |    |    |    |    |    | Layer of M  |
| 268 |    |    |    |    |    |    |    |             |
| 269 |    |    |    |    |    |    |    | 1/2 Cylinde |
| 270 |    |    |    |    |    |    |    | Segment -   |
| 271 |    |    |    |    |    |    |    | Layer Volu  |
| 272 |    |    |    |    |    |    |    | Target Cell |
| 273 |    |    |    |    |    |    |    | Dis from C  |
| 274 |    |    |    |    |    |    |    |             |
| 275 |    |    |    |    |    |    |    |             |
| 276 |    |    |    |    |    |    |    |             |
| 277 |    |    |    |    |    |    |    |             |
| 278 |    |    |    |    |    |    |    |             |
| 279 |    |    |    |    |    |    |    |             |
| 280 |    |    |    |    |    |    |    |             |
| 281 |    |    |    |    |    |    |    |             |
| 282 |    |    |    |    |    |    |    |             |
| 283 |    |    |    |    |    |    |    |             |
| 284 |    |    |    |    |    |    |    |             |
| 285 |    |    |    |    |    |    |    |             |
| 286 |    |    |    |    |    |    |    |             |
| 287 |    |    |    |    |    |    |    |             |
| 288 |    |    |    |    |    |    |    |             |
| 289 |    |    |    |    |    |    |    |             |

|    | AP   | AQ          | AR   | AS | AT   | AU          | AV       | AW        |
|----|--|-------------|------|----|--|-------------|----------|-----------|
| 1  |  |             |      |    |  |             |          |           |
| 2  |  |             |      |    |  |             |          |           |
| 3  |  |             |      |    |  |             |          |           |
| 4  |  |             |      |    |  |             |          |           |
| 5  | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 150000 g of Fe2O3, Void Fra</b> |             |      |    |  |             |          |           |
| 6  |  |             |      |    |  |             |          |           |
| 7  |  |             |      |    |  |             |          |           |
| 8  | Segment Volume Calculation   |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 9  | DHLW)  |             |      |    |  |             |          |           |
| 10 |  |             |      |    |  |             |          |           |
| 11 | Calculations   |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 12 | radius (R)   | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 13 | length   | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 14 | volume   | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 15 | volume   | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 16 |  | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 17 | enter (y1)   | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 18 |  |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 19 |  |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 20 |  |             |      |    |  |             |          |           |
| 21 | T Fuel and Others  |             |      |    |  |             |          |           |
| 22 |  |             |      |    |  |             |          |           |
| 23 | Volume   | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 24 | 1/2 Cylin.   | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 25 | me   | 1.14796E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 26 |  | 1.14798E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 27 | enter (y2)   | 5.22053E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 28 |  |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 29 |  |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 30 |  |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |
| 31 |  |             |      |    | Fe   | 1.05E+05    | 55.847   | 26000.55C |
| 32 |  |             |      |    | O  | 1.23E+06    | 15.99492 | 8016.50C  |
| 33 |  |             |      |    | H  | 1.02E+05    | 1.007825 | 1001.50C  |
| 34 |  |             |      |    | Gd-152   |             |          | 64152.50C |
| 35 |  |             |      |    | Gd-154   |             |          | 64154.50C |
| 36 |  |             |      |    | Gd-155   |             |          | 64155.50C |
| 37 |  |             |      |    | Gd-156   |             |          | 64156.50C |
| 38 |  |             |      |    | Gd-157   |             |          | 64157.50C |
| 39 |  |             |      |    | Gd-158   |             |          | 64158.50C |
| 40 |  |             |      |    | Gd-160   |             |          | 64160.50C |
| 41 |  |             |      |    | den (g/cm^                                     | 1.64710E+00 |          |           |
| 42 |  |             |      |    |  |             |          |           |
| 43 |  |             |      |    | H/U-235 Ratio                                  |             |          |           |
| 44 |  |             |      |    |  |             |          |           |
| 45 |  |             |      |    |  |             |          |           |
| 46 | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 300000 g of Fe2O3, Void Fra</b> |             |      |    |  |             |          |           |
| 47 |  |             |      |    |  |             |          |           |
| 48 |  |             |      |    |  |             |          |           |
| 49 | Segment Volume Calculation   |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 50 | DHLW)  |             |      |    |  |             |          |           |
| 51 |  |             |      |    |  |             |          |           |

Fe\_gd

|     | AP  | AQ          | AR   | AS | AT   | AU          | AV       | AW        |
|-----|---|-------------|------|----|--|-------------|----------|-----------|
| 52  | Calculations  |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 53  | radius (R)  | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 54  | length  | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 55  | volume  | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 56  | volume  | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 57  |   | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 58  | center (y1)   | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 59  |   |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 60  |   |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 61  |   |             |      |    |  |             |          |           |
| 62  | T Fuel and Others   |             |      |    |  |             |          |           |
| 63  |   |             |      |    |  |             |          |           |
| 64  | core Volume   | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 65  | 1/2 Cylin.  | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 66  | volume  | 1.29109E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 67  |   | 1.29111E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 68  | center (y2)   | 5.56875E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 69  |   |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 70  |   |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 71  |   |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |
| 72  |   |             |      |    | Fe   | 2.10E+05    | 55.847   | 26000.55C |
| 73  |   |             |      |    | O  | 1.38E+06    | 15.99492 | 8016.50C  |
| 74  |   |             |      |    | H  | 1.15E+05    | 1.007825 | 1001.50C  |
| 75  |   |             |      |    | Gd-152   |             |          | 64152.50C |
| 76  |   |             |      |    | Gd-154   |             |          | 64154.50C |
| 77  |   |             |      |    | Gd-155   |             |          | 64155.50C |
| 78  |   |             |      |    | Gd-156   |             |          | 64156.50C |
| 79  |   |             |      |    | Gd-157   |             |          | 64157.50C |
| 80  |   |             |      |    | Gd-158   |             |          | 64158.50C |
| 81  |   |             |      |    | Gd-160   |             |          | 64160.50C |
| 82  |   |             |      |    | den (g/cm^3)                                   | 1.66943E+00 |          |           |
| 83  |   |             |      |    |  |             |          |           |
| 84  |   |             |      |    | H/U-235 Ratio                                  |             |          |           |
| 85  |   |             |      |    |  |             |          |           |
| 86  |   |             |      |    |  |             |          |           |
| 87  | Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 600000 g of Fe2O3, Void Fra |             |      |    |  |             |          |           |
| 88  |   |             |      |    |  |             |          |           |
| 89  |   |             |      |    |  |             |          |           |
| 90  | Segment Volume Calculation  |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 91  | DHLW)   |             |      |    |  |             |          |           |
| 92  |   |             |      |    |  |             |          |           |
| 93  | Calculations  |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 94  | radius (R)  | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 95  | length  | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 96  | volume  | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 97  | volume  | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 98  |   | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 99  | center (y1)   | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 100 |   |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 101 |   |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 102 |   |             |      |    |  |             |          |           |



Fe\_gd

|     | AP  | AQ          | AR   | AS | AT   | AU          | AV       | AW        |
|-----|---|-------------|------|----|--|-------------|----------|-----------|
| 103 | T Fuel and Others   |             |      |    |  |             |          |           |
| 104 |   |             |      |    |  |             |          |           |
| 105 | r Volume  | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 106 | 1/2 Cylin.  | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 107 | me  | 1.57735E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 108 |   | 1.57737E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 109 | enter (y2)  | 6.83677E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 110 |   |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 111 |   |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 112 |   |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |
| 113 |   |             |      |    | Fe   | 4.20E+05    | 55.847   | 26000.55C |
| 114 |   |             |      |    | O  | 1.67E+06    | 15.99492 | 8016.50C  |
| 115 |   |             |      |    | H  | 1.40E+05    | 1.007825 | 1001.50C  |
| 116 |   |             |      |    | Gd-152   |             |          | 64152.50C |
| 117 |   |             |      |    | Gd-154   |             |          | 64154.50C |
| 118 |   |             |      |    | Gd-155   |             |          | 64155.50C |
| 119 |   |             |      |    | Gd-156   |             |          | 64156.50C |
| 120 |   |             |      |    | Gd-157   |             |          | 64157.50C |
| 121 |   |             |      |    | Gd-158   |             |          | 64158.50C |
| 122 |   |             |      |    | Gd-160   |             |          | 64160.50C |
| 123 |   |             |      |    | den (g/cm^                                     | 1.70193E+00 |          |           |
| 124 |   |             |      |    |  |             |          |           |
| 125 |   |             |      |    | H/U-235 Ration                                 |             |          |           |
| 126 |   |             |      |    |  |             |          |           |
| 127 |   |             |      |    |  |             |          |           |
| 128 | Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 800000 g of Fe2O3, Void Fra |             |      |    |  |             |          |           |
| 129 |   |             |      |    |  |             |          |           |
| 130 |   |             |      |    |  |             |          |           |
| 131 | Segment Volume Calculation  |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 132 | DHLW)   |             |      |    |  |             |          |           |
| 133 |   |             |      |    |  |             |          |           |
| 134 | Calculations  |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 135 | radius (R)  | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 136 | length  | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 137 | Volume  | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 138 | Volume  | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 139 |   | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 140 | enter (y1)  | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 141 |   |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 142 |   |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 143 |   |             |      |    |  |             |          |           |
| 144 | T Fuel and Others   |             |      |    |  |             |          |           |
| 145 |   |             |      |    |  |             |          |           |
| 146 | r Volume  | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 147 | 1/2 Cylin.  | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 148 | me  | 1.76819E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 149 |   | 1.76817E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 150 | enter (y2)  | 6.88057E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 151 |   |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 152 |   |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 153 |   |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |

|     | AP  | AQ               | AR   | AS   | AT                        | AU          | AV        | AW        |
|-----|---|------------------|------|--|---------------------------|-------------|-----------|-----------|
| 154 |   |                  |      |  | Fe                        | 5.60E+05    | 55.847    | 26000.55C |
| 155 |   |                  |      |  | O                         | 1.87E+06    | 15.99492  | 8016.50C  |
| 156 |   |                  |      |  | H                         | 1.57E+05    | 1.007825  | 1001.50C  |
| 157 |   |                  |      |  | Gd-152                    |             |           | 64152.50C |
| 158 |   |                  |      |  | Gd-154                    |             |           | 64154.50C |
| 159 |   |                  |      |  | Gd-155                    |             |           | 64155.50C |
| 160 |   |                  |      |  | Gd-156                    |             |           | 64156.50C |
| 161 |   |                  |      |  | Gd-157                    |             |           | 64157.50C |
| 162 |   |                  |      |  | Gd-158                    |             |           | 64158.50C |
| 163 |   |                  |      |  | Gd-160                    |             |           | 64160.50C |
| 164 |   |                  |      |  | den (g/cm^                | 1.71775E+00 |           |           |
| 165 |   |                  |      |  |                           |             |           |           |
| 166 |   |                  |      |  | H/U-235 Ration            |             |           |           |
| 167 |   |                  |      |  |                           |             |           |           |
| 168 |   |                  |      |  |                           |             |           |           |
| 169 | Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 850000 g of Fe2O3, Void Fra |                  |      |  |                           |             |           |           |
| 170 |   |                  |      |  |                           |             |           |           |
| 171 |   |                  |      |  |                           |             |           |           |
| 172 | Segment Volume Calculation  |                  |      |  | Degraded MIT Fuel         |             |           |           |
| 173 | DHLW)   |                  |      |  |                           |             |           |           |
| 174 |   |                  |      |  |                           |             |           |           |
| 175 | Calculations  |                  |      |  | Fraction of UO2 Remaining |             |           |           |
| 176 | radius (R)  | 86.5 cm          |      | Mass of Gd                                     |                           |             |           |           |
| 177 | length  | 304 cm           |      | Density of Gd                                  |                           |             |           |           |
| 178 | volume  | 7.14588E+06 cm^3 |      | Mass of Fe2O3                                  |                           |             |           |           |
| 179 | volume  | 4.99330E+06 cm^3 |      | Nominal Den of UO2+Al2O3+Fe2O3                 |                           |             |           |           |
| 180 |   | 4.99330E+06      |      | Total Mas of UO2+Al2O3+Fe2O3                   |                           |             |           |           |
| 181 | center (y1)   | 2.74765E+01      | cm   | Void Fraction                                  |                           |             |           |           |
| 182 |   |                  |      | Den of UO2+Al2O3+Fe2O3+Void Used               |                           |             |           |           |
| 183 |   |                  |      | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |                           |             |           |           |
| 184 |   |                  |      |  |                           |             |           |           |
| 185 | MIT Fuel and Others   |                  |      |  |                           |             |           |           |
| 186 |   |                  |      |  |                           |             |           |           |
| 187 | radius Volume   | 3.57294E+06      | cm^3 |  |                           |             |           |           |
| 188 | 1/2 Cylin.  | 1.42036E+06      | cm^3 |  |                           |             |           |           |
| 189 | volume  | 1.81590E+06      | cm^3 |  |                           |             |           |           |
| 190 |   | 1.81592E+06      |      | Atomic Density Calculation (Degraded MIT Fuel) |                           |             |           |           |
| 191 | center (y2)   | 7.03335E+01      | cm   | U-235  | Mass(g)                   | WT          | MCNP      |           |
| 192 |   |                  |      | U-234  | 32912                     | 235.0439    | 92235.50C |           |
| 193 |   |                  |      | U-238  | 352                       | 234.0409    | 92234.50C |           |
| 194 |   |                  |      | Al   | 1936                      | 238.0508    | 92238.50C |           |
| 195 |   |                  |      | Fe   | 4.14E+05                  | 26.98154    | 13027.50C |           |
| 196 |   |                  |      | Fe   | 5.95E+05                  | 55.847      | 26000.55C |           |
| 197 |   |                  |      | O  | 1.92E+06                  | 15.99492    | 8016.50C  |           |
| 198 |   |                  |      | H  | 1.61E+05                  | 1.007825    | 1001.50C  |           |
| 199 |   |                  |      | Gd-152   |                           |             | 64152.50C |           |
| 200 |   |                  |      | Gd-154   |                           |             | 64154.50C |           |
| 201 |   |                  |      | Gd-155   |                           |             | 64155.50C |           |
| 202 |   |                  |      | Gd-156   |                           |             | 64156.50C |           |
| 203 |   |                  |      | Gd-157   |                           |             | 64157.50C |           |
| 204 |   |                  |      | Gd-158   |                           |             | 64158.50C |           |
| 204 |   |                  |      | Gd-160   |                           |             | 64160.50C |           |

|     | AP  | AQ          | AR   | AS | AT   | AU          | AV       | AW        |
|-----|---|-------------|------|----|--|-------------|----------|-----------|
| 205 |   |             |      |    | den (g/cm^                                     | 1.72119E+00 |          |           |
| 206 |   |             |      |    |  |             |          |           |
| 207 |   |             |      |    | H/U-235 Ration                                 |             |          |           |
| 208 |   |             |      |    |  |             |          |           |
| 209 |   |             |      |    |  |             |          |           |
| 210 | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 900000 g of Fe2O3, Void Fra</b>  |             |      |    |  |             |          |           |
| 211 |   |             |      |    |  |             |          |           |
| 212 |   |             |      |    |  |             |          |           |
| 213 | Segment Volume Calculation  |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 214 | DHLW)   |             |      |    |  |             |          |           |
| 215 |   |             |      |    |  |             |          |           |
| 216 | Calculations  |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 217 | radius (R)  | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 218 | length  | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 219 | Volume  | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 220 | Volume  | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 221 |   | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 222 | center (y1)   | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 223 |   |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 224 |   |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 225 |   |             |      |    |  |             |          |           |
| 226 | MIT Fuel and Others   |             |      |    |  |             |          |           |
| 227 |   |             |      |    |  |             |          |           |
| 228 | Core Volume   | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 229 | 1/2 Cylin.  | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 230 | Volume  | 1.86361E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 231 |   | 1.86363E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 232 | center (y2)   | 7.19280E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 233 |   |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 234 |   |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 235 |   |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |
| 236 |   |             |      |    | Fe   | 6.30E+05    | 55.847   | 26000.55C |
| 237 |   |             |      |    | O  | 1.97E+06    | 15.99492 | 8016.50C  |
| 238 |   |             |      |    | H  | 1.66E+05    | 1.007825 | 1001.50C  |
| 239 |   |             |      |    | Gd-152   |             |          | 64152.50C |
| 240 |   |             |      |    | Gd-154   |             |          | 64154.50C |
| 241 |   |             |      |    | Gd-155   |             |          | 64155.50C |
| 242 |   |             |      |    | Gd-156   |             |          | 64156.50C |
| 243 |   |             |      |    | Gd-157   |             |          | 64157.50C |
| 244 |   |             |      |    | Gd-158   |             |          | 64158.50C |
| 245 |   |             |      |    | Gd-160   |             |          | 64160.50C |
| 246 |   |             |      |    | den (g/cm^                                     | 1.72445E+00 |          |           |
| 247 |   |             |      |    |  |             |          |           |
| 248 |   |             |      |    | H/U-235 Ration                                 |             |          |           |
| 249 |   |             |      |    |  |             |          |           |
| 250 |   |             |      |    |  |             |          |           |
| 251 | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 1200000 g of Fe2O3, Void Fra</b> |             |      |    |  |             |          |           |
| 252 |   |             |      |    |  |             |          |           |
| 253 |   |             |      |    |  |             |          |           |
| 254 | Segment Volume Calculation  |             |      |    | Degraded MIT Fuel                              |             |          |           |
| 255 | DHLW)   |             |      |    |  |             |          |           |

Fe\_gd

|     | AP                | AQ          | AR   | AS | AT   | AU          | AV       | AW        |
|-----|-------------------|-------------|------|----|--|-------------|----------|-----------|
| 256 |                   |             |      |    |  |             |          |           |
| 257 | Calculations      |             |      |    | Fraction of UO2 Remaining                      |             |          |           |
| 258 | radius (R)        | 86.5        | cm   |    | Mass of Gd                                     |             |          |           |
| 259 | length            | 304         | cm   |    | Density of Gd                                  |             |          |           |
| 260 | volume            | 7.14588E+06 | cm^3 |    | Mass of Fe2O3                                  |             |          |           |
| 261 | volume            | 4.99330E+06 | cm^3 |    | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |
| 262 |                   | 4.99330E+06 |      |    | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |
| 263 | center (y1)       | 2.74765E+01 | cm   |    | Void Fraction                                  |             |          |           |
| 264 |                   |             |      |    | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |
| 265 |                   |             |      |    | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |
| 266 |                   |             |      |    |  |             |          |           |
| 267 | T Fuel and Others |             |      |    |  |             |          |           |
| 268 |                   |             |      |    |  |             |          |           |
| 269 | core Volume       | 3.57294E+06 | cm^3 |    |  |             |          |           |
| 270 | 1/2 Cylin.        | 1.42036E+06 | cm^3 |    |  |             |          |           |
| 271 | volume            | 2.14987E+06 | cm^3 |    | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |
| 272 |                   | 2.14989E+06 |      |    | Mass(g)  | WT          | MCNP     |           |
| 273 | center (y2)       | 8.58660E+01 | cm   |    | U-235  | 32912       | 235.0439 | 92235.50C |
| 274 |                   |             |      |    | U-234  | 352         | 234.0409 | 92234.50C |
| 275 |                   |             |      |    | U-238  | 1936        | 238.0508 | 92238.50C |
| 276 |                   |             |      |    | Al   | 4.14E+05    | 26.98154 | 13027.50C |
| 277 |                   |             |      |    | Fe   | 8.40E+05    | 55.847   | 26000.55C |
| 278 |                   |             |      |    | O  | 2.26E+06    | 15.99492 | 8016.50C  |
| 279 |                   |             |      |    | H  | 1.91E+05    | 1.007825 | 1001.50C  |
| 280 |                   |             |      |    | Gd-152   |             |          | 64152.50C |
| 281 |                   |             |      |    | Gd-154   |             |          | 64154.50C |
| 282 |                   |             |      |    | Gd-155   |             |          | 64155.50C |
| 283 |                   |             |      |    | Gd-156   |             |          | 64156.50C |
| 284 |                   |             |      |    | Gd-157   |             |          | 64157.50C |
| 285 |                   |             |      |    | Gd-158   |             |          | 64158.50C |
| 286 |                   |             |      |    | Gd-160   |             |          | 64160.50C |
| 287 |                   |             |      |    | den (g/cm^                                     | 1.74097E+00 |          |           |
| 288 |                   |             |      |    |  |             |          |           |
| 289 |                   |             |      |    | H/U-235 Ration                                 |             |          |           |

|    | AX                         | AY     | AZ |
|----|----------------------------|--------|----|
| 1  |                            |        |    |
| 2  |                            |        |    |
| 3  |                            |        |    |
| 4  |                            |        |    |
| 5  | ction 0.8)                 |        |    |
| 6  |                            |        |    |
| 7  |                            |        |    |
| 8  |                            |        |    |
| 9  |                            |        |    |
| 10 |                            |        |    |
| 11 | 1.00                       |        |    |
| 12 |                            | g      |    |
| 13 | 7.9004E+00                 | g/cm^3 |    |
| 14 | 1.50E+05                   | g      |    |
| 15 | 4.23514E+00                | g/cm^3 |    |
| 16 | 9.72353E+05                | g      |    |
| 17 | 8.00000E-01                |        |    |
| 18 | 8.47029E-01                | g/cm^3 |    |
| 19 | 1.14796E+06                | cm^3   |    |
| 20 |                            |        |    |
| 21 |                            |        |    |
| 22 |                            |        |    |
| 23 |                            |        |    |
| 24 |                            |        |    |
| 25 |                            |        |    |
| 26 | Atomic Density (#/barn cm) |        |    |
| 27 | 7.3461E-05                 |        |    |
| 28 | 7.8905E-07                 |        |    |
| 29 | 4.2666E-06                 |        |    |
| 30 | 8.0535E-03                 |        |    |
| 31 | 9.8637E-04                 |        |    |
| 32 | 4.0487E-02                 |        |    |
| 33 | 5.3118E-02                 |        |    |
| 34 | 0.0000E+00                 |        |    |
| 35 | 0.0000E+00                 |        |    |
| 36 | 0.0000E+00                 |        |    |
| 37 | 0.0000E+00                 |        |    |
| 38 | 0.0000E+00                 |        |    |
| 39 | 0.0000E+00                 |        |    |
| 40 | 0.0000E+00                 |        |    |
| 41 | 1.0272E-01                 |        |    |
| 42 |                            |        |    |
| 43 | 723.0741597                |        |    |
| 44 |                            |        |    |
| 45 |                            |        |    |
| 46 | ction 0.8)                 |        |    |
| 47 |                            |        |    |
| 48 |                            |        |    |
| 49 |                            |        |    |
| 50 |                            |        |    |
| 51 |                            |        |    |

|     | AX                         | AY     | AZ |
|-----|----------------------------|--------|----|
| 52  | 1.00                       |        |    |
| 53  |                            | g      |    |
| 54  | 7.9004E+00                 | g/cm^3 |    |
| 55  | 3.00E+05                   | g      |    |
| 56  | 4.34654E+00                | g/cm^3 |    |
| 57  | 1.12235E+06                | g      |    |
| 58  | 8.00000E-01                |        |    |
| 59  | 8.69308E-01                | g/cm^3 |    |
| 60  | 1.29109E+06                | cm^3   |    |
| 61  |                            |        |    |
| 62  |                            |        |    |
| 63  |                            |        |    |
| 64  |                            |        |    |
| 65  |                            |        |    |
| 66  |                            |        |    |
| 67  | Atomic Density (#/barn cm) |        |    |
| 68  | 6.5317E-05                 |        |    |
| 69  | 7.0157E-07                 |        |    |
| 70  | 3.7936E-06                 |        |    |
| 71  | 7.1607E-03                 |        |    |
| 72  | 1.7540E-03                 |        |    |
| 73  | 4.0281E-02                 |        |    |
| 74  | 5.3118E-02                 |        |    |
| 75  | 0.0000E+00                 |        |    |
| 76  | 0.0000E+00                 |        |    |
| 77  | 0.0000E+00                 |        |    |
| 78  | 0.0000E+00                 |        |    |
| 79  | 0.0000E+00                 |        |    |
| 80  | 0.0000E+00                 |        |    |
| 81  | 0.0000E+00                 |        |    |
| 82  | 1.0238E-01                 |        |    |
| 83  |                            |        |    |
| 84  | 813.2285882                |        |    |
| 85  |                            |        |    |
| 86  |                            |        |    |
| 87  | ction 0.8)                 |        |    |
| 88  |                            |        |    |
| 89  |                            |        |    |
| 90  |                            |        |    |
| 91  |                            |        |    |
| 92  |                            |        |    |
| 93  | 1.00                       |        |    |
| 94  |                            | g      |    |
| 95  | 7.9004E+00                 | g/cm^3 |    |
| 96  | 6.00E+05                   | g      |    |
| 97  | 4.50869E+00                | g/cm^3 |    |
| 98  | 1.42235E+06                | g      |    |
| 99  | 8.00000E-01                |        |    |
| 100 | 9.01738E-01                | g/cm^3 |    |
| 101 | 1.57735E+06                | cm^3   |    |
| 102 |                            |        |    |

|     | AX                         | AY     | AZ |
|-----|----------------------------|--------|----|
| 103 |                            |        |    |
| 104 |                            |        |    |
| 105 |                            |        |    |
| 106 |                            |        |    |
| 107 |                            |        |    |
| 108 | Atomic Density (#/barn cm) |        |    |
| 109 | 5.3463E-05                 |        |    |
| 110 | 5.7425E-07                 |        |    |
| 111 | 3.1052E-06                 |        |    |
| 112 | 5.8611E-03                 |        |    |
| 113 | 2.8714E-03                 |        |    |
| 114 | 3.9982E-02                 |        |    |
| 115 | 5.3118E-02                 |        |    |
| 116 | 0.0000E+00                 |        |    |
| 117 | 0.0000E+00                 |        |    |
| 118 | 0.0000E+00                 |        |    |
| 119 | 0.0000E+00                 |        |    |
| 120 | 0.0000E+00                 |        |    |
| 121 | 0.0000E+00                 |        |    |
| 122 | 0.0000E+00                 |        |    |
| 123 | 1.0189E-01                 |        |    |
| 124 |                            |        |    |
| 125 | 993.5374452                |        |    |
| 126 |                            |        |    |
| 127 |                            |        |    |
| 128 | ction 0.8)                 |        |    |
| 129 |                            |        |    |
| 130 |                            |        |    |
| 131 |                            |        |    |
| 132 |                            |        |    |
| 133 |                            |        |    |
| 134 | 1.00                       |        |    |
| 135 |                            | g      |    |
| 136 | 7.9004E+00                 | g/cm^3 |    |
| 137 | 8.00E+05                   | g      |    |
| 138 | 4.58762E+00                | g/cm^3 |    |
| 139 | 1.62235E+06                | g      |    |
| 140 | 8.00000E-01                |        |    |
| 141 | 9.17524E-01                | g/cm^3 |    |
| 142 | 1.76819E+06                | cm^3   |    |
| 143 |                            |        |    |
| 144 |                            |        |    |
| 145 |                            |        |    |
| 146 |                            |        |    |
| 147 |                            |        |    |
| 148 |                            |        |    |
| 149 | Atomic Density (#/barn cm) |        |    |
| 150 | 4.7693E-05                 |        |    |
| 151 | 5.1227E-07                 |        |    |
| 152 | 2.7700E-06                 |        |    |
| 153 | 5.2286E-03                 |        |    |

|     | AX                         | AY     | AZ |
|-----|----------------------------|--------|----|
| 154 | 3.4154E-03                 |        |    |
| 155 | 3.9837E-02                 |        |    |
| 156 | 5.3118E-02                 |        |    |
| 157 | 0.0000E+00                 |        |    |
| 158 | 0.0000E+00                 |        |    |
| 159 | 0.0000E+00                 |        |    |
| 160 | 0.0000E+00                 |        |    |
| 161 | 0.0000E+00                 |        |    |
| 162 | 0.0000E+00                 |        |    |
| 163 | 0.0000E+00                 |        |    |
| 164 | 1.0165E-01                 |        |    |
| 165 |                            |        |    |
| 166 | 1113.74335                 |        |    |
| 167 |                            |        |    |
| 168 |                            |        |    |
| 169 | ction 0.8)                 |        |    |
| 170 |                            |        |    |
| 171 |                            |        |    |
| 172 |                            |        |    |
| 173 |                            |        |    |
| 174 |                            |        |    |
| 175 | 1.00                       |        |    |
| 176 |                            | g      |    |
| 177 | 7.9004E+00                 | g/cm^3 |    |
| 178 | 8.50E+05                   | g      |    |
| 179 | 4.60476E+00                | g/cm^3 |    |
| 180 | 1.67235E+06                | g      |    |
| 181 | 8.00000E-01                |        |    |
| 182 | 9.20952E-01                | g/cm^3 |    |
| 183 | 1.81590E+06                | cm^3   |    |
| 184 |                            |        |    |
| 185 |                            |        |    |
| 186 |                            |        |    |
| 187 |                            |        |    |
| 188 |                            |        |    |
| 189 |                            |        |    |
| 190 | Atomic Density (#/barn cm) |        |    |
| 191 | 4.6440E-05                 |        |    |
| 192 | 4.9881E-07                 |        |    |
| 193 | 2.6973E-06                 |        |    |
| 194 | 5.0912E-03                 |        |    |
| 195 | 3.5335E-03                 |        |    |
| 196 | 3.9805E-02                 |        |    |
| 197 | 5.3118E-02                 |        |    |
| 198 | 0.0000E+00                 |        |    |
| 199 | 0.0000E+00                 |        |    |
| 200 | 0.0000E+00                 |        |    |
| 201 | 0.0000E+00                 |        |    |
| 202 | 0.0000E+00                 |        |    |
| 203 | 0.0000E+00                 |        |    |
| 204 | 0.0000E+00                 |        |    |



|     | AX                         | AY     | AZ |
|-----|----------------------------|--------|----|
| 205 | 1.0160E-01                 |        |    |
| 206 |                            |        |    |
| 207 | 1143.794826                |        |    |
| 208 |                            |        |    |
| 209 |                            |        |    |
| 210 | action 0.8)                |        |    |
| 211 |                            |        |    |
| 212 |                            |        |    |
| 213 |                            |        |    |
| 214 |                            |        |    |
| 215 |                            |        |    |
| 216 | 1.00                       |        |    |
| 217 |                            | g      |    |
| 218 | 7.9004E+00                 | g/cm^3 |    |
| 219 | 9.00E+05                   | g      |    |
| 220 | 4.62102E+00                | g/cm^3 |    |
| 221 | 1.72235E+06                | g      |    |
| 222 | 8.00000E-01                |        |    |
| 223 | 9.24204E-01                | g/cm^3 |    |
| 224 | 1.86361E+06                | cm^3   |    |
| 225 |                            |        |    |
| 226 |                            |        |    |
| 227 |                            |        |    |
| 228 |                            |        |    |
| 229 |                            |        |    |
| 230 |                            |        |    |
| 231 | Atomic Density (#/barn cm) |        |    |
| 232 | 4.5251E-05                 |        |    |
| 233 | 4.8604E-07                 |        |    |
| 234 | 2.6282E-06                 |        |    |
| 235 | 4.9608E-03                 |        |    |
| 236 | 3.6456E-03                 |        |    |
| 237 | 3.9775E-02                 |        |    |
| 238 | 5.3118E-02                 |        |    |
| 239 | 0.0000E+00                 |        |    |
| 240 | 0.0000E+00                 |        |    |
| 241 | 0.0000E+00                 |        |    |
| 242 | 0.0000E+00                 |        |    |
| 243 | 0.0000E+00                 |        |    |
| 244 | 0.0000E+00                 |        |    |
| 245 | 0.0000E+00                 |        |    |
| 246 | 1.0155E-01                 |        |    |
| 247 |                            |        |    |
| 248 | 1173.846302                |        |    |
| 249 |                            |        |    |
| 250 |                            |        |    |
| 251 | action 0.8)                |        |    |
| 252 |                            |        |    |
| 253 |                            |        |    |
| 254 |                            |        |    |
| 255 |                            |        |    |

|     | AX                         | AY     | AZ |
|-----|----------------------------|--------|----|
| 256 |                            |        |    |
| 257 | 1.00                       |        |    |
| 258 |                            | g      |    |
| 259 | 7.9004E+00                 | g/cm^3 |    |
| 260 | 1.20E+06                   | g      |    |
| 261 | 4.70344E+00                | g/cm^3 |    |
| 262 | 2.02235E+06                | g      |    |
| 263 | 8.00000E-01                |        |    |
| 264 | 9.40688E-01                | g/cm^3 |    |
| 265 | 2.14987E+06                | cm^3   |    |
| 266 |                            |        |    |
| 267 |                            |        |    |
| 268 |                            |        |    |
| 269 |                            |        |    |
| 270 |                            |        |    |
| 271 |                            |        |    |
| 272 | Atomic Density (#/barn cm) |        |    |
| 273 | 3.9226E-05                 |        |    |
| 274 | 4.2132E-07                 |        |    |
| 275 | 2.2782E-06                 |        |    |
| 276 | 4.3003E-03                 |        |    |
| 277 | 4.2135E-03                 |        |    |
| 278 | 3.9623E-02                 |        |    |
| 279 | 5.3118E-02                 |        |    |
| 280 | 0.0000E+00                 |        |    |
| 281 | 0.0000E+00                 |        |    |
| 282 | 0.0000E+00                 |        |    |
| 283 | 0.0000E+00                 |        |    |
| 284 | 0.0000E+00                 |        |    |
| 285 | 0.0000E+00                 |        |    |
| 286 | 0.0000E+00                 |        |    |
| 287 | 1.0130E-01                 |        |    |
| 288 |                            |        |    |
| 289 | 1354.155159                |        |    |

|    | A | B   | C | D           | E               | F  | G           | H |
|----|---|---|---|-------------|-----------------|--|-------------|---|
| 1  |   |   |   |             |                 |  |             |   |
| 2  |   | <b>75% Uranium Loading</b>  |   |             |                 |  |             |   |
| 3  |   |   |   |             |                 |  |             |   |
| 4  |   |   |   |             |                 |  |             |   |
| 5  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |                 |  |             |   |
| 6  |   |   |   |             |                 |  |             |   |
| 7  |   |   |   |             |                 |  |             |   |
| 8  |   | Cylinder Segment Volume Calculation                                       |   |             |                 | Degraded MIT Fuel  |             |   |
| 9  |   | (Degraded DHLW)   |   |             |                 |  |             |   |
| 10 |   |   |   |             |                 |  |             |   |
| 11 |   | Geometry Calculations   |   |             |                 | Fraction of UO2 Remaining  |             |   |
| 12 |   | Cylinder Radius (R)   |   | 86.5        | cm              | Mass of Gd   |             |   |
| 13 |   | Cylinder Length   |   | 304         | cm              | Density of Gd  |             |   |
| 14 |   | Cylinder Volume   |   | 7.14588E+06 | cm <sup>3</sup> | Mass of Fe <sub>2</sub> O <sub>3</sub>   |             |   |
| 15 |   | Segment Volume  |   | 4.99330E+06 | cm <sup>3</sup> | Nominal Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                         |             |   |
| 16 |   | Target Cell   |   | 4.99330E+06 |                 | Total Mas of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                           |             |   |
| 17 |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm              | Void Fraction  |             |   |
| 18 |   |   |   |             |                 | Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> |             |   |
| 19 |   |   |   |             |                 | Vol. Occupied by UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                       |             |   |
| 20 |   |   |   |             |                 |  |             |   |
| 21 |   | Layer of MIT Fuel and Others  |   |             |                 |  |             |   |
| 22 |   |   |   |             |                 |  |             |   |
| 23 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm <sup>3</sup> |  |             |   |
| 24 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm <sup>3</sup> |  |             |   |
| 25 |   | Layer Volume  |   | 6.66844E+05 | cm <sup>3</sup> | Atomic Density Calculation   |             |   |
| 26 |   | Target Cell   |   | 6.68846E+05 |                 | Mass(g)  |             |   |
| 27 |   | Dis from Center (y2)  |   | 4.13598E+01 | cm              | U-235  | 24684       |   |
| 28 |   |   |   |             |                 | U-234  | 264         |   |
| 29 |   |   |   |             |                 | U-238  | 1452        |   |
| 30 |   |   |   |             |                 | Al   | 4.14E+05    |   |
| 31 |   |   |   |             |                 | Fe   | 0.00E+00    |   |
| 32 |   |   |   |             |                 | O  | 7.87E+05    |   |
| 33 |   |   |   |             |                 | H  | 5.19E+04    |   |
| 34 |   |   |   |             |                 | Gd-152   |             |   |
| 35 |   |   |   |             |                 | Gd-154   |             |   |
| 36 |   |   |   |             |                 | Gd-155   |             |   |
| 37 |   |   |   |             |                 | Gd-156   |             |   |
| 38 |   |   |   |             |                 | Gd-157   |             |   |
| 39 |   |   |   |             |                 | Gd-158   |             |   |
| 40 |   |   |   |             |                 | Gd-160   |             |   |
| 41 |   |   |   |             |                 | den (g/cm <sup>3</sup> )   | 1.91821E+00 |   |
| 42 |   |   |   |             |                 |  |             |   |
| 43 |   |   |   |             |                 | H/U-235 Ration   |             |   |
| 44 |   |   |   |             |                 |  |             |   |
| 45 |   |   |   |             |                 |  |             |   |
| 46 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |                 |  |             |   |
| 47 |   |   |   |             |                 |  |             |   |
| 48 |   |   |   |             |                 |  |             |   |
| 49 |   | Cylinder Segment Volume Calculation                                       |   |             |                 | Degraded MIT Fuel  |             |   |
| 50 |   | (Degraded DHLW)   |   |             |                 |  |             |   |
| 51 |   |   |   |             |                 |  |             |   |

|     | A | B   | C           | D               | E  | F | G                         | H                        |  |
|-----|---|---|-------------|-----------------|----|---|---------------------------|--------------------------|--|
| 52  |   | Geometry Calculations   |             |                 |    |   |                           | Fraction of UO2 Remainin |  |
| 53  |   | Cylinder Radius (R)   |             | 86.5            | cm |   | Mass of Gd                |                          |  |
| 54  |   | Cylinder Length   |             | 304             | cm |   | Density of Gd             |                          |  |
| 55  |   | Cylinder Volume   | 7.14588E+06 | cm <sup>3</sup> |    |   | Mass of Fe2O3             |                          |  |
| 56  |   | Segment Volume  | 4.99330E+06 | cm <sup>3</sup> |    |   | Nominal Den of UO2+Al2O   |                          |  |
| 57  |   | Target Cell   | 4.99330E+06 |                 |    |   | Total Mas of UO2+Al2O3-   |                          |  |
| 58  |   | Dis. from Center (y1)   | 2.74765E+01 | cm              |    |   | Void Fraction             |                          |  |
| 59  |   |   |             |                 |    |   | Den of UO2+Al2O3+Fe2O     |                          |  |
| 60  |   |   |             |                 |    |   | Vol. Occupied by UO2+Al   |                          |  |
| 61  |   |   |             |                 |    |   |                           |                          |  |
| 62  |   | Layer of MIT Fuel and Others  |             |                 |    |   |                           |                          |  |
| 63  |   |   |             |                 |    |   |                           |                          |  |
| 64  |   | 1/2 Cylinder Volume   | 3.57294E+06 | cm <sup>3</sup> |    |   |                           |                          |  |
| 65  |   | Segment - 1/2 Cylin.  | 1.42036E+06 | cm <sup>3</sup> |    |   |                           |                          |  |
| 66  |   | Layer Volume  | 8.00213E+05 | cm <sup>3</sup> |    |   | Atomic Density Calculatio |                          |  |
| 67  |   | Target Cell   | 8.00216E+05 |                 |    |   | Mass(g)                   |                          |  |
| 68  |   | Dis from Center (y2)  | 4.42344E+01 | cm              |    |   | U-235                     | 24684                    |  |
| 69  |   |   |             |                 |    |   | U-234                     | 264                      |  |
| 70  |   |   |             |                 |    |   | U-238                     | 1452                     |  |
| 71  |   |   |             |                 |    |   | Al                        | 4.14E+05                 |  |
| 72  |   |   |             |                 |    |   | Fe                        | 0.00E+00                 |  |
| 73  |   |   |             |                 |    |   | O                         | 9.05E+05                 |  |
| 74  |   |   |             |                 |    |   | H                         | 6.67E+04                 |  |
| 75  |   |   |             |                 |    |   | Gd-152                    |                          |  |
| 76  |   |   |             |                 |    |   | Gd-154                    |                          |  |
| 77  |   |   |             |                 |    |   | Gd-155                    |                          |  |
| 78  |   |   |             |                 |    |   | Gd-156                    |                          |  |
| 79  |   |   |             |                 |    |   | Gd-157                    |                          |  |
| 80  |   |   |             |                 |    |   | Gd-158                    |                          |  |
| 81  |   |   |             |                 |    |   | Gd-160                    |                          |  |
| 82  |   |   |             |                 |    |   | den (g/cm <sup>3</sup> )  | 1.76517E+00              |  |
| 83  |   |   |             |                 |    |   |                           |                          |  |
| 84  |   |   |             |                 |    |   | H/U-235 Ration            |                          |  |
| 85  |   |   |             |                 |    |   |                           |                          |  |
| 86  |   |   |             |                 |    |   |                           |                          |  |
| 87  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |             |                 |    |   |                           |                          |  |
| 88  |   |   |             |                 |    |   |                           |                          |  |
| 89  |   |   |             |                 |    |   |                           |                          |  |
| 90  |   | Cylinder Segment Volume Calculation                                       |             |                 |    |   |                           | Degraded MIT Fuel        |  |
| 91  |   | (Degraded DHLW)   |             |                 |    |   |                           |                          |  |
| 92  |   |   |             |                 |    |   |                           |                          |  |
| 93  |   | Geometry Calculations   |             |                 |    |   |                           | Fraction of UO2 Remainin |  |
| 94  |   | Cylinder Radius (R)   |             | 86.5            | cm |   | Mass of Gd                |                          |  |
| 95  |   | Cylinder Length   |             | 304             | cm |   | Density of Gd             |                          |  |
| 96  |   | Cylinder Volume   | 7.14588E+06 | cm <sup>3</sup> |    |   | Mass of Fe2O3             |                          |  |
| 97  |   | Segment Volume  | 4.99330E+06 | cm <sup>3</sup> |    |   | Nominal Den of UO2+Al2O   |                          |  |
| 98  |   | Target Cell   | 4.99330E+06 |                 |    |   | Total Mas of UO2+Al2O3-   |                          |  |
| 99  |   | Dis. from Center (y1)   | 2.74765E+01 | cm              |    |   | Void Fraction             |                          |  |
| 100 |   |   |             |                 |    |   | Den of UO2+Al2O3+Fe2O     |                          |  |
| 101 |   |   |             |                 |    |   | Vol. Occupied by UO2+Al   |                          |  |
| 102 |   |   |             |                 |    |   |                           |                          |  |

## Fe\_gd

|     | A | B   | C | D           | E               | F | G  | H           |
|-----|---|---|---|-------------|-----------------|---|--|-------------|
| 103 |   | Layer of MIT Fuel and Others  |   |             |                 |   |  |             |
| 104 |   |   |   |             |                 |   |  |             |
| 105 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm <sup>3</sup> |   |  |             |
| 106 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm <sup>3</sup> |   |  |             |
| 107 |   | Layer Volume  |   | 1.00027E+06 | cm <sup>3</sup> |   | Atomic Density Calculation   |             |
| 108 |   | Target Cell   |   | 1.00027E+06 |                 |   |  | Mass(g)     |
| 109 |   | Dis from Center (y2)  |   | 4.87462E+01 | cm              |   | U-235  | 24684       |
| 110 |   |   |   |             |                 |   | U-234  | 264         |
| 111 |   |   |   |             |                 |   | U-238  | 1452        |
| 112 |   |   |   |             |                 |   | Al   | 4.14E+05    |
| 113 |   |   |   |             |                 |   | Fe   | 0.00E+00    |
| 114 |   |   |   |             |                 |   | O  | 1.08E+06    |
| 115 |   |   |   |             |                 |   | H  | 8.89E+04    |
| 116 |   |   |   |             |                 |   | Gd-152   |             |
| 117 |   |   |   |             |                 |   | Gd-154   |             |
| 118 |   |   |   |             |                 |   | Gd-155   |             |
| 119 |   |   |   |             |                 |   | Gd-156   |             |
| 120 |   |   |   |             |                 |   | Gd-157   |             |
| 121 |   |   |   |             |                 |   | Gd-158   |             |
| 122 |   |   |   |             |                 |   | Gd-160   |             |
| 123 |   |   |   |             |                 |   | den (g/cm <sup>3</sup> )   | 1.61214E+00 |
| 124 |   |   |   |             |                 |   |  |             |
| 125 |   |   |   |             |                 |   | H/U-235 Ration   |             |
| 126 |   |   |   |             |                 |   |  |             |
| 127 |   |   |   |             |                 |   |  |             |
| 128 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |                 |   |  |             |
| 129 |   |   |   |             |                 |   |  |             |
| 130 |   |   |   |             |                 |   |  |             |
| 131 |   | Cylinder Segment Volume Calculation                                       |   |             |                 |   | Degraded MIT Fuel  |             |
| 132 |   | (Degraded DHLW)   |   |             |                 |   |  |             |
| 133 |   |   |   |             |                 |   |  |             |
| 134 |   | Geometry Calculations   |   |             |                 |   | Fraction of UO <sub>2</sub> Remainin   |             |
| 135 |   | Cylinder Radius (R)   |   | 86.5        | cm              |   | Mass of Gd   |             |
| 136 |   | Cylinder Length   |   | 304         | cm              |   | Density of Gd  |             |
| 137 |   | Cylinder Volume   |   | 7.14588E+06 | cm <sup>3</sup> |   | Mass of Fe <sub>2</sub> O <sub>3</sub>   |             |
| 138 |   | Segment Volume  |   | 4.99330E+06 | cm <sup>3</sup> |   | Nominal Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                         |             |
| 139 |   | Target Cell   |   | 4.99330E+06 |                 |   | Total Mas of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                           |             |
| 140 |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm              |   | Void Fraction  |             |
| 141 |   |   |   |             |                 |   | Den of UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> |             |
| 142 |   |   |   |             |                 |   | Vol. Occupied by UO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub>                       |             |
| 143 |   |   |   |             |                 |   |  |             |
| 144 |   | Layer of MIT Fuel and Others  |   |             |                 |   |  |             |
| 145 |   |   |   |             |                 |   |  |             |
| 146 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm <sup>3</sup> |   |  |             |
| 147 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm <sup>3</sup> |   |  |             |
| 148 |   | Layer Volume  |   | 1.33369E+06 | cm <sup>3</sup> |   | Atomic Density Calculation   |             |
| 149 |   | Target Cell   |   | 1.33369E+06 |                 |   |  | Mass(g)     |
| 150 |   | Dis from Center (y2)  |   | 5.67528E+01 | cm              |   | U-235  | 24684       |
| 151 |   |   |   |             |                 |   | U-234  | 264         |
| 152 |   |   |   |             |                 |   | U-238  | 1452        |
| 153 |   |   |   |             |                 |   | Al   | 4.14E+05    |

Fe\_gd

|     | A | B                                   | C | D   | E    | F | G                         | H           |  |
|-----|---|-------------------------------------|---|---|------|---|---------------------------|-------------|--|
| 154 |   |                                     |   |   |      |   | Fe                        | 0.00E+00    |  |
| 155 |   |                                     |   |   |      |   | O                         | 1.38E+06    |  |
| 156 |   |                                     |   |   |      |   | H                         | 1.26E+05    |  |
| 157 |   |                                     |   |   |      |   | Gd-152                    |             |  |
| 158 |   |                                     |   |   |      |   | Gd-154                    |             |  |
| 159 |   |                                     |   |   |      |   | Gd-155                    |             |  |
| 160 |   |                                     |   |   |      |   | Gd-156                    |             |  |
| 161 |   |                                     |   |   |      |   | Gd-157                    |             |  |
| 162 |   |                                     |   |   |      |   | Gd-158                    |             |  |
| 163 |   |                                     |   |   |      |   | Gd-160                    |             |  |
| 164 |   |                                     |   |   |      |   | den (g/cm^                | 1.45910E+00 |  |
| 165 |   |                                     |   |   |      |   |                           |             |  |
| 166 |   |                                     |   |   |      |   | H/U-235 Ration            |             |  |
| 167 |   |                                     |   |   |      |   |                           |             |  |
| 168 |   |                                     |   |   |      |   |                           |             |  |
| 169 |   |                                     |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |      |   |                           |             |  |
| 170 |   |                                     |   |   |      |   |                           |             |  |
| 171 |   |                                     |   |   |      |   |                           |             |  |
| 172 |   | Cylinder Segment Volume Calculation |   |   |      |   | Degraded MIT Fuel         |             |  |
| 173 |   | (Degraded DHLW)                     |   |   |      |   |                           |             |  |
| 174 |   |                                     |   |   |      |   |                           |             |  |
| 175 |   | Geometry Calculations               |   |   |      |   | Fraction of UO2 Remainin  |             |  |
| 176 |   | Cylinder Radius (R)                 |   | 86.5  | cm   |   | Mass of Gd                |             |  |
| 177 |   | Cylinder Length                     |   | 304   | cm   |   | Density of Gd             |             |  |
| 178 |   | Cylinder Volume                     |   | 7.14588E+06   | cm^3 |   | Mass of Fe2O3             |             |  |
| 179 |   | Segment Volume                      |   | 4.99330E+06   | cm^3 |   | Nominal Den of UO2+Al2O   |             |  |
| 180 |   | Target Cell                         |   | 4.99330E+06   |      |   | Total Mas of UO2+Al2O3-   |             |  |
| 181 |   | Dis. from Center (y1)               |   | 2.74765E+01   | cm   |   | Void Fraction             |             |  |
| 182 |   |                                     |   |   |      |   | Den of UO2+Al2O3+Fe2O     |             |  |
| 183 |   |                                     |   |   |      |   | Vol. Occupied by UO2+Al   |             |  |
| 184 |   |                                     |   |   |      |   |                           |             |  |
| 185 |   | Layer of MIT Fuel and Others        |   |   |      |   |                           |             |  |
| 186 |   |                                     |   |   |      |   |                           |             |  |
| 187 |   | 1/2 Cylinder Volume                 |   | 3.57294E+06   | cm^3 |   |                           |             |  |
| 188 |   | Segment - 1/2 Cylin.                |   | 1.42036E+06   | cm^3 |   |                           |             |  |
| 189 |   | Layer Volume                        |   | 2.00053E+06   | cm^3 |   | Atomic Density Calculatio |             |  |
| 190 |   | Target Cell                         |   | 2.00053E+06   |      |   | Mass(g)                   |             |  |
| 191 |   | Dis from Center (y2)                |   | 7.70610E+01   | cm   |   | U-235                     | 24684       |  |
| 192 |   |                                     |   |   |      |   | U-234                     | 264         |  |
| 193 |   |                                     |   |   |      |   | U-238                     | 1452        |  |
| 194 |   |                                     |   |   |      |   | Al                        | 4.14E+05    |  |
| 195 |   |                                     |   |   |      |   | Fe                        | 0.00E+00    |  |
| 196 |   |                                     |   |   |      |   | O                         | 1.97E+06    |  |
| 197 |   |                                     |   |   |      |   | H                         | 2.00E+05    |  |
| 198 |   |                                     |   |   |      |   | Gd-152                    |             |  |
| 199 |   |                                     |   |   |      |   | Gd-154                    |             |  |
| 200 |   |                                     |   |   |      |   | Gd-155                    |             |  |
| 201 |   |                                     |   |   |      |   | Gd-156                    |             |  |
| 202 |   |                                     |   |   |      |   | Gd-157                    |             |  |
| 203 |   |                                     |   |   |      |   | Gd-158                    |             |  |
| 204 |   |                                     |   |   |      |   | Gd-160                    |             |  |

Fe\_gd

|     | A | B | C | D | E | F | G                        | H           |
|-----|---|---|---|---|---|---|--------------------------|-------------|
| 205 |   |   |   |   |   |   | den (g/cm <sup>3</sup> ) | 1.30607E+00 |
| 206 |   |   |   |   |   |   |                          |             |
| 207 |   |   |   |   |   |   | H/U-235 Ration           |             |
| 208 |   |   |   |   |   |   |                          |             |
| 209 |   |   |   |   |   |   |                          |             |
| 210 |   |   |   |   |   |   |                          |             |
| 211 |   |   |   |   |   |   |                          |             |
| 212 |   |   |   |   |   |   |                          |             |
| 213 |   |   |   |   |   |   |                          |             |
| 214 |   |   |   |   |   |   |                          |             |
| 215 |   |   |   |   |   |   |                          |             |
| 216 |   |   |   |   |   |   |                          |             |
| 217 |   |   |   |   |   |   |                          |             |
| 218 |   |   |   |   |   |   |                          |             |
| 219 |   |   |   |   |   |   |                          |             |
| 220 |   |   |   |   |   |   |                          |             |
| 221 |   |   |   |   |   |   |                          |             |
| 222 |   |   |   |   |   |   |                          |             |
| 223 |   |   |   |   |   |   |                          |             |
| 224 |   |   |   |   |   |   |                          |             |
| 225 |   |   |   |   |   |   |                          |             |
| 226 |   |   |   |   |   |   |                          |             |
| 227 |   |   |   |   |   |   |                          |             |
| 228 |   |   |   |   |   |   |                          |             |
| 229 |   |   |   |   |   |   |                          |             |
| 230 |   |   |   |   |   |   |                          |             |
| 231 |   |   |   |   |   |   |                          |             |
| 232 |   |   |   |   |   |   |                          |             |
| 233 |   |   |   |   |   |   |                          |             |
| 234 |   |   |   |   |   |   |                          |             |
| 235 |   |   |   |   |   |   |                          |             |
| 236 |   |   |   |   |   |   |                          |             |
| 237 |   |   |   |   |   |   |                          |             |
| 238 |   |   |   |   |   |   |                          |             |
| 239 |   |   |   |   |   |   |                          |             |
| 240 |   |   |   |   |   |   |                          |             |
| 241 |   |   |   |   |   |   |                          |             |
| 242 |   |   |   |   |   |   |                          |             |
| 243 |   |   |   |   |   |   |                          |             |
| 244 |   |   |   |   |   |   |                          |             |
| 245 |   |   |   |   |   |   |                          |             |
| 246 |   |   |   |   |   |   |                          |             |
| 247 |   |   |   |   |   |   |                          |             |
| 248 |   |   |   |   |   |   |                          |             |

Fe\_gd

|    | I                          | J         | K                          | L      | M | N | O | P                       |              |
|----|----------------------------|-----------|----------------------------|--------|---|---|---|-------------------------|--------------|
| 1  |                            |           |                            |        |   |   |   |                         |              |
| 2  |                            |           |                            |        |   |   |   |                         |              |
| 3  |                            |           |                            |        |   |   |   |                         |              |
| 4  |                            |           |                            |        |   |   |   |                         |              |
| 5  | Fe2O3, Void Fraction 0.7)  |           |                            |        |   |   |   |                         | Degraded     |
| 6  |                            |           |                            |        |   |   |   |                         |              |
| 7  |                            |           |                            |        |   |   |   |                         |              |
| 8  |                            |           |                            |        |   |   |   | Cylinder Segment Volume |              |
| 9  |                            |           |                            |        |   |   |   | (Degraded DHLW)         |              |
| 10 |                            |           |                            |        |   |   |   |                         |              |
| 11 | g                          |           | 0.75                       |        |   |   |   | Geometry Calculations   |              |
| 12 |                            |           |                            |        |   |   |   | Cylinder Radius (R)     |              |
| 13 |                            |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length         |              |
| 14 |                            |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume         |              |
| 15 | D3+Fe2O3                   |           | 4.06069E+00                | g/cm^3 |   |   |   | Segment Volume          |              |
| 16 | Fe2O3                      |           | 8.12355E+05                | g      |   |   |   | Target Cell             |              |
| 17 |                            |           | 7.00000E-01                |        |   |   |   | Dis. from Center (y1)   |              |
| 18 | D3+Void Used               |           | 1.21821E+00                | g/cm^3 |   |   |   |                         |              |
| 19 | D3O3+Fe2O3+Void            |           | 6.66844E+05                | cm^3   |   |   |   |                         |              |
| 20 |                            |           |                            |        |   |   |   |                         |              |
| 21 |                            |           |                            |        |   |   |   | Layer of MIT Fuel and   |              |
| 22 |                            |           |                            |        |   |   |   |                         |              |
| 23 |                            |           |                            |        |   |   |   | 1/2 Cylinder Volume     |              |
| 24 |                            |           |                            |        |   |   |   | Segment - 1/2 Cylin.    |              |
| 25 | h (Degraded MIT Fuel)      |           |                            |        |   |   |   |                         | Layer Volume |
| 26 | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell             |              |
| 27 | 235.0439                   | 92235.50C | 9.4846E-05                 |        |   |   |   | Dis from Center (y2)    |              |
| 28 | 234.0409                   | 92234.50C | 1.0187E-06                 |        |   |   |   |                         |              |
| 29 | 238.0508                   | 92238.50C | 5.5087E-06                 |        |   |   |   |                         |              |
| 30 | 26.98154                   | 13027.50C | 1.3864E-02                 |        |   |   |   |                         |              |
| 31 | 55.847                     | 26000.55C | 0.0000E+00                 |        |   |   |   |                         |              |
| 32 | 15.99492                   | 8016.50C  | 4.4420E-02                 |        |   |   |   |                         |              |
| 33 | 1.007825                   | 1001.50C  | 4.6478E-02                 |        |   |   |   |                         |              |
| 34 |                            | 64152.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 35 |                            | 64154.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 36 |                            | 64155.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 37 |                            | 64156.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 38 |                            | 64157.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 39 |                            | 64158.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 40 |                            | 64160.50C | 0.0000E+00                 |        |   |   |   |                         |              |
| 41 |                            |           | 1.0486E-01                 |        |   |   |   |                         |              |
| 42 |                            |           |                            |        |   |   |   |                         |              |
| 43 |                            |           | 490.0363212                |        |   |   |   |                         |              |
| 44 |                            |           |                            |        |   |   |   |                         |              |
| 45 |                            |           |                            |        |   |   |   |                         |              |
| 46 | Fe2O3, Void Fraction 0.75) |           |                            |        |   |   |   |                         | Degraded     |
| 47 |                            |           |                            |        |   |   |   |                         |              |
| 48 |                            |           |                            |        |   |   |   |                         |              |
| 49 |                            |           |                            |        |   |   |   | Cylinder Segment Volume |              |
| 50 |                            |           |                            |        |   |   |   | (Degraded DHLW)         |              |
| 51 |                            |           |                            |        |   |   |   |                         |              |



Fe\_gd

|     | I                          | J         | K                          | L      | M | N | O | P                     |
|-----|----------------------------|-----------|----------------------------|--------|---|---|---|-----------------------|
| 52  | g                          |           | 0.75                       |        |   |   |   | Geometry Calculations |
| 53  |                            |           |                            | g      |   |   |   | Cylinder Radius (R)   |
| 54  |                            |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length       |
| 55  |                            |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume       |
| 56  | D3+Fe2O3                   |           | 4.06069E+00                | g/cm^3 |   |   |   | Segment Volume        |
| 57  | Fe2O3                      |           | 8.12355E+05                | g      |   |   |   | Target Cell           |
| 58  |                            |           | 7.50000E-01                |        |   |   |   | Dis. from Center (y1) |
| 59  | D3+Void Used               |           | 1.01517E+00                | g/cm^3 |   |   |   |                       |
| 60  | D2O3+Fe2O3+Void            |           | 8.00213E+05                | cm^3   |   |   |   |                       |
| 61  |                            |           |                            |        |   |   |   |                       |
| 62  |                            |           |                            |        |   |   |   | Layer of MIT Fuel and |
| 63  |                            |           |                            |        |   |   |   |                       |
| 64  |                            |           |                            |        |   |   |   | 1/2 Cylinder Volume   |
| 65  |                            |           |                            |        |   |   |   | Segment - 1/2 Cylin.  |
| 66  | h (Degraded MIT Fuel)      |           |                            |        |   |   |   | Layer Volume          |
| 67  | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |   |   | Target Cell           |
| 68  | 235.0439                   | 92235.50C | 7.9038E-05                 |        |   |   |   | Dis from Center (y2)  |
| 69  | 234.0409                   | 92234.50C | 8.4895E-07                 |        |   |   |   |                       |
| 70  | 238.0508                   | 92238.50C | 4.5906E-06                 |        |   |   |   |                       |
| 71  | 26.98154                   | 13027.50C | 1.1553E-02                 |        |   |   |   |                       |
| 72  | 55.847                     | 26000.55C | 0.0000E+00                 |        |   |   |   |                       |
| 73  | 15.99492                   | 8016.50C  | 4.2594E-02                 |        |   |   |   |                       |
| 74  | 1.007825                   | 1001.50C  | 4.9798E-02                 |        |   |   |   |                       |
| 75  |                            | 64152.50C | 0.0000E+00                 |        |   |   |   |                       |
| 76  |                            | 64154.50C | 0.0000E+00                 |        |   |   |   |                       |
| 77  |                            | 64155.50C | 0.0000E+00                 |        |   |   |   |                       |
| 78  |                            | 64156.50C | 0.0000E+00                 |        |   |   |   |                       |
| 79  |                            | 64157.50C | 0.0000E+00                 |        |   |   |   |                       |
| 80  |                            | 64158.50C | 0.0000E+00                 |        |   |   |   |                       |
| 81  |                            | 64160.50C | 0.0000E+00                 |        |   |   |   |                       |
| 82  |                            |           | 1.0403E-01                 |        |   |   |   |                       |
| 83  |                            |           |                            |        |   |   |   |                       |
| 84  |                            |           | 630.0466987                |        |   |   |   |                       |
| 85  |                            |           |                            |        |   |   |   |                       |
| 86  |                            |           |                            |        |   |   |   |                       |
| 87  | Fe2O3, Void Fraction 0.80) |           |                            |        |   |   |   | Degraded              |
| 88  |                            |           |                            |        |   |   |   |                       |
| 89  |                            |           |                            |        |   |   |   |                       |
| 90  |                            |           |                            |        |   |   |   | Cylinder Segment Volu |
| 91  |                            |           |                            |        |   |   |   | (Degraded DHLW)       |
| 92  |                            |           |                            |        |   |   |   |                       |
| 93  | g                          |           | 0.75                       |        |   |   |   | Geometry Calculations |
| 94  |                            |           |                            | g      |   |   |   | Cylinder Radius (R)   |
| 95  |                            |           | 7.9004E+00                 | g/cm^3 |   |   |   | Cylinder Length       |
| 96  |                            |           | 0.00E+00                   | g      |   |   |   | Cylinder Volume       |
| 97  | D3+Fe2O3                   |           | 4.06069E+00                | g/cm^3 |   |   |   | Segment Volume        |
| 98  | Fe2O3                      |           | 8.12355E+05                | g      |   |   |   | Target Cell           |
| 99  |                            |           | 8.00000E-01                |        |   |   |   | Dis. from Center (y1) |
| 100 | D3+Void Used               |           | 8.12138E-01                | g/cm^3 |   |   |   |                       |
| 101 | D2O3+Fe2O3+Void            |           | 1.00027E+06                | cm^3   |   |   |   |                       |
| 102 |                            |           |                            |        |   |   |   |                       |

|     | I                          | J         | K                          | L | M | N | O                     | P            |  |
|-----|----------------------------|-----------|----------------------------|---|---|---|-----------------------|--------------|--|
| 103 |                            |           |                            |   |   |   | Layer of MIT Fuel and |              |  |
| 104 |                            |           |                            |   |   |   |                       |              |  |
| 105 |                            |           |                            |   |   |   | 1/2 Cylinder Volume   |              |  |
| 106 |                            |           |                            |   |   |   | Segment - 1/2 Cylin.  |              |  |
| 107 | h (Degraded MIT Fuel)      |           |                            |   |   |   |                       | Layer Volume |  |
| 108 | WT                         | MCNP      | Atomic Density (#/barn cm) |   |   |   | Target Cell           |              |  |
| 109 | 235.0439                   | 92235.50C | 6.3231E-05                 |   |   |   | Dis from Center (y2)  |              |  |
| 110 | 234.0409                   | 92234.50C | 6.7916E-07                 |   |   |   |                       |              |  |
| 111 | 238.0508                   | 92238.50C | 3.6725E-06                 |   |   |   |                       |              |  |
| 112 | 26.98154                   | 13027.50C | 9.2426E-03                 |   |   |   |                       |              |  |
| 113 | 55.847                     | 26000.55C | 0.0000E+00                 |   |   |   |                       |              |  |
| 114 | 15.99492                   | 8016.50C  | 4.0769E-02                 |   |   |   |                       |              |  |
| 115 | 1.007825                   | 1001.50C  | 5.3118E-02                 |   |   |   |                       |              |  |
| 116 |                            | 64152.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 117 |                            | 64154.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 118 |                            | 64155.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 119 |                            | 64156.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 120 |                            | 64157.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 121 |                            | 64158.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 122 |                            | 64160.50C | 0.0000E+00                 |   |   |   |                       |              |  |
| 123 |                            |           | 1.0320E-01                 |   |   |   |                       |              |  |
| 124 |                            |           |                            |   |   |   |                       |              |  |
| 125 |                            |           | 840.0622649                |   |   |   |                       |              |  |
| 126 |                            |           |                            |   |   |   |                       |              |  |
| 127 |                            |           |                            |   |   |   |                       |              |  |
| 128 | Fe2O3, Void Fraction 0.85) |           |                            |   |   |   |                       | Degraded     |  |
| 129 |                            |           |                            |   |   |   |                       |              |  |
| 130 |                            |           |                            |   |   |   |                       |              |  |
| 131 |                            |           |                            |   |   |   | Cylinder Segment Volu |              |  |
| 132 |                            |           |                            |   |   |   | (Degraded DHLW)       |              |  |
| 133 |                            |           |                            |   |   |   |                       |              |  |
| 134 | g                          |           | 0.75                       |   |   |   | Geometry Calculations |              |  |
| 135 |                            |           | 0 g                        |   |   |   | Cylinder Radius (R)   |              |  |
| 136 |                            |           | 7.9004E+00 g/cm^3          |   |   |   | Cylinder Length       |              |  |
| 137 |                            |           | 0.00E+00 g                 |   |   |   | Cylinder Volume       |              |  |
| 138 | D3+Fe2O3                   |           | 4.06069E+00 g/cm^3         |   |   |   | Segment Volume        |              |  |
| 139 | Fe2O3                      |           | 8.12355E+05 g              |   |   |   | Target Cell           |              |  |
| 140 |                            |           | 8.50000E-01                |   |   |   | Dis. from Center (y1) |              |  |
| 141 | D3+Void Used               |           | 6.09104E-01 g/cm^3         |   |   |   |                       |              |  |
| 142 | D3+Fe2O3+Void              |           | 1.33369E+06 cm^3           |   |   |   |                       |              |  |
| 143 |                            |           |                            |   |   |   |                       |              |  |
| 144 |                            |           |                            |   |   |   | Layer of MIT Fuel and |              |  |
| 145 |                            |           |                            |   |   |   |                       |              |  |
| 146 |                            |           |                            |   |   |   | 1/2 Cylinder Volume   |              |  |
| 147 |                            |           |                            |   |   |   | Segment - 1/2 Cylin.  |              |  |
| 148 | h (Degraded MIT Fuel)      |           |                            |   |   |   |                       | Layer Volume |  |
| 149 | WT                         | MCNP      | Atomic Density (#/barn cm) |   |   |   | Target Cell           |              |  |
| 150 | 235.0439                   | 92235.50C | 4.7423E-05                 |   |   |   | Dis from Center (y2)  |              |  |
| 151 | 234.0409                   | 92234.50C | 5.0937E-07                 |   |   |   |                       |              |  |
| 152 | 238.0508                   | 92238.50C | 2.7544E-06                 |   |   |   |                       |              |  |
| 153 | 26.98154                   | 13027.50C | 6.9319E-03                 |   |   |   |                       |              |  |

|     | I                         | J         | K                          | L      | M | N                    | O                       | P |  |
|-----|---------------------------|-----------|----------------------------|--------|---|----------------------|-------------------------|---|--|
| 154 | 55.847                    | 26000.55C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 155 | 15.99492                  | 8016.50C  | 3.8944E-02                 |        |   |                      |                         |   |  |
| 156 | 1.007825                  | 1001.50C  | 5.6438E-02                 |        |   |                      |                         |   |  |
| 157 |                           | 64152.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 158 |                           | 64154.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 159 |                           | 64155.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 160 |                           | 64156.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 161 |                           | 64157.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 162 |                           | 64158.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 163 |                           | 64160.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 164 |                           |           | 1.0236E-01                 |        |   |                      |                         |   |  |
| 165 |                           |           |                            |        |   |                      |                         |   |  |
| 166 |                           |           | 1190.088209                |        |   |                      |                         |   |  |
| 167 |                           |           |                            |        |   |                      |                         |   |  |
| 168 |                           |           |                            |        |   |                      |                         |   |  |
| 169 | Fe2O3, Void Fraction 0.9) |           |                            |        |   |                      | Degraded                |   |  |
| 170 |                           |           |                            |        |   |                      |                         |   |  |
| 171 |                           |           |                            |        |   |                      |                         |   |  |
| 172 |                           |           |                            |        |   |                      | Cylinder Segment Volume |   |  |
| 173 |                           |           |                            |        |   |                      | (Degraded DHLW)         |   |  |
| 174 |                           |           |                            |        |   |                      |                         |   |  |
| 175 | g                         |           | 0.75                       |        |   |                      | Geometry Calculations   |   |  |
| 176 |                           |           | g                          |        |   |                      | Cylinder Radius (R)     |   |  |
| 177 |                           |           | 7.9004E+00                 | g/cm^3 |   |                      | Cylinder Length         |   |  |
| 178 |                           |           | 0.00E+00                   | g      |   |                      | Cylinder Volume         |   |  |
| 179 | D3+Fe2O3                  |           | 4.06069E+00                | g/cm^3 |   |                      | Segment Volume          |   |  |
| 180 | Fe2O3                     |           | 8.12355E+05                | g      |   |                      | Target Cell             |   |  |
| 181 |                           |           | 9.00000E-01                |        |   |                      | Dis. from Center (y1)   |   |  |
| 182 | 3+Void Used               |           | 4.06069E-01                | g/cm^3 |   |                      |                         |   |  |
| 183 | D3+Fe2O3+Void             |           | 2.00053E+06                | cm^3   |   |                      |                         |   |  |
| 184 |                           |           |                            |        |   |                      |                         |   |  |
| 185 |                           |           |                            |        |   |                      | Layer of MIT Fuel and   |   |  |
| 186 |                           |           |                            |        |   |                      |                         |   |  |
| 187 |                           |           |                            |        |   |                      | 1/2 Cylinder Volume     |   |  |
| 188 |                           |           |                            |        |   |                      | Segment - 1/2 Cylin.    |   |  |
| 189 | h (Degraded MIT Fuel)     |           |                            |        |   |                      | Layer Volume            |   |  |
| 190 | WT                        | MCNP      | Atomic Density (#/barn cm) |        |   | Target Cell          |                         |   |  |
| 191 | 235.0439                  | 92235.50C | 3.1615E-05                 |        |   | Dis from Center (y2) |                         |   |  |
| 192 | 234.0409                  | 92234.50C | 3.3958E-07                 |        |   |                      |                         |   |  |
| 193 | 238.0508                  | 92238.50C | 1.8362E-06                 |        |   |                      |                         |   |  |
| 194 | 26.98154                  | 13027.50C | 4.6213E-03                 |        |   |                      |                         |   |  |
| 195 | 55.847                    | 26000.55C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 196 | 15.99492                  | 8016.50C  | 3.7119E-02                 |        |   |                      |                         |   |  |
| 197 | 1.007825                  | 1001.50C  | 5.9757E-02                 |        |   |                      |                         |   |  |
| 198 |                           | 64152.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 199 |                           | 64154.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 200 |                           | 64155.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 201 |                           | 64156.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 202 |                           | 64157.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 203 |                           | 64158.50C | 0.0000E+00                 |        |   |                      |                         |   |  |
| 204 |                           | 64160.50C | 0.0000E+00                 |        |   |                      |                         |   |  |

Fe\_gd

|     | I | J | K           | L | M | N | O | P                       |
|-----|---|---|-------------|---|---|---|---|-------------------------|
| 205 |   |   | 1.0153E-01  |   |   |   |   |                         |
| 206 |   |   |             |   |   |   |   |                         |
| 207 |   |   | 1890.140096 |   |   |   |   |                         |
| 208 |   |   |             |   |   |   |   |                         |
| 209 |   |   |             |   |   |   |   |                         |
| 210 |   |   |             |   |   |   |   | Degraded                |
| 211 |   |   |             |   |   |   |   |                         |
| 212 |   |   |             |   |   |   |   |                         |
| 213 |   |   |             |   |   |   |   | Cylinder Segment Volume |
| 214 |   |   |             |   |   |   |   | (Degraded DHLW)         |
| 215 |   |   |             |   |   |   |   |                         |
| 216 |   |   |             |   |   |   |   | Geometry Calculations   |
| 217 |   |   |             |   |   |   |   | Cylinder Radius (R)     |
| 218 |   |   |             |   |   |   |   | Cylinder Length         |
| 219 |   |   |             |   |   |   |   | Cylinder Volume         |
| 220 |   |   |             |   |   |   |   | Segment Volume          |
| 221 |   |   |             |   |   |   |   | Target Cell             |
| 222 |   |   |             |   |   |   |   | Dis. from Center (y1)   |
| 223 |   |   |             |   |   |   |   |                         |
| 224 |   |   |             |   |   |   |   |                         |
| 225 |   |   |             |   |   |   |   |                         |
| 226 |   |   |             |   |   |   |   | Layer of MIT Fuel and   |
| 227 |   |   |             |   |   |   |   |                         |
| 228 |   |   |             |   |   |   |   | 1/2 Cylinder Volume     |
| 229 |   |   |             |   |   |   |   | Segment - 1/2 Cylin.    |
| 230 |   |   |             |   |   |   |   | Layer Volume            |
| 231 |   |   |             |   |   |   |   | Target Cell             |
| 232 |   |   |             |   |   |   |   | Dis from Center (y2)    |
| 233 |   |   |             |   |   |   |   |                         |
| 234 |   |   |             |   |   |   |   |                         |
| 235 |   |   |             |   |   |   |   |                         |
| 236 |   |   |             |   |   |   |   |                         |
| 237 |   |   |             |   |   |   |   |                         |
| 238 |   |   |             |   |   |   |   |                         |
| 239 |   |   |             |   |   |   |   |                         |
| 240 |   |   |             |   |   |   |   |                         |
| 241 |   |   |             |   |   |   |   |                         |
| 242 |   |   |             |   |   |   |   |                         |
| 243 |   |   |             |   |   |   |   |                         |
| 244 |   |   |             |   |   |   |   |                         |
| 245 |   |   |             |   |   |   |   |                         |
| 246 |   |   |             |   |   |   |   |                         |
| 247 |   |   |             |   |   |   |   |                         |
| 248 |   |   |             |   |   |   |   |                         |

Fe\_gd

|    | Q  | R    | S | T | U  | V           | W        | X                    |
|----|--|------|---|---|--|-------------|----------|----------------------|
| 1  |  |      |   |   |  |             |          |                      |
| 2  |  |      |   |   |  |             |          |                      |
| 3  |  |      |   |   |  |             |          |                      |
| 4  |  |      |   |   |  |             |          |                      |
| 5  | <b>MIT Fuel On Top of Degraded DHLW Clay ( 120 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |   |  |             |          |                      |
| 6  |  |      |   |   |  |             |          |                      |
| 7  |  |      |   |   |  |             |          |                      |
| 8  | Time Calculation   |      |   |   | Degraded MIT Fuel                              |             |          |                      |
| 9  |  |      |   |   |  |             |          |                      |
| 10 |  |      |   |   |  |             |          |                      |
| 11 |  |      |   |   | Fraction of UO2 Remaining                      |             |          | 0.75                 |
| 12 | 86.5   | cm   |   |   | Mass of Gd                                     |             |          | 20                   |
| 13 | 304  | cm   |   |   | Density of Gd                                  |             |          | 7.9004E+00           |
| 14 | 7.14588E+06  | cm^3 |   |   | Mass of Fe2O3                                  |             |          | 0.00E+00             |
| 15 | 4.99330E+06  | cm^3 |   |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          | 4.06098E+00          |
| 16 | 4.99330E+06  |      |   |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          | 8.12475E+05          |
| 17 | 2.74765E+01  | cm   |   |   | Void Fraction                                  |             |          | 8.00000E-01          |
| 18 |  |      |   |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          | 8.12197E-01          |
| 19 |  |      |   |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          | 1.00034E+06          |
| 20 |  |      |   |   |  |             |          |                      |
| 21 | Others   |      |   |   |  |             |          |                      |
| 22 |  |      |   |   |  |             |          |                      |
| 23 | 3.57294E+06  | cm^3 |   |   |  |             |          |                      |
| 24 | 1.42036E+06  | cm^3 |   |   |  |             |          |                      |
| 25 | 1.00034E+06  | cm^3 |   |   | Atomic Density Calculation (Degraded MIT Fuel) |             |          |                      |
| 26 | 1.00034E+06  |      |   |   | Mass(g)  | WT          | MCNP     | Atomic Density       |
| 27 | 4.87478E+01  | cm   |   |   | U-235  | 24684       | 235.0439 | 92235.50C 6.3226E-05 |
| 28 |  |      |   |   | U-234  | 264         | 234.0409 | 92234.50C 6.7911E-07 |
| 29 |  |      |   |   | U-238  | 1452        | 238.0508 | 92238.50C 3.6722E-06 |
| 30 |  |      |   |   | Al   | 4.14E+05    | 26.98154 | 13027.50C 9.2419E-03 |
| 31 |  |      |   |   | Fe   | 0.00E+00    | 55.847   | 26000.55C 0.0000E+00 |
| 32 |  |      |   |   | O  | 1.08E+06    | 15.99492 | 8016.50C 4.0768E-02  |
| 33 |  |      |   |   | H  | 8.89E+04    | 1.007825 | 1001.50C 5.3118E-02  |
| 34 |  |      |   |   | Gd-152   |             |          | 64152.50C 9.1886E-10 |
| 35 |  |      |   |   | Gd-154   |             |          | 64154.50C 1.0016E-08 |
| 36 |  |      |   |   | Gd-155   |             |          | 64155.50C 6.7996E-08 |
| 37 |  |      |   |   | Gd-156   |             |          | 64156.50C 9.4046E-08 |
| 38 |  |      |   |   | Gd-157   |             |          | 64157.50C 7.1901E-08 |
| 39 |  |      |   |   | Gd-158   |             |          | 64158.50C 1.1412E-07 |
| 40 |  |      |   |   | Gd-160   |             |          | 64160.50C 1.0043E-07 |
| 41 |  |      |   |   | den (g/cm^                                     | 1.61220E+00 |          | 1.0320E-01           |
| 42 |  |      |   |   |  |             |          |                      |
| 43 |  |      |   |   | H/U-235 Ration                                 |             |          | 840.1260469          |
| 44 |  |      |   |   |  |             |          |                      |
| 45 |  |      |   |   |  |             |          |                      |
| 46 | <b>MIT Fuel On Top of Degraded DHLW Clay ( 100 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |   |  |             |          |                      |
| 47 |  |      |   |   |  |             |          |                      |
| 48 |  |      |   |   |  |             |          |                      |
| 49 | Time Calculation   |      |   |   | Degraded MIT Fuel                              |             |          |                      |
| 50 |  |      |   |   |  |             |          |                      |
| 51 |  |      |   |   |  |             |          |                      |

Fe\_gd

|     | Q  | R    | S | T  | U           | V        | W              | X           |
|-----|--|------|---|--|-------------|----------|----------------|-------------|
| 52  |  |      |   | Fraction of UO2 Remaining                      |             |          |                | 0.75        |
| 53  | 86.5   | cm   |   | Mass of Gd                                     |             |          |                | 80          |
| 54  | 304  | cm   |   | Density of Gd                                  |             |          |                | 7.9004E+00  |
| 55  | 7.14588E+06  | cm^3 |   | Mass of Fe2O3                                  |             |          |                | 0.00E+00    |
| 56  | 4.99330E+06  | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |                | 4.06094E+00 |
| 57  | 4.99330E+06  |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |                | 8.12455E+05 |
| 58  | 2.74765E+01  | cm   |   | Void Fraction                                  |             |          |                | 8.00000E-01 |
| 59  |  |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |                | 8.12187E-01 |
| 60  |  |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |                | 1.00033E+06 |
| 61  |  |      |   |  |             |          |                |             |
| 62  | Others   |      |   |  |             |          |                |             |
| 63  |  |      |   |  |             |          |                |             |
| 64  | 3.57294E+06  | cm^3 |   |  |             |          |                |             |
| 65  | 1.42036E+06  | cm^3 |   |  |             |          |                |             |
| 66  | 1.00033E+06  | cm^3 |   | Atomic Density Calculation (Degraded MIT Fuel) |             |          |                |             |
| 67  | 1.00033E+06  |      |   | Mass(g)  | WT          | MCNP     | Atomic Density |             |
| 68  | 4.87476E+01  | cm   |   | U-235  | 24684       | 235.0439 | 92235.50C      | 6.3227E-05  |
| 69  |  |      |   | U-234  | 264         | 234.0409 | 92234.50C      | 6.7912E-07  |
| 70  |  |      |   | U-238  | 1452        | 238.0508 | 92238.50C      | 3.6722E-06  |
| 71  |  |      |   | Al   | 4.14E+05    | 26.98154 | 13027.50C      | 9.2420E-03  |
| 72  |  |      |   | Fe   | 0.00E+00    | 55.847   | 26000.55C      | 0.0000E+00  |
| 73  |  |      |   | O  | 1.08E+06    | 15.99492 | 8016.50C       | 4.0768E-02  |
| 74  |  |      |   | H  | 8.89E+04    | 1.007825 | 1001.50C       | 5.3118E-02  |
| 75  |  |      |   | Gd-152   |             |          | 64152.50C      | 7.6573E-10  |
| 76  |  |      |   | Gd-154   |             |          | 64154.50C      | 8.3464E-09  |
| 77  |  |      |   | Gd-155   |             |          | 64155.50C      | 5.6664E-08  |
| 78  |  |      |   | Gd-156   |             |          | 64156.50C      | 7.8372E-08  |
| 79  |  |      |   | Gd-157   |             |          | 64157.50C      | 5.9918E-08  |
| 80  |  |      |   | Gd-158   |             |          | 64158.50C      | 9.5103E-08  |
| 81  |  |      |   | Gd-160   |             |          | 64160.50C      | 8.3694E-08  |
| 82  |  |      |   | den (g/cm^3)                                   | 1.61219E+00 |          |                | 1.0320E-01  |
| 83  |  |      |   |  |             |          |                |             |
| 84  |  |      |   | H/U-235 Ratio                                  |             |          |                | 840.1154166 |
| 85  |  |      |   |  |             |          |                |             |
| 86  |  |      |   |  |             |          |                |             |
| 87  | MIT Fuel On Top of Degraded DHLW Clay ( 80 g of Gd, 0 g of Fe2O3, Void Fraction 0.8) |      |   |  |             |          |                |             |
| 88  |  |      |   |  |             |          |                |             |
| 89  |  |      |   |  |             |          |                |             |
| 90  | Time Calculation   |      |   | Degraded MIT Fuel                              |             |          |                |             |
| 91  |  |      |   |  |             |          |                |             |
| 92  |  |      |   |  |             |          |                |             |
| 93  |  |      |   | Fraction of UO2 Remaining                      |             |          |                | 0.75        |
| 94  | 86.5   | cm   |   | Mass of Gd                                     |             |          |                | 80          |
| 95  | 304  | cm   |   | Density of Gd                                  |             |          |                | 7.9004E+00  |
| 96  | 7.14588E+06  | cm^3 |   | Mass of Fe2O3                                  |             |          |                | 0.00E+00    |
| 97  | 4.99330E+06  | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |                | 4.06089E+00 |
| 98  | 4.99330E+06  |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |                | 8.12435E+05 |
| 99  | 2.74765E+01  | cm   |   | Void Fraction                                  |             |          |                | 8.00000E-01 |
| 100 |  |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |                | 8.12177E-01 |
| 101 |  |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |                | 1.00032E+06 |
| 102 |  |      |   |  |             |          |                |             |

Fe\_gd

|     | Q  | R    | S  | T           | U        | V         | W              | X           |  |
|-----|--|------|--|-------------|----------|-----------|----------------|-------------|--|
| 103 | Others   |      |  |             |          |           |                |             |  |
| 104 |  |      |  |             |          |           |                |             |  |
| 105 | 3.57294E+06  | cm^3 |  |             |          |           |                |             |  |
| 106 | 1.42036E+06  | cm^3 |  |             |          |           |                |             |  |
| 107 | 1.00032E+06  | cm^3 | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |                |             |  |
| 108 | 1.00032E+06  |      |  | Mass(g)     | WT       | MCNP      | Atomic Density |             |  |
| 109 | 4.87474E+01  | cm   | U-235  | 24684       | 235.0439 | 92235.50C | 6.3227E-05     |             |  |
| 110 |  |      | U-234  | 264         | 234.0409 | 92234.50C | 6.7913E-07     |             |  |
| 111 |  |      | U-238  | 1452        | 238.0508 | 92238.50C | 3.6723E-06     |             |  |
| 112 |  |      | Al   | 4.14E+05    | 26.98154 | 13027.50C | 9.2421E-03     |             |  |
| 113 |  |      | Fe   | 0.00E+00    | 55.847   | 26000.55C | 0.0000E+00     |             |  |
| 114 |  |      | O  | 1.08E+06    | 15.99492 | 8016.50C  | 4.0769E-02     |             |  |
| 115 |  |      | H  | 8.89E+04    | 1.007825 | 1001.50C  | 5.3118E-02     |             |  |
| 116 |  |      | Gd-152   |             |          | 64152.50C | 6.1259E-10     |             |  |
| 117 |  |      | Gd-154   |             |          | 64154.50C | 6.6772E-09     |             |  |
| 118 |  |      | Gd-155   |             |          | 64155.50C | 4.5332E-08     |             |  |
| 119 |  |      | Gd-156   |             |          | 64156.50C | 6.2699E-08     |             |  |
| 120 |  |      | Gd-157   |             |          | 64157.50C | 4.7935E-08     |             |  |
| 121 |  |      | Gd-158   |             |          | 64158.50C | 7.6084E-08     |             |  |
| 122 |  |      | Gd-160   |             |          | 64160.50C | 6.6956E-08     |             |  |
| 123 |  |      | den (g/cm^                                     | 1.61218E+00 |          |           | 1.0320E-01     |             |  |
| 124 |  |      |  |             |          |           |                |             |  |
| 125 |  |      | H/U-235 Ration                                 | 840.1047863 |          |           |                |             |  |
| 126 |  |      |  |             |          |           |                |             |  |
| 127 |  |      |  |             |          |           |                |             |  |
| 128 | MIT Fuel On Top of Degraded DHLW Clay ( 60 g of Gd, 0 g of Fe2O3, Void Fraction 0.8) |      |  |             |          |           |                |             |  |
| 129 |  |      |  |             |          |           |                |             |  |
| 130 |  |      |  |             |          |           |                |             |  |
| 131 | Time Calculation   |      | Degraded MIT Fuel                              |             |          |           |                |             |  |
| 132 |  |      |  |             |          |           |                |             |  |
| 133 |  |      |  |             |          |           |                |             |  |
| 134 |  |      | Fraction of UO2 Remaining                      |             |          |           |                | 0.75        |  |
| 135 | 86.5   | cm   | Mass of Gd                                     |             |          |           |                | 60          |  |
| 136 | 304  | cm   | Density of Gd                                  |             |          |           |                | 7.9004E+00  |  |
| 137 | 7.14588E+06  | cm^3 | Mass of Fe2O3                                  |             |          |           |                | 0.00E+00    |  |
| 138 | 4.99330E+06  | cm^3 | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           |                | 4.06084E+00 |  |
| 139 | 4.99330E+06  |      | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           |                | 8.12415E+05 |  |
| 140 | 2.74765E+01  | cm   | Void Fraction                                  |             |          |           |                | 8.00000E-01 |  |
| 141 |  |      | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           |                | 8.12168E-01 |  |
| 142 |  |      | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           |                | 1.00030E+06 |  |
| 143 |  |      |  |             |          |           |                |             |  |
| 144 | Others   |      |  |             |          |           |                |             |  |
| 145 |  |      |  |             |          |           |                |             |  |
| 146 | 3.57294E+06  | cm^3 |  |             |          |           |                |             |  |
| 147 | 1.42036E+06  | cm^3 |  |             |          |           |                |             |  |
| 148 | 1.00030E+06  | cm^3 | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |                |             |  |
| 149 | 1.00030E+06  |      |  | Mass(g)     | WT       | MCNP      | Atomic Density |             |  |
| 150 | 4.87470E+01  | cm   | U-235  | 24684       | 235.0439 | 92235.50C | 6.3228E-05     |             |  |
| 151 |  |      | U-234  | 264         | 234.0409 | 92234.50C | 6.7914E-07     |             |  |
| 152 |  |      | U-238  | 1452        | 238.0508 | 92238.50C | 3.6723E-06     |             |  |
| 153 |  |      | Al   | 4.14E+05    | 26.98154 | 13027.50C | 9.2422E-03     |             |  |

Fe\_gd

|     | Q   | R    | S | T  | U           | V        | W         | X              |
|-----|---|------|---|--|-------------|----------|-----------|----------------|
| 154 |   |      |   | Fe   | 0.00E+00    | 55.847   | 26000.55C | 0.0000E+00     |
| 155 |   |      |   | O  | 1.08E+06    | 15.99492 | 8016.50C  | 4.0769E-02     |
| 156 |   |      |   | H  | 8.89E+04    | 1.007825 | 1001.50C  | 5.3118E-02     |
| 157 |   |      |   | Gd-152   |             |          | 64152.50C | 4.5945E-10     |
| 158 |   |      |   | Gd-154   |             |          | 64154.50C | 5.0080E-09     |
| 159 |   |      |   | Gd-155   |             |          | 64155.50C | 3.3999E-08     |
| 160 |   |      |   | Gd-156   |             |          | 64156.50C | 4.7025E-08     |
| 161 |   |      |   | Gd-157   |             |          | 64157.50C | 3.5952E-08     |
| 162 |   |      |   | Gd-158   |             |          | 64158.50C | 5.7063E-08     |
| 163 |   |      |   | Gd-160   |             |          | 64160.50C | 5.0218E-08     |
| 164 |   |      |   | den (g/cm^                                     | 1.61217E+00 |          |           | 1.0320E-01     |
| 165 |   |      |   |  |             |          |           |                |
| 166 |   |      |   | H/U-235 Ration                                 |             |          |           | 840.0941559    |
| 167 |   |      |   |  |             |          |           |                |
| 168 |   |      |   |  |             |          |           |                |
| 169 | <b>MIT Fuel On Top of Degraded DHLW Clay ( 40 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)</b> |      |   |  |             |          |           |                |
| 170 |   |      |   |  |             |          |           |                |
| 171 |   |      |   |  |             |          |           |                |
| 172 | Time Calculation  |      |   | Degraded MIT Fuel                              |             |          |           |                |
| 173 |   |      |   |  |             |          |           |                |
| 174 |   |      |   |  |             |          |           |                |
| 175 |   |      |   | Fraction of UO2 Remaining                      |             |          |           | 0.75           |
| 176 | 86.5  | cm   |   | Mass of Gd                                     |             |          |           | 40             |
| 177 | 304   | cm   |   | Density of Gd                                  |             |          |           | 7.9004E+00     |
| 178 | 7.14588E+06   | cm^3 |   | Mass of Fe2O3                                  |             |          |           | 0.00E+00       |
| 179 | 4.99330E+06   | cm^3 |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |           | 4.06079E+00    |
| 180 | 4.99330E+06   |      |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |           | 8.12395E+05    |
| 181 | 2.74765E+01   | cm   |   | Void Fraction                                  |             |          |           | 8.00000E-01    |
| 182 |   |      |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |           | 8.12158E-01    |
| 183 |   |      |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |           | 1.00029E+06    |
| 184 |   |      |   |  |             |          |           |                |
| 185 | Others  |      |   |  |             |          |           |                |
| 186 |   |      |   |  |             |          |           |                |
| 187 | 3.57294E+06   | cm^3 |   |  |             |          |           |                |
| 188 | 1.42036E+06   | cm^3 |   |  |             |          |           |                |
| 189 | 1.00029E+06   | cm^3 |   | Atomic Density Calculation (Degraded MIT Fuel) |             |          |           |                |
| 190 | 1.00029E+06   |      |   | Mass(g)  | WT          | MCNP     |           | Atomic Density |
| 191 | 4.87466E+01   | cm   |   | U-235  | 24684       | 235.0439 | 92235.50C | 6.3229E-05     |
| 192 |   |      |   | U-234  | 264         | 234.0409 | 92234.50C | 6.7914E-07     |
| 193 |   |      |   | U-238  | 1452        | 238.0508 | 92238.50C | 3.6724E-06     |
| 194 |   |      |   | Al   | 4.14E+05    | 26.98154 | 13027.50C | 9.2424E-03     |
| 195 |   |      |   | Fe   | 0.00E+00    | 55.847   | 26000.55C | 0.0000E+00     |
| 196 |   |      |   | O  | 1.08E+06    | 15.99492 | 8016.50C  | 4.0769E-02     |
| 197 |   |      |   | H  | 8.89E+04    | 1.007825 | 1001.50C  | 5.3118E-02     |
| 198 |   |      |   | Gd-152   |             |          | 64152.50C | 3.0630E-10     |
| 199 |   |      |   | Gd-154   |             |          | 64154.50C | 3.3387E-09     |
| 200 |   |      |   | Gd-155   |             |          | 64155.50C | 2.2666E-08     |
| 201 |   |      |   | Gd-156   |             |          | 64156.50C | 3.1350E-08     |
| 202 |   |      |   | Gd-157   |             |          | 64157.50C | 2.3968E-08     |
| 203 |   |      |   | Gd-158   |             |          | 64158.50C | 3.8043E-08     |
| 204 |   |      |   | Gd-160   |             |          | 64160.50C | 3.3479E-08     |



Fe\_gd

|     | Q  | R | S | T  | U           | V        | W              | X           |
|-----|--|---|---|--|-------------|----------|----------------|-------------|
| 205 |  |   |   | den (g/cm^                                     | 1.61216E+00 |          |                | 1.0320E-01  |
| 206 |  |   |   |  |             |          |                |             |
| 207 |  |   |   | H/U-235 Ration                                 |             |          |                | 840.0835256 |
| 208 |  |   |   |  |             |          |                |             |
| 209 |  |   |   |  |             |          |                |             |
| 210 | MIT Fuel On Top of Degraded DHLW Clay ( 20 g of Gd, 0 g of Fe2O3, Void Fraction 0.8) |   |   |  |             |          |                |             |
| 211 |  |   |   |  |             |          |                |             |
| 212 |  |   |   |  |             |          |                |             |
| 213 | Time Calculation   |   |   | Degraded MIT Fuel                              |             |          |                |             |
| 214 |  |   |   |  |             |          |                |             |
| 215 |  |   |   |  |             |          |                |             |
| 216 |  |   |   | Fraction of UO2 Remaining                      |             |          |                | 0.75        |
| 217 | 86.5 cm  |   |   | Mass of Gd                                     |             |          |                | 20          |
| 218 | 304 cm   |   |   | Density of Gd                                  |             |          |                | 7.9004E+00  |
| 219 | 7.14588E+06 cm^3   |   |   | Mass of Fe2O3                                  |             |          |                | 0.00E+00    |
| 220 | 4.99330E+06 cm^3   |   |   | Nominal Den of UO2+Al2O3+Fe2O3                 |             |          |                | 4.06074E+00 |
| 221 | 4.99330E+06  |   |   | Total Mas of UO2+Al2O3+Fe2O3                   |             |          |                | 8.12375E+05 |
| 222 | 2.74765E+01 cm   |   |   | Void Fraction                                  |             |          |                | 8.00000E-01 |
| 223 |  |   |   | Den of UO2+Al2O3+Fe2O3+Void Used               |             |          |                | 8.12148E-01 |
| 224 |  |   |   | Vol. Occupied by UO2+Al2O3+Fe2O3+Void          |             |          |                | 1.00028E+06 |
| 225 |  |   |   |  |             |          |                |             |
| 226 | Others   |   |   |  |             |          |                |             |
| 227 |  |   |   |  |             |          |                |             |
| 228 | 3.57294E+06 cm^3   |   |   |  |             |          |                |             |
| 229 | 1.42036E+06 cm^3   |   |   |  |             |          |                |             |
| 230 | 1.00028E+06 cm^3   |   |   | Atomic Density Calculation (Degraded MIT Fuel) |             |          |                |             |
| 231 | 1.00028E+06  |   |   | Mass(g)  | WT          | MCNP     | Atomic Density |             |
| 232 | 3.67464E+01 cm   |   |   | U-235  | 24684       | 235.0439 | 92235.50C      | 6.3230E-05  |
| 233 |  |   |   | U-234  | 264         | 234.0409 | 92234.50C      | 6.7915E-07  |
| 234 |  |   |   | U-238  | 1452        | 238.0508 | 92238.50C      | 3.6724E-06  |
| 235 |  |   |   | Al   | 4.14E+05    | 26.98154 | 13027.50C      | 9.2425E-03  |
| 236 |  |   |   | Fe   | 0.00E+00    | 55.847   | 26000.55C      | 0.0000E+00  |
| 237 |  |   |   | O  | 1.08E+06    | 15.99492 | 8016.50C       | 4.0769E-02  |
| 238 |  |   |   | H  | 8.89E+04    | 1.007825 | 1001.50C       | 5.3118E-02  |
| 239 |  |   |   | Gd-152   |             |          | 64152.50C      | 1.5315E-10  |
| 240 |  |   |   | Gd-154   |             |          | 64154.50C      | 1.6694E-09  |
| 241 |  |   |   | Gd-155   |             |          | 64155.50C      | 1.1333E-08  |
| 242 |  |   |   | Gd-156   |             |          | 64156.50C      | 1.5675E-08  |
| 243 |  |   |   | Gd-157   |             |          | 64157.50C      | 1.1984E-08  |
| 244 |  |   |   | Gd-158   |             |          | 64158.50C      | 1.9022E-08  |
| 245 |  |   |   | Gd-160   |             |          | 64160.50C      | 1.6740E-08  |
| 246 |  |   |   | den (g/cm^                                     | 1.61215E+00 |          |                | 1.0320E-01  |
| 247 |  |   |   |  |             |          |                |             |
| 248 |  |   |   | H/U-235 Ration                                 |             |          |                | 840.0728953 |

Fe\_gd

|    | Y           | Z | AA | AB | AC | AD          | AE   | AF | AG   |
|----|-------------|---|----|----|----|-------------|------|----|--|
| 1  |             |   |    |    |    |             |      |    |  |
| 2  |             |   |    |    |    |             |      |    |  |
| 3  |             |   |    |    |    |             |      |    |  |
| 4  |             |   |    |    |    |             |      |    |  |
| 5  |             |   |    |    |    |             |      |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 12</b> |
| 6  |             |   |    |    |    |             |      |    |  |
| 7  |             |   |    |    |    |             |      |    |  |
| 8  |             |   |    |    |    |             |      |    | Cylinder Segment Volume Calculation                        |
| 9  |             |   |    |    |    |             |      |    | (Degraded DHLW)  |
| 10 |             |   |    |    |    |             |      |    |  |
| 11 |             |   |    |    |    |             |      |    | Geometry Calculations                                      |
| 12 | g           |   |    |    |    | 86.5        | cm   |    | Fraction of  |
| 13 | g/cm^3      |   |    |    |    | 304         | cm   |    | Mass of Gd   |
| 14 | g           |   |    |    |    | 7.14588E+06 | cm^3 |    | Density of   |
| 15 | g/cm^3      |   |    |    |    | 4.99330E+06 | cm^3 |    | Mass of Fe   |
| 16 | g           |   |    |    |    | 4.99330E+06 |      |    | Nominal D  |
| 17 |             |   |    |    |    | 2.74765E+01 | cm   |    | Total Mas  |
| 18 | g/cm^3      |   |    |    |    |             |      |    | Void Fracti  |
| 19 | cm^3        |   |    |    |    |             |      |    | Den of UO  |
| 20 |             |   |    |    |    |             |      |    | Vol. Occup   |
| 21 |             |   |    |    |    |             |      |    | Layer of MIT Fuel and Others                               |
| 22 |             |   |    |    |    |             |      |    |  |
| 23 |             |   |    |    |    | 3.57294E+06 | cm^3 |    |  |
| 24 |             |   |    |    |    | 1.42036E+06 | cm^3 |    |  |
| 25 |             |   |    |    |    | 1.28193E+06 | cm^3 |    | Atomic Den   |
| 26 | (#/barn cm) |   |    |    |    | 1.28193E+06 |      |    |  |
| 27 |             |   |    |    |    | 5.54595E+01 | cm   |    | U-235  |
| 28 |             |   |    |    |    |             |      |    | U-234  |
| 29 |             |   |    |    |    |             |      |    | U-238  |
| 30 |             |   |    |    |    |             |      |    | Al   |
| 31 |             |   |    |    |    |             |      |    | Fe   |
| 32 |             |   |    |    |    |             |      |    | O  |
| 33 |             |   |    |    |    |             |      |    | H  |
| 34 |             |   |    |    |    |             |      |    | Gd-152   |
| 35 |             |   |    |    |    |             |      |    | Gd-154   |
| 36 |             |   |    |    |    |             |      |    | Gd-155   |
| 37 |             |   |    |    |    |             |      |    | Gd-156   |
| 38 |             |   |    |    |    |             |      |    | Gd-157   |
| 39 |             |   |    |    |    |             |      |    | Gd-158   |
| 40 |             |   |    |    |    |             |      |    | Gd-160   |
| 41 |             |   |    |    |    |             |      |    | den (g/cm^3)   |
| 42 |             |   |    |    |    |             |      |    |  |
| 43 |             |   |    |    |    |             |      |    | H/U-235 R  |
| 44 |             |   |    |    |    |             |      |    |  |
| 45 |             |   |    |    |    |             |      |    |  |
| 46 |             |   |    |    |    |             |      |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 10</b> |
| 47 |             |   |    |    |    |             |      |    |  |
| 48 |             |   |    |    |    |             |      |    |  |
| 49 |             |   |    |    |    |             |      |    | Cylinder Segment Volume Calculation                        |
| 50 |             |   |    |    |    |             |      |    | (Degraded DHLW)  |
| 51 |             |   |    |    |    |             |      |    | Degraded   |

Fe\_gd

|     | Y           | Z | AA | AB   | AC | AD               | AE | AF          | AG          |
|-----|-------------|---|----|--|----|------------------|----|-------------|-------------|
| 52  |             |   |    | Geometry Calculations                                      |    |                  |    |             | Fraction of |
| 53  | g           |   |    | Cylinder Radius (R)  |    | 86.5 cm          |    | Mass of Gd  |             |
| 54  | g/cm^3      |   |    | Cylinder Length  |    | 304 cm           |    | Density of  |             |
| 55  | g           |   |    | Cylinder Volume  |    | 7.14588E+06 cm^3 |    | Mass of Fe  |             |
| 56  | g/cm^3      |   |    | Segment Volume   |    | 4.99330E+06 cm^3 |    | Nominal D   |             |
| 57  | g           |   |    | Target Cell  |    | 4.99330E+06      |    | Total Mas   |             |
| 58  |             |   |    | Dis. from Center (y1)                                      |    | 2.74765E+01 cm   |    | Void Fracti |             |
| 59  | g/cm^3      |   |    |  |    |                  |    | Den of UO   |             |
| 60  | cm^3        |   |    |  |    |                  |    | Vol. Occup  |             |
| 61  |             |   |    |  |    |                  |    |             |             |
| 62  |             |   |    | Layer of MIT Fuel and Others                               |    |                  |    |             |             |
| 63  |             |   |    |  |    |                  |    |             |             |
| 64  |             |   |    | 1/2 Cylinder Volume  |    | 3.57294E+06 cm^3 |    |             |             |
| 65  |             |   |    | Segment - 1/2 Cylin.                                       |    | 1.42036E+06 cm^3 |    |             |             |
| 66  |             |   |    | Layer Volume   |    | 1.28192E+06 cm^3 |    | Atomic Der  |             |
| 67  | (#/barn cm) |   |    | Target Cell  |    | 1.28192E+06      |    |             |             |
| 68  |             |   |    | Dis from Center (y2)                                       |    | 5.54594E+01 cm   |    | U-235       |             |
| 69  |             |   |    |  |    |                  |    | U-234       |             |
| 70  |             |   |    |  |    |                  |    | U-238       |             |
| 71  |             |   |    |  |    |                  |    | Al          |             |
| 72  |             |   |    |  |    |                  |    | Fe          |             |
| 73  |             |   |    |  |    |                  |    | O           |             |
| 74  |             |   |    |  |    |                  |    | H           |             |
| 75  |             |   |    |  |    |                  |    | Gd-152      |             |
| 76  |             |   |    |  |    |                  |    | Gd-154      |             |
| 77  |             |   |    |  |    |                  |    | Gd-155      |             |
| 78  |             |   |    |  |    |                  |    | Gd-156      |             |
| 79  |             |   |    |  |    |                  |    | Gd-157      |             |
| 80  |             |   |    |  |    |                  |    | Gd-158      |             |
| 81  |             |   |    |  |    |                  |    | Gd-160      |             |
| 82  |             |   |    |  |    |                  |    | den (g/cm^  |             |
| 83  |             |   |    |  |    |                  |    |             |             |
| 84  |             |   |    |  |    |                  |    | H/U-235 R   |             |
| 85  |             |   |    |  |    |                  |    |             |             |
| 86  |             |   |    |  |    |                  |    |             |             |
| 87  |             |   |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 80</b> |    |                  |    |             |             |
| 88  |             |   |    |  |    |                  |    |             |             |
| 89  |             |   |    |  |    |                  |    |             |             |
| 90  |             |   |    | Cylinder Segment Volume Calculation                        |    |                  |    |             | Degraded    |
| 91  |             |   |    | (Degraded DHLW)  |    |                  |    |             |             |
| 92  |             |   |    |  |    |                  |    |             |             |
| 93  |             |   |    | Geometry Calculations                                      |    |                  |    |             | Fraction of |
| 94  | g           |   |    | Cylinder Radius (R)  |    | 86.5 cm          |    | Mass of Gd  |             |
| 95  | g/cm^3      |   |    | Cylinder Length  |    | 304 cm           |    | Density of  |             |
| 96  | g           |   |    | Cylinder Volume  |    | 7.14588E+06 cm^3 |    | Mass of Fe  |             |
| 97  | g/cm^3      |   |    | Segment Volume   |    | 4.99330E+06 cm^3 |    | Nominal D   |             |
| 98  | g           |   |    | Target Cell  |    | 4.99330E+06      |    | Total Mas   |             |
| 99  |             |   |    | Dis. from Center (y1)                                      |    | 2.74765E+01 cm   |    | Void Fracti |             |
| 100 | g/cm^3      |   |    |  |    |                  |    | Den of UO   |             |
| 101 | cm^3        |   |    |  |    |                  |    | Vol. Occup  |             |
| 102 |             |   |    |  |    |                  |    |             |             |

Fe\_gd

|     | Y           | Z | AA | AB   | AC | AD          | AE   | AF | AG           |  |
|-----|-------------|---|----|--|----|-------------|------|----|--------------|--|
| 103 |             |   |    | Layer of MIT Fuel and Others                               |    |             |      |    |              |  |
| 104 |             |   |    |  |    |             |      |    |              |  |
| 105 |             |   |    | 1/2 Cylinder Volume  |    | 3.57294E+06 | cm^3 |    |              |  |
| 106 |             |   |    | Segment - 1/2 Cylin.                                       |    | 1.42036E+06 | cm^3 |    |              |  |
| 107 |             |   |    | Layer Volume   |    | 1.28191E+06 | cm^3 |    | Atomic Den   |  |
| 108 | (#/barn cm) |   |    | Target Cell  |    | 1.28191E+06 |      |    |              |  |
| 109 |             |   |    | Dis from Center (y2)                                       |    | 5.54592E+01 | cm   |    | U-235        |  |
| 110 |             |   |    |  |    |             |      |    | U-234        |  |
| 111 |             |   |    |  |    |             |      |    | U-238        |  |
| 112 |             |   |    |  |    |             |      |    | Al           |  |
| 113 |             |   |    |  |    |             |      |    | Fe           |  |
| 114 |             |   |    |  |    |             |      |    | O            |  |
| 115 |             |   |    |  |    |             |      |    | H            |  |
| 116 |             |   |    |  |    |             |      |    | Gd-152       |  |
| 117 |             |   |    |  |    |             |      |    | Gd-154       |  |
| 118 |             |   |    |  |    |             |      |    | Gd-155       |  |
| 119 |             |   |    |  |    |             |      |    | Gd-156       |  |
| 120 |             |   |    |  |    |             |      |    | Gd-157       |  |
| 121 |             |   |    |  |    |             |      |    | Gd-158       |  |
| 122 |             |   |    |  |    |             |      |    | Gd-160       |  |
| 123 |             |   |    |  |    |             |      |    | den (g/cm^3) |  |
| 124 |             |   |    |  |    |             |      |    |              |  |
| 125 |             |   |    |  |    |             |      |    | H/U-235 R    |  |
| 126 |             |   |    |  |    |             |      |    |              |  |
| 127 |             |   |    |  |    |             |      |    |              |  |
| 128 |             |   |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 60</b> |    |             |      |    |              |  |
| 129 |             |   |    |  |    |             |      |    |              |  |
| 130 |             |   |    |  |    |             |      |    |              |  |
| 131 |             |   |    | Cylinder Segment Volume Calculation                        |    |             |      |    | Degraded     |  |
| 132 |             |   |    | (Degraded DHLW)  |    |             |      |    |              |  |
| 133 |             |   |    |  |    |             |      |    |              |  |
| 134 |             |   |    | Geometry Calculations                                      |    |             |      |    | Fraction of  |  |
| 135 | g           |   |    | Cylinder Radius (R)  |    | 86.5        | cm   |    | Mass of Gd   |  |
| 136 | g/cm^3      |   |    | Cylinder Length  |    | 304         | cm   |    | Density of   |  |
| 137 | g           |   |    | Cylinder Volume  |    | 7.14588E+06 | cm^3 |    | Mass of Fe   |  |
| 138 | g/cm^3      |   |    | Segment Volume   |    | 4.99330E+06 | cm^3 |    | Nominal De   |  |
| 139 | g           |   |    | Target Cell  |    | 4.99330E+06 |      |    | Total Mas    |  |
| 140 |             |   |    | Dis. from Center (y1)                                      |    | 2.74765E+01 | cm   |    | Void Fracti  |  |
| 141 | g/cm^3      |   |    |  |    |             |      |    | Den of UO    |  |
| 142 | cm^3        |   |    |  |    |             |      |    | Vol. Occup   |  |
| 143 |             |   |    |  |    |             |      |    |              |  |
| 144 |             |   |    | Layer of MIT Fuel and Others                               |    |             |      |    |              |  |
| 145 |             |   |    |  |    |             |      |    |              |  |
| 146 |             |   |    | 1/2 Cylinder Volume  |    | 3.57294E+06 | cm^3 |    |              |  |
| 147 |             |   |    | Segment - 1/2 Cylin.                                       |    | 1.42036E+06 | cm^3 |    |              |  |
| 148 |             |   |    | Layer Volume   |    | 1.28189E+06 | cm^3 |    | Atomic Den   |  |
| 149 | (#/barn cm) |   |    | Target Cell  |    | 1.28189E+06 |      |    |              |  |
| 150 |             |   |    | Dis from Center (y2)                                       |    | 5.54587E+01 | cm   |    | U-235        |  |
| 151 |             |   |    |  |    |             |      |    | U-234        |  |
| 152 |             |   |    |  |    |             |      |    | U-238        |  |
| 153 |             |   |    |  |    |             |      |    | Al           |  |

Fe\_gd

|     | Y                 | Z | AA | AB | AC | AD | AE | AF | AG   |
|-----|-------------------|---|----|----|----|----|----|----|--|
| 154 |                   |   |    |    |    |    |    |    | Fe   |
| 155 |                   |   |    |    |    |    |    |    | O  |
| 156 |                   |   |    |    |    |    |    |    | H  |
| 157 |                   |   |    |    |    |    |    |    | Gd-152   |
| 158 |                   |   |    |    |    |    |    |    | Gd-154   |
| 159 |                   |   |    |    |    |    |    |    | Gd-155   |
| 160 |                   |   |    |    |    |    |    |    | Gd-156   |
| 161 |                   |   |    |    |    |    |    |    | Gd-157   |
| 162 |                   |   |    |    |    |    |    |    | Gd-158   |
| 163 |                   |   |    |    |    |    |    |    | Gd-160   |
| 164 |                   |   |    |    |    |    |    |    | den (g/cm <sup>3</sup> )                                   |
| 165 |                   |   |    |    |    |    |    |    |  |
| 166 |                   |   |    |    |    |    |    |    | H/U-235 R  |
| 167 |                   |   |    |    |    |    |    |    |  |
| 168 |                   |   |    |    |    |    |    |    |  |
| 169 |                   |   |    |    |    |    |    |    | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 40</b> |
| 170 |                   |   |    |    |    |    |    |    |  |
| 171 |                   |   |    |    |    |    |    |    |  |
| 172 |                   |   |    |    |    |    |    |    | Cylinder Segment Volume Calculation                        |
| 173 |                   |   |    |    |    |    |    |    | (Degraded DHLW)  |
| 174 |                   |   |    |    |    |    |    |    |  |
| 175 |                   |   |    |    |    |    |    |    | Geometry Calculations                                      |
| 176 | g                 |   |    |    |    |    |    |    | Fraction of  |
| 177 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Mass of Gd   |
| 178 | g                 |   |    |    |    |    |    |    | Density of   |
| 179 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Density of   |
| 180 | g                 |   |    |    |    |    |    |    | Mass of Fe   |
| 181 |                   |   |    |    |    |    |    |    | Nominal D  |
| 182 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Total Mas  |
| 183 | cm <sup>3</sup>   |   |    |    |    |    |    |    | Total Mas  |
| 184 |                   |   |    |    |    |    |    |    | Void Fracti  |
| 185 |                   |   |    |    |    |    |    |    | Den of UO <sub>2</sub>                                     |
| 186 |                   |   |    |    |    |    |    |    | Vol. Occup   |
| 187 |                   |   |    |    |    |    |    |    |  |
| 188 |                   |   |    |    |    |    |    |    | Layer of MIT Fuel and Others                               |
| 189 |                   |   |    |    |    |    |    |    |  |
| 190 | (#/barn cm)       |   |    |    |    |    |    |    | 1/2 Cylinder Volume  |
| 191 |                   |   |    |    |    |    |    |    | Segment - 1/2 Cylin.                                       |
| 192 |                   |   |    |    |    |    |    |    | Layer Volume   |
| 193 |                   |   |    |    |    |    |    |    | Target Cell  |
| 194 |                   |   |    |    |    |    |    |    | Dis from Center (y2)                                       |
| 195 |                   |   |    |    |    |    |    |    | 3.57294E+06 cm <sup>3</sup>                                |
| 196 |                   |   |    |    |    |    |    |    | 1.42036E+06 cm <sup>3</sup>                                |
| 197 |                   |   |    |    |    |    |    |    | 1.28188E+06 cm <sup>3</sup>                                |
| 198 |                   |   |    |    |    |    |    |    | 1.28188E+06  |
| 199 |                   |   |    |    |    |    |    |    | 5.54584E+01 cm   |
| 200 |                   |   |    |    |    |    |    |    | U-235  |
| 201 |                   |   |    |    |    |    |    |    | U-234  |
| 202 |                   |   |    |    |    |    |    |    | U-238  |
| 203 |                   |   |    |    |    |    |    |    | Al   |
| 204 |                   |   |    |    |    |    |    |    | Fe   |
| 205 |                   |   |    |    |    |    |    |    | O  |
| 206 |                   |   |    |    |    |    |    |    | H  |
| 207 |                   |   |    |    |    |    |    |    | Gd-152   |
| 208 |                   |   |    |    |    |    |    |    | Gd-154   |
| 209 |                   |   |    |    |    |    |    |    | Gd-155   |
| 210 |                   |   |    |    |    |    |    |    | Gd-156   |
| 211 |                   |   |    |    |    |    |    |    | Gd-157   |
| 212 |                   |   |    |    |    |    |    |    | Gd-158   |
| 213 |                   |   |    |    |    |    |    |    | Gd-160   |

Fe\_gd

|     | Y                 | Z | AA | AB | AC | AD | AE | AF | AG   |
|-----|-------------------|---|----|----|----|----|----|----|--|
| 205 |                   |   |    |    |    |    |    |    | den (g/cm <sup>3</sup> )                               |
| 206 |                   |   |    |    |    |    |    |    |  |
| 207 |                   |   |    |    |    |    |    |    | H/U-235 R  |
| 208 |                   |   |    |    |    |    |    |    |  |
| 209 |                   |   |    |    |    |    |    |    |  |
| 210 |                   |   |    |    |    |    |    |    | Degraded MIT Fuel On Top of Degraded DHLW Clay ( 20    |
| 211 |                   |   |    |    |    |    |    |    |  |
| 212 |                   |   |    |    |    |    |    |    |  |
| 213 |                   |   |    |    |    |    |    |    | Degraded   |
| 214 |                   |   |    |    |    |    |    |    | Cylinder Segment Volume Calculation<br>(Degraded DHLW) |
| 215 |                   |   |    |    |    |    |    |    |  |
| 216 |                   |   |    |    |    |    |    |    | Geometry Calculations                                  |
| 217 | g                 |   |    |    |    |    |    |    | Fraction of  |
| 218 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Mass of Gd   |
| 219 | g                 |   |    |    |    |    |    |    | Density of   |
| 220 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Mass of Fe   |
| 221 | g                 |   |    |    |    |    |    |    | Nominal D  |
| 222 |                   |   |    |    |    |    |    |    | Total Mas  |
| 223 | g/cm <sup>3</sup> |   |    |    |    |    |    |    | Void Fracti  |
| 224 | cm <sup>3</sup>   |   |    |    |    |    |    |    | Den of UO <sub>2</sub>                                 |
| 225 |                   |   |    |    |    |    |    |    | Vol. Occup   |
| 226 |                   |   |    |    |    |    |    |    | Layer of MIT Fuel and Others                           |
| 227 |                   |   |    |    |    |    |    |    |  |
| 228 |                   |   |    |    |    |    |    |    | 1/2 Cylinder Volume                                    |
| 229 |                   |   |    |    |    |    |    |    | Segment - 1/2 Cylin.                                   |
| 230 |                   |   |    |    |    |    |    |    | Layer Volume   |
| 231 | (#/barn cm)       |   |    |    |    |    |    |    | Atomic Den   |
| 232 |                   |   |    |    |    |    |    |    | Target Cell  |
| 233 |                   |   |    |    |    |    |    |    | Dis from Center (y2)                                   |
| 234 |                   |   |    |    |    |    |    |    | 5.54582E+01 cm   |
| 235 |                   |   |    |    |    |    |    |    | U-235  |
| 236 |                   |   |    |    |    |    |    |    | U-234  |
| 237 |                   |   |    |    |    |    |    |    | U-238  |
| 238 |                   |   |    |    |    |    |    |    | Al   |
| 239 |                   |   |    |    |    |    |    |    | Fe   |
| 240 |                   |   |    |    |    |    |    |    | O  |
| 241 |                   |   |    |    |    |    |    |    | H  |
| 242 |                   |   |    |    |    |    |    |    | Gd-152   |
| 243 |                   |   |    |    |    |    |    |    | Gd-154   |
| 244 |                   |   |    |    |    |    |    |    | Gd-155   |
| 245 |                   |   |    |    |    |    |    |    | Gd-156   |
| 246 |                   |   |    |    |    |    |    |    | Gd-157   |
| 247 |                   |   |    |    |    |    |    |    | Gd-158   |
| 248 |                   |   |    |    |    |    |    |    | Gd-160   |
|     |                   |   |    |    |    |    |    |    | den (g/cm <sup>3</sup> )                               |
|     |                   |   |    |    |    |    |    |    | H/U-235 R  |

Fe\_gd

|    | AH   | AI       | AJ        | AK                         | AL     | AM |
|----|--|----------|-----------|----------------------------|--------|----|
| 1  |  |          |           |                            |        |    |
| 2  |  |          |           |                            |        |    |
| 3  |  |          |           |                            |        |    |
| 4  |  |          |           |                            |        |    |
| 5  | D g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |
| 6  |  |          |           |                            |        |    |
| 7  |  |          |           |                            |        |    |
| 8  | MIT Fuel   |          |           |                            |        |    |
| 9  |  |          |           |                            |        |    |
| 10 |  |          |           |                            |        |    |
| 11 | UO2 Remaining                                    |          |           | 0.75                       |        |    |
| 12 |  |          |           | 20                         | g      |    |
| 13 | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |
| 14 | 2O3  |          |           | 2.95E+05                   | g      |    |
| 15 | en of UO2+Al2O3+Fe2O3                            |          |           | 4.31997E+00                | g/cm^3 |    |
| 16 | of UO2+Al2O3+Fe2O3                               |          |           | 1.10758E+06                | g      |    |
| 17 | en   |          |           | 8.00000E-01                |        |    |
| 18 | 2+Al2O3+Fe2O3+Void Used                          |          |           | 8.63993E-01                | g/cm^3 |    |
| 19 | ed by UO2+Al2O3+Fe2O3+Void                       |          |           | 1.28193E+06                | cm^3   |    |
| 20 |  |          |           |                            |        |    |
| 21 |  |          |           |                            |        |    |
| 22 |  |          |           |                            |        |    |
| 23 |  |          |           |                            |        |    |
| 24 |  |          |           |                            |        |    |
| 25 | ensity Calculation (Degraded MIT Fuel)           |          |           |                            |        |    |
| 26 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |
| 27 | 24684  | 235.0439 | 92235.50C | 4.9338E-05                 |        |    |
| 28 | 264  | 234.0409 | 92234.50C | 5.2994E-07                 |        |    |
| 29 | 1452   | 238.0508 | 92238.50C | 2.8656E-06                 |        |    |
| 30 | 4.14E+05   | 26.98154 | 13027.50C | 7.2118E-03                 |        |    |
| 31 | 2.07E+05   | 55.847   | 26000.55C | 1.7377E-03                 |        |    |
| 32 | 1.37E+06   | 15.99492 | 8016.50C  | 4.0299E-02                 |        |    |
| 33 | 1.14E+05   | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |
| 34 |  |          | 64152.50C | 7.1702E-10                 |        |    |
| 35 |  |          | 64154.50C | 7.8156E-09                 |        |    |
| 36 |  |          | 64155.50C | 5.3060E-08                 |        |    |
| 37 |  |          | 64156.50C | 7.3387E-08                 |        |    |
| 38 |  |          | 64157.50C | 5.6107E-08                 |        |    |
| 39 |  |          | 64158.50C | 8.9054E-08                 |        |    |
| 40 |  |          | 64160.50C | 7.8371E-08                 |        |    |
| 41 | 1.66411E+00                                      |          |           | 1.0242E-01                 |        |    |
| 42 |  |          |           |                            |        |    |
| 43 | ation  |          |           | 1076.615137                |        |    |
| 44 |  |          |           |                            |        |    |
| 45 |  |          |           |                            |        |    |
| 46 | D g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |
| 47 |  |          |           |                            |        |    |
| 48 |  |          |           |                            |        |    |
| 49 | MIT Fuel   |          |           |                            |        |    |
| 50 |  |          |           |                            |        |    |
| 51 |  |          |           |                            |        |    |

Fe\_gd

|     | AH   | AI       | AJ        | AK                         | AL     | AM |
|-----|--|----------|-----------|----------------------------|--------|----|
| 52  | UO2 Remaining                                  |          |           | 0.75                       |        |    |
| 53  |  |          |           |                            |        |    |
| 54  | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |
| 55  | 2O3  |          |           | 2.95E+05                   | g      |    |
| 56  | en of UO2+Al2O3+Fe2O3                          |          |           | 4.31993E+00                | g/cm^3 |    |
| 57  | of UO2+Al2O3+Fe2O3                             |          |           | 1.10756E+06                | g      |    |
| 58  | pn   |          |           | 8.00000E-01                |        |    |
| 59  | 2+Al2O3+Fe2O3+Void Used                        |          |           | 8.63986E-01                | g/cm^3 |    |
| 60  | ed by UO2+Al2O3+Fe2O3+Void                     |          |           | 1.28192E+06                | cm^3   |    |
| 61  |  |          |           |                            |        |    |
| 62  |  |          |           |                            |        |    |
| 63  |  |          |           |                            |        |    |
| 64  |  |          |           |                            |        |    |
| 65  |  |          |           |                            |        |    |
| 66  | Density Calculation (Degraded MIT Fuel)        |          |           |                            |        |    |
| 67  | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |
| 68  | 24684  | 235.0439 | 92235.50C | 4.9338E-05                 |        |    |
| 69  | 264  | 234.0409 | 92234.50C | 5.2994E-07                 |        |    |
| 70  | 1452   | 238.0508 | 92238.50C | 2.8656E-06                 |        |    |
| 71  | 4.14E+05                                       | 26.98154 | 13027.50C | 7.2119E-03                 |        |    |
| 72  | 2.07E+05                                       | 55.847   | 26000.55C | 1.7378E-03                 |        |    |
| 73  | 1.37E+06                                       | 15.99492 | 8016.50C  | 4.0299E-02                 |        |    |
| 74  | 1.14E+05                                       | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |
| 75  |  |          | 64152.50C | 5.9753E-10                 |        |    |
| 76  |  |          | 64154.50C | 6.5130E-09                 |        |    |
| 77  |  |          | 64155.50C | 4.4217E-08                 |        |    |
| 78  |  |          | 64156.50C | 6.1157E-08                 |        |    |
| 79  |  |          | 64157.50C | 4.6756E-08                 |        |    |
| 80  |  |          | 64158.50C | 7.4213E-08                 |        |    |
| 81  |  |          | 64160.50C | 6.5310E-08                 |        |    |
| 82  | 1.66410E+00                                    |          |           | 1.0242E-01                 |        |    |
| 83  |  |          |           |                            |        |    |
| 84  | ation  |          |           | 1076.604507                |        |    |
| 85  |  |          |           |                            |        |    |
| 86  |  |          |           |                            |        |    |
| 87  | g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |
| 88  |  |          |           |                            |        |    |
| 89  |  |          |           |                            |        |    |
| 90  | MIT Fuel                                       |          |           |                            |        |    |
| 91  |  |          |           |                            |        |    |
| 92  |  |          |           |                            |        |    |
| 93  | UO2 Remaining                                  |          |           | 0.75                       |        |    |
| 94  |  |          |           |                            |        |    |
| 95  | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |
| 96  | 2O3  |          |           | 2.95E+05                   | g      |    |
| 97  | en of UO2+Al2O3+Fe2O3                          |          |           | 4.31990E+00                | g/cm^3 |    |
| 98  | of UO2+Al2O3+Fe2O3                             |          |           | 1.10754E+06                | g      |    |
| 99  | pn   |          |           | 8.00000E-01                |        |    |
| 100 | 2+Al2O3+Fe2O3+Void Used                        |          |           | 8.63979E-01                | g/cm^3 |    |
| 101 | ed by UO2+Al2O3+Fe2O3+Void                     |          |           | 1.28191E+06                | cm^3   |    |
| 102 |  |          |           |                            |        |    |



|     | AH  | AI       | AJ        | AK                         | AL | AM |
|-----|---|----------|-----------|----------------------------|----|----|
| 103 |   |          |           |                            |    |    |
| 104 |   |          |           |                            |    |    |
| 105 |   |          |           |                            |    |    |
| 106 |   |          |           |                            |    |    |
| 107 | Density Calculation (Degraded MIT Fuel)               |          |           |                            |    |    |
| 108 | Mass(g)   | WT       | MCNP      | Atomic Density (#/barn cm) |    |    |
| 109 | 24684   | 235.0439 | 92235.50C | 4.9339E-05                 |    |    |
| 110 | 264   | 234.0409 | 92234.50C | 5.2995E-07                 |    |    |
| 111 | 1452  | 238.0508 | 92238.50C | 2.8656E-06                 |    |    |
| 112 | 4.14E+05  | 26.98154 | 13027.50C | 7.2120E-03                 |    |    |
| 113 | 2.07E+05  | 55.847   | 26000.55C | 1.7378E-03                 |    |    |
| 114 | 1.37E+06  | 15.99492 | 8016.50C  | 4.0300E-02                 |    |    |
| 115 | 1.14E+05  | 1.007825 | 1001.50C  | 5.3118E-02                 |    |    |
| 116 |   |          | 64152.50C | 4.7803E-10                 |    |    |
| 117 |   |          | 64154.50C | 5.2105E-09                 |    |    |
| 118 |   |          | 64155.50C | 3.5374E-08                 |    |    |
| 119 |   |          | 64156.50C | 4.8926E-08                 |    |    |
| 120 |   |          | 64157.50C | 3.7406E-08                 |    |    |
| 121 |   |          | 64158.50C | 5.9371E-08                 |    |    |
| 122 |   |          | 64160.50C | 5.2248E-08                 |    |    |
| 123 | 1.66410E+00   |          |           | 1.0242E-01                 |    |    |
| 124 |   |          |           |                            |    |    |
| 125 | ation   |          |           | 1076.593876                |    |    |
| 126 |   |          |           |                            |    |    |
| 127 |   |          |           |                            |    |    |
| 128 | <b>g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)</b> |          |           |                            |    |    |
| 129 |   |          |           |                            |    |    |
| 130 |   |          |           |                            |    |    |
| 131 | MIT Fuel  |          |           |                            |    |    |
| 132 |   |          |           |                            |    |    |
| 133 |   |          |           |                            |    |    |
| 134 | UO2 Remaining   |          |           | 0.75                       |    |    |
| 135 |   |          |           | g                          |    |    |
| 136 | Gd  |          |           | 7.9004E+00 g/cm^3          |    |    |
| 137 | 2O3   |          |           | 2.95E+05 g                 |    |    |
| 138 | en of UO2+Al2O3+Fe2O3                                 |          |           | 4.31986E+00 g/cm^3         |    |    |
| 139 | of UO2+Al2O3+Fe2O3                                    |          |           | 1.10752E+06 g              |    |    |
| 140 | bn  |          |           | 8.00000E-01                |    |    |
| 141 | 2+Al2O3+Fe2O3+Void Used                               |          |           | 8.63972E-01 g/cm^3         |    |    |
| 142 | led by UO2+Al2O3+Fe2O3+Void                           |          |           | 1.28189E+06 cm^3           |    |    |
| 143 |   |          |           |                            |    |    |
| 144 |   |          |           |                            |    |    |
| 145 |   |          |           |                            |    |    |
| 146 |   |          |           |                            |    |    |
| 147 |   |          |           |                            |    |    |
| 148 | Density Calculation (Degraded MIT Fuel)               |          |           |                            |    |    |
| 149 | Mass(g)   | WT       | MCNP      | Atomic Density (#/barn cm) |    |    |
| 150 | 24684   | 235.0439 | 92235.50C | 4.9339E-05                 |    |    |
| 151 | 264   | 234.0409 | 92234.50C | 5.2995E-07                 |    |    |
| 152 | 1452  | 238.0508 | 92238.50C | 2.8656E-06                 |    |    |
| 153 | 4.14E+05  | 26.98154 | 13027.50C | 7.2120E-03                 |    |    |

## Fe\_gd

|     | AH   | AI       | AJ        | AK                         | AL     | AM |
|-----|--|----------|-----------|----------------------------|--------|----|
| 154 | 2.07E+05                                       | 55.847   | 26000.55C | 1.7378E-03                 |        |    |
| 155 | 1.37E+06                                       | 15.99492 | 8016.50C  | 4.0300E-02                 |        |    |
| 156 | 1.14E+05                                       | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |
| 157 |  |          | 64152.50C | 3.5852E-10                 |        |    |
| 158 |  |          | 64154.50C | 3.9079E-09                 |        |    |
| 159 |  |          | 64155.50C | 2.6531E-08                 |        |    |
| 160 |  |          | 64156.50C | 3.6695E-08                 |        |    |
| 161 |  |          | 64157.50C | 2.8054E-08                 |        |    |
| 162 |  |          | 64158.50C | 4.4529E-08                 |        |    |
| 163 |  |          | 64160.50C | 3.9187E-08                 |        |    |
| 164 | 1.66409E+00                                    |          |           | 1.0242E-01                 |        |    |
| 165 |  |          |           |                            |        |    |
| 166 | ation  |          |           | 1076.583246                |        |    |
| 167 |  |          |           |                            |        |    |
| 168 |  |          |           |                            |        |    |
| 169 | g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |
| 170 |  |          |           |                            |        |    |
| 171 |  |          |           |                            |        |    |
| 172 | MIT Fuel                                       |          |           |                            |        |    |
| 173 |  |          |           |                            |        |    |
| 174 |  |          |           |                            |        |    |
| 175 | UO2 Remaining                                  |          |           | 0.75                       |        |    |
| 176 |  |          |           | g                          |        |    |
| 177 | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |
| 178 | 2O3  |          |           | 2.95E+05                   | g      |    |
| 179 | en of UO2+Al2O3+Fe2O3                          |          |           | 4.31982E+00                | g/cm^3 |    |
| 180 | of UO2+Al2O3+Fe2O3                             |          |           | 1.10750E+06                | g      |    |
| 181 | on   |          |           | 8.00000E-01                |        |    |
| 182 | 2+Al2O3+Fe2O3+Void Used                        |          |           | 8.63965E-01                | g/cm^3 |    |
| 183 | ed by UO2+Al2O3+Fe2O3+Void                     |          |           | 1.28188E+06                | cm^3   |    |
| 184 |  |          |           |                            |        |    |
| 185 |  |          |           |                            |        |    |
| 186 |  |          |           |                            |        |    |
| 187 |  |          |           |                            |        |    |
| 188 |  |          |           |                            |        |    |
| 189 | ensity Calculation (Degraded MIT Fuel)         |          |           |                            |        |    |
| 190 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |
| 191 | 24684  | 235.0439 | 92235.50C | 4.9340E-05                 |        |    |
| 192 | 264  | 234.0409 | 92234.50C | 5.2996E-07                 |        |    |
| 193 | 1452   | 238.0508 | 92238.50C | 2.8657E-06                 |        |    |
| 194 | 4.14E+05                                       | 26.98154 | 13027.50C | 7.2121E-03                 |        |    |
| 195 | 2.07E+05                                       | 55.847   | 26000.55C | 1.7378E-03                 |        |    |
| 196 | 1.37E+06                                       | 15.99492 | 8016.50C  | 4.0300E-02                 |        |    |
| 197 | 1.14E+05                                       | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |
| 198 |  |          | 64152.50C | 2.3902E-10                 |        |    |
| 199 |  |          | 64154.50C | 2.6053E-09                 |        |    |
| 200 |  |          | 64155.50C | 1.7687E-08                 |        |    |
| 201 |  |          | 64156.50C | 2.4463E-08                 |        |    |
| 202 |  |          | 64157.50C | 1.8703E-08                 |        |    |
| 203 |  |          | 64158.50C | 2.9686E-08                 |        |    |
| 204 |  |          | 64160.50C | 2.6125E-08                 |        |    |

Fe\_gd

|     | AH   | AI       | AJ        | AK                         | AL     | AM |
|-----|--|----------|-----------|----------------------------|--------|----|
| 205 | 1.66408E+00                                    |          |           | 1.0242E-01                 |        |    |
| 206 |  |          |           |                            |        |    |
| 207 | ation  |          |           | 1076.572616                |        |    |
| 208 |  |          |           |                            |        |    |
| 209 |  |          |           |                            |        |    |
| 210 | g of Gd, 295105 g of Fe2O3, Void Fraction 0.8) |          |           |                            |        |    |
| 211 |  |          |           |                            |        |    |
| 212 |  |          |           |                            |        |    |
| 213 | MIT Fuel                                       |          |           |                            |        |    |
| 214 |  |          |           |                            |        |    |
| 215 |  |          |           |                            |        |    |
| 216 | UO2 Remaining                                  |          |           | 0.75                       |        |    |
| 217 |  |          |           |                            |        |    |
| 218 | Gd   |          |           | 7.9004E+00                 | g/cm^3 |    |
| 219 | 2O3  |          |           | 2.95E+05                   | g      |    |
| 220 | bn of UO2+Al2O3+Fe2O3                          |          |           | 4.31979E+00                | g/cm^3 |    |
| 221 | bf UO2+Al2O3+Fe2O3                             |          |           | 1.10748E+06                | g      |    |
| 222 | bn   |          |           | 8.00000E-01                |        |    |
| 223 | 2+Al2O3+Fe2O3+Void Used                        |          |           | 8.63958E-01                | g/cm^3 |    |
| 224 | ded by UO2+Al2O3+Fe2O3+Void                    |          |           | 1.28187E+06                | cm^3   |    |
| 225 |  |          |           |                            |        |    |
| 226 |  |          |           |                            |        |    |
| 227 |  |          |           |                            |        |    |
| 228 |  |          |           |                            |        |    |
| 229 |  |          |           |                            |        |    |
| 230 | ensity Calculation (Degraded MIT Fuel)         |          |           |                            |        |    |
| 231 | Mass(g)  | WT       | MCNP      | Atomic Density (#/barn cm) |        |    |
| 232 | 24684  | 235.0439 | 92235.50C | 4.9340E-05                 |        |    |
| 233 | 264  | 234.0409 | 92234.50C | 5.2996E-07                 |        |    |
| 234 | 1452   | 238.0508 | 92238.50C | 2.8657E-06                 |        |    |
| 235 | 4.14E+05                                       | 26.98154 | 13027.50C | 7.2122E-03                 |        |    |
| 236 | 2.07E+05                                       | 55.847   | 26000.55C | 1.7378E-03                 |        |    |
| 237 | 1.37E+06                                       | 15.99492 | 8016.50C  | 4.0300E-02                 |        |    |
| 238 | 1.14E+05                                       | 1.007825 | 1001.50C  | 5.3118E-02                 |        |    |
| 239 |  |          | 64152.50C | 1.1951E-10                 |        |    |
| 240 |  |          | 64154.50C | 1.3027E-09                 |        |    |
| 241 |  |          | 64155.50C | 8.8437E-09                 |        |    |
| 242 |  |          | 64156.50C | 1.2232E-08                 |        |    |
| 243 |  |          | 64157.50C | 9.3517E-09                 |        |    |
| 244 |  |          | 64158.50C | 1.4843E-08                 |        |    |
| 245 |  |          | 64160.50C | 1.3062E-08                 |        |    |
| 246 | 1.66407E+00                                    |          |           | 1.0242E-01                 |        |    |
| 247 |  |          |           |                            |        |    |
| 248 | ation  |          |           | 1076.561985                |        |    |

|    | A | B   | C | D           | E    | F | G                         | H           |  |
|----|---|---|---|-------------|------|---|---------------------------|-------------|--|
| 1  |   |   |   |             |      |   |                           |             |  |
| 2  |   | <b>50% Uranium Loading</b>  |   |             |      |   |                           |             |  |
| 3  |   |   |   |             |      |   |                           |             |  |
| 4  |   |   |   |             |      |   |                           |             |  |
| 5  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |      |   |                           |             |  |
| 6  |   |   |   |             |      |   |                           |             |  |
| 7  |   |   |   |             |      |   |                           |             |  |
| 8  |   | Cylinder Segment Volume Calculation                                       |   |             |      |   | Degraded MIT Fuel         |             |  |
| 9  |   | (Degraded DHLW)   |   |             |      |   |                           |             |  |
| 10 |   |   |   |             |      |   |                           |             |  |
| 11 |   | Geometry Calculations   |   |             |      |   | Fraction of UO2 Remainin  |             |  |
| 12 |   | Cylinder Radius (R)   |   | 86.5        | cm   |   | Mass of Gd                |             |  |
| 13 |   | Cylinder Length   |   | 304         | cm   |   | Density of Gd             |             |  |
| 14 |   | Cylinder Volume   |   | 7.14588E+06 | cm^3 |   | Mass of Fe2O3             |             |  |
| 15 |   | Segment Volume  |   | 4.99330E+06 | cm^3 |   | Nominal Den of UO2+Al2O   |             |  |
| 16 |   | Target Cell   |   | 4.99330E+06 |      |   | Total Mas of UO2+Al2O3-   |             |  |
| 17 |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm   |   | Void Fraction             |             |  |
| 18 |   |   |   |             |      |   | Den of UO2+Al2O3+Fe2O     |             |  |
| 19 |   |   |   |             |      |   | Vol. Occupied by UO2+Al   |             |  |
| 20 |   |   |   |             |      |   |                           |             |  |
| 21 |   | Layer of MIT Fuel and Others  |   |             |      |   |                           |             |  |
| 22 |   |   |   |             |      |   |                           |             |  |
| 23 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm^3 |   |                           |             |  |
| 24 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm^3 |   |                           |             |  |
| 25 |   | Layer Volume  |   | 6.63803E+05 | cm^3 |   | Atomic Density Calculatio |             |  |
| 26 |   | Target Cell   |   | 6.63804E+05 |      |   | Mass(g)                   |             |  |
| 27 |   | Dis from Center (y2)  |   | 4.12507E+01 | cm   |   | U-235                     | 16456       |  |
| 28 |   |   |   |             |      |   | U-234                     | 176         |  |
| 29 |   |   |   |             |      |   | U-238                     | 968         |  |
| 30 |   |   |   |             |      |   | Al                        | 4.14E+05    |  |
| 31 |   |   |   |             |      |   | Fe                        | 0.00E+00    |  |
| 32 |   |   |   |             |      |   | O                         | 7.84E+05    |  |
| 33 |   |   |   |             |      |   | H                         | 5.16E+04    |  |
| 34 |   |   |   |             |      |   | Gd-152                    |             |  |
| 35 |   |   |   |             |      |   | Gd-154                    |             |  |
| 36 |   |   |   |             |      |   | Gd-155                    |             |  |
| 37 |   |   |   |             |      |   | Gd-156                    |             |  |
| 38 |   |   |   |             |      |   | Gd-157                    |             |  |
| 39 |   |   |   |             |      |   | Gd-158                    |             |  |
| 40 |   |   |   |             |      |   | Gd-160                    |             |  |
| 41 |   |   |   |             |      |   | den (g/cm^                | 1.90873E+00 |  |
| 42 |   |   |   |             |      |   |                           |             |  |
| 43 |   |   |   |             |      |   | H/U-235 Ration            |             |  |
| 44 |   |   |   |             |      |   |                           |             |  |
| 45 |   |   |   |             |      |   |                           |             |  |
| 46 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |      |   |                           |             |  |
| 47 |   |   |   |             |      |   |                           |             |  |
| 48 |   |   |   |             |      |   |                           |             |  |
| 49 |   | Cylinder Segment Volume Calculation                                       |   |             |      |   | Degraded MIT Fuel         |             |  |
| 50 |   | (Degraded DHLW)   |   |             |      |   |                           |             |  |
| 51 |   |   |   |             |      |   |                           |             |  |

|     | A | B   | C | D           | E    | F | G                          | H        |
|-----|---|---|---|-------------|------|---|----------------------------|----------|
| 52  |   | Geometry Calculations   |   |             |      |   | Fraction of UO2 Remainin   |          |
| 53  |   | Cylinder Radius (R)   |   | 86.5        | cm   |   | Mass of Gd                 |          |
| 54  |   | Cylinder Length   |   | 304         | cm   |   | Density of Gd              |          |
| 55  |   | Cylinder Volume   |   | 7.14588E+06 | cm^3 |   | Mass of Fe2O3              |          |
| 56  |   | Segment Volume  |   | 4.99330E+06 | cm^3 |   | Nominal Den of UO2+Al2O    |          |
| 57  |   | Target Cell   |   | 4.99330E+06 |      |   | Total Mas of UO2+Al2O3-    |          |
| 58  |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm   |   | Void Fraction              |          |
| 59  |   |   |   |             |      |   | Den of UO2+Al2O3+Fe2O      |          |
| 60  |   |   |   |             |      |   | Vol. Occupied by UO2+Al    |          |
| 61  |   |   |   |             |      |   |                            |          |
| 62  |   | Layer of MIT Fuel and Others  |   |             |      |   |                            |          |
| 63  |   |   |   |             |      |   |                            |          |
| 64  |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm^3 |   |                            |          |
| 65  |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm^3 |   |                            |          |
| 66  |   | Layer Volume  |   | 7.96564E+05 | cm^3 |   | Atomic Density Calculation |          |
| 67  |   | Target Cell   |   | 7.96563E+05 |      |   | Mass(g)                    |          |
| 68  |   | Dis from Center (y2)  |   | 2.41536E+01 | cm   |   | U-235                      | 16456    |
| 69  |   |   |   |             |      |   | U-234                      | 176      |
| 70  |   |   |   |             |      |   | U-238                      | 968      |
| 71  |   |   |   |             |      |   | Al                         | 4.14E+05 |
| 72  |   |   |   |             |      |   | Fe                         | 0.00E+00 |
| 73  |   |   |   |             |      |   | O                          | 9.02E+05 |
| 74  |   |   |   |             |      |   | H                          | 6.64E+04 |
| 75  |   |   |   |             |      |   | Gd-152                     |          |
| 76  |   |   |   |             |      |   | Gd-154                     |          |
| 77  |   |   |   |             |      |   | Gd-155                     |          |
| 78  |   |   |   |             |      |   | Gd-156                     |          |
| 79  |   |   |   |             |      |   | Gd-157                     |          |
| 80  |   |   |   |             |      |   | Gd-158                     |          |
| 81  |   |   |   |             |      |   | Gd-160                     |          |
| 82  |   |   |   |             |      |   | den (g/cm^ 1.75727E+00     |          |
| 83  |   |   |   |             |      |   |                            |          |
| 84  |   |   |   |             |      |   | H/U-235 Ration             |          |
| 85  |   |   |   |             |      |   |                            |          |
| 86  |   |   |   |             |      |   |                            |          |
| 87  |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |      |   |                            |          |
| 88  |   |   |   |             |      |   |                            |          |
| 89  |   |   |   |             |      |   |                            |          |
| 90  |   | Cylinder Segment Volume Calculation                                       |   |             |      |   | Degraded MIT Fuel          |          |
| 91  |   | (Degraded DHLW)   |   |             |      |   |                            |          |
| 92  |   |   |   |             |      |   |                            |          |
| 93  |   | Geometry Calculations   |   |             |      |   | Fraction of UO2 Remainin   |          |
| 94  |   | Cylinder Radius (R)   |   | 86.5        | cm   |   | Mass of Gd                 |          |
| 95  |   | Cylinder Length   |   | 304         | cm   |   | Density of Gd              |          |
| 96  |   | Cylinder Volume   |   | 7.14588E+06 | cm^3 |   | Mass of Fe2O3              |          |
| 97  |   | Segment Volume  |   | 4.99330E+06 | cm^3 |   | Nominal Den of UO2+Al2O    |          |
| 98  |   | Target Cell   |   | 4.99330E+06 |      |   | Total Mas of UO2+Al2O3-    |          |
| 99  |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm   |   | Void Fraction              |          |
| 100 |   |   |   |             |      |   | Den of UO2+Al2O3+Fe2O      |          |
| 101 |   |   |   |             |      |   | Vol. Occupied by UO2+Al    |          |
| 102 |   |   |   |             |      |   |                            |          |

|     | A | B   | C | D           | E               | F | G                          | H           |  |
|-----|---|---|---|-------------|-----------------|---|----------------------------|-------------|--|
| 103 |   | Layer of MIT Fuel and Others  |   |             |                 |   |                            |             |  |
| 104 |   |   |   |             |                 |   |                            |             |  |
| 105 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm <sup>3</sup> |   |                            |             |  |
| 106 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm <sup>3</sup> |   |                            |             |  |
| 107 |   | Layer Volume  |   | 9.95705E+05 | cm <sup>3</sup> |   | Atomic Density Calculation |             |  |
| 108 |   | Target Cell   |   | 9.95706E+05 |                 |   | Mass(g)                    |             |  |
| 109 |   | Dis from Center (y2)  |   | 4.86412E+01 | cm              |   | U-235                      | 16456       |  |
| 110 |   |   |   |             |                 |   | U-234                      | 176         |  |
| 111 |   |   |   |             |                 |   | U-238                      | 968         |  |
| 112 |   |   |   |             |                 |   | Al                         | 4.14E+05    |  |
| 113 |   |   |   |             |                 |   | Fe                         | 0.00E+00    |  |
| 114 |   |   |   |             |                 |   | O                          | 1.08E+06    |  |
| 115 |   |   |   |             |                 |   | H                          | 8.85E+04    |  |
| 116 |   |   |   |             |                 |   | Gd-152                     |             |  |
| 117 |   |   |   |             |                 |   | Gd-154                     |             |  |
| 118 |   |   |   |             |                 |   | Gd-155                     |             |  |
| 119 |   |   |   |             |                 |   | Gd-156                     |             |  |
| 120 |   |   |   |             |                 |   | Gd-157                     |             |  |
| 121 |   |   |   |             |                 |   | Gd-158                     |             |  |
| 122 |   |   |   |             |                 |   | Gd-160                     |             |  |
| 123 |   |   |   |             |                 |   | den (g/cm <sup>3</sup> )   | 1.60582E+00 |  |
| 124 |   |   |   |             |                 |   |                            |             |  |
| 125 |   |   |   |             |                 |   | H/U-235 Ration             |             |  |
| 126 |   |   |   |             |                 |   |                            |             |  |
| 127 |   |   |   |             |                 |   |                            |             |  |
| 128 |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |   |             |                 |   |                            |             |  |
| 129 |   |   |   |             |                 |   |                            |             |  |
| 130 |   |   |   |             |                 |   |                            |             |  |
| 131 |   | Cylinder Segment Volume Calculation                                       |   |             |                 |   | Degraded MIT Fuel          |             |  |
| 132 |   | (Degraded DHLW)   |   |             |                 |   |                            |             |  |
| 133 |   |   |   |             |                 |   |                            |             |  |
| 134 |   | Geometry Calculations   |   |             |                 |   | Fraction of UO2 Remainin   |             |  |
| 135 |   | Cylinder Radius (R)   |   | 86.5        | cm              |   | Mass of Gd                 |             |  |
| 136 |   | Cylinder Length   |   | 304         | cm              |   | Density of Gd              |             |  |
| 137 |   | Cylinder Volume   |   | 7.14588E+06 | cm <sup>3</sup> |   | Mass of Fe2O3              |             |  |
| 138 |   | Segment Volume  |   | 4.99330E+06 | cm <sup>3</sup> |   | Nominal Den of UO2+Al2O    |             |  |
| 139 |   | Target Cell   |   | 4.99330E+06 |                 |   | Total Mas of UO2+Al2O3-    |             |  |
| 140 |   | Dis. from Center (y1)   |   | 2.74765E+01 | cm              |   | Void Fraction              |             |  |
| 141 |   |   |   |             |                 |   | Den of UO2+Al2O3+Fe2O      |             |  |
| 142 |   |   |   |             |                 |   | Vol. Occupied by UO2+Al    |             |  |
| 143 |   |   |   |             |                 |   |                            |             |  |
| 144 |   | Layer of MIT Fuel and Others  |   |             |                 |   |                            |             |  |
| 145 |   |   |   |             |                 |   |                            |             |  |
| 146 |   | 1/2 Cylinder Volume   |   | 3.57294E+06 | cm <sup>3</sup> |   |                            |             |  |
| 147 |   | Segment - 1/2 Cylin.  |   | 1.42036E+06 | cm <sup>3</sup> |   |                            |             |  |
| 148 |   | Layer Volume  |   | 1.32761E+06 | cm <sup>3</sup> |   | Atomic Density Calculation |             |  |
| 149 |   | Target Cell   |   | 1.32761E+06 |                 |   | Mass(g)                    |             |  |
| 150 |   | Dis from Center (y2)  |   | 5.65997E+01 | cm              |   | U-235                      | 16456       |  |
| 151 |   |   |   |             |                 |   | U-234                      | 176         |  |
| 152 |   |   |   |             |                 |   | U-238                      | 968         |  |
| 153 |   |   |   |             |                 |   | Al                         | 4.14E+05    |  |

Fe\_gd

|     | A | B | C | D | E | F | G   | H                        |
|-----|---|---|---|---|---|---|---|--------------------------|
| 154 |   |   |   |   |   |   | Fe  | 0.00E+00                 |
| 155 |   |   |   |   |   |   | O   | 1.37E+06                 |
| 156 |   |   |   |   |   |   | H   | 1.25E+05                 |
| 157 |   |   |   |   |   |   | Gd-152  |                          |
| 158 |   |   |   |   |   |   | Gd-154  |                          |
| 159 |   |   |   |   |   |   | Gd-155  |                          |
| 160 |   |   |   |   |   |   | Gd-156  |                          |
| 161 |   |   |   |   |   |   | Gd-157  |                          |
| 162 |   |   |   |   |   |   | Gd-158  |                          |
| 163 |   |   |   |   |   |   | Gd-160  |                          |
| 164 |   |   |   |   |   |   | den (g/cm^  | 1.45436E+00              |
| 165 |   |   |   |   |   |   |   |                          |
| 166 |   |   |   |   |   |   | H/U-235 Ration  |                          |
| 167 |   |   |   |   |   |   |   |                          |
| 168 |   |   |   |   |   |   |   |                          |
| 169 |   |   |   |   |   |   | <b>Degraded MIT Fuel On Top of Degraded DHLW Clay ( 0 g of Gd, 0 g of</b> |                          |
| 170 |   |   |   |   |   |   |   |                          |
| 171 |   |   |   |   |   |   |   |                          |
| 172 |   |   |   |   |   |   | Cylinder Segment Volume Calculation                                       | Degraded MIT Fuel        |
| 173 |   |   |   |   |   |   | (Degraded DHLW)   |                          |
| 174 |   |   |   |   |   |   |   |                          |
| 175 |   |   |   |   |   |   | Geometry Calculations   | Fraction of UO2 Remainin |
| 176 |   |   |   |   |   |   | Cylinder Radius (R)   | 86.5 cm                  |
| 177 |   |   |   |   |   |   | Cylinder Length   | 304 cm                   |
| 178 |   |   |   |   |   |   | Cylinder Volume   | 7.14588E+06 cm^3         |
| 179 |   |   |   |   |   |   | Segment Volume  | 4.99330E+06 cm^3         |
| 180 |   |   |   |   |   |   | Target Cell   | 4.99330E+06              |
| 181 |   |   |   |   |   |   | Dis. from Center (y1)   | 2.74765E+01 cm           |
| 182 |   |   |   |   |   |   |   | Void Fraction            |
| 183 |   |   |   |   |   |   |   | Den of UO2+Al2O3+Fe2O    |
| 184 |   |   |   |   |   |   |   | Vol. Occupied by UO2+Al  |
| 185 |   |   |   |   |   |   | Layer of MIT Fuel and Others  |                          |
| 186 |   |   |   |   |   |   |   |                          |
| 187 |   |   |   |   |   |   | 1/2 Cylinder Volume   | 3.57294E+06 cm^3         |
| 188 |   |   |   |   |   |   | Segment - 1/2 Cylin.  | 1.42036E+06 cm^3         |
| 189 |   |   |   |   |   |   | Layer Volume  | 1.99141E+06 cm^3         |
| 190 |   |   |   |   |   |   | Target Cell   | 1.99141E+06              |
| 191 |   |   |   |   |   |   | Dis from Center (y2)  | 7.66830E+01 cm           |
| 192 |   |   |   |   |   |   | U-235   | 16456                    |
| 193 |   |   |   |   |   |   | U-234   | 176                      |
| 194 |   |   |   |   |   |   | U-238   | 968                      |
| 195 |   |   |   |   |   |   | Al  | 4.14E+05                 |
| 196 |   |   |   |   |   |   | Fe  | 0.00E+00                 |
| 197 |   |   |   |   |   |   | O   | 1.96E+06                 |
| 198 |   |   |   |   |   |   | H   | 1.99E+05                 |
| 199 |   |   |   |   |   |   | Gd-152  |                          |
| 200 |   |   |   |   |   |   | Gd-154  |                          |
| 201 |   |   |   |   |   |   | Gd-155  |                          |
| 202 |   |   |   |   |   |   | Gd-156  |                          |
| 203 |   |   |   |   |   |   | Gd-157  |                          |
| 204 |   |   |   |   |   |   | Gd-158  |                          |
| 204 |   |   |   |   |   |   | Gd-160  |                          |

Fe\_gd

|     | A | B | C | D | E | F | G                        | H           |
|-----|---|---|---|---|---|---|--------------------------|-------------|
| 205 |   |   |   |   |   |   | den (g/cm <sup>3</sup> ) | 1.30291E+00 |
| 206 |   |   |   |   |   |   |                          |             |
| 207 |   |   |   |   |   |   | H/U-235 Ration           |             |



|    | I                          | J         | K                          | L      | M |
|----|----------------------------|-----------|----------------------------|--------|---|
| 1  |                            |           |                            |        |   |
| 2  |                            |           |                            |        |   |
| 3  |                            |           |                            |        |   |
| 4  |                            |           |                            |        |   |
| 5  | Fe2O3, Void Fraction 0.7)  |           |                            |        |   |
| 6  |                            |           |                            |        |   |
| 7  |                            |           |                            |        |   |
| 8  |                            |           |                            |        |   |
| 9  |                            |           |                            |        |   |
| 10 |                            |           |                            |        |   |
| 11 | g                          |           | 0.50                       |        |   |
| 12 |                            |           |                            | g      |   |
| 13 |                            |           | 7.9004E+00                 | g/cm^3 |   |
| 14 |                            |           | 0.00E+00                   | g      |   |
| 15 | O3+Fe2O3                   |           | 4.02909E+00                | g/cm^3 |   |
| 16 | Fe2O3                      |           | 8.02357E+05                | g      |   |
| 17 |                            |           | 7.00000E-01                |        |   |
| 18 | O3+Void Used               |           | 1.20873E+00                | g/cm^3 |   |
| 19 | O3+Fe2O3+Void              |           | 6.63803E+05                | cm^3   |   |
| 20 |                            |           |                            |        |   |
| 21 |                            |           |                            |        |   |
| 22 |                            |           |                            |        |   |
| 23 |                            |           |                            |        |   |
| 24 |                            |           |                            |        |   |
| 25 | n (Degraded MIT Fuel)      |           |                            |        |   |
| 26 | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |
| 27 | 235.0439                   | 92235.50C | 6.3520E-05                 |        |   |
| 28 | 234.0409                   | 92234.50C | 6.8227E-07                 |        |   |
| 29 | 238.0508                   | 92238.50C | 3.6893E-06                 |        |   |
| 30 | 26.98154                   | 13027.50C | 1.3927E-02                 |        |   |
| 31 | 55.847                     | 26000.55C | 0.0000E+00                 |        |   |
| 32 | 15.99492                   | 8016.50C  | 4.4448E-02                 |        |   |
| 33 | 1.007825                   | 1001.50C  | 4.6478E-02                 |        |   |
| 34 |                            | 64152.50C | 0.0000E+00                 |        |   |
| 35 |                            | 64154.50C | 0.0000E+00                 |        |   |
| 36 |                            | 64155.50C | 0.0000E+00                 |        |   |
| 37 |                            | 64156.50C | 0.0000E+00                 |        |   |
| 38 |                            | 64157.50C | 0.0000E+00                 |        |   |
| 39 |                            | 64158.50C | 0.0000E+00                 |        |   |
| 40 |                            | 64160.50C | 0.0000E+00                 |        |   |
| 41 |                            |           | 1.0492E-01                 |        |   |
| 42 |                            |           |                            |        |   |
| 43 |                            |           | 731.7026106                |        |   |
| 44 |                            |           |                            |        |   |
| 45 |                            |           |                            |        |   |
| 46 | Fe2O3, Void Fraction 0.75) |           |                            |        |   |
| 47 |                            |           |                            |        |   |
| 48 |                            |           |                            |        |   |
| 49 |                            |           |                            |        |   |
| 50 |                            |           |                            |        |   |
| 51 |                            |           |                            |        |   |

|     | I                                 | J         | K                          | L                 | M |
|-----|-----------------------------------|-----------|----------------------------|-------------------|---|
| 52  | g                                 |           | 0.50                       |                   |   |
| 53  |                                   |           |                            | g                 |   |
| 54  |                                   |           | 7.9004E+00                 | g/cm <sup>3</sup> |   |
| 55  |                                   |           | 0.00E+00                   | g                 |   |
| 56  | O3+Fe2O3                          |           | 4.02909E+00                | g/cm <sup>3</sup> |   |
| 57  | Fe2O3                             |           | 8.02357E+05                | g                 |   |
| 58  |                                   |           | 7.50000E-01                |                   |   |
| 59  | 3+Void Used                       |           | 1.00727E+00                | g/cm <sup>3</sup> |   |
| 60  | 2O3+Fe2O3+Void                    |           | 7.96564E+05                | cm <sup>3</sup>   |   |
| 61  |                                   |           |                            |                   |   |
| 62  |                                   |           |                            |                   |   |
| 63  |                                   |           |                            |                   |   |
| 64  |                                   |           |                            |                   |   |
| 65  |                                   |           |                            |                   |   |
| 66  | h (Degraded MIT Fuel)             |           |                            |                   |   |
| 67  | WT                                | MCNP      | Atomic Density (#/barn cm) |                   |   |
| 68  | 235.0439                          | 92235.50C | 5.2934E-05                 |                   |   |
| 69  | 234.0409                          | 92234.50C | 5.6856E-07                 |                   |   |
| 70  | 238.0508                          | 92238.50C | 3.0744E-06                 |                   |   |
| 71  | 26.98154                          | 13027.50C | 1.1606E-02                 |                   |   |
| 72  | 55.847                            | 26000.55C | 0.0000E+00                 |                   |   |
| 73  | 15.99492                          | 8016.50C  | 4.2618E-02                 |                   |   |
| 74  | 1.007825                          | 1001.50C  | 4.9798E-02                 |                   |   |
| 75  |                                   | 64152.50C | 0.0000E+00                 |                   |   |
| 76  |                                   | 64154.50C | 0.0000E+00                 |                   |   |
| 77  |                                   | 64155.50C | 0.0000E+00                 |                   |   |
| 78  |                                   | 64156.50C | 0.0000E+00                 |                   |   |
| 79  |                                   | 64157.50C | 0.0000E+00                 |                   |   |
| 80  |                                   | 64158.50C | 0.0000E+00                 |                   |   |
| 81  |                                   | 64160.50C | 0.0000E+00                 |                   |   |
| 82  |                                   |           | 1.0408E-01                 |                   |   |
| 83  |                                   |           |                            |                   |   |
| 84  |                                   |           | 940.7604994                |                   |   |
| 85  |                                   |           |                            |                   |   |
| 86  |                                   |           |                            |                   |   |
| 87  | <b>Fe2O3, Void Fraction 0.80)</b> |           |                            |                   |   |
| 88  |                                   |           |                            |                   |   |
| 89  |                                   |           |                            |                   |   |
| 90  |                                   |           |                            |                   |   |
| 91  |                                   |           |                            |                   |   |
| 92  |                                   |           |                            |                   |   |
| 93  | g                                 |           | 0.50                       |                   |   |
| 94  |                                   |           |                            | g                 |   |
| 95  |                                   |           | 7.9004E+00                 | g/cm <sup>3</sup> |   |
| 96  |                                   |           | 0.00E+00                   | g                 |   |
| 97  | O3+Fe2O3                          |           | 4.02909E+00                | g/cm <sup>3</sup> |   |
| 98  | Fe2O3                             |           | 8.02357E+05                | g                 |   |
| 99  |                                   |           | 8.00000E-01                |                   |   |
| 100 | 3+Void Used                       |           | 8.05817E-01                | g/cm <sup>3</sup> |   |
| 101 | 2O3+Fe2O3+Void                    |           | 9.95705E+05                | cm <sup>3</sup>   |   |
| 102 |                                   |           |                            |                   |   |

|     | I                          | J         | K                          | L      | M |
|-----|----------------------------|-----------|----------------------------|--------|---|
| 103 |                            |           |                            |        |   |
| 104 |                            |           |                            |        |   |
| 105 |                            |           |                            |        |   |
| 106 |                            |           |                            |        |   |
| 107 | h (Degraded MIT Fuel)      |           |                            |        |   |
| 108 | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |
| 109 | 235.0439                   | 92235.50C | 4.2347E-05                 |        |   |
| 110 | 234.0409                   | 92234.50C | 4.5485E-07                 |        |   |
| 111 | 238.0508                   | 92238.50C | 2.4595E-06                 |        |   |
| 112 | 26.98154                   | 13027.50C | 9.2849E-03                 |        |   |
| 113 | 55.847                     | 26000.55C | 0.0000E+00                 |        |   |
| 114 | 15.99492                   | 8016.50C  | 4.0788E-02                 |        |   |
| 115 | 1.007825                   | 1001.50C  | 5.3118E-02                 |        |   |
| 116 |                            | 64152.50C | 0.0000E+00                 |        |   |
| 117 |                            | 64154.50C | 0.0000E+00                 |        |   |
| 118 |                            | 64155.50C | 0.0000E+00                 |        |   |
| 119 |                            | 64156.50C | 0.0000E+00                 |        |   |
| 120 |                            | 64157.50C | 0.0000E+00                 |        |   |
| 121 |                            | 64158.50C | 0.0000E+00                 |        |   |
| 122 |                            | 64160.50C | 0.0000E+00                 |        |   |
| 123 |                            |           | 1.0324E-01                 |        |   |
| 124 |                            |           |                            |        |   |
| 125 |                            |           | 1254.347333                |        |   |
| 126 |                            |           |                            |        |   |
| 127 |                            |           |                            |        |   |
| 128 | Fe2O3, Void Fraction 0.85) |           |                            |        |   |
| 129 |                            |           |                            |        |   |
| 130 |                            |           |                            |        |   |
| 131 |                            |           |                            |        |   |
| 132 |                            |           |                            |        |   |
| 133 |                            |           |                            |        |   |
| 134 | g                          |           | 0.50                       |        |   |
| 135 |                            |           | 0 g                        |        |   |
| 136 |                            |           | 7.9004E+00                 | g/cm^3 |   |
| 137 |                            |           | 0.00E+00                   | g      |   |
| 138 | O3+Fe2O3                   |           | 4.02909E+00                | g/cm^3 |   |
| 139 | Fe2O3                      |           | 8.02357E+05                | g      |   |
| 140 |                            |           | 8.50000E-01                |        |   |
| 141 | O3+Void Used               |           | 6.04363E-01                | g/cm^3 |   |
| 142 | O3+Fe2O3+Void              |           | 1.32761E+06                | cm^3   |   |
| 143 |                            |           |                            |        |   |
| 144 |                            |           |                            |        |   |
| 145 |                            |           |                            |        |   |
| 146 |                            |           |                            |        |   |
| 147 |                            |           |                            |        |   |
| 148 | h (Degraded MIT Fuel)      |           |                            |        |   |
| 149 | WT                         | MCNP      | Atomic Density (#/barn cm) |        |   |
| 150 | 235.0439                   | 92235.50C | 3.1760E-05                 |        |   |
| 151 | 234.0409                   | 92234.50C | 3.4114E-07                 |        |   |
| 152 | 238.0508                   | 92238.50C | 1.8446E-06                 |        |   |
| 153 | 26.98154                   | 13027.50C | 6.9637E-03                 |        |   |

Fe\_gd

|     | I                                | J         | K                          | L      | M |
|-----|----------------------------------|-----------|----------------------------|--------|---|
| 154 | 55.847                           | 26000.55C | 0.0000E+00                 |        |   |
| 155 | 15.99492                         | 8016.50C  | 3.8958E-02                 |        |   |
| 156 | 1.007825                         | 1001.50C  | 5.6438E-02                 |        |   |
| 157 |                                  | 64152.50C | 0.0000E+00                 |        |   |
| 158 |                                  | 64154.50C | 0.0000E+00                 |        |   |
| 159 |                                  | 64155.50C | 0.0000E+00                 |        |   |
| 160 |                                  | 64156.50C | 0.0000E+00                 |        |   |
| 161 |                                  | 64157.50C | 0.0000E+00                 |        |   |
| 162 |                                  | 64158.50C | 0.0000E+00                 |        |   |
| 163 |                                  | 64160.50C | 0.0000E+00                 |        |   |
| 164 |                                  |           | 1.0239E-01                 |        |   |
| 165 |                                  |           |                            |        |   |
| 166 |                                  |           | 1776.992054                |        |   |
| 167 |                                  |           |                            |        |   |
| 168 |                                  |           |                            |        |   |
| 169 | <b>Fe2O3, Void Fraction 0.9)</b> |           |                            |        |   |
| 170 |                                  |           |                            |        |   |
| 171 |                                  |           |                            |        |   |
| 172 |                                  |           |                            |        |   |
| 173 |                                  |           |                            |        |   |
| 174 |                                  |           |                            |        |   |
| 175 | g                                |           | 0.50                       |        |   |
| 176 |                                  |           |                            | g      |   |
| 177 |                                  |           | 7.9004E+00                 | g/cm^3 |   |
| 178 |                                  |           | 0.00E+00                   | g      |   |
| 179 | O3+Fe2O3                         |           | 4.02909E+00                | g/cm^3 |   |
| 180 | Fe2O3                            |           | 8.02357E+05                | g      |   |
| 181 |                                  |           | 9.00000E-01                |        |   |
| 182 | O3+Void Used                     |           | 4.02909E-01                | g/cm^3 |   |
| 183 | O3+Fe2O3+Void                    |           | 1.99141E+06                | cm^3   |   |
| 184 |                                  |           |                            |        |   |
| 185 |                                  |           |                            |        |   |
| 186 |                                  |           |                            |        |   |
| 187 |                                  |           |                            |        |   |
| 188 |                                  |           |                            |        |   |
| 189 | <b>h (Degraded MIT Fuel)</b>     |           |                            |        |   |
| 190 | WT                               | MCNP      | Atomic Density (#/barn cm) |        |   |
| 191 | 235.0439                         | 92235.50C | 2.1173E-05                 |        |   |
| 192 | 234.0409                         | 92234.50C | 2.2742E-07                 |        |   |
| 193 | 238.0508                         | 92238.50C | 1.2298E-06                 |        |   |
| 194 | 26.98154                         | 13027.50C | 4.6425E-03                 |        |   |
| 195 | 55.847                           | 26000.55C | 0.0000E+00                 |        |   |
| 196 | 15.99492                         | 8016.50C  | 3.7129E-02                 |        |   |
| 197 | 1.007825                         | 1001.50C  | 5.9757E-02                 |        |   |
| 198 |                                  | 64152.50C | 0.0000E+00                 |        |   |
| 199 |                                  | 64154.50C | 0.0000E+00                 |        |   |
| 200 |                                  | 64155.50C | 0.0000E+00                 |        |   |
| 201 |                                  | 64156.50C | 0.0000E+00                 |        |   |
| 202 |                                  | 64157.50C | 0.0000E+00                 |        |   |
| 203 |                                  | 64158.50C | 0.0000E+00                 |        |   |
| 204 |                                  | 64160.50C | 0.0000E+00                 |        |   |

Fe\_gd

|     | I | J | K           | L | M |
|-----|---|---|-------------|---|---|
| 205 |   |   | 1.0155E-01  |   |   |
| 206 |   |   |             |   |   |
| 207 |   |   | 2822.281498 |   |   |

Homogen

|    | A | B  | C | D                                     | E                             | F |
|----|---|--|---|---------------------------------------|-------------------------------|---|
| 1  |   |  |   |                                       |                               |   |
| 2  |   |  |   | <b>DHLW and Degraded MIT Fuel Hom</b> |                               |   |
| 3  |   |  |   |                                       |                               |   |
| 4  |   |  |   |                                       |                               |   |
| 5  |   | Cylinder Segment Volume Calculation                          |   |                                       |                               |   |
| 6  |   |  |   |                                       |                               |   |
| 7  |   | Geometry Calculations  |   |                                       |                               |   |
| 8  |   |  |   |                                       |                               |   |
| 9  |   | Cylinder Radius (R)  |   | 86.5                                  | cm                            |   |
| 10 |   | Cylinder Length (lt)   |   | 304                                   | cm                            |   |
| 11 |   | Cylinder Volume  |   | 7.14588E+06                           | cm <sup>3</sup>               |   |
| 12 |   | 1/2 Cylinder Volume  |   | 3.57294E+06                           |                               |   |
| 13 |   | DHLW Volume  |   | 4.9933E+06                            | cm <sup>3</sup>               |   |
| 14 |   | Degraded MIT Volume  |   | 2.00970E+05                           | cm <sup>3</sup>               |   |
| 15 |   | Mass of Fe <sub>2</sub> O <sub>3</sub>                       |   | 0.00000E+00                           | g                             |   |
| 16 |   | Den. of Fe <sub>2</sub> O <sub>3</sub>                       |   | 5.24000E+00                           | g/cm <sup>3</sup>             |   |
| 17 |   | Vol. of Fe <sub>2</sub> O <sub>3</sub>                       |   | 0.00000E+00                           |                               |   |
| 18 |   | Void Fraction  |   |                                       |                               |   |
| 19 |   | Total Volume   |   | 6.49284E+06                           | cm <sup>3</sup>               |   |
| 20 |   | Calculated Volume  |   | 6.49284E+06                           | cm <sup>3</sup>               |   |
| 21 |   | Dis. from Center (y)   |   | 6.10608E+01                           | cm                            |   |
| 22 |   |  |   |                                       |                               |   |
| 23 |   |  |   |                                       |                               |   |
| 24 |   |  |   |                                       |                               |   |
| 25 |   |  |   |                                       |                               |   |
| 26 |   |  |   |                                       |                               |   |
| 27 |   |  |   |                                       |                               |   |
| 28 |   |  |   |                                       |                               |   |
| 29 |   |  |   |                                       |                               |   |
| 30 |   |  |   |                                       |                               |   |
| 31 |   | <b>Total Volume =</b>  |   | <b>(DHLW Volume + Degraded MIT Vo</b> |                               |   |
| 32 |   |  |   |                                       |                               |   |
| 33 |   | <b>Calculated Volume = Total Volume =</b>                    |   | <b>1/2 Cyl. Vo</b>                    |                               |   |
| 34 |   |  |   |                                       |                               |   |
| 35 |   | <b>DHLW Clay Atomic Number Densities are from mitclay-2.</b> |   |                                       |                               |   |
| 36 |   |  |   |                                       |                               |   |
| 37 |   | <b>Mixture Atomic Numbers Den =</b>                          |   | <b>DHLW Clay Atomic N</b>             |                               |   |
| 38 |   |  |   |                                       |                               |   |
| 39 |   |  |   |                                       | <b>+ MIT Isotope Mass *</b>   |   |
| 40 |   |  |   |                                       |                               |   |
| 41 |   |  |   |                                       | <b>+ Void Fraction * 0.06</b> |   |
| 42 |   |  |   |                                       |                               |   |
| 43 |   |  |   |                                       | <b>+ Void Fraction * 0.03</b> |   |
| 44 |   |  |   |                                       |                               |   |
| 45 |   |  |   |                                       |                               |   |
| 46 |   |  |   |                                       |                               |   |

Homogen

|    | G   | H           | I | J                 | K        | L        | M |
|----|---|-------------|---|-------------------|----------|----------|---|
| 1  |   |             |   |                   |          |          |   |
| 2  | <b>ogeneous Mixture</b>                                   |             |   |                   |          |          |   |
| 3  |   |             |   |                   |          |          |   |
| 4  | DHLW Clay   |             |   | Degraded MIT Fuel |          |          |   |
| 5  | (atom/barn/cm)  |             |   |                   | Mass(g)  | WT       |   |
| 6  | H   | 3.55893E-03 |   |                   |          |          |   |
| 7  | O   | 1.97883E-02 |   | O                 | 3.73E+05 | 15.99492 |   |
| 8  | F   | 5.88292E-07 |   |                   |          |          |   |
| 9  | Na  | 2.49797E-05 |   |                   |          |          |   |
| 10 | Mg  | 2.57324E-04 |   |                   |          |          |   |
| 11 | Al  | 1.18129E-03 |   | Al                | 4.14E+05 | 26.98154 |   |
| 12 | Si  | 6.18950E-03 |   |                   |          |          |   |
| 13 | P   | 1.76488E-06 |   |                   |          |          |   |
| 14 | K   | 4.59207E-04 |   |                   |          |          |   |
| 15 | Ca  | 1.34777E-04 |   |                   |          |          |   |
| 16 | Mn  | 2.50252E-04 |   |                   |          |          |   |
| 17 | Fe  | 1.67546E-03 |   | Fe                | 0.00E+00 | 55.847   |   |
| 18 | Ni  | 2.05882E-04 |   |                   |          |          |   |
| 19 | U-238   | 0.00000E+00 |   | U-238             | 1936     | 238.0508 |   |
| 20 |   |             |   | U-235             | 32912    | 235.0439 |   |
| 21 |   |             |   | U-234             | 352      | 234.0409 |   |
| 22 | Pu-239  | 1.03481E-09 |   |                   |          |          |   |
| 23 |   |             |   |                   |          |          |   |
| 24 |   |             |   |                   |          |          |   |
| 25 |   |             |   |                   |          |          |   |
| 26 |   |             |   |                   |          |          |   |
| 27 |   |             |   |                   |          |          |   |
| 28 |   |             |   |                   |          |          |   |
| 29 |   |             |   |                   |          |          |   |
| 30 |   |             |   |                   |          |          |   |
| 31 | ume)/(1 - Void Fraction)                                  |             |   |                   |          |          |   |
| 32 |   |             |   |                   |          |          |   |
| 33 | lume + It*(y*sqrt(r^2-y^2) + r^2*arccos(sqrt(r^2-y^2)/r)) |             |   |                   |          |          |   |
| 34 |   |             |   |                   |          |          |   |
| 35 | xls spreadsheet.  |             |   |                   |          |          |   |
| 36 |   |             |   |                   |          |          |   |
| 37 | um. Den. * DHLW Volume / Total Volume                     |             |   |                   |          |          |   |
| 38 |   |             |   |                   |          |          |   |
| 39 | Avogadro's Number / Molecular Weight / Total Volume       |             |   |                   |          |          |   |
| 40 |   |             |   |                   |          |          |   |
| 41 | 6878 (If Hydrogen)  |             |   |                   |          |          |   |
| 42 |   |             |   |                   |          |          |   |
| 43 | 3439 (If Oxygen)  |             |   |                   |          |          |   |
| 44 |   |             |   |                   |          |          |   |
| 45 |   |             |   |                   |          |          |   |
| 46 |   |             |   |                   |          |          |   |

Homogen

|    | N                   | O         | P               |
|----|---------------------|-----------|-----------------|
| 1  | Void Frac.          | 0.2       |                 |
| 2  | Homogeneous Mixture |           |                 |
| 3  |                     |           | (atoms/barn cm) |
| 4  |                     |           |                 |
| 5  |                     |           |                 |
| 6  | H                   | 1001.50C  | 1.6113E-02      |
| 7  | O                   | 8016.50C  | 2.4069E-02      |
| 8  | F                   | 9019.50C  | 4.5242E-07      |
| 9  | Na                  | 11023.50C | 1.9211E-05      |
| 10 | Mg                  | 12000.50C | 1.9789E-04      |
| 11 | Al                  | 13027.50C | 2.3324E-03      |
| 12 | Si                  | 14000.50C | 4.7600E-03      |
| 13 | P                   | 15031.50C | 1.3573E-06      |
| 14 | K                   | 19000.50C | 3.5315E-04      |
| 15 | Ca                  | 20000.50C | 1.0365E-04      |
| 16 | Mn                  | 25055.50C | 1.9246E-04      |
| 17 | Fe                  | 26000.55C | 1.2885E-03      |
| 18 | Ni                  | 28000.50C | 1.5833E-04      |
| 19 | U-238               | 92238.50C | 7.5436E-07      |
| 20 | U-235               | 92235.50C | 1.2988E-05      |
| 21 | U-234               | 92234.50C | 1.3951E-07      |
| 22 | Pu-239              | 94239.55C | 7.9581E-10      |
| 23 |                     |           |                 |
| 24 | Total               |           | 4.9603E-02      |
| 25 |                     |           |                 |
| 26 | H/U-235             |           | 1240.555654     |
| 27 |                     |           |                 |
| 28 |                     |           |                 |
| 29 |                     |           |                 |
| 30 |                     |           |                 |
| 31 |                     |           |                 |
| 32 |                     |           |                 |
| 33 |                     |           |                 |
| 34 |                     |           |                 |
| 35 |                     |           |                 |
| 36 |                     |           |                 |
| 37 |                     |           |                 |
| 38 |                     |           |                 |
| 39 |                     |           |                 |
| 40 |                     |           |                 |
| 41 |                     |           |                 |
| 42 |                     |           |                 |
| 43 |                     |           |                 |
| 44 |                     |           |                 |
| 45 |                     |           |                 |
| 46 |                     |           |                 |



Homogen

|    | A   | B                                      | C | D           | E                 | F | G         | H              | I           | J                 | K        |  |
|----|---|--|---|-------------|-------------------|---|-----------|----------------|-------------|-------------------|----------|--|
| 1  |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 2  | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.0)</b> |  |   |             |                   |   |           |                |             |                   |          |  |
| 3  |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 4  |   |  |   |             |                   |   | DHLW Clay |                |             | Degraded MIT Fuel |          |  |
| 5  |   | Cylinder Segment Volume Calculation    |   |             |                   |   |           | (atom/barn/cm) |             |                   | Mass(g)  |  |
| 6  |   |  |   |             |                   |   | H         | 3.55893E-03    |             |                   |          |  |
| 7  |   | Geometry Calculations                  |   |             |                   |   |           | O              | 1.97883E-02 | O                 | 3.73E+05 |  |
| 8  |   |  |   |             |                   |   | F         | 5.88292E-07    |             |                   |          |  |
| 9  |   | Cylinder Radius (R)                    |   | 86.5        | cm                |   | Na        | 2.49797E-05    |             |                   |          |  |
| 10 |   | Cylinder Length                        |   | 304         | cm                |   | Mg        | 2.57324E-04    |             |                   |          |  |
| 11 |   | Cylinder Volume                        |   | 7.14588E+06 | cm <sup>3</sup>   |   | Al        | 1.18129E-03    | Al          | 4.14E+05          |          |  |
| 12 |   | 1/2 Cylinder Volume                    |   | 3.57294E+06 |                   |   | Si        | 6.18950E-03    |             |                   |          |  |
| 13 |   | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | P         | 1.76488E-06    |             |                   |          |  |
| 14 |   | Degraded MIT Volume                    |   | 2.00970E+05 | cm <sup>3</sup>   |   | K         | 4.59207E-04    |             |                   |          |  |
| 15 |   | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.00000E+00 | g                 |   | Ca        | 1.34777E-04    |             |                   |          |  |
| 16 |   | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.24000E+00 | g/cm <sup>3</sup> |   | Mn        | 2.50252E-04    |             |                   |          |  |
| 17 |   | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.00000E+00 |                   |   | Fe        | 1.67546E-03    | Fe          | 0.00E+00          |          |  |
| 18 |   | Void Fraction                          |   |             |                   |   | Ni        | 2.05882E-04    |             |                   |          |  |
| 19 |   | Total Volume                           |   | 5.19427E+06 | cm <sup>3</sup>   |   | U-238     | 0.00000E+00    | U-238       | 1936              |          |  |
| 20 |   | Calculated Volume                      |   | 5.19427E+06 | cm <sup>3</sup>   |   |           |                | U-235       | 32912             |          |  |
| 21 |   | Dis. from Center (y)                   |   | 3.15421E+01 | cm                |   |           |                | U-234       | 352               |          |  |
| 22 |   |  |   |             |                   |   | Pu-239    | 1.03481E-09    |             |                   |          |  |
| 23 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 24 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 25 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 26 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 27 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 28 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 29 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 30 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 31 | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.1)</b> |  |   |             |                   |   |           |                |             |                   |          |  |
| 32 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 33 |   |  |   |             |                   |   | DHLW Clay |                |             | Degraded MIT Fuel |          |  |
| 34 |   | Cylinder Segment Volume Calculation    |   |             |                   |   |           | (atom/barn/cm) |             |                   | Mass(g)  |  |
| 35 |   |  |   |             |                   |   | H         | 3.55893E-03    |             |                   |          |  |
| 36 |   | Geometry Calculations                  |   |             |                   |   |           | O              | 1.97883E-02 | O                 | 3.73E+05 |  |
| 37 |   |  |   |             |                   |   | F         | 5.88292E-07    |             |                   |          |  |
| 38 |   | Cylinder Radius (R)                    |   | 86.5        | cm                |   | Na        | 2.49797E-05    |             |                   |          |  |
| 39 |   | Cylinder Length                        |   | 304         | cm                |   | Mg        | 2.57324E-04    |             |                   |          |  |
| 40 |   | Cylinder Volume                        |   | 7.14588E+06 | cm <sup>3</sup>   |   | Al        | 1.18129E-03    | Al          | 4.14E+05          |          |  |
| 41 |   | 1/2 Cylinder Volume                    |   | 3.57294E+06 |                   |   | Si        | 6.18950E-03    |             |                   |          |  |
| 42 |   | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | P         | 1.76488E-06    |             |                   |          |  |
| 43 |   | Degraded MIT Volume                    |   | 2.00970E+05 | cm <sup>3</sup>   |   | K         | 4.59207E-04    |             |                   |          |  |
| 44 |   | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.00000E+00 | g                 |   | Ca        | 1.34777E-04    |             |                   |          |  |
| 45 |   | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.24000E+00 | g/cm <sup>3</sup> |   | Mn        | 2.50252E-04    |             |                   |          |  |
| 46 |   | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.00000E+00 |                   |   | Fe        | 1.67546E-03    | Fe          | 0.00E+00          |          |  |
| 47 |   | Void Fraction                          |   |             |                   |   | Ni        | 2.05882E-04    |             |                   |          |  |
| 48 |   | Total Volume                           |   | 5.77141E+06 | cm <sup>3</sup>   |   | U-238     | 0.00000E+00    | U-238       | 1936              |          |  |
| 49 |   | Calculated Volume                      |   | 5.77141E+06 | cm <sup>3</sup>   |   |           |                | U-235       | 32912             |          |  |
| 50 |   | Dis. from Center (y)                   |   | 4.37463E+01 | cm                |   |           |                | U-234       | 352               |          |  |
| 51 |   |  |   |             |                   |   | Pu-239    | 1.03481E-09    |             |                   |          |  |
| 52 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 53 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 54 |   |  |   |             |                   |   |           |                |             |                   |          |  |
| 55 |   |  |   |             |                   |   |           |                |             |                   |          |  |

Homogen

|     | A | B                                   | C | D  | E                 | F | G              | H           | I | J                 | K        |  |  |
|-----|---|-------------------------------------|---|--|-------------------|---|----------------|-------------|---|-------------------|----------|--|--|
| 56  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 57  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 58  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 59  |   |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.2)</b>  |                   |   |                |             |   |                   |          |  |  |
| 60  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 61  |   |                                     |   |  |                   |   | DHLW Clay      |             |   | Degraded MIT Fuel |          |  |  |
| 62  |   | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |   | Mass(g)           |          |  |  |
| 63  |   |                                     |   |  |                   |   | H              | 3.55893E-03 |   |                   |          |  |  |
| 64  |   | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |   | O                 | 3.73E+05 |  |  |
| 65  |   |                                     |   |  |                   |   | F              | 5.88292E-07 |   |                   |          |  |  |
| 66  |   | Cylinder Radius (R)                 |   | 86.5   | cm                |   | Na             | 2.49797E-05 |   |                   |          |  |  |
| 67  |   | Cylinder Length                     |   | 304  | cm                |   | Mg             | 2.57324E-04 |   |                   |          |  |  |
| 68  |   | Cylinder Volume                     |   | 7.14588E+06  | cm <sup>3</sup>   |   | Al             | 1.18129E-03 |   | Al                | 4.14E+05 |  |  |
| 69  |   | 1/2 Cylinder Volume                 |   | 3.57294E+06  |                   |   | Si             | 6.18950E-03 |   |                   |          |  |  |
| 70  |   | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | P              | 1.76488E-06 |   |                   |          |  |  |
| 71  |   | Degraded MIT Volume                 |   | 2.00970E+05  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |   |                   |          |  |  |
| 72  |   | Mass of Fe2O3                       |   | 0.00000E+00  | g                 |   | Ca             | 1.34777E-04 |   |                   |          |  |  |
| 73  |   | Den. of Fe2O3                       |   | 5.24000E+00  | g/cm <sup>3</sup> |   | Mn             | 2.50252E-04 |   |                   |          |  |  |
| 74  |   | Vol. of Fe2O3                       |   | 0.00000E+00  |                   |   | Fe             | 1.67546E-03 |   | Fe                | 0.00E+00 |  |  |
| 75  |   | Void Fraction                       |   |  |                   |   | Ni             | 2.05882E-04 |   |                   |          |  |  |
| 76  |   | Total Volume                        |   | 6.49284E+06  | cm <sup>3</sup>   |   | U-238          | 0.00000E+00 |   | U-238             | 1936     |  |  |
| 77  |   | Calculated Volume                   |   | 6.49284E+06  | cm <sup>3</sup>   |   |                |             |   | U-235             | 32912    |  |  |
| 78  |   | Dis. from Center (y)                |   | 6.10608E+01  | cm                |   |                |             |   | U-234             | 352      |  |  |
| 79  |   |                                     |   |  |                   |   | Pu-239         | 1.03481E-09 |   |                   |          |  |  |
| 80  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 81  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 82  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 83  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 84  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 85  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 86  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 87  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 88  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 89  |   |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.25)</b> |                   |   |                |             |   |                   |          |  |  |
| 90  |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 91  |   |                                     |   |  |                   |   | DHLW Clay      |             |   | Degraded MIT Fuel |          |  |  |
| 92  |   | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |   | Mass(g)           |          |  |  |
| 93  |   |                                     |   |  |                   |   | H              | 3.55893E-03 |   |                   |          |  |  |
| 94  |   | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |   | O                 | 3.73E+05 |  |  |
| 95  |   |                                     |   |  |                   |   | F              | 5.88292E-07 |   |                   |          |  |  |
| 96  |   | Cylinder Radius (R)                 |   | 86.5   | cm                |   | Na             | 2.49797E-05 |   |                   |          |  |  |
| 97  |   | Cylinder Length                     |   | 304  | cm                |   | Mg             | 2.57324E-04 |   |                   |          |  |  |
| 98  |   | Cylinder Volume                     |   | 7.14588E+06  | cm <sup>3</sup>   |   | Al             | 1.18129E-03 |   | Al                | 4.14E+05 |  |  |
| 99  |   | 1/2 Cylinder Volume                 |   | 3.57294E+06  |                   |   | Si             | 6.18950E-03 |   |                   |          |  |  |
| 100 |   | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | P              | 1.76488E-06 |   |                   |          |  |  |
| 101 |   | Degraded MIT Volume                 |   | 2.00970E+05  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |   |                   |          |  |  |
| 102 |   | Mass of Fe2O3                       |   | 0.00000E+00  | g                 |   | Ca             | 1.34777E-04 |   |                   |          |  |  |
| 103 |   | Den. of Fe2O3                       |   | 5.24000E+00  | g/cm <sup>3</sup> |   | Mn             | 2.50252E-04 |   |                   |          |  |  |
| 104 |   | Vol. of Fe2O3                       |   | 0.00000E+00  |                   |   | Fe             | 1.67546E-03 |   | Fe                | 0.00E+00 |  |  |
| 105 |   | Void Fraction                       |   |  |                   |   | Ni             | 2.05882E-04 |   |                   |          |  |  |
| 106 |   | Total Volume                        |   | 6.92569E+06  | cm <sup>3</sup>   |   | U-238          | 0.00000E+00 |   | U-238             | 1936     |  |  |
| 107 |   | Calculated Volume                   |   | 6.92569E+06  | cm <sup>3</sup>   |   |                |             |   | U-235             | 32912    |  |  |
| 108 |   | Dis. from Center (y)                |   | 7.43790E+01  | cm                |   |                |             |   | U-234             | 352      |  |  |
| 109 |   |                                     |   |  |                   |   | Pu-239         | 1.03481E-09 |   |                   |          |  |  |
| 110 |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 111 |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 112 |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |
| 113 |   |                                     |   |  |                   |   |                |             |   |                   |          |  |  |

## Homogen

|    | L        | M | N                   | O         | P               | Q |
|----|----------|---|---------------------|-----------|-----------------|---|
| 1  |          |   | Void Frac.          | 0         |                 |   |
| 2  |          |   | Homogeneous Mixture |           |                 |   |
| 3  |          |   |                     |           | (atoms/barn cm) |   |
| 4  |          |   |                     |           |                 |   |
| 5  | WT       |   |                     |           |                 |   |
| 6  |          |   | H                   | 1001.50C  | 3.4212E-03      |   |
| 7  | 15.99492 |   | O                   | 8016.50C  | 2.1726E-02      |   |
| 8  |          |   | F                   | 9019.50C  | 5.6553E-07      |   |
| 9  |          |   | Na                  | 11023.50C | 2.4013E-05      |   |
| 10 |          |   | Mg                  | 12000.50C | 2.4737E-04      |   |
| 11 | 26.98154 |   | Al                  | 13027.50C | 2.9154E-03      |   |
| 12 |          |   | Si                  | 14000.50C | 5.9500E-03      |   |
| 13 |          |   | P                   | 15031.50C | 1.6966E-06      |   |
| 14 |          |   | K                   | 19000.50C | 4.4144E-04      |   |
| 15 |          |   | Ca                  | 20000.50C | 1.2956E-04      |   |
| 16 |          |   | Mn                  | 25055.50C | 2.4057E-04      |   |
| 17 | 55.847   |   | Fe                  | 26000.55C | 1.6106E-03      |   |
| 18 |          |   | Ni                  | 28000.50C | 1.9792E-04      |   |
| 19 | 238.0508 |   | U-238               | 92238.50C | 9.4295E-07      |   |
| 20 | 235.0439 |   | U-235               | 92235.50C | 1.6235E-05      |   |
| 21 | 234.0409 |   | U-234               | 92234.50C | 1.7438E-07      |   |
| 22 |          |   | Pu-239              | 94239.55C | 9.9477E-10      |   |
| 23 |          |   |                     |           |                 |   |
| 24 |          |   | Total               |           | 3.6924E-02      |   |
| 25 |          |   |                     |           |                 |   |
| 26 |          |   | H/U-235             |           | 210.72861       |   |
| 27 |          |   |                     |           |                 |   |
| 28 |          |   |                     |           |                 |   |
| 29 |          |   |                     |           |                 |   |
| 30 |          |   | Void Frac.          | 0.1       |                 |   |
| 31 |          |   | Homogeneous Mixture |           |                 |   |
| 32 |          |   |                     |           | (atoms/barn cm) |   |
| 33 |          |   |                     |           |                 |   |
| 34 | WT       |   |                     |           |                 |   |
| 35 |          |   | H                   | 1001.50C  | 9.7669E-03      |   |
| 36 | 15.99492 |   | O                   | 8016.50C  | 2.2898E-02      |   |
| 37 |          |   | F                   | 9019.50C  | 5.0898E-07      |   |
| 38 |          |   | Na                  | 11023.50C | 2.1612E-05      |   |
| 39 |          |   | Mg                  | 12000.50C | 2.2263E-04      |   |
| 40 | 26.98154 |   | Al                  | 13027.50C | 2.6239E-03      |   |
| 41 |          |   | Si                  | 14000.50C | 5.3550E-03      |   |
| 42 |          |   | P                   | 15031.50C | 1.5269E-06      |   |
| 43 |          |   | K                   | 19000.50C | 3.9730E-04      |   |
| 44 |          |   | Ca                  | 20000.50C | 1.1661E-04      |   |
| 45 |          |   | Mn                  | 25055.50C | 2.1651E-04      |   |
| 46 | 55.847   |   | Fe                  | 26000.55C | 1.4496E-03      |   |
| 47 |          |   | Ni                  | 28000.50C | 1.7812E-04      |   |
| 48 | 238.0508 |   | U-238               | 92238.50C | 8.4866E-07      |   |
| 49 | 235.0439 |   | U-235               | 92235.50C | 1.4612E-05      |   |
| 50 | 234.0409 |   | U-234               | 92234.50C | 1.5694E-07      |   |
| 51 |          |   | Pu-239              | 94239.55C | 8.9529E-10      |   |
| 52 |          |   |                     |           |                 |   |
| 53 |          |   | Total               |           | 4.3263E-02      |   |
| 54 |          |   |                     |           |                 |   |
| 55 |          |   | H/U-235             |           | 668.42952       |   |

## Homogen

|     | L        | M | N                   | O         | P               | Q |
|-----|----------|---|---------------------|-----------|-----------------|---|
| 56  |          |   |                     |           |                 |   |
| 57  |          |   |                     |           |                 |   |
| 58  |          |   | Void Frac.          | 0.2       |                 |   |
| 59  |          |   | Homogeneous Mixture |           |                 |   |
| 60  |          |   |                     |           | (atoms/barn cm) |   |
| 61  |          |   |                     |           |                 |   |
| 62  | WT       |   |                     |           |                 |   |
| 63  |          |   | H                   | 1001.50C  | 1.6113E-02      |   |
| 64  | 15.99492 |   | O                   | 8016.50C  | 2.4069E-02      |   |
| 65  |          |   | F                   | 9019.50C  | 4.5242E-07      |   |
| 66  |          |   | Na                  | 11023.50C | 1.9211E-05      |   |
| 67  |          |   | Mg                  | 12000.50C | 1.9789E-04      |   |
| 68  | 26.98154 |   | Al                  | 13027.50C | 2.3324E-03      |   |
| 69  |          |   | Si                  | 14000.50C | 4.7600E-03      |   |
| 70  |          |   | P                   | 15031.50C | 1.3573E-06      |   |
| 71  |          |   | K                   | 19000.50C | 3.5315E-04      |   |
| 72  |          |   | Ca                  | 20000.50C | 1.0365E-04      |   |
| 73  |          |   | Mn                  | 25055.50C | 1.9246E-04      |   |
| 74  | 55.847   |   | Fe                  | 26000.55C | 1.2885E-03      |   |
| 75  |          |   | Ni                  | 28000.50C | 1.5833E-04      |   |
| 76  | 238.0508 |   | U-238               | 92238.50C | 7.5436E-07      |   |
| 77  | 235.0439 |   | U-235               | 92235.50C | 1.2988E-05      |   |
| 78  | 234.0409 |   | U-234               | 92234.50C | 1.3951E-07      |   |
| 79  |          |   | Pu-239              | 94239.55C | 7.9581E-10      |   |
| 80  |          |   |                     |           |                 |   |
| 81  |          |   | Total               |           | 4.9603E-02      |   |
| 82  |          |   |                     |           |                 |   |
| 83  |          |   | H/U-235             |           | 1240.5557       |   |
| 84  |          |   |                     |           |                 |   |
| 85  |          |   |                     |           |                 |   |
| 86  |          |   |                     |           |                 |   |
| 87  |          |   |                     |           |                 |   |
| 88  |          |   | Void Frac.          | 0.25      |                 |   |
| 89  |          |   | Homogeneous Mixture |           |                 |   |
| 90  |          |   |                     |           | (atoms/barn cm) |   |
| 91  |          |   |                     |           |                 |   |
| 92  | WT       |   |                     |           |                 |   |
| 93  |          |   | H                   | 1001.50C  | 1.9285E-02      |   |
| 94  | 15.99492 |   | O                   | 8016.50C  | 2.4654E-02      |   |
| 95  |          |   | F                   | 9019.50C  | 4.2415E-07      |   |
| 96  |          |   | Na                  | 11023.50C | 1.8010E-05      |   |
| 97  |          |   | Mg                  | 12000.50C | 1.8553E-04      |   |
| 98  | 26.98154 |   | Al                  | 13027.50C | 2.1866E-03      |   |
| 99  |          |   | Si                  | 14000.50C | 4.4625E-03      |   |
| 100 |          |   | P                   | 15031.50C | 1.2724E-06      |   |
| 101 |          |   | K                   | 19000.50C | 3.3108E-04      |   |
| 102 |          |   | Ca                  | 20000.50C | 9.7172E-05      |   |
| 103 |          |   | Mn                  | 25055.50C | 1.8043E-04      |   |
| 104 | 55.847   |   | Fe                  | 26000.55C | 1.2080E-03      |   |
| 105 |          |   | Ni                  | 28000.50C | 1.4844E-04      |   |
| 106 | 238.0508 |   | U-238               | 92238.50C | 7.0721E-07      |   |
| 107 | 235.0439 |   | U-235               | 92235.50C | 1.2176E-05      |   |
| 108 | 234.0409 |   | U-234               | 92234.50C | 1.3079E-07      |   |
| 109 |          |   | Pu-239              | 94239.55C | 7.4608E-10      |   |
| 110 |          |   |                     |           |                 |   |
| 111 |          |   | Total               |           | 5.2772E-02      |   |
| 112 |          |   |                     |           |                 |   |
| 113 |          |   | H/U-235             |           | 1583.8313       |   |

|    | A       | B  | C | D   | E | F | G         | H              |             |
|----|---------|--|---|---|---|---|-----------|----------------|-------------|
| 1  |         |  |   |   |   |   |           |                |             |
| 2  |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>           |   |   |           |                |             |
| 3  |         |  |   |   |   |   |           |                |             |
| 4  |         |  |   |   |   |   | DHLW Clay |                |             |
| 5  |         | Cylinder Segment Volume Calculation                                    |   |   |   |   |           | (atom/barn/cm) |             |
| 6  |         |  |   |   |   |   | H         | 3.55893E-03    |             |
| 7  |         | Geometry Calculations  |   |   |   |   |           | O              | 1.97883E-02 |
| 8  |         |  |   |   |   |   | F         | 5.88292E-07    |             |
| 9  |         | UO2 Frac. Remaing  |   | 0.75  |   |   | Na        | 2.49797E-05    |             |
| 10 |         | Cylinder Radius (R)  |   | 86.5 cm   |   |   | Mg        | 2.57324E-04    |             |
| 11 |         | Cylinder Length (lt)   |   | 304 cm  |   |   | Al        | 1.18129E-03    |             |
| 12 |         | Cylinder Volume  |   | 7.1459E+06 cm <sup>3</sup>  |   |   | Si        | 6.18950E-03    |             |
| 13 |         | 1/2 Cylinder Volume  |   | 3.5729E+06  |   |   | P         | 1.76488E-06    |             |
| 14 |         | DHLW Volume  |   | 4.9933E+06 cm <sup>3</sup>  |   |   | K         | 4.59207E-04    |             |
| 15 |         | Degraded MIT Volume  |   | 2.0005E+05 cm <sup>3</sup>  |   |   | Ca        | 1.34777E-04    |             |
| 16 |         | Mass of Gd   |   | 0.0000E+00 g  |   |   | Mn        | 2.50252E-04    |             |
| 17 |         | Den. of Gd   |   | 7.9004E+00 g/cm <sup>3</sup>  |   |   | Fe        | 1.67546E-03    |             |
| 18 |         | Vol. of Gd   |   | 0.0000E+00 cm <sup>3</sup>  |   |   | Ni        | 2.05882E-04    |             |
| 19 |         | Mass of Fe2O3  |   | 0.0000E+00 g  |   |   | U-238     | 0.00000E+00    |             |
| 20 |         | Den. of Fe2O3  |   | 5.2400E+00 g/cm <sup>3</sup>  |   |   |           |                |             |
| 21 |         | Vol. of Fe2O3  |   | 0.0000E+00 cm <sup>3</sup>  |   |   |           |                |             |
| 22 | Total   | Void Fraction  |   |   |   |   | Pu-239    | 1.03481E-09    |             |
| 23 |         | Total Volume   |   | 7.1337E+06 cm <sup>3</sup>  |   |   |           |                |             |
| 24 |         | Calculated Volume  |   | 7.1337E+06 cm <sup>3</sup>  |   |   | Total     | 3.37283E-02    |             |
| 25 | Mixture | Dis. from Center (y2)  |   | 8.47600E+01 cm  |   |   |           |                |             |
| 26 |         | Frac. of DHLW Mixed  |   |   |   |   |           |                |             |
| 27 |         | with MIT Fuel  |   | 1.5000E-01  |   |   |           |                |             |
| 28 |         | Mixture Volume   |   | 1.3036E+06 cm <sup>3</sup>  |   |   |           |                |             |
| 29 |         | Calculated Volume  |   | 1.3036E+06 cm <sup>3</sup>  |   |   |           |                |             |
| 30 |         | Dis. from Center (y1)  |   | 4.53190E+01 cm  |   |   |           |                |             |
| 31 |         |  |   |   |   |   |           |                |             |
| 32 |         |  |   |   |   |   |           |                |             |
| 33 |         |  |   |   |   |   |           |                |             |
| 34 |         |  |   |   |   |   |           |                |             |
| 35 |         |  |   |   |   |   |           |                |             |
| 36 |         |  |   |   |   |   |           |                |             |
| 37 |         | Total Volume =   |   | (Vol. Of DHLW + Vol. Of MIT Fuel + Vol. Of Gd + Vol. Of Fe2O3)        |   |   |           |                |             |
| 38 |         |  |   |   |   |   |           |                |             |
| 39 |         | Total Volume =   |   | 1/2 Cyl. Volume + lt*(y2*sqrt(r^2-y2^2) + r^2*arccos(sqrt(r^2-y2^2))) |   |   |           |                |             |
| 40 |         |  |   |   |   |   |           |                |             |
| 41 |         | <b>DHLW Atomic Number Densities are from mitclay-2.xls spreadsheet</b> |   |   |   |   |           |                |             |
| 42 |         |  |   |   |   |   |           |                |             |
| 43 |         | Atomic Num. Den. =   |   | Vol. Frac. Of DHLW*Volume of DHLW* DHLW Atomic Num. D                 |   |   |           |                |             |
| 44 |         | (in the Mixture)   |   |   |   |   |           |                |             |
| 45 |         |  |   | + Mass of Isotope *Avogadro's Number / Molecular Weight /             |   |   |           |                |             |
| 46 |         |  |   |   |   |   |           |                |             |
| 47 |         |  |   | + Void Fraction * 0.066878 (If Hydrogen)                              |   |   |           |                |             |
| 48 |         |  |   |   |   |   |           |                |             |
| 49 |         |  |   | + Void Fraction * 0.033439 (If Oxygen)                                |   |   |           |                |             |
| 50 |         |  |   |   |   |   |           |                |             |
| 51 |         |  |   |   |   |   |           |                |             |

Inverse

|    | A | B                 | C   | D | E | F | G | H |
|----|---|-------------------|---|---|---|---|---|---|
| 52 |   | Atomic Num. Den.= | DHLW Atomic Num. Den. * (1-Void Fraction) |   |   |   |   |   |
| 53 |   | (DHLW Layer)      |   |   |   |   |   |   |
| 54 |   |                   | + Void Fraction * 0.033439 (If Oxygen)    |   |   |   |   |   |
| 55 |   |                   |   |   |   |   |   |   |
| 56 |   |                   | + Void Fraction * 0.066878 (If Hydrogen)  |   |   |   |   |   |

Inverse

|    | I           | J                      | K          | L        | M | N              | O         | P              |
|----|-------------|------------------------|------------|----------|---|----------------|-----------|----------------|
| 1  |             |                        |            |          |   | Void Frac.     | 0.272     |                |
| 2  | <b>DHLW</b> |                        |            |          |   |                |           |                |
| 3  |             |                        |            |          |   |                |           |                |
| 4  |             | Degraded MIT Fuel      |            |          |   | <b>Mixture</b> |           | (atoms/barn cm |
| 5  |             | Mass(g)                | WT         |          |   |                |           |                |
| 6  |             |                        |            |          |   | H              | 1001.50C  | 2.0236E-02     |
| 7  |             | O                      | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.1202E-02     |
| 8  |             |                        |            |          |   | F              | 9019.50C  | 3.3800E-07     |
| 9  |             |                        |            |          |   | Na             | 11023.50C | 1.4352E-05     |
| 10 |             |                        |            |          |   | Mg             | 12000.50C | 1.4784E-04     |
| 11 |             | Al                     | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 7.7705E-03     |
| 12 |             |                        |            |          |   | Si             | 14000.50C | 3.5561E-03     |
| 13 |             |                        |            |          |   | P              | 15031.50C | 1.0140E-06     |
| 14 |             |                        |            |          |   | K              | 19000.50C | 2.6383E-04     |
| 15 |             |                        |            |          |   | Ca             | 20000.50C | 7.7435E-05     |
| 16 |             |                        |            |          |   | Mn             | 25055.50C | 1.4378E-04     |
| 17 |             | Fe                     | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 9.6262E-04     |
| 18 |             |                        |            |          |   | Ni             | 28000.50C | 1.1829E-04     |
| 19 |             | U-238                  | 1452       | 238.0508 |   | U-238          | 92238.50C | 2.8179E-06     |
| 20 |             | U-235                  | 24684      | 235.0439 |   | U-235          | 92235.50C | 4.8516E-05     |
| 21 |             | U-234                  | 264        | 234.0409 |   | U-234          | 92234.50C | 5.2112E-07     |
| 22 |             |                        |            |          |   | Pu-239         | 94239.55C | 5.9454E-10     |
| 23 |             | Gd                     | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00     |
| 24 |             |                        |            |          |   | Gd-154         | 64154.50C | 0.0000E+00     |
| 25 |             |                        |            |          |   | Gd-155         | 64155.50C | 0.0000E+00     |
| 26 |             |                        |            |          |   | Gd-156         | 64156.50C | 0.0000E+00     |
| 27 |             |                        |            |          |   | Gd-157         | 64157.50C | 0.0000E+00     |
| 28 |             |                        |            |          |   | Gd-158         | 64158.50C | 0.0000E+00     |
| 29 |             |                        |            |          |   | Gd-160         | 64160.50C | 0.0000E+00     |
| 30 |             |                        |            |          |   |                |           |                |
| 31 |             |                        |            |          |   | Total          |           | 6.4546E-02     |
| 32 |             |                        |            |          |   |                |           |                |
| 33 |             |                        |            |          |   | H/U-235        |           | 417.0877195    |
| 34 |             |                        |            |          |   |                |           |                |
| 35 |             |                        |            |          |   |                |           |                |
| 36 |             |                        |            |          |   |                |           |                |
| 37 |             | 3)/(1 - Void Fraction) |            |          |   |                |           |                |
| 38 |             |                        |            |          |   |                |           |                |
| 39 |             | y2^2)/r)))             |            |          |   |                |           |                |
| 40 |             |                        |            |          |   |                |           |                |
| 41 |             |                        |            |          |   |                |           |                |
| 42 |             |                        |            |          |   |                |           |                |
| 43 |             | Den. / Mixture Volume  |            |          |   |                |           |                |
| 44 |             |                        |            |          |   |                |           |                |
| 45 |             | Volume                 |            |          |   |                |           |                |
| 46 |             |                        |            |          |   |                |           |                |
| 47 |             |                        |            |          |   |                |           |                |
| 48 |             |                        |            |          |   |                |           |                |
| 49 |             |                        |            |          |   |                |           |                |
| 50 |             |                        |            |          |   |                |           |                |
| 51 |             |                        |            |          |   |                |           |                |

Inverse

|    | I | J | K | L | M | N | O | P |
|----|---|---|---|---|---|---|---|---|
| 52 |   |   |   |   |   |   |   |   |
| 53 |   |   |   |   |   |   |   |   |
| 54 |   |   |   |   |   |   |   |   |
| 55 |   |   |   |   |   |   |   |   |
| 56 |   |   |   |   |   |   |   |   |



## Inverse

|    | Q | R      | S         | T               | U |
|----|---|--------|-----------|-----------------|---|
| 1  |   |        |           |                 |   |
| 2  |   |        |           |                 |   |
| 3  |   |        |           |                 |   |
| 4  | ) | DHLW   |           | (atoms/barn cm) |   |
| 5  |   |        |           |                 |   |
| 6  |   | H      | 1001.50C  | 2.0782E-02      |   |
| 7  |   | O      | 8016.50C  | 2.3501E-02      |   |
| 8  |   | F      | 9019.50C  | 4.2828E-07      |   |
| 9  |   | Na     | 11023.50C | 1.8185E-05      |   |
| 10 |   | Mg     | 12000.50C | 1.8733E-04      |   |
| 11 |   | Al     | 13027.50C | 8.5998E-04      |   |
| 12 |   | Si     | 14000.50C | 4.5060E-03      |   |
| 13 |   | P      | 15031.50C | 1.2848E-06      |   |
| 14 |   | K      | 19000.50C | 3.3430E-04      |   |
| 15 |   | Ca     | 20000.50C | 9.8118E-05      |   |
| 16 |   | Mn     | 25055.50C | 1.8218E-04      |   |
| 17 |   | Fe     | 26000.55C | 1.2197E-03      |   |
| 18 |   | Ni     | 28000.50C | 1.4988E-04      |   |
| 19 |   |        |           |                 |   |
| 20 |   |        |           |                 |   |
| 21 |   |        |           |                 |   |
| 22 |   | Pu-239 | 94239.55C | 7.5334E-10      |   |
| 23 |   | Total  |           | 5.1840E-02      |   |
| 24 |   |        |           |                 |   |
| 25 |   |        |           |                 |   |
| 26 |   |        |           |                 |   |
| 27 |   |        |           |                 |   |
| 28 |   |        |           |                 |   |
| 29 |   |        |           |                 |   |
| 30 |   |        |           |                 |   |
| 31 |   |        |           |                 |   |
| 32 |   |        |           |                 |   |
| 33 |   |        |           |                 |   |
| 34 |   |        |           |                 |   |
| 35 |   |        |           |                 |   |
| 36 |   |        |           |                 |   |
| 37 |   |        |           |                 |   |
| 38 |   |        |           |                 |   |
| 39 |   |        |           |                 |   |
| 40 |   |        |           |                 |   |
| 41 |   |        |           |                 |   |
| 42 |   |        |           |                 |   |
| 43 |   |        |           |                 |   |
| 44 |   |        |           |                 |   |
| 45 |   |        |           |                 |   |
| 46 |   |        |           |                 |   |
| 47 |   |        |           |                 |   |
| 48 |   |        |           |                 |   |
| 49 |   |        |           |                 |   |
| 50 |   |        |           |                 |   |
| 51 |   |        |           |                 |   |

Inverse

|    | Q | R | S | T | U |
|----|---|---|---|---|---|
| 52 |   |   |   |   |   |
| 53 |   |   |   |   |   |
| 54 |   |   |   |   |   |
| 55 |   |   |   |   |   |
| 56 |   |   |   |   |   |

## Inverse

|    | A       | B  | C           | D                 | E | F | G         | H              |             |
|----|---------|--|-------------|-------------------|---|---|-----------|----------------|-------------|
| 1  |         |  |             |                   |   |   |           |                |             |
| 2  |         | <b>Full Uranium Loading</b>  |             |                   |   |   |           |                |             |
| 3  |         |  |             |                   |   |   |           |                |             |
| 4  |         |  |             |                   |   |   |           |                |             |
| 5  |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |             |                   |   |   |           |                |             |
| 6  |         | <b>(0% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |             |                   |   |   |           |                |             |
| 7  |         |  |             |                   |   |   | DHLW Clay |                |             |
| 8  |         | Cylinder Segment Volume Calculation                                |             |                   |   |   |           | (atom/barn/cm) |             |
| 9  |         |  |             |                   |   |   | H         | 3.55893E-03    |             |
| 10 |         | Geometry Calculations  |             |                   |   |   |           | O              | 1.97883E-02 |
| 11 |         |  |             |                   |   |   | F         | 5.88292E-07    |             |
| 12 |         | UO2 Frac. Remaing  | 1.00        |                   |   |   | Na        | 2.49797E-05    |             |
| 13 |         | Cylinder Radius  | 86.5        | cm                |   |   | Mg        | 2.57324E-04    |             |
| 14 |         | Cylinder Length  | 304         | cm                |   |   | Al        | 1.18129E-03    |             |
| 15 |         | Cylinder Volume  | 7.1459E+06  | cm <sup>3</sup>   |   |   | Si        | 6.18950E-03    |             |
| 16 |         | 1/2 Cylinder Volume  | 3.5729E+06  |                   |   |   | P         | 1.76488E-06    |             |
| 17 |         | DHLW Volume  | 4.9933E+06  | cm <sup>3</sup>   |   |   | K         | 4.59207E-04    |             |
| 18 |         | Degraded MIT Volume  | 2.0097E+05  | cm <sup>3</sup>   |   |   | Ca        | 1.34777E-04    |             |
| 19 |         | Mass of Gd   | 0.0000E+00  | g                 |   |   | Mn        | 2.50252E-04    |             |
| 20 |         | Den. of Gd   | 7.9004E+00  | g/cm <sup>3</sup> |   |   | Fe        | 1.67546E-03    |             |
| 21 |         | Vol. of Gd   | 0.0000E+00  | cm <sup>3</sup>   |   |   | Ni        | 2.05882E-04    |             |
| 22 |         | Mass of Fe2O3  | 0.0000E+00  | g                 |   |   | U-238     | 0.00000E+00    |             |
| 23 |         | Den. of Fe2O3  | 5.2400E+00  | g/cm <sup>3</sup> |   |   |           |                |             |
| 24 |         | Vol. of Fe2O3  | 0.0000E+00  | cm <sup>3</sup>   |   |   |           |                |             |
| 25 | Total   | Void Fraction  |             |                   |   |   | Pu-239    | 1.03481E-09    |             |
| 26 |         | Total Volume   | 6.1109E+06  | cm <sup>3</sup>   |   |   |           |                |             |
| 27 |         | Calculated Volume  | 6.1109E+06  | cm <sup>3</sup>   |   |   | Total     | 3.37283E-02    |             |
| 28 | Mixture | Distance from Center   | 5.14845E+01 | cm                |   |   |           |                |             |
| 29 |         | Frac. of DHLW Mixed  |             |                   |   |   |           |                |             |
| 30 |         | with MIT Fuel  | 0.0000E+00  |                   |   |   |           |                |             |
| 31 |         | Mixture Volume   | 2.3643E+05  | cm <sup>3</sup>   |   |   |           |                |             |
| 32 |         | Calculated Volume  | 2.3644E+05  | cm <sup>3</sup>   |   |   |           |                |             |
| 33 |         | Distance from Center   | 7.37805E+01 | cm                |   |   |           |                |             |
| 34 |         |  |             |                   |   |   |           |                |             |
| 35 |         |  |             |                   |   |   |           |                |             |
| 36 |         |  |             |                   |   |   |           |                |             |
| 37 |         |  |             |                   |   |   |           |                |             |
| 38 |         |  |             |                   |   |   |           |                |             |
| 39 |         |  |             |                   |   |   |           |                |             |
| 40 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |             |                   |   |   |           |                |             |
| 41 |         | <b>(0% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |             |                   |   |   |           |                |             |
| 42 |         |  |             |                   |   |   | DHLW Clay |                |             |
| 43 |         | Cylinder Segment Volume Calculation                                |             |                   |   |   |           | (atom/barn/cm) |             |
| 44 |         |  |             |                   |   |   | H         | 3.55893E-03    |             |
| 45 |         | Geometry Calculations  |             |                   |   |   |           | O              | 1.97883E-02 |
| 46 |         |  |             |                   |   |   | F         | 5.88292E-07    |             |
| 47 |         | UO2 Frac. Remaing  | 1.00        |                   |   |   | Na        | 2.49797E-05    |             |
| 48 |         | Cylinder Radius  | 86.5        | cm                |   |   | Mg        | 2.57324E-04    |             |
| 49 |         | Cylinder Length  | 304         | cm                |   |   | Al        | 1.18129E-03    |             |
| 50 |         | Cylinder Volume  | 7.1459E+06  | cm <sup>3</sup>   |   |   | Si        | 6.18950E-03    |             |
| 51 |         | 1/2 Cylinder Volume  | 3.5729E+06  |                   |   |   | P         | 1.76488E-06    |             |

## Inverse

|     | A       | B                                      | C | D  | E                 | F | G              | H           |
|-----|---------|--|---|--|-------------------|---|----------------|-------------|
| 52  |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 53  |         | Degraded MIT Volume                    |   | 2.0097E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 54  |         | Mass of Gd                             |   | 0.0000E+00   | g                 |   | Mn             | 2.50252E-04 |
| 55  |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 56  |         | Vol. of Gd                             |   | 0.0000E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 57  |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 58  |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 59  |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 60  | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 61  |         | Total Volume                           |   | 6.4928E+06   | cm <sup>3</sup>   |   |                |             |
| 62  |         | Calculated Volume                      |   | 6.4928E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 63  | Mixture | Distance from Center                   |   | 6.10600E+01  | cm                |   |                |             |
| 64  |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 65  |         | with MIT Fuel                          |   | 0.0000E+00   |                   |   |                |             |
| 66  |         | Mixture Volume                         |   | 2.5121E+05   | cm <sup>3</sup>   |   |                |             |
| 67  |         | Calculated Volume                      |   | 2.5121E+05   | cm <sup>3</sup>   |   |                |             |
| 68  |         | Distance from Center                   |   | 7.32477E+01  | cm                |   |                |             |
| 69  |         |  |   |  |                   |   |                |             |
| 70  |         |  |   |  |                   |   |                |             |
| 71  |         |  |   |  |                   |   |                |             |
| 72  |         |  |   |  |                   |   |                |             |
| 73  |         |  |   |  |                   |   |                |             |
| 74  |         |  |   |  |                   |   |                |             |
| 75  |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                              |                   |   |                |             |
| 76  |         |  |   | <b>(0% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 77  |         |  |   |  |                   |   | DHLW Clay      |             |
| 78  |         | Cylinder Segment Volume Calculation    |   |  |                   |   | (atom/barn/cm) |             |
| 79  |         |  |   |  |                   |   | H              | 3.55893E-03 |
| 80  |         | Geometry Calculations                  |   |  |                   |   | O              | 1.97883E-02 |
| 81  |         |  |   |  |                   |   | F              | 5.88292E-07 |
| 82  |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00   |                   |   | Na             | 2.49797E-05 |
| 83  |         | Cylinder Radius                        |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 84  |         | Cylinder Length                        |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 85  |         | Cylinder Volume                        |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 86  |         | 1/2 Cylinder Volume                    |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 87  |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 88  |         | Degraded MIT Volume                    |   | 2.0097E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 89  |         | Mass of Gd                             |   | 0.0000E+00   | g                 |   | Mn             | 2.50252E-04 |
| 90  |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 91  |         | Vol. of Gd                             |   | 0.0000E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 92  |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 93  |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 94  |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 95  | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 96  |         | Total Volume                           |   | 6.9257E+06   | cm <sup>3</sup>   |   |                |             |
| 97  |         | Calculated Volume                      |   | 6.9257E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 98  | Mixture | Distance from Center                   |   | 7.43800E+01  | cm                |   |                |             |
| 99  |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 100 |         | with MIT Fuel                          |   | 0.0000E+00   |                   |   |                |             |
| 101 |         | Mixture Volume                         |   | 2.6795E+05   | cm <sup>3</sup>   |   |                |             |
| 102 |         | Calculated Volume                      |   | 2.6796E+05   | cm <sup>3</sup>   |   |                |             |

## Inverse

|     | A       | B                                   | C | D   | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|---|-------------------|---|----------------|-------------|
| 103 |         | Distance from Center                |   | 7.26550E+01   | cm                |   |                |             |
| 104 |         |                                     |   |   |                   |   |                |             |
| 105 |         |                                     |   |   |                   |   |                |             |
| 106 |         |                                     |   |   |                   |   |                |             |
| 107 |         |                                     |   |   |                   |   |                |             |
| 108 |         |                                     |   |   |                   |   |                |             |
| 109 |         |                                     |   |   |                   |   |                |             |
| 110 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 111 |         |                                     |   | <b>(10% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 112 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 113 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 114 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 115 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 116 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 117 |         | UO2 Frac. Remaining                 |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 118 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 119 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 120 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 121 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 122 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 123 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 124 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 125 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 126 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 127 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 128 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 129 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 130 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 131 |         | Total Volume                        |   | 6.1109E+06  | cm <sup>3</sup>   |   |                |             |
| 132 |         | Calculated Volume                   |   | 6.1109E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 133 | Mixture | Distance from Center                |   | 5.14845E+01   | cm                |   |                |             |
| 134 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 135 |         | with MIT Fuel                       |   | 1.0000E-01  |                   |   |                |             |
| 136 |         | Mixture Volume                      |   | 8.2388E+05  | cm <sup>3</sup>   |   |                |             |
| 137 |         | Calculated Volume                   |   | 8.2388E+05  | cm <sup>3</sup>   |   |                |             |
| 138 |         | Distance from Center                |   | 5.66270E+01   | cm                |   |                |             |
| 139 |         |                                     |   |   |                   |   |                |             |
| 140 |         |                                     |   |   |                   |   |                |             |
| 141 |         |                                     |   |   |                   |   |                |             |
| 142 |         |                                     |   |   |                   |   |                |             |
| 143 |         |                                     |   |   |                   |   |                |             |
| 144 |         |                                     |   |   |                   |   |                |             |
| 145 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 146 |         |                                     |   | <b>(10% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 147 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 148 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 149 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 150 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 151 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 152 |         | UO2 Frac. Remaining                 |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 153 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |

## Inverse

|     | A       | B                                      | C | D   | E | F | G              | H           |
|-----|---------|--|---|---|---|---|----------------|-------------|
| 154 |         | Cylinder Length                        |   | 304 cm  |   |   | Al             | 1.18129E-03 |
| 155 |         | Cylinder Volume                        |   | 7.1459E+06 cm <sup>3</sup>  |   |   | Si             | 6.18950E-03 |
| 156 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |   |   | P              | 1.76488E-06 |
| 157 |         | DHLW Volume                            |   | 4.9933E+06 cm <sup>3</sup>  |   |   | K              | 4.59207E-04 |
| 158 |         | Degraded MIT Volume                    |   | 2.0097E+05 cm <sup>3</sup>  |   |   | Ca             | 1.34777E-04 |
| 159 |         | Mass of Gd                             |   | 0.0000E+00 g  |   |   | Mn             | 2.50252E-04 |
| 160 |         | Den. of Gd                             |   | 7.9004E+00 g/cm <sup>3</sup>  |   |   | Fe             | 1.67546E-03 |
| 161 |         | Vol. of Gd                             |   | 0.0000E+00 cm <sup>3</sup>  |   |   | Ni             | 2.05882E-04 |
| 162 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 g  |   |   | U-238          | 0.00000E+00 |
| 163 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00 g/cm <sup>3</sup>  |   |   |                |             |
| 164 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 cm <sup>3</sup>  |   |   |                |             |
| 165 | Total   | Void Fraction                          |   |   |   |   | Pu-239         | 1.03481E-09 |
| 166 |         | Total Volume                           |   | 6.4928E+06 cm <sup>3</sup>  |   |   |                |             |
| 167 |         | Calculated Volume                      |   | 6.4928E+06 cm <sup>3</sup>  |   |   | Total          | 3.37283E-02 |
| 168 | Mixture | Distance from Center                   |   | 6.10600E+01 cm  |   |   |                |             |
| 169 |         | Frac. of DHLW Mixed                    |   |   |   |   |                |             |
| 170 |         | with MIT Fuel                          |   | 1.0000E-01  |   |   |                |             |
| 171 |         | Mixture Volume                         |   | 8.7537E+05 cm <sup>3</sup>  |   |   |                |             |
| 172 |         | Calculated Volume                      |   | 8.7538E+05 cm <sup>3</sup>  |   |   |                |             |
| 173 |         | Distance from Center                   |   | 5.53425E+01 cm  |   |   |                |             |
| 174 |         |  |   |   |   |   |                |             |
| 175 |         |  |   |   |   |   |                |             |
| 176 |         |  |   |   |   |   |                |             |
| 177 |         |  |   |   |   |   |                |             |
| 178 |         |  |   |   |   |   |                |             |
| 179 |         |  |   |   |   |   |                |             |
| 180 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |   |   |                |             |
| 181 |         |  |   | <b>(10% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |   |   |                |             |
| 182 |         |  |   |   |   |   | DHLW Clay      |             |
| 183 |         | Cylinder Segment Volume Calculation    |   |   |   |   | (atom/barn/cm) |             |
| 184 |         |  |   |   |   |   | H              | 3.55893E-03 |
| 185 |         | Geometry Calculations                  |   |   |   |   | O              | 1.97883E-02 |
| 186 |         |  |   |   |   |   | F              | 5.88292E-07 |
| 187 |         | UO <sub>2</sub> Frac. Remaining        |   | 1.00  |   |   | Na             | 2.49797E-05 |
| 188 |         | Cylinder Radius                        |   | 86.5 cm   |   |   | Mg             | 2.57324E-04 |
| 189 |         | Cylinder Length                        |   | 304 cm  |   |   | Al             | 1.18129E-03 |
| 190 |         | Cylinder Volume                        |   | 7.1459E+06 cm <sup>3</sup>  |   |   | Si             | 6.18950E-03 |
| 191 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |   |   | P              | 1.76488E-06 |
| 192 |         | DHLW Volume                            |   | 4.9933E+06 cm <sup>3</sup>  |   |   | K              | 4.59207E-04 |
| 193 |         | Degraded MIT Volume                    |   | 2.0097E+05 cm <sup>3</sup>  |   |   | Ca             | 1.34777E-04 |
| 194 |         | Mass of Gd                             |   | 0.0000E+00 g  |   |   | Mn             | 2.50252E-04 |
| 195 |         | Den. of Gd                             |   | 7.9004E+00 g/cm <sup>3</sup>  |   |   | Fe             | 1.67546E-03 |
| 196 |         | Vol. of Gd                             |   | 0.0000E+00 cm <sup>3</sup>  |   |   | Ni             | 2.05882E-04 |
| 197 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 g  |   |   | U-238          | 0.00000E+00 |
| 198 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00 g/cm <sup>3</sup>  |   |   |                |             |
| 199 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 cm <sup>3</sup>  |   |   |                |             |
| 200 | Total   | Void Fraction                          |   |   |   |   | Pu-239         | 1.03481E-09 |
| 201 |         | Total Volume                           |   | 6.9257E+06 cm <sup>3</sup>  |   |   |                |             |
| 202 |         | Calculated Volume                      |   | 6.9257E+06 cm <sup>3</sup>  |   |   | Total          | 3.37283E-02 |
| 203 | Mixture | Distance from Center                   |   | 7.43800E+01 cm  |   |   |                |             |
| 204 |         | Frac. of DHLW Mixed                    |   |   |   |   |                |             |

## Inverse

|     | A       | B                                      | C | D   | E                 | F | G              | H           |
|-----|---------|--|---|---|-------------------|---|----------------|-------------|
| 205 |         | with MIT Fuel                          |   | 1.0000E-01  |                   |   |                |             |
| 206 |         | Mixture Volume                         |   | 9.3373E+05  | cm <sup>3</sup>   |   |                |             |
| 207 |         | Calculated Volume                      |   | 9.3373E+05  | cm <sup>3</sup>   |   |                |             |
| 208 |         | Distance from Center                   |   | 5.39115E+01   | cm                |   |                |             |
| 209 |         |  |   |   |                   |   |                |             |
| 210 |         |  |   |   |                   |   |                |             |
| 211 |         |  |   |   |                   |   |                |             |
| 212 |         |  |   |   |                   |   |                |             |
| 213 |         |  |   |   |                   |   |                |             |
| 214 |         |  |   |   |                   |   |                |             |
| 215 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |                   |   |                |             |
| 216 |         |  |   | <b>(15% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 217 |         |  |   |   |                   |   | DHLW Clay      |             |
| 218 |         | Cylinder Segment Volume Calculation    |   |   |                   |   | (atom/barn/cm) |             |
| 219 |         |  |   |   |                   |   | H              | 3.55893E-03 |
| 220 |         | Geometry Calculations                  |   |   |                   |   | O              | 1.97883E-02 |
| 221 |         |  |   |   |                   |   | F              | 5.88292E-07 |
| 222 |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 223 |         | Cylinder Radius                        |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 224 |         | Cylinder Length                        |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 225 |         | Cylinder Volume                        |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 226 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 227 |         | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 228 |         | Degraded MIT Volume                    |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 229 |         | Mass of Gd                             |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 230 |         | Den. of Gd                             |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 231 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 232 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 233 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 234 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 235 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 236 |         | Total Volume                           |   | 6.1109E+06  | cm <sup>3</sup>   |   |                |             |
| 237 |         | Calculated Volume                      |   | 6.1109E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 238 | Mixture | Distance from Center                   |   | 5.14845E+01   | cm                |   |                |             |
| 239 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |
| 240 |         | with MIT Fuel                          |   | 1.5000E-01  |                   |   |                |             |
| 241 |         | Mixture Volume                         |   | 1.1176E+06  | cm <sup>3</sup>   |   |                |             |
| 242 |         | Calculated Volume                      |   | 1.1176E+06  | cm <sup>3</sup>   |   |                |             |
| 243 |         | Distance from Center                   |   | 4.95490E+01   | cm                |   |                |             |
| 244 |         |  |   |   |                   |   |                |             |
| 245 |         |  |   |   |                   |   |                |             |
| 246 |         |  |   |   |                   |   |                |             |
| 247 |         |  |   |   |                   |   |                |             |
| 248 |         |  |   |   |                   |   |                |             |
| 249 |         |  |   |   |                   |   |                |             |
| 250 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |                   |   |                |             |
| 251 |         |  |   | <b>(15% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 252 |         |  |   |   |                   |   | DHLW Clay      |             |
| 253 |         | Cylinder Segment Volume Calculation    |   |   |                   |   | (atom/barn/cm) |             |
| 254 |         |  |   |   |                   |   | H              | 3.55893E-03 |
| 255 |         | Geometry Calculations                  |   |   |                   |   | O              | 1.97883E-02 |

## Inverse

|     | A       | B                                   | C | D   | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|---|-------------------|---|----------------|-------------|
| 256 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 257 |         | UO2 Frac. Remaing                   |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 258 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 259 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 260 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 261 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 262 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 263 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 264 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 265 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 266 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 267 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 268 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 269 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 270 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 271 |         | Total Volume                        |   | 6.4928E+06  | cm <sup>3</sup>   |   |                |             |
| 272 |         | Calculated Volume                   |   | 6.4928E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 273 | Mixture | Distance from Center                |   | 6.10600E+01   | cm                |   |                |             |
| 274 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 275 |         | with MIT Fuel                       |   | 1.5000E-01  |                   |   |                |             |
| 276 |         | Mixture Volume                      |   | 1.1875E+06  | cm <sup>3</sup>   |   |                |             |
| 277 |         | Calculated Volume                   |   | 1.1875E+06  | cm <sup>3</sup>   |   |                |             |
| 278 |         | Distance from Center                |   | 4.79400E+01   | cm                |   |                |             |
| 279 |         |                                     |   |   |                   |   |                |             |
| 280 |         |                                     |   |   |                   |   |                |             |
| 281 |         |                                     |   |   |                   |   |                |             |
| 282 |         |                                     |   |   |                   |   |                |             |
| 283 |         |                                     |   |   |                   |   |                |             |
| 284 |         |                                     |   |   |                   |   |                |             |
| 285 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 286 |         |                                     |   | <b>(15% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 287 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 288 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 289 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 290 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 291 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 292 |         | UO2 Frac. Remaing                   |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 293 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 294 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 295 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 296 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 297 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 298 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 299 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 300 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 301 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 302 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 303 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 304 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 305 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 306 |         | Total Volume                        |   | 6.9257E+06  | cm <sup>3</sup>   |   |                |             |



## Inverse

|     | A       | B  | C | D           | E                 | F | G              | H           |
|-----|---------|--|---|-------------|-------------------|---|----------------|-------------|
| 307 |         | Calculated Volume  |   | 6.9257E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 308 | Mixture | Distance from Center   |   | 7.43800E+01 | cm                |   |                |             |
| 309 |         | Frac. of DHLW Mixed  |   |             |                   |   |                |             |
| 310 |         | with MIT Fuel  |   | 1.5000E-01  |                   |   |                |             |
| 311 |         | Mixture Volume   |   | 1.2666E+06  | cm <sup>3</sup>   |   |                |             |
| 312 |         | Calculated Volume  |   | 1.2666E+06  | cm <sup>3</sup>   |   |                |             |
| 313 |         | Distance from Center   |   | 4.61470E+01 | cm                |   |                |             |
| 314 |         |  |   |             |                   |   |                |             |
| 315 |         |  |   |             |                   |   |                |             |
| 316 |         |  |   |             |                   |   |                |             |
| 317 |         |  |   |             |                   |   |                |             |
| 318 |         |  |   |             |                   |   |                |             |
| 319 |         |  |   |             |                   |   |                |             |
| 320 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>          |   |             |                   |   |                |             |
| 321 |         | <b>(15% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |   |             |                   |   |                |             |
| 322 |         |  |   |             |                   |   | DHLW Clay      |             |
| 323 |         | Cylinder Segment Volume Calculation                                  |   |             |                   |   | (atom/barn/cm) |             |
| 324 |         |  |   |             |                   |   | H              | 3.55893E-03 |
| 325 |         | Geometry Calculations  |   |             |                   |   | O              | 1.97883E-02 |
| 326 |         |  |   |             |                   |   | F              | 5.88292E-07 |
| 327 |         | UO2 Frac. Remaining  |   | 1.00        |                   |   | Na             | 2.49797E-05 |
| 328 |         | Cylinder Radius  |   | 86.5        | cm                |   | Mg             | 2.57324E-04 |
| 329 |         | Cylinder Length  |   | 304         | cm                |   | Al             | 1.18129E-03 |
| 330 |         | Cylinder Volume  |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 331 |         | 1/2 Cylinder Volume  |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 332 |         | DHLW Volume  |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 333 |         | Degraded MIT Volume  |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 334 |         | Mass of Gd   |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 335 |         | Den. of Gd   |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 336 |         | Vol. of Gd   |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 337 |         | Mass of Fe2O3  |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 338 |         | Den. of Fe2O3  |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 339 |         | Vol. of Fe2O3  |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 340 | Total   | Void Fraction  |   |             |                   |   | Pu-239         | 1.03481E-09 |
| 341 |         | Total Volume   |   | 7.1350E+06  | cm <sup>3</sup>   |   |                |             |
| 342 |         | Calculated Volume  |   | 7.1350E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 343 | Mixture | Distance from Center   |   | 8.48900E+01 | cm                |   |                |             |
| 344 |         | Frac. of DHLW Mixed  |   |             |                   |   |                |             |
| 345 |         | with MIT Fuel  |   | 1.5000E-01  |                   |   |                |             |
| 346 |         | Mixture Volume   |   | 1.3049E+06  | cm <sup>3</sup>   |   |                |             |
| 347 |         | Calculated Volume  |   | 1.3049E+06  | cm <sup>3</sup>   |   |                |             |
| 348 |         | Distance from Center   |   | 4.52900E+01 | cm                |   |                |             |
| 349 |         |  |   |             |                   |   |                |             |
| 350 |         |  |   |             |                   |   |                |             |
| 351 |         |  |   |             |                   |   |                |             |
| 352 |         |  |   |             |                   |   |                |             |
| 353 |         |  |   |             |                   |   |                |             |
| 354 |         |  |   |             |                   |   |                |             |
| 355 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>          |   |             |                   |   |                |             |
| 356 |         | <b>(20% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3)</b>  |   |             |                   |   |                |             |
| 357 |         |  |   |             |                   |   | DHLW Clay      |             |

## Inverse

|     | A       | B                                   | C | D   | E                 | F | G         | H              |             |
|-----|---------|-------------------------------------|---|---|-------------------|---|-----------|----------------|-------------|
| 358 |         | Cylinder Segment Volume Calculation |   |   |                   |   |           | (atom/barn/cm) |             |
| 359 |         |                                     |   |   |                   |   | H         | 3.55893E-03    |             |
| 360 |         | Geometry Calculations               |   |   |                   |   |           | O              | 1.97883E-02 |
| 361 |         |                                     |   |   |                   |   | F         | 5.88292E-07    |             |
| 362 |         | UO2 Frac. Remaing                   |   | 1.00  |                   |   | Na        | 2.49797E-05    |             |
| 363 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg        | 2.57324E-04    |             |
| 364 |         | Cylinder Length                     |   | 304   | cm                |   | Al        | 1.18129E-03    |             |
| 365 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si        | 6.18950E-03    |             |
| 366 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P         | 1.76488E-06    |             |
| 367 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K         | 4.59207E-04    |             |
| 368 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca        | 1.34777E-04    |             |
| 369 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn        | 2.50252E-04    |             |
| 370 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe        | 1.67546E-03    |             |
| 371 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni        | 2.05882E-04    |             |
| 372 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238     | 0.00000E+00    |             |
| 373 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |           |                |             |
| 374 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |           |                |             |
| 375 | Total   | Void Fraction                       |   |   |                   |   | Pu-239    | 1.03481E-09    |             |
| 376 |         | Total Volume                        |   | 6.1109E+06  | cm <sup>3</sup>   |   |           |                |             |
| 377 |         | Calculated Volume                   |   | 6.1109E+06  | cm <sup>3</sup>   |   | Total     | 3.37283E-02    |             |
| 378 | Mixture | Distance from Center                |   | 5.14845E+01   | cm                |   |           |                |             |
| 379 |         | Frac. of DHLW Mixed                 |   |   |                   |   |           |                |             |
| 380 |         | with MIT Fuel                       |   | 2.0000E-01  |                   |   |           |                |             |
| 381 |         | Mixture Volume                      |   | 1.4113E+06  | cm <sup>3</sup>   |   |           |                |             |
| 382 |         | Calculated Volume                   |   | 1.4113E+06  | cm <sup>3</sup>   |   |           |                |             |
| 383 |         | Distance from Center                |   | 4.29370E+01   | cm                |   |           |                |             |
| 384 |         |                                     |   |   |                   |   |           |                |             |
| 385 |         |                                     |   |   |                   |   |           |                |             |
| 386 |         |                                     |   |   |                   |   |           |                |             |
| 387 |         |                                     |   |   |                   |   |           |                |             |
| 388 |         |                                     |   |   |                   |   |           |                |             |
| 389 |         |                                     |   |   |                   |   |           |                |             |
| 390 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |           |                |             |
| 391 |         |                                     |   | <b>(20% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |                   |   |           |                |             |
| 392 |         |                                     |   |   |                   |   | DHLW Clay |                |             |
| 393 |         | Cylinder Segment Volume Calculation |   |   |                   |   |           | (atom/barn/cm) |             |
| 394 |         |                                     |   |   |                   |   | H         | 3.55893E-03    |             |
| 395 |         | Geometry Calculations               |   |   |                   |   |           | O              | 1.97883E-02 |
| 396 |         |                                     |   |   |                   |   | F         | 5.88292E-07    |             |
| 397 |         | UO2 Frac. Remaing                   |   | 1.00  |                   |   | Na        | 2.49797E-05    |             |
| 398 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg        | 2.57324E-04    |             |
| 399 |         | Cylinder Length                     |   | 304   | cm                |   | Al        | 1.18129E-03    |             |
| 400 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si        | 6.18950E-03    |             |
| 401 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P         | 1.76488E-06    |             |
| 402 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K         | 4.59207E-04    |             |
| 403 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca        | 1.34777E-04    |             |
| 404 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn        | 2.50252E-04    |             |
| 405 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe        | 1.67546E-03    |             |
| 406 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni        | 2.05882E-04    |             |
| 407 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238     | 0.00000E+00    |             |
| 408 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |           |                |             |

## Inverse

|     | A       | B   | C | D           | E      | F | G              | H           |
|-----|---------|---|---|-------------|--------|---|----------------|-------------|
| 409 |         | Vol. of Fe2O3   |   | 0.0000E+00  | cm^3   |   |                |             |
| 410 | Total   | Void Fraction   |   |             |        |   | Pu-239         | 1.03481E-09 |
| 411 |         | Total Volume  |   | 6.4928E+06  | cm^3   |   |                |             |
| 412 |         | Calculated Volume   |   | 6.4928E+06  | cm^3   |   | Total          | 3.37283E-02 |
| 413 | Mixture | Distance from Center  |   | 6.10600E+01 | cm     |   |                |             |
| 414 |         | Frac. of DHLW Mixed   |   |             |        |   |                |             |
| 415 |         | with MIT Fuel   |   | 2.0000E-01  |        |   |                |             |
| 416 |         | Mixture Volume  |   | 1.4995E+06  | cm^3   |   |                |             |
| 417 |         | Calculated Volume   |   | 1.4995E+06  | cm^3   |   |                |             |
| 418 |         | Distance from Center  |   | 4.10180E+01 | cm     |   |                |             |
| 419 |         |   |   |             |        |   |                |             |
| 420 |         |   |   |             |        |   |                |             |
| 421 |         |   |   |             |        |   |                |             |
| 422 |         |   |   |             |        |   |                |             |
| 423 |         |   |   |             |        |   |                |             |
| 424 |         |   |   |             |        |   |                |             |
| 425 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |   |             |        |   |                |             |
| 426 |         | <b>(20% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |   |             |        |   |                |             |
| 427 |         |   |   |             |        |   | DHLW Clay      |             |
| 428 |         | Cylinder Segment Volume Calculation                                 |   |             |        |   | (atom/barn/cm) |             |
| 429 |         |   |   |             |        |   | H              | 3.55893E-03 |
| 430 |         | Geometry Calculations   |   |             |        |   | O              | 1.97883E-02 |
| 431 |         |   |   |             |        |   | F              | 5.88292E-07 |
| 432 |         | UO2 Frac. Remaing   |   | 1.00        |        |   | Na             | 2.49797E-05 |
| 433 |         | Cylinder Radius   |   | 86.5        | cm     |   | Mg             | 2.57324E-04 |
| 434 |         | Cylinder Length   |   | 304         | cm     |   | Al             | 1.18129E-03 |
| 435 |         | Cylinder Volume   |   | 7.1459E+06  | cm^3   |   | Si             | 6.18950E-03 |
| 436 |         | 1/2 Cylinder Volume   |   | 3.5729E+06  |        |   | P              | 1.76488E-06 |
| 437 |         | DHLW Volume   |   | 4.9933E+06  | cm^3   |   | K              | 4.59207E-04 |
| 438 |         | Degraded MIT Volume   |   | 2.0097E+05  | cm^3   |   | Ca             | 1.34777E-04 |
| 439 |         | Mass of Gd  |   | 0.0000E+00  | g      |   | Mn             | 2.50252E-04 |
| 440 |         | Den. of Gd  |   | 7.9004E+00  | g/cm^3 |   | Fe             | 1.67546E-03 |
| 441 |         | Vol. of Gd  |   | 0.0000E+00  | cm^3   |   | Ni             | 2.05882E-04 |
| 442 |         | Mass of Fe2O3   |   | 0.0000E+00  | g      |   | U-238          | 0.00000E+00 |
| 443 |         | Den. of Fe2O3   |   | 5.2400E+00  | g/cm^3 |   |                |             |
| 444 |         | Vol. of Fe2O3   |   | 0.0000E+00  | cm^3   |   |                |             |
| 445 | Total   | Void Fraction   |   |             |        |   | Pu-239         | 1.03481E-09 |
| 446 |         | Total Volume  |   | 6.9257E+06  | cm^3   |   |                |             |
| 447 |         | Calculated Volume   |   | 6.9257E+06  | cm^3   |   | Total          | 3.37283E-02 |
| 448 | Mixture | Distance from Center  |   | 7.43800E+01 | cm     |   |                |             |
| 449 |         | Frac. of DHLW Mixed   |   |             |        |   |                |             |
| 450 |         | with MIT Fuel   |   | 2.0000E-01  |        |   |                |             |
| 451 |         | Mixture Volume  |   | 1.5995E+06  | cm^3   |   |                |             |
| 452 |         | Calculated Volume   |   | 1.5995E+06  | cm^3   |   |                |             |
| 453 |         | Distance from Center  |   | 3.88750E+01 | cm     |   |                |             |
| 454 |         |   |   |             |        |   |                |             |
| 455 |         |   |   |             |        |   |                |             |
| 456 |         |   |   |             |        |   |                |             |
| 457 |         |   |   |             |        |   |                |             |
| 458 |         |   |   |             |        |   |                |             |
| 459 |         |   |   |             |        |   |                |             |

## Inverse

|     | A       | B                                   | C | D   | E      | F | G              | H           |  |
|-----|---------|-------------------------------------|---|---|--------|---|----------------|-------------|--|
| 460 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |        |   |                |             |  |
| 461 |         |                                     |   | <b>(25% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |        |   |                |             |  |
| 462 |         |                                     |   |   |        |   | DHLW Clay      |             |  |
| 463 |         | Cylinder Segment Volume Calculation |   |   |        |   | (atom/barn/cm) |             |  |
| 464 |         |                                     |   |   |        |   | H              | 3.55893E-03 |  |
| 465 |         | Geometry Calculations               |   |   |        |   | O              | 1.97883E-02 |  |
| 466 |         |                                     |   |   |        |   | F              | 5.88292E-07 |  |
| 467 |         | UO2 Frac. Remaing                   |   | 1.00  |        |   | Na             | 2.49797E-05 |  |
| 468 |         | Cylinder Radius                     |   | 86.5  | cm     |   | Mg             | 2.57324E-04 |  |
| 469 |         | Cylinder Length                     |   | 304   | cm     |   | Al             | 1.18129E-03 |  |
| 470 |         | Cylinder Volume                     |   | 7.1459E+06  | cm^3   |   | Si             | 6.18950E-03 |  |
| 471 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |        |   | P              | 1.76488E-06 |  |
| 472 |         | DHLW Volume                         |   | 4.9933E+06  | cm^3   |   | K              | 4.59207E-04 |  |
| 473 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm^3   |   | Ca             | 1.34777E-04 |  |
| 474 |         | Mass of Gd                          |   | 0.0000E+00  | g      |   | Mn             | 2.50252E-04 |  |
| 475 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm^3 |   | Fe             | 1.67546E-03 |  |
| 476 |         | Vol. of Gd                          |   | 0.0000E+00  | cm^3   |   | Ni             | 2.05882E-04 |  |
| 477 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g      |   | U-238          | 0.00000E+00 |  |
| 478 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm^3 |   |                |             |  |
| 479 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm^3   |   |                |             |  |
| 480 | Total   | Void Fraction                       |   |   |        |   | Pu-239         | 1.03481E-09 |  |
| 481 |         | Total Volume                        |   | 6.1109E+06  | cm^3   |   |                |             |  |
| 482 |         | Calculated Volume                   |   | 6.1109E+06  | cm^3   |   | Total          | 3.37283E-02 |  |
| 483 | Mixture | Distance from Center                |   | 5.14845E+01   | cm     |   |                |             |  |
| 484 |         | Frac. of DHLW Mixed                 |   |   |        |   |                |             |  |
| 485 |         | with MIT Fuel                       |   | 2.5000E-01  |        |   |                |             |  |
| 486 |         | Mixture Volume                      |   | 1.7050E+06  | cm^3   |   |                |             |  |
| 487 |         | Calculated Volume                   |   | 1.7051E+06  | cm^3   |   |                |             |  |
| 488 |         | Distance from Center                |   | 3.66440E+01   | cm     |   |                |             |  |
| 489 |         |                                     |   |   |        |   |                |             |  |
| 490 |         |                                     |   |   |        |   |                |             |  |
| 491 |         |                                     |   |   |        |   |                |             |  |
| 492 |         |                                     |   |   |        |   |                |             |  |
| 493 |         |                                     |   |   |        |   |                |             |  |
| 494 |         |                                     |   |   |        |   |                |             |  |
| 495 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |        |   |                |             |  |
| 496 |         |                                     |   | <b>(25% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |        |   |                |             |  |
| 497 |         |                                     |   |   |        |   | DHLW Clay      |             |  |
| 498 |         | Cylinder Segment Volume Calculation |   |   |        |   | (atom/barn/cm) |             |  |
| 499 |         |                                     |   |   |        |   | H              | 3.55893E-03 |  |
| 500 |         | Geometry Calculations               |   |   |        |   | O              | 1.97883E-02 |  |
| 501 |         |                                     |   |   |        |   | F              | 5.88292E-07 |  |
| 502 |         | UO2 Frac. Remaing                   |   | 1.00  |        |   | Na             | 2.49797E-05 |  |
| 503 |         | Cylinder Radius                     |   | 86.5  | cm     |   | Mg             | 2.57324E-04 |  |
| 504 |         | Cylinder Length                     |   | 304   | cm     |   | Al             | 1.18129E-03 |  |
| 505 |         | Cylinder Volume                     |   | 7.1459E+06  | cm^3   |   | Si             | 6.18950E-03 |  |
| 506 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |        |   | P              | 1.76488E-06 |  |
| 507 |         | DHLW Volume                         |   | 4.9933E+06  | cm^3   |   | K              | 4.59207E-04 |  |
| 508 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm^3   |   | Ca             | 1.34777E-04 |  |
| 509 |         | Mass of Gd                          |   | 0.0000E+00  | g      |   | Mn             | 2.50252E-04 |  |
| 510 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm^3 |   | Fe             | 1.67546E-03 |  |

## Inverse

|     | A       | B                                      | C | D   | E                 | F | G              | H           |
|-----|---------|--|---|---|-------------------|---|----------------|-------------|
| 511 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 512 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 513 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 514 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 515 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 516 |         | Total Volume                           |   | 6.4928E+06  | cm <sup>3</sup>   |   |                |             |
| 517 |         | Calculated Volume                      |   | 6.4928E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 518 | Mixture | Distance from Center                   |   | 6.10600E+01   | cm                |   |                |             |
| 519 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |
| 520 |         | with MIT Fuel                          |   | 2.5000E-01  |                   |   |                |             |
| 521 |         | Mixture Volume                         |   | 1.8116E+06  | cm <sup>3</sup>   |   |                |             |
| 522 |         | Calculated Volume                      |   | 1.8116E+06  | cm <sup>3</sup>   |   |                |             |
| 523 |         | Distance from Center                   |   | 3.44230E+01   | cm                |   |                |             |
| 524 |         |  |   |   |                   |   |                |             |
| 525 |         |  |   |   |                   |   |                |             |
| 526 |         |  |   |   |                   |   |                |             |
| 527 |         |  |   |   |                   |   |                |             |
| 528 |         |  |   |   |                   |   |                |             |
| 529 |         |  |   |   |                   |   |                |             |
| 530 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |                   |   |                |             |
| 531 |         |  |   | <b>(25% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 532 |         |  |   |   |                   |   | DHLW Clay      |             |
| 533 |         | Cylinder Segment Volume Calculation    |   |   |                   |   | (atom/barn/cm) |             |
| 534 |         |  |   |   |                   |   | H              | 3.55893E-03 |
| 535 |         | Geometry Calculations                  |   |   |                   |   | O              | 1.97883E-02 |
| 536 |         |  |   |   |                   |   | F              | 5.88292E-07 |
| 537 |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 538 |         | Cylinder Radius                        |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 539 |         | Cylinder Length                        |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 540 |         | Cylinder Volume                        |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 541 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 542 |         | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 543 |         | Degraded MIT Volume                    |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 544 |         | Mass of Gd                             |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 545 |         | Den. of Gd                             |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 546 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 547 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 548 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 549 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 550 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 551 |         | Total Volume                           |   | 6.9257E+06  | cm <sup>3</sup>   |   |                |             |
| 552 |         | Calculated Volume                      |   | 6.9257E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 553 | Mixture | Distance from Center                   |   | 7.43800E+01   | cm                |   |                |             |
| 554 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |
| 555 |         | with MIT Fuel                          |   | 2.5000E-01  |                   |   |                |             |
| 556 |         | Mixture Volume                         |   | 1.9324E+06  | cm <sup>3</sup>   |   |                |             |
| 557 |         | Calculated Volume                      |   | 1.9324E+06  | cm <sup>3</sup>   |   |                |             |
| 558 |         | Distance from Center                   |   | 3.19350E+01   | cm                |   |                |             |
| 559 |         |  |   |   |                   |   |                |             |
| 560 |         |  |   |   |                   |   |                |             |
| 561 |         |  |   |   |                   |   |                |             |

## Inverse

|     | A       | B                                   | C | D  | E | F | G              | H           |  |
|-----|---------|-------------------------------------|---|--|---|---|----------------|-------------|--|
| 562 |         |                                     |   |  |   |   |                |             |  |
| 563 |         |                                     |   |  |   |   |                |             |  |
| 564 |         |                                     |   |  |   |   |                |             |  |
| 565 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |   |   |                |             |  |
| 566 |         |                                     |   | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O</b> |   |   |                |             |  |
| 567 |         |                                     |   |  |   |   | DHLW Clay      |             |  |
| 568 |         | Cylinder Segment Volume Calculation |   |  |   |   | (atom/barn/cm) |             |  |
| 569 |         |                                     |   |  |   |   | H              | 3.55893E-03 |  |
| 570 |         | Geometry Calculations               |   |  |   |   | O              | 1.97883E-02 |  |
| 571 |         |                                     |   |  |   |   | F              | 5.88292E-07 |  |
| 572 |         | UO2 Frac. Remaing                   |   | 1.00   |   |   | Na             | 2.49797E-05 |  |
| 573 |         | Cylinder Radius                     |   | 86.5 cm  |   |   | Mg             | 2.57324E-04 |  |
| 574 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |  |
| 575 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |  |
| 576 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |  |
| 577 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |  |
| 578 |         | Degraded MIT Volume                 |   | 2.0097E+05 cm <sup>3</sup>   |   |   | Ca             | 1.34777E-04 |  |
| 579 |         | Mass of Gd                          |   | 0.0000E+00 g   |   |   | Mn             | 2.50252E-04 |  |
| 580 |         | Den. of Gd                          |   | 7.9004E+00 g/cm <sup>3</sup>                                       |   |   | Fe             | 1.67546E-03 |  |
| 581 |         | Vol. of Gd                          |   | 0.0000E+00 cm <sup>3</sup>   |   |   | Ni             | 2.05882E-04 |  |
| 582 |         | Mass of Fe2O3                       |   | 0.0000E+00 g   |   |   | U-238          | 0.00000E+00 |  |
| 583 |         | Den. of Fe2O3                       |   | 5.2400E+00 g/cm <sup>3</sup>                                       |   |   |                |             |  |
| 584 |         | Vol. of Fe2O3                       |   | 0.0000E+00 cm <sup>3</sup>   |   |   |                |             |  |
| 585 | Total   | Void Fraction                       |   |  |   |   | Pu-239         | 1.03481E-09 |  |
| 586 |         | Total Volume                        |   | 7.1350E+06 cm <sup>3</sup>   |   |   |                |             |  |
| 587 |         | Calculated Volume                   |   | 7.1350E+06 cm <sup>3</sup>   |   |   | Total          | 3.37283E-02 |  |
| 588 | Mixture | Distance from Center                |   | 8.48900E+01 cm   |   |   |                |             |  |
| 589 |         | Frac. of DHLW Mixed                 |   |  |   |   |                |             |  |
| 590 |         | with MIT Fuel                       |   | 2.5000E-01   |   |   |                |             |  |
| 591 |         | Mixture Volume                      |   | 1.9908E+06 cm <sup>3</sup>   |   |   |                |             |  |
| 592 |         | Calculated Volume                   |   | 1.9908E+06 cm <sup>3</sup>   |   |   |                |             |  |
| 593 |         | Distance from Center                |   | 3.07430E+01 cm   |   |   |                |             |  |
| 594 |         |                                     |   |  |   |   |                |             |  |
| 595 |         |                                     |   |  |   |   |                |             |  |
| 596 |         |                                     |   |  |   |   |                |             |  |
| 597 |         |                                     |   |  |   |   |                |             |  |
| 598 |         |                                     |   |  |   |   |                |             |  |
| 599 |         |                                     |   |  |   |   |                |             |  |
| 600 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |   |   |                |             |  |
| 601 |         |                                     |   | <b>(50% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3</b> |   |   |                |             |  |
| 602 |         |                                     |   |  |   |   | DHLW Clay      |             |  |
| 603 |         | Cylinder Segment Volume Calculation |   |  |   |   | (atom/barn/cm) |             |  |
| 604 |         |                                     |   |  |   |   | H              | 3.55893E-03 |  |
| 605 |         | Geometry Calculations               |   |  |   |   | O              | 1.97883E-02 |  |
| 606 |         |                                     |   |  |   |   | F              | 5.88292E-07 |  |
| 607 |         | UO2 Frac. Remaing                   |   | 1.00   |   |   | Na             | 2.49797E-05 |  |
| 608 |         | Cylinder Radius                     |   | 86.5 cm  |   |   | Mg             | 2.57324E-04 |  |
| 609 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |  |
| 610 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |  |
| 611 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |  |
| 612 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |  |

## Inverse

|     | A       | B                                   | C | D   | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|---|-------------------|---|----------------|-------------|
| 613 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 614 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 615 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 616 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 617 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 618 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 619 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 620 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 621 |         | Total Volume                        |   | 6.1109E+06  | cm <sup>3</sup>   |   |                |             |
| 622 |         | Calculated Volume                   |   | 6.1109E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 623 | Mixture | Distance from Center                |   | 5.14845E+01   | cm                |   |                |             |
| 624 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 625 |         | with MIT Fuel                       |   | 5.0000E-01  |                   |   |                |             |
| 626 |         | Mixture Volume                      |   | 3.1737E+06  | cm <sup>3</sup>   |   |                |             |
| 627 |         | Calculated Volume                   |   | 3.1737E+06  | cm <sup>3</sup>   |   |                |             |
| 628 |         | Distance from Center                |   | 7.60100E+00   | cm                |   |                |             |
| 629 |         |                                     |   |   |                   |   |                |             |
| 630 |         |                                     |   |   |                   |   |                |             |
| 631 |         |                                     |   |   |                   |   |                |             |
| 632 |         |                                     |   |   |                   |   |                |             |
| 633 |         |                                     |   |   |                   |   |                |             |
| 634 |         |                                     |   |   |                   |   |                |             |
| 635 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 636 |         |                                     |   | <b>(50% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 637 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 638 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 639 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 640 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 641 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 642 |         | UO2 Frac. Remaing                   |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 643 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 644 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 645 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 646 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 647 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 648 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 649 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 650 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 651 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 652 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 653 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 654 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 655 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 656 |         | Total Volume                        |   | 6.4928E+06  | cm <sup>3</sup>   |   |                |             |
| 657 |         | Calculated Volume                   |   | 6.4928E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 658 | Mixture | Distance from Center                |   | 6.10600E+01   | cm                |   |                |             |
| 659 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 660 |         | with MIT Fuel                       |   | 5.0000E-01  |                   |   |                |             |
| 661 |         | Mixture Volume                      |   | 3.3720E+06  | cm <sup>3</sup>   |   |                |             |
| 662 |         | Calculated Volume                   |   | 3.3720E+06  | cm <sup>3</sup>   |   |                |             |
| 663 |         | Distance from Center                |   | 3.82200E+00   | cm                |   |                |             |

## Inverse

|     | A       | B                                      | C | D   | E | F | G              | H           |  |
|-----|---------|--|---|---|---|---|----------------|-------------|--|
| 664 |         |  |   |   |   |   |                |             |  |
| 665 |         |  |   |   |   |   |                |             |  |
| 666 |         |  |   |   |   |   |                |             |  |
| 667 |         |  |   |   |   |   |                |             |  |
| 668 |         |  |   |   |   |   |                |             |  |
| 669 |         |  |   |   |   |   |                |             |  |
| 670 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |   |   |                |             |  |
| 671 |         |  |   | <b>(50% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |   |   |                |             |  |
| 672 |         |  |   |   |   |   | DHLW Clay      |             |  |
| 673 |         | Cylinder Segment Volume Calculation    |   |   |   |   | (atom/barn/cm) |             |  |
| 674 |         |  |   |   |   |   | H              | 3.55893E-03 |  |
| 675 |         | Geometry Calculations                  |   |   |   |   | O              | 1.97883E-02 |  |
| 676 |         |  |   |   |   |   | F              | 5.88292E-07 |  |
| 677 |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00  |   |   | Na             | 2.49797E-05 |  |
| 678 |         | Cylinder Radius                        |   | 86.5 cm   |   |   | Mg             | 2.57324E-04 |  |
| 679 |         | Cylinder Length                        |   | 304 cm  |   |   | Al             | 1.18129E-03 |  |
| 680 |         | Cylinder Volume                        |   | 7.1459E+06 cm <sup>3</sup>  |   |   | Si             | 6.18950E-03 |  |
| 681 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |   |   | P              | 1.76488E-06 |  |
| 682 |         | DHLW Volume                            |   | 4.9933E+06 cm <sup>3</sup>  |   |   | K              | 4.59207E-04 |  |
| 683 |         | Degraded MIT Volume                    |   | 2.0097E+05 cm <sup>3</sup>  |   |   | Ca             | 1.34777E-04 |  |
| 684 |         | Mass of Gd                             |   | 0.0000E+00 g  |   |   | Mn             | 2.50252E-04 |  |
| 685 |         | Den. of Gd                             |   | 7.9004E+00 g/cm <sup>3</sup>  |   |   | Fe             | 1.67546E-03 |  |
| 686 |         | Vol. of Gd                             |   | 0.0000E+00 cm <sup>3</sup>  |   |   | Ni             | 2.05882E-04 |  |
| 687 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 g  |   |   | U-238          | 0.00000E+00 |  |
| 688 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00 g/cm <sup>3</sup>  |   |   |                |             |  |
| 689 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00 cm <sup>3</sup>  |   |   |                |             |  |
| 690 | Total   | Void Fraction                          |   |   |   |   | Pu-239         | 1.03481E-09 |  |
| 691 |         | Total Volume                           |   | 6.9257E+06 cm <sup>3</sup>  |   |   |                |             |  |
| 692 |         | Calculated Volume                      |   | 6.9257E+06 cm <sup>3</sup>  |   |   | Total          | 3.37283E-02 |  |
| 693 | Mixture | Distance from Center                   |   | 7.43800E+01 cm  |   |   |                |             |  |
| 694 |         | Frac. of DHLW Mixed                    |   |   |   |   |                |             |  |
| 695 |         | with MIT Fuel                          |   | 5.0000E-01  |   |   |                |             |  |
| 696 |         | Mixture Volume                         |   | 3.5968E+06 cm <sup>3</sup>  |   |   |                |             |  |
| 697 |         | Calculated Volume                      |   | 3.5968E+06 cm <sup>3</sup>  |   |   |                |             |  |
| 698 |         | Distance from Center                   |   | 4.54000E-01 cm  |   |   |                |             |  |
| 699 |         |  |   |   |   |   |                |             |  |
| 700 |         |  |   |   |   |   |                |             |  |
| 701 |         |  |   |   |   |   |                |             |  |
| 702 |         |  |   |   |   |   |                |             |  |
| 703 |         |  |   |   |   |   |                |             |  |
| 704 |         |  |   |   |   |   |                |             |  |
| 705 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |   |   |                |             |  |
| 706 |         |  |   | <b>(75% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |   |   |                |             |  |
| 707 |         |  |   |   |   |   | DHLW Clay      |             |  |
| 708 |         | Cylinder Segment Volume Calculation    |   |   |   |   | (atom/barn/cm) |             |  |
| 709 |         |  |   |   |   |   | H              | 3.55893E-03 |  |
| 710 |         | Geometry Calculations                  |   |   |   |   | O              | 1.97883E-02 |  |
| 711 |         |  |   |   |   |   | F              | 5.88292E-07 |  |
| 712 |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00  |   |   | Na             | 2.49797E-05 |  |
| 713 |         | Cylinder Radius                        |   | 86.5 cm   |   |   | Mg             | 2.57324E-04 |  |
| 714 |         | Cylinder Length                        |   | 304 cm  |   |   | Al             | 1.18129E-03 |  |



## Inverse

|     | A       | B                                      | C | D   | E                 | F | G              | H           |  |
|-----|---------|--|---|---|-------------------|---|----------------|-------------|--|
| 715 |         | Cylinder Volume                        |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |  |
| 716 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |  |
| 717 |         | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |  |
| 718 |         | Degraded MIT Volume                    |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |  |
| 719 |         | Mass of Gd                             |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |  |
| 720 |         | Den. of Gd                             |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |  |
| 721 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |  |
| 722 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |  |
| 723 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |  |
| 724 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |  |
| 725 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |  |
| 726 |         | Total Volume                           |   | 6.1109E+06  | cm <sup>3</sup>   |   |                |             |  |
| 727 |         | Calculated Volume                      |   | 6.1109E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |  |
| 728 | Mixture | Distance from Center                   |   | 5.14845E+01   | cm                |   |                |             |  |
| 729 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |  |
| 730 |         | with MIT Fuel                          |   | 7.5000E-01  |                   |   |                |             |  |
| 731 |         | Mixture Volume                         |   | 4.6423E+06  | cm <sup>3</sup>   |   |                |             |  |
| 732 |         | Calculated Volume                      |   | 4.6423E+06  | cm <sup>3</sup>   |   |                |             |  |
| 733 |         | Distance from Center                   |   | 2.05270E+01   | cm                |   |                |             |  |
| 734 |         |  |   |   |                   |   |                |             |  |
| 735 |         |  |   |   |                   |   |                |             |  |
| 736 |         |  |   |   |                   |   |                |             |  |
| 737 |         |  |   |   |                   |   |                |             |  |
| 738 |         |  |   |   |                   |   |                |             |  |
| 739 |         |  |   |   |                   |   |                |             |  |
| 740 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                               |                   |   |                |             |  |
| 741 |         |  |   | <b>(75% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |  |
| 742 |         |  |   |   |                   |   | DHLW Clay      |             |  |
| 743 |         | Cylinder Segment Volume Calculation    |   |   |                   |   | (atom/barn/cm) |             |  |
| 744 |         |  |   |   |                   |   | H              | 3.55893E-03 |  |
| 745 |         | Geometry Calculations                  |   |   |                   |   | O              | 1.97883E-02 |  |
| 746 |         |  |   |   |                   |   | F              | 5.88292E-07 |  |
| 747 |         | UO <sub>2</sub> Frac. Remaing          |   | 1.00  |                   |   | Na             | 2.49797E-05 |  |
| 748 |         | Cylinder Radius                        |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |  |
| 749 |         | Cylinder Length                        |   | 304   | cm                |   | Al             | 1.18129E-03 |  |
| 750 |         | Cylinder Volume                        |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |  |
| 751 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |  |
| 752 |         | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |  |
| 753 |         | Degraded MIT Volume                    |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |  |
| 754 |         | Mass of Gd                             |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |  |
| 755 |         | Den. of Gd                             |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |  |
| 756 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |  |
| 757 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |  |
| 758 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |  |
| 759 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |  |
| 760 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |  |
| 761 |         | Total Volume                           |   | 6.4928E+06  | cm <sup>3</sup>   |   |                |             |  |
| 762 |         | Calculated Volume                      |   | 6.4928E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |  |
| 763 | Mixture | Distance from Center                   |   | 6.10600E+01   | cm                |   |                |             |  |
| 764 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |  |
| 765 |         | with MIT Fuel                          |   | 7.5000E-01  |                   |   |                |             |  |

## Inverse

|     | A       | B  | C | D           | E                 | F | G              | H           |
|-----|---------|--|---|-------------|-------------------|---|----------------|-------------|
| 766 |         | Mixture Volume   |   | 4.9324E+06  | cm <sup>3</sup>   |   |                |             |
| 767 |         | Calculated Volume  |   | 4.9324E+06  | cm <sup>3</sup>   |   |                |             |
| 768 |         | Distance from Center   |   | 2.62580E+01 | cm                |   |                |             |
| 769 |         |  |   |             |                   |   |                |             |
| 770 |         |  |   |             |                   |   |                |             |
| 771 |         |  |   |             |                   |   |                |             |
| 772 |         |  |   |             |                   |   |                |             |
| 773 |         |  |   |             |                   |   |                |             |
| 774 |         |  |   |             |                   |   |                |             |
| 775 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>            |   |             |                   |   |                |             |
| 776 |         | <b>(75% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3)</b>    |   |             |                   |   |                |             |
| 777 |         |  |   |             |                   |   | DHLW Clay      |             |
| 778 |         | Cylinder Segment Volume Calculation                                    |   |             |                   |   | (atom/barn/cm) |             |
| 779 |         |  |   |             |                   |   | H              | 3.55893E-03 |
| 780 |         | Geometry Calculations  |   |             |                   |   | O              | 1.97883E-02 |
| 781 |         |  |   |             |                   |   | F              | 5.88292E-07 |
| 782 |         | UO2 Frac. Remaing  |   | 1.00        |                   |   | Na             | 2.49797E-05 |
| 783 |         | Cylinder Radius  |   | 86.5        | cm                |   | Mg             | 2.57324E-04 |
| 784 |         | Cylinder Length  |   | 304         | cm                |   | Al             | 1.18129E-03 |
| 785 |         | Cylinder Volume  |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 786 |         | 1/2 Cylinder Volume  |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 787 |         | DHLW Volume  |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 788 |         | Degraded MIT Volume  |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 789 |         | Mass of Gd   |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 790 |         | Den. of Gd   |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 791 |         | Vol. of Gd   |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 792 |         | Mass of Fe2O3  |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 793 |         | Den. of Fe2O3  |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 794 |         | Vol. of Fe2O3  |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 795 | Total   | Void Fraction  |   |             |                   |   | Pu-239         | 1.03481E-09 |
| 796 |         | Total Volume   |   | 6.9257E+06  | cm <sup>3</sup>   |   |                |             |
| 797 |         | Calculated Volume  |   | 6.9257E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 798 | Mixture | Distance from Center   |   | 7.43800E+01 | cm                |   |                |             |
| 799 |         | Frac. of DHLW Mixed  |   |             |                   |   |                |             |
| 800 |         | with MIT Fuel  |   | 7.5000E-01  |                   |   |                |             |
| 801 |         | Mixture Volume   |   | 5.2613E+06  | cm <sup>3</sup>   |   |                |             |
| 802 |         | Calculated Volume  |   | 5.2613E+06  | cm <sup>3</sup>   |   |                |             |
| 803 |         | Distance from Center   |   | 3.29150E+01 | cm                |   |                |             |
| 804 |         |  |   |             |                   |   |                |             |
| 805 |         |  |   |             |                   |   |                |             |
| 806 |         |  |   |             |                   |   |                |             |
| 807 |         |  |   |             |                   |   |                |             |
| 808 |         |  |   |             |                   |   |                |             |
| 809 |         |  |   |             |                   |   |                |             |
| 810 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>            |   |             |                   |   |                |             |
| 811 |         | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 200 g Gd, 0 g Fe2O3)</b> |   |             |                   |   |                |             |
| 812 |         |  |   |             |                   |   | DHLW Clay      |             |
| 813 |         | Cylinder Segment Volume Calculation                                    |   |             |                   |   | (atom/barn/cm) |             |
| 814 |         |  |   |             |                   |   | H              | 3.55893E-03 |
| 815 |         | Geometry Calculations  |   |             |                   |   | O              | 1.97883E-02 |
| 816 |         |  |   |             |                   |   | F              | 5.88292E-07 |

## Inverse

|     | A       | B                                   | C | D   | E      | F | G              | H           |
|-----|---------|-------------------------------------|---|---|--------|---|----------------|-------------|
| 817 |         | UO2 Frac. Remaing                   |   | 1.00  |        |   | Na             | 2.49797E-05 |
| 818 |         | Cylinder Radius                     |   | 86.5  | cm     |   | Mg             | 2.57324E-04 |
| 819 |         | Cylinder Length                     |   | 304   | cm     |   | Al             | 1.18129E-03 |
| 820 |         | Cylinder Volume                     |   | 7.1459E+06  | cm^3   |   | Si             | 6.18950E-03 |
| 821 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |        |   | P              | 1.76488E-06 |
| 822 |         | DHLW Volume                         |   | 4.9933E+06  | cm^3   |   | K              | 4.59207E-04 |
| 823 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm^3   |   | Ca             | 1.34777E-04 |
| 824 |         | Mass of Gd                          |   | 2.0000E+02  | g      |   | Mn             | 2.50252E-04 |
| 825 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm^3 |   | Fe             | 1.67546E-03 |
| 826 |         | Vol. of Gd                          |   | 2.5315E+01  | cm^3   |   | Ni             | 2.05882E-04 |
| 827 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g      |   | U-238          | 0.00000E+00 |
| 828 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm^3 |   |                |             |
| 829 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm^3   |   |                |             |
| 830 | Total   | Void Fraction                       |   |   |        |   | Pu-239         | 1.03481E-09 |
| 831 |         | Total Volume                        |   | 7.1350E+06  | cm^3   |   |                |             |
| 832 |         | Calculated Volume                   |   | 7.1350E+06  | cm^3   |   | Total          | 3.37283E-02 |
| 833 | Mixture | Distance from Center                |   | 8.48900E+01   | cm     |   |                |             |
| 834 |         | Frac. of DHLW Mixed                 |   |   |        |   |                |             |
| 835 |         | with MIT Fuel                       |   | 2.5000E-01  |        |   |                |             |
| 836 |         | Mixture Volume                      |   | 1.9908E+06  | cm^3   |   |                |             |
| 837 |         | Calculated Volume                   |   | 1.9908E+06  | cm^3   |   |                |             |
| 838 |         | Distance from Center                |   | 3.07430E+01   | cm     |   |                |             |
| 839 |         |                                     |   |   |        |   |                |             |
| 840 |         |                                     |   |   |        |   |                |             |
| 841 |         |                                     |   |   |        |   |                |             |
| 842 |         |                                     |   |   |        |   |                |             |
| 843 |         |                                     |   |   |        |   |                |             |
| 844 |         |                                     |   |   |        |   |                |             |
| 845 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |        |   |                |             |
| 846 |         |                                     |   | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 100 g Gd, 0 g Fe)</b> |        |   |                |             |
| 847 |         |                                     |   |   |        |   | DHLW Clay      |             |
| 848 |         | Cylinder Segment Volume Calculation |   |   |        |   | (atom/barn/cm) |             |
| 849 |         |                                     |   |   |        |   | H              | 3.55893E-03 |
| 850 |         | Geometry Calculations               |   |   |        |   | O              | 1.97883E-02 |
| 851 |         |                                     |   |   |        |   | F              | 5.88292E-07 |
| 852 |         | UO2 Frac. Remaing                   |   | 1.00  |        |   | Na             | 2.49797E-05 |
| 853 |         | Cylinder Radius                     |   | 86.5  | cm     |   | Mg             | 2.57324E-04 |
| 854 |         | Cylinder Length                     |   | 304   | cm     |   | Al             | 1.18129E-03 |
| 855 |         | Cylinder Volume                     |   | 7.1459E+06  | cm^3   |   | Si             | 6.18950E-03 |
| 856 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |        |   | P              | 1.76488E-06 |
| 857 |         | DHLW Volume                         |   | 4.9933E+06  | cm^3   |   | K              | 4.59207E-04 |
| 858 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm^3   |   | Ca             | 1.34777E-04 |
| 859 |         | Mass of Gd                          |   | 1.0000E+02  | g      |   | Mn             | 2.50252E-04 |
| 860 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm^3 |   | Fe             | 1.67546E-03 |
| 861 |         | Vol. of Gd                          |   | 1.2658E+01  | cm^3   |   | Ni             | 2.05882E-04 |
| 862 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g      |   | U-238          | 0.00000E+00 |
| 863 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm^3 |   |                |             |
| 864 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm^3   |   |                |             |
| 865 | Total   | Void Fraction                       |   |   |        |   | Pu-239         | 1.03481E-09 |
| 866 |         | Total Volume                        |   | 7.1350E+06  | cm^3   |   |                |             |
| 867 |         | Calculated Volume                   |   | 7.1350E+06  | cm^3   |   | Total          | 3.37283E-02 |

## Inverse

|     | A       | B                                   | C | D   | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|---|-------------------|---|----------------|-------------|
| 868 | Mixture | Distance from Center                |   | 8.48900E+01   | cm                |   |                |             |
| 869 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 870 |         | with MIT Fuel                       |   | 2.5000E-01  |                   |   |                |             |
| 871 |         | Mixture Volume                      |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 872 |         | Calculated Volume                   |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 873 |         | Distance from Center                |   | 3.07430E+01   | cm                |   |                |             |
| 874 |         |                                     |   |   |                   |   |                |             |
| 875 |         |                                     |   |   |                   |   |                |             |
| 876 |         |                                     |   |   |                   |   |                |             |
| 877 |         |                                     |   |   |                   |   |                |             |
| 878 |         |                                     |   |   |                   |   |                |             |
| 879 |         |                                     |   |   |                   |   |                |             |
| 880 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>           |                   |   |                |             |
| 881 |         |                                     |   | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 50 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 882 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 883 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 884 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 885 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 886 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 887 |         | UO2 Frac. Remaining                 |   | 1.00  |                   |   | Na             | 2.49797E-05 |
| 888 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 889 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 890 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 891 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 892 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 893 |         | Degraded MIT Volume                 |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 894 |         | Mass of Gd                          |   | 5.0000E+01  | g                 |   | Mn             | 2.50252E-04 |
| 895 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 896 |         | Vol. of Gd                          |   | 6.3288E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 897 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 898 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 899 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 900 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 901 |         | Total Volume                        |   | 7.1350E+06  | cm <sup>3</sup>   |   |                |             |
| 902 |         | Calculated Volume                   |   | 7.1350E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 903 | Mixture | Distance from Center                |   | 8.48900E+01   | cm                |   |                |             |
| 904 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 905 |         | with MIT Fuel                       |   | 2.5000E-01  |                   |   |                |             |
| 906 |         | Mixture Volume                      |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 907 |         | Calculated Volume                   |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 908 |         | Distance from Center                |   | 3.07430E+01   | cm                |   |                |             |
| 909 |         |                                     |   |   |                   |   |                |             |
| 910 |         |                                     |   |   |                   |   |                |             |
| 911 |         |                                     |   |   |                   |   |                |             |
| 912 |         |                                     |   |   |                   |   |                |             |
| 913 |         |                                     |   |   |                   |   |                |             |
| 914 |         |                                     |   |   |                   |   |                |             |
| 915 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>           |                   |   |                |             |
| 916 |         |                                     |   | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 20 g Gd, 0 g Fe2O3)</b> |                   |   |                |             |
| 917 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 918 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |

## Inverse

|     | A       | B   | C | D           | E                 | F | G              | H           |
|-----|---------|---|---|-------------|-------------------|---|----------------|-------------|
| 919 |         |   |   |             |                   |   | H              | 3.55893E-03 |
| 920 |         | Geometry Calculations   |   |             |                   |   | O              | 1.97883E-02 |
| 921 |         |   |   |             |                   |   | F              | 5.88292E-07 |
| 922 |         | UO2 Frac. Remaing   |   | 1.00        |                   |   | Na             | 2.49797E-05 |
| 923 |         | Cylinder Radius   |   | 86.5        | cm                |   | Mg             | 2.57324E-04 |
| 924 |         | Cylinder Length   |   | 304         | cm                |   | Al             | 1.18129E-03 |
| 925 |         | Cylinder Volume   |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 926 |         | 1/2 Cylinder Volume   |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 927 |         | DHLW Volume   |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 928 |         | Degraded MIT Volume   |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 929 |         | Mass of Gd  |   | 2.0000E+01  | g                 |   | Mn             | 2.50252E-04 |
| 930 |         | Den. of Gd  |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 931 |         | Vol. of Gd  |   | 2.5315E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 932 |         | Mass of Fe2O3   |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 933 |         | Den. of Fe2O3   |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 934 |         | Vol. of Fe2O3   |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 935 | Total   | Void Fraction   |   |             |                   |   | Pu-239         | 1.03481E-09 |
| 936 |         | Total Volume  |   | 7.1350E+06  | cm <sup>3</sup>   |   |                |             |
| 937 |         | Calculated Volume   |   | 7.1350E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 938 | Mixture | Distance from Center  |   | 8.48900E+01 | cm                |   |                |             |
| 939 |         | Frac. of DHLW Mixed   |   |             |                   |   |                |             |
| 940 |         | with MIT Fuel   |   | 2.5000E-01  |                   |   |                |             |
| 941 |         | Mixture Volume  |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 942 |         | Calculated Volume   |   | 1.9908E+06  | cm <sup>3</sup>   |   |                |             |
| 943 |         | Distance from Center  |   | 3.07430E+01 | cm                |   |                |             |
| 944 |         |   |   |             |                   |   |                |             |
| 945 |         |   |   |             |                   |   |                |             |
| 946 |         |   |   |             |                   |   |                |             |
| 947 |         |   |   |             |                   |   |                |             |
| 948 |         |   |   |             |                   |   |                |             |
| 949 |         |   |   |             |                   |   |                |             |
| 950 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |   |             |                   |   |                |             |
| 951 |         | <b>(25% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 295105 g F</b> |   |             |                   |   |                |             |
| 952 |         |   |   |             |                   |   | DHLW Clay      |             |
| 953 |         | Cylinder Segment Volume Calculation                                 |   |             |                   |   | (atom/barn/cm) |             |
| 954 |         |   |   |             |                   |   | H              | 3.55893E-03 |
| 955 |         | Geometry Calculations   |   |             |                   |   | O              | 1.97883E-02 |
| 956 |         |   |   |             |                   |   | F              | 5.88292E-07 |
| 957 |         | UO2 Frac. Remaing   |   | 1.00        |                   |   | Na             | 2.49797E-05 |
| 958 |         | Cylinder Radius   |   | 86.5        | cm                |   | Mg             | 2.57324E-04 |
| 959 |         | Cylinder Length   |   | 304         | cm                |   | Al             | 1.18129E-03 |
| 960 |         | Cylinder Volume   |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 961 |         | 1/2 Cylinder Volume   |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 962 |         | DHLW Volume   |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 963 |         | Degraded MIT Volume   |   | 2.0097E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 964 |         | Mass of Gd  |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 965 |         | Den. of Gd  |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 966 |         | Vol. of Gd  |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 967 |         | Mass of Fe2O3   |   | 2.9511E+05  | g                 |   | U-238          | 0.00000E+00 |
| 968 |         | Den. of Fe2O3   |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 969 |         | Vol. of Fe2O3   |   | 5.6318E+04  | cm <sup>3</sup>   |   |                |             |

## Inverse

|      | A       | B                                   | C | D  | E                 | F | G              | H           |
|------|---------|-------------------------------------|---|--|-------------------|---|----------------|-------------|
| 970  | Total   | Void Fraction                       |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 971  |         | Total Volume                        |   | 7.0954E+06   | cm <sup>3</sup>   |   |                |             |
| 972  |         | Calculated Volume                   |   | 7.0954E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 973  | Mixture | Distance from Center                |   | 8.20000E+01  | cm                |   |                |             |
| 974  |         | Frac. of DHLW Mixed                 |   |  |                   |   |                |             |
| 975  |         | with MIT Fuel                       |   | 2.5000E-01   |                   |   |                |             |
| 976  |         | Mixture Volume                      |   | 2.0346E+06   | cm <sup>3</sup>   |   |                |             |
| 977  |         | Calculated Volume                   |   | 2.0346E+06   | cm <sup>3</sup>   |   |                |             |
| 978  |         | Distance from Center                |   | 2.98550E+01  | cm                |   |                |             |
| 979  |         |                                     |   |  |                   |   |                |             |
| 980  |         |                                     |   |  |                   |   |                |             |
| 981  |         |                                     |   |  |                   |   |                |             |
| 982  |         |                                     |   |  |                   |   |                |             |
| 983  |         |                                     |   |  |                   |   |                |             |
| 984  |         |                                     |   |  |                   |   |                |             |
| 985  |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 986  |         |                                     |   | <b>(25% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 295105 g</b> |                   |   |                |             |
| 987  |         |                                     |   |  |                   |   | DHLW Clay      |             |
| 988  |         | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |
| 989  |         |                                     |   |  |                   |   | H              | 3.55893E-03 |
| 990  |         | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |
| 991  |         |                                     |   |  |                   |   | F              | 5.88292E-07 |
| 992  |         | UO2 Frac. Remaing                   |   | 1.00   |                   |   | Na             | 2.49797E-05 |
| 993  |         | Cylinder Radius                     |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 994  |         | Cylinder Length                     |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 995  |         | Cylinder Volume                     |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 996  |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 997  |         | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 998  |         | Degraded MIT Volume                 |   | 2.0097E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 999  |         | Mass of Gd                          |   | 2.0000E+01   | g                 |   | Mn             | 2.50252E-04 |
| 1000 |         | Den. of Gd                          |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 1001 |         | Vol. of Gd                          |   | 2.5315E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 1002 |         | Mass of Fe2O3                       |   | 2.95105E+05  | g                 |   | U-238          | 0.00000E+00 |
| 1003 |         | Den. of Fe2O3                       |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 1004 |         | Vol. of Fe2O3                       |   | 5.6318E+04   | cm <sup>3</sup>   |   |                |             |
| 1005 | Total   | Void Fraction                       |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 1006 |         | Total Volume                        |   | 7.0954E+06   | cm <sup>3</sup>   |   |                |             |
| 1007 |         | Calculated Volume                   |   | 7.0954E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 1008 | Mixture | Distance from Center                |   | 8.20000E+01  | cm                |   |                |             |
| 1009 |         | Frac. of DHLW Mixed                 |   |  |                   |   |                |             |
| 1010 |         | with MIT Fuel                       |   | 2.5000E-01   |                   |   |                |             |
| 1011 |         | Mixture Volume                      |   | 2.0346E+06   | cm <sup>3</sup>   |   |                |             |
| 1012 |         | Calculated Volume                   |   | 2.0346E+06   | cm <sup>3</sup>   |   |                |             |
| 1013 |         | Distance from Center                |   | -2.98550E+01   | cm                |   |                |             |
| 1014 |         |                                     |   |  |                   |   |                |             |
| 1015 |         |                                     |   |  |                   |   |                |             |
| 1016 |         |                                     |   |  |                   |   |                |             |

## Inverse

|    | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 1  |             |                   |            |          |   |                |           |                 |   |
| 2  |             |                   |            |          |   |                |           |                 |   |
| 3  |             |                   |            |          |   |                |           |                 |   |
| 4  |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |
| 5  | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 6  |             |                   |            |          |   |                |           |                 |   |
| 7  |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 8  |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 9  |             |                   |            |          |   | H              | 1001.50C  | 1.0032E-02      |   |
| 10 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 6.4412E-02      |   |
| 11 |             |                   |            |          |   | F              | 9019.50C  | 0.0000E+00      |   |
| 12 |             |                   |            |          |   | Na             | 11023.50C | 0.0000E+00      |   |
| 13 |             |                   |            |          |   | Mg             | 12000.50C | 0.0000E+00      |   |
| 14 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.9103E-02      |   |
| 15 |             |                   |            |          |   | Si             | 14000.50C | 0.0000E+00      |   |
| 16 |             |                   |            |          |   | P              | 15031.50C | 0.0000E+00      |   |
| 17 |             |                   |            |          |   | K              | 19000.50C | 0.0000E+00      |   |
| 18 |             |                   |            |          |   | Ca             | 20000.50C | 0.0000E+00      |   |
| 19 |             |                   |            |          |   | Mn             | 25055.50C | 0.0000E+00      |   |
| 20 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 0.0000E+00      |   |
| 21 |             |                   |            |          |   | Ni             | 28000.50C | 0.0000E+00      |   |
| 22 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.0716E-05      |   |
| 23 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 3.5668E-04      |   |
| 24 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 3.8311E-06      |   |
| 25 |             |                   |            |          |   | Pu-239         | 94239.55C | 0.0000E+00      |   |
| 26 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 27 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 28 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 29 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 30 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 31 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 32 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 33 |             |                   |            |          |   |                |           |                 |   |
| 34 |             |                   |            |          |   | Total          |           | 1.1393E-01      |   |
| 35 |             |                   |            |          |   |                |           |                 |   |
| 36 |             |                   |            |          |   | H/U-235        |           | 28.1249996      |   |
| 37 |             |                   |            |          |   |                |           |                 |   |
| 38 |             |                   |            |          |   |                |           |                 |   |
| 39 |             |                   |            |          |   | Void Frac.     | 0.2       |                 |   |
| 40 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 41 |             |                   |            |          |   |                |           |                 |   |
| 42 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 43 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 44 |             |                   |            |          |   | H              | 1001.50C  | 1.3376E-02      |   |
| 45 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 6.2590E-02      |   |
| 46 |             |                   |            |          |   | F              | 9019.50C  | 0.0000E+00      |   |
| 47 |             |                   |            |          |   | Na             | 11023.50C | 0.0000E+00      |   |
| 48 |             |                   |            |          |   | Mg             | 12000.50C | 0.0000E+00      |   |
| 49 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.6803E-02      |   |
| 50 |             |                   |            |          |   | Si             | 14000.50C | 0.0000E+00      |   |
| 51 |             |                   |            |          |   | P              | 15031.50C | 0.0000E+00      |   |

Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 52  |             |                   |            |          |   | K              | 19000.50C | 0.0000E+00      |   |
| 53  |             |                   |            |          |   | Ca             | 20000.50C | 0.0000E+00      |   |
| 54  |             |                   |            |          |   | Mn             | 25055.50C | 0.0000E+00      |   |
| 55  |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 0.0000E+00      |   |
| 56  |             |                   |            |          |   | Ni             | 28000.50C | 0.0000E+00      |   |
| 57  |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 1.9498E-05      |   |
| 58  |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 3.3570E-04      |   |
| 59  |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 3.6058E-06      |   |
| 60  |             |                   |            |          |   | Pu-239         | 94239.55C | 0.0000E+00      |   |
| 61  |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 62  |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 63  |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 64  |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 65  |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 66  |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 67  |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 68  |             |                   |            |          |   |                |           |                 |   |
| 69  |             |                   |            |          |   | Total          |           | 1.1313E-01      |   |
| 70  |             |                   |            |          |   |                |           |                 |   |
| 71  |             |                   |            |          |   | H/U-235        |           | 39.8437494      |   |
| 72  |             |                   |            |          |   |                |           |                 |   |
| 73  |             |                   |            |          |   |                |           |                 |   |
| 74  |             |                   |            |          |   | Void Frac.     | 0.25      |                 |   |
| 75  | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 76  |             |                   |            |          |   |                |           |                 |   |
| 77  |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 78  |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 79  |             |                   |            |          |   | H              | 1001.50C  | 1.6720E-02      |   |
| 80  |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 6.0768E-02      |   |
| 81  |             |                   |            |          |   | F              | 9019.50C  | 0.0000E+00      |   |
| 82  |             |                   |            |          |   | Na             | 11023.50C | 0.0000E+00      |   |
| 83  |             |                   |            |          |   | Mg             | 12000.50C | 0.0000E+00      |   |
| 84  |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.4503E-02      |   |
| 85  |             |                   |            |          |   | Si             | 14000.50C | 0.0000E+00      |   |
| 86  |             |                   |            |          |   | P              | 15031.50C | 0.0000E+00      |   |
| 87  |             |                   |            |          |   | K              | 19000.50C | 0.0000E+00      |   |
| 88  |             |                   |            |          |   | Ca             | 20000.50C | 0.0000E+00      |   |
| 89  |             |                   |            |          |   | Mn             | 25055.50C | 0.0000E+00      |   |
| 90  |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 0.0000E+00      |   |
| 91  |             |                   |            |          |   | Ni             | 28000.50C | 0.0000E+00      |   |
| 92  |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 1.8279E-05      |   |
| 93  |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 3.1472E-04      |   |
| 94  |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 3.3804E-06      |   |
| 95  |             |                   |            |          |   | Pu-239         | 94239.55C | 0.0000E+00      |   |
| 96  |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 97  |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 98  |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 99  |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 100 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 101 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 102 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |



## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 103 |             |                   |            |          |   |                |           |                 |   |
| 104 |             |                   |            |          |   | Total          |           | 1.1233E-01      |   |
| 105 |             |                   |            |          |   |                |           |                 |   |
| 106 |             |                   |            |          |   | H/U-235        |           | 53.1249992      |   |
| 107 |             |                   |            |          |   |                |           |                 |   |
| 108 |             |                   |            |          |   |                |           |                 |   |
| 109 |             |                   |            |          |   | Void Frac.     |           | 0.15            |   |
| 110 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 111 |             |                   |            |          |   |                |           |                 |   |
| 112 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 113 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 114 |             |                   |            |          |   | H              | 1001.50C  | 1.2189E-02      |   |
| 115 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.4054E-02      |   |
| 116 |             |                   |            |          |   | F              | 9019.50C  | 3.5655E-07      |   |
| 117 |             |                   |            |          |   | Na             | 11023.50C | 1.5140E-05      |   |
| 118 |             |                   |            |          |   | Mg             | 12000.50C | 1.5596E-04      |   |
| 119 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.1937E-02      |   |
| 120 |             |                   |            |          |   | Si             | 14000.50C | 3.7513E-03      |   |
| 121 |             |                   |            |          |   | P              | 15031.50C | 1.0696E-06      |   |
| 122 |             |                   |            |          |   | K              | 19000.50C | 2.7831E-04      |   |
| 123 |             |                   |            |          |   | Ca             | 20000.50C | 8.1685E-05      |   |
| 124 |             |                   |            |          |   | Mn             | 25055.50C | 1.5167E-04      |   |
| 125 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0155E-03      |   |
| 126 |             |                   |            |          |   | Ni             | 28000.50C | 1.2478E-04      |   |
| 127 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 5.9450E-06      |   |
| 128 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 1.0236E-04      |   |
| 129 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 1.0994E-06      |   |
| 130 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.2717E-10      |   |
| 131 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 132 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 133 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 134 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 135 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 136 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 137 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 138 |             |                   |            |          |   |                |           |                 |   |
| 139 |             |                   |            |          |   | Total          |           | 6.3865E-02      |   |
| 140 |             |                   |            |          |   |                |           |                 |   |
| 141 |             |                   |            |          |   | H/U-235        |           | 119.078964      |   |
| 142 |             |                   |            |          |   |                |           |                 |   |
| 143 |             |                   |            |          |   |                |           |                 |   |
| 144 |             |                   |            |          |   | Void Frac.     |           | 0.2             |   |
| 145 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 146 |             |                   |            |          |   |                |           |                 |   |
| 147 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 148 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 149 |             |                   |            |          |   | H              | 1001.50C  | 1.5406E-02      |   |
| 150 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.4018E-02      |   |
| 151 |             |                   |            |          |   | F              | 9019.50C  | 3.3557E-07      |   |
| 152 |             |                   |            |          |   | Na             | 11023.50C | 1.4249E-05      |   |
| 153 |             |                   |            |          |   | Mg             | 12000.50C | 1.4678E-04      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N          | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|------------|-----------|-----------------|---|
| 154 |             | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 1.1235E-02      |   |
| 155 |             |                   |            |          |   | Si         | 14000.50C | 3.5306E-03      |   |
| 156 |             |                   |            |          |   | P          | 15031.50C | 1.0067E-06      |   |
| 157 |             |                   |            |          |   | K          | 19000.50C | 2.6194E-04      |   |
| 158 |             |                   |            |          |   | Ca         | 20000.50C | 7.6880E-05      |   |
| 159 |             |                   |            |          |   | Mn         | 25055.50C | 1.4275E-04      |   |
| 160 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 9.5572E-04      |   |
| 161 |             |                   |            |          |   | Ni         | 28000.50C | 1.1744E-04      |   |
| 162 |             | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 5.5953E-06      |   |
| 163 |             | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 9.6337E-05      |   |
| 164 |             | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 1.0348E-06      |   |
| 165 |             |                   |            |          |   | Pu-239     | 94239.55C | 5.9028E-10      |   |
| 166 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 167 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 168 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 169 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 170 |             |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 171 |             |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 172 |             |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 173 |             |                   |            |          |   |            |           |                 |   |
| 174 |             |                   |            |          |   | Total      |           | 6.6010E-02      |   |
| 175 |             |                   |            |          |   |            |           |                 |   |
| 176 |             |                   |            |          |   | H/U-235    |           | 159.914841      |   |
| 177 |             |                   |            |          |   |            |           |                 |   |
| 178 |             |                   |            |          |   |            |           |                 |   |
| 179 |             |                   |            |          |   | Void Frac. | 0.25      |                 |   |
| 180 | <b>DHLW</b> |                   |            |          |   |            |           |                 |   |
| 181 |             |                   |            |          |   |            |           |                 |   |
| 182 |             | Degraded MIT Fuel |            |          |   | Mixture    |           | (atoms/barn cm) |   |
| 183 |             | Mass(g)           | WT         |          |   |            |           |                 |   |
| 184 |             |                   |            |          |   | H          | 1001.50C  | 1.8623E-02      |   |
| 185 |             | O                 | 3.73E+05   | 15.99492 |   | O          | 8016.50C  | 3.3982E-02      |   |
| 186 |             |                   |            |          |   | F          | 9019.50C  | 3.1460E-07      |   |
| 187 |             |                   |            |          |   | Na         | 11023.50C | 1.3358E-05      |   |
| 188 |             |                   |            |          |   | Mg         | 12000.50C | 1.3761E-04      |   |
| 189 |             | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 1.0533E-02      |   |
| 190 |             |                   |            |          |   | Si         | 14000.50C | 3.3100E-03      |   |
| 191 |             |                   |            |          |   | P          | 15031.50C | 9.4380E-07      |   |
| 192 |             |                   |            |          |   | K          | 19000.50C | 2.4557E-04      |   |
| 193 |             |                   |            |          |   | Ca         | 20000.50C | 7.2075E-05      |   |
| 194 |             |                   |            |          |   | Mn         | 25055.50C | 1.3383E-04      |   |
| 195 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 8.9599E-04      |   |
| 196 |             |                   |            |          |   | Ni         | 28000.50C | 1.1010E-04      |   |
| 197 |             | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 5.2456E-06      |   |
| 198 |             | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 9.0316E-05      |   |
| 199 |             | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 9.7008E-07      |   |
| 200 |             |                   |            |          |   | Pu-239     | 94239.55C | 5.5338E-10      |   |
| 201 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 202 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 203 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 204 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 205 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 206 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 207 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 208 |             |                   |            |          |   |                |           |                 |   |
| 209 |             |                   |            |          |   | Total          |           | 6.8154E-02      |   |
| 210 |             |                   |            |          |   |                |           |                 |   |
| 211 |             |                   |            |          |   | H/U-235        |           | 206.195501      |   |
| 212 |             |                   |            |          |   |                |           |                 |   |
| 213 |             |                   |            |          |   |                |           |                 |   |
| 214 |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |
| 215 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 216 |             |                   |            |          |   |                |           |                 |   |
| 217 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 218 |             | Mass(g)           |            | WT       |   |                |           |                 |   |
| 219 |             |                   |            |          |   | H              | 1001.50C  | 1.2417E-02      |   |
| 220 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.0843E-02      |   |
| 221 |             |                   |            |          |   | F              | 9019.50C  | 3.9426E-07      |   |
| 222 |             |                   |            |          |   | Na             | 11023.50C | 1.6741E-05      |   |
| 223 |             |                   |            |          |   | Mg             | 12000.50C | 1.7245E-04      |   |
| 224 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 9.0639E-03      |   |
| 225 |             |                   |            |          |   | Si             | 14000.50C | 4.1481E-03      |   |
| 226 |             |                   |            |          |   | P              | 15031.50C | 1.1828E-06      |   |
| 227 |             |                   |            |          |   | K              | 19000.50C | 3.0775E-04      |   |
| 228 |             |                   |            |          |   | Ca             | 20000.50C | 9.0325E-05      |   |
| 229 |             |                   |            |          |   | Mn             | 25055.50C | 1.6771E-04      |   |
| 230 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.1229E-03      |   |
| 231 |             |                   |            |          |   | Ni             | 28000.50C | 1.3798E-04      |   |
| 232 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 4.3826E-06      |   |
| 233 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 7.5457E-05      |   |
| 234 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 8.1048E-07      |   |
| 235 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.9351E-10      |   |
| 236 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 237 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 238 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 239 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 240 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 241 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 242 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 243 |             |                   |            |          |   |                |           |                 |   |
| 244 |             |                   |            |          |   | Total          |           | 5.8570E-02      |   |
| 245 |             |                   |            |          |   |                |           |                 |   |
| 246 |             |                   |            |          |   | H/U-235        |           | 164.555947      |   |
| 247 |             |                   |            |          |   |                |           |                 |   |
| 248 |             |                   |            |          |   |                |           |                 |   |
| 249 |             |                   |            |          |   | Void Frac.     | 0.2       |                 |   |
| 250 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 251 |             |                   |            |          |   |                |           |                 |   |
| 252 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 253 |             | Mass(g)           |            | WT       |   |                |           |                 |   |
| 254 |             |                   |            |          |   | H              | 1001.50C  | 1.5620E-02      |   |
| 255 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.0996E-02      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 256 |             |                   |            |          |   | F              | 9019.50C  | 3.7107E-07      |   |
| 257 |             |                   |            |          |   | Na             | 11023.50C | 1.5756E-05      |   |
| 258 |             |                   |            |          |   | Mg             | 12000.50C | 1.6231E-04      |   |
| 259 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 8.5308E-03      |   |
| 260 |             |                   |            |          |   | Si             | 14000.50C | 3.9041E-03      |   |
| 261 |             |                   |            |          |   | P              | 15031.50C | 1.1132E-06      |   |
| 262 |             |                   |            |          |   | K              | 19000.50C | 2.8965E-04      |   |
| 263 |             |                   |            |          |   | Ca             | 20000.50C | 8.5012E-05      |   |
| 264 |             |                   |            |          |   | Mn             | 25055.50C | 1.5785E-04      |   |
| 265 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0568E-03      |   |
| 266 |             |                   |            |          |   | Ni             | 28000.50C | 1.2986E-04      |   |
| 267 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 4.1248E-06      |   |
| 268 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 7.1018E-05      |   |
| 269 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 7.6281E-07      |   |
| 270 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.5271E-10      |   |
| 271 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 272 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 273 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 274 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 275 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 276 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 277 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 278 |             |                   |            |          |   |                |           |                 |   |
| 279 |             |                   |            |          |   | Total          |           | 6.1026E-02      |   |
| 280 |             |                   |            |          |   |                |           |                 |   |
| 281 |             |                   |            |          |   | H/U-235        |           | 219.950386      |   |
| 282 |             |                   |            |          |   |                |           |                 |   |
| 283 |             |                   |            |          |   |                |           |                 |   |
| 284 |             |                   |            |          |   | Void Frac.     | 0.25      |                 |   |
| 285 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 286 |             |                   |            |          |   |                |           |                 |   |
| 287 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 288 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 289 |             |                   |            |          |   | H              | 1001.50C  | 1.8824E-02      |   |
| 290 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.1148E-02      |   |
| 291 |             |                   |            |          |   | F              | 9019.50C  | 3.4788E-07      |   |
| 292 |             |                   |            |          |   | Na             | 11023.50C | 1.4771E-05      |   |
| 293 |             |                   |            |          |   | Mg             | 12000.50C | 1.5217E-04      |   |
| 294 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 7.9976E-03      |   |
| 295 |             |                   |            |          |   | Si             | 14000.50C | 3.6601E-03      |   |
| 296 |             |                   |            |          |   | P              | 15031.50C | 1.0436E-06      |   |
| 297 |             |                   |            |          |   | K              | 19000.50C | 2.7155E-04      |   |
| 298 |             |                   |            |          |   | Ca             | 20000.50C | 7.9699E-05      |   |
| 299 |             |                   |            |          |   | Mn             | 25055.50C | 1.4798E-04      |   |
| 300 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 9.9076E-04      |   |
| 301 |             |                   |            |          |   | Ni             | 28000.50C | 1.2175E-04      |   |
| 302 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 3.8670E-06      |   |
| 303 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 6.6579E-05      |   |
| 304 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 7.1513E-07      |   |
| 305 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.1192E-10      |   |
| 306 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 307 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 308 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 309 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 310 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 311 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 312 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 313 |             |                   |            |          |   |                |           |                 |   |
| 314 |             |                   |            |          |   | Total          |           | 6.3481E-02      |   |
| 315 |             |                   |            |          |   |                |           |                 |   |
| 316 |             |                   |            |          |   | H/U-235        |           | 282.730751      |   |
| 317 |             |                   |            |          |   |                |           |                 |   |
| 318 |             |                   |            |          |   |                |           |                 |   |
| 319 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 320 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 321 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 322 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 323 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 324 |             |                   |            |          |   | H              | 1001.50C  | 2.0234E-02      |   |
| 325 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 3.1216E-02      |   |
| 326 |             |                   |            |          |   | F              | 9019.50C  | 3.3767E-07      |   |
| 327 |             |                   |            |          |   | Na             | 11023.50C | 1.4338E-05      |   |
| 328 |             |                   |            |          |   | Mg             | 12000.50C | 1.4770E-04      |   |
| 329 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 7.7630E-03      |   |
| 330 |             |                   |            |          |   | Si             | 14000.50C | 3.5527E-03      |   |
| 331 |             |                   |            |          |   | P              | 15031.50C | 1.0130E-06      |   |
| 332 |             |                   |            |          |   | K              | 19000.50C | 2.6358E-04      |   |
| 333 |             |                   |            |          |   | Ca             | 20000.50C | 7.7361E-05      |   |
| 334 |             |                   |            |          |   | Mn             | 25055.50C | 1.4364E-04      |   |
| 335 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 9.6170E-04      |   |
| 336 |             |                   |            |          |   | Ni             | 28000.50C | 1.1817E-04      |   |
| 337 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 3.7535E-06      |   |
| 338 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 6.4626E-05      |   |
| 339 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 6.9415E-07      |   |
| 340 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.9397E-10      |   |
| 341 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 342 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 343 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 344 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 345 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 346 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 347 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 348 |             |                   |            |          |   |                |           |                 |   |
| 349 |             |                   |            |          |   | Total          |           | 6.4562E-02      |   |
| 350 |             |                   |            |          |   |                |           |                 |   |
| 351 |             |                   |            |          |   | H/U-235        |           | 313.086093      |   |
| 352 |             |                   |            |          |   |                |           |                 |   |
| 353 |             |                   |            |          |   |                |           |                 |   |
| 354 |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |
| 355 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 356 | <b>)</b>    |                   |            |          |   |                |           |                 |   |
| 357 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 358 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 359 |             |                   |            |          |   | H              | 1001.50C  | 1.2550E-02      |   |
| 360 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8968E-02      |   |
| 361 |             |                   |            |          |   | F              | 9019.50C  | 4.1628E-07      |   |
| 362 |             |                   |            |          |   | Na             | 11023.50C | 1.7676E-05      |   |
| 363 |             |                   |            |          |   | Mg             | 12000.50C | 1.8208E-04      |   |
| 364 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 7.3865E-03      |   |
| 365 |             |                   |            |          |   | Si             | 14000.50C | 4.3797E-03      |   |
| 366 |             |                   |            |          |   | P              | 15031.50C | 1.2488E-06      |   |
| 367 |             |                   |            |          |   | K              | 19000.50C | 3.2494E-04      |   |
| 368 |             |                   |            |          |   | Ca             | 20000.50C | 9.5369E-05      |   |
| 369 |             |                   |            |          |   | Mn             | 25055.50C | 1.7708E-04      |   |
| 370 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.1856E-03      |   |
| 371 |             |                   |            |          |   | Ni             | 28000.50C | 1.4568E-04      |   |
| 372 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 3.4705E-06      |   |
| 373 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 5.9753E-05      |   |
| 374 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 6.4180E-07      |   |
| 375 |             |                   |            |          |   | Pu-239         | 94239.55C | 7.3223E-10      |   |
| 376 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 377 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 378 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 379 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 380 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 381 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 382 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 383 |             |                   |            |          |   |                |           |                 |   |
| 384 |             |                   |            |          |   | Total          |           | 5.5479E-02      |   |
| 385 |             |                   |            |          |   |                |           |                 |   |
| 386 |             |                   |            |          |   | H/U-235        |           | 210.032929      |   |
| 387 |             |                   |            |          |   |                |           |                 |   |
| 388 |             |                   |            |          |   |                |           |                 |   |
| 389 |             |                   |            |          |   | Void Frac.     | 0.2       |                 |   |
| 390 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 391 |             |                   |            |          |   |                |           |                 |   |
| 392 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 393 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 394 |             |                   |            |          |   | H              | 1001.50C  | 1.5746E-02      |   |
| 395 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.9231E-02      |   |
| 396 |             |                   |            |          |   | F              | 9019.50C  | 3.9179E-07      |   |
| 397 |             |                   |            |          |   | Na             | 11023.50C | 1.6636E-05      |   |
| 398 |             |                   |            |          |   | Mg             | 12000.50C | 1.7137E-04      |   |
| 399 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 6.9520E-03      |   |
| 400 |             |                   |            |          |   | Si             | 14000.50C | 4.1221E-03      |   |
| 401 |             |                   |            |          |   | P              | 15031.50C | 1.1754E-06      |   |
| 402 |             |                   |            |          |   | K              | 19000.50C | 3.0582E-04      |   |
| 403 |             |                   |            |          |   | Ca             | 20000.50C | 8.9759E-05      |   |
| 404 |             |                   |            |          |   | Mn             | 25055.50C | 1.6666E-04      |   |
| 405 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.1158E-03      |   |
| 406 |             |                   |            |          |   | Ni             | 28000.50C | 1.3711E-04      |   |
| 407 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 3.2663E-06      |   |
| 408 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 5.6238E-05      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 409 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 6.0405E-07      |   |
| 410 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.8916E-10      |   |
| 411 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 412 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 413 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 414 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 415 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 416 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 417 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 418 |             |                   |            |          |   |                |           |                 |   |
| 419 |             |                   |            |          |   | Total          |           | 5.8116E-02      |   |
| 420 |             |                   |            |          |   |                |           |                 |   |
| 421 |             |                   |            |          |   | H/U-235        |           | 279.985932      |   |
| 422 |             |                   |            |          |   |                |           |                 |   |
| 423 |             |                   |            |          |   |                |           |                 |   |
| 424 |             |                   |            |          |   | Void Frac.     | 0.25      |                 |   |
| 425 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 426 |             |                   |            |          |   |                |           |                 |   |
| 427 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 428 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 429 |             |                   |            |          |   | H              | 1001.50C  | 1.8942E-02      |   |
| 430 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.9494E-02      |   |
| 431 |             |                   |            |          |   | F              | 9019.50C  | 3.6730E-07      |   |
| 432 |             |                   |            |          |   | Na             | 11023.50C | 1.5596E-05      |   |
| 433 |             |                   |            |          |   | Mg             | 12000.50C | 1.6066E-04      |   |
| 434 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 6.5175E-03      |   |
| 435 |             |                   |            |          |   | Si             | 14000.50C | 3.8645E-03      |   |
| 436 |             |                   |            |          |   | P              | 15031.50C | 1.1019E-06      |   |
| 437 |             |                   |            |          |   | K              | 19000.50C | 2.8671E-04      |   |
| 438 |             |                   |            |          |   | Ca             | 20000.50C | 8.4149E-05      |   |
| 439 |             |                   |            |          |   | Mn             | 25055.50C | 1.5625E-04      |   |
| 440 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0461E-03      |   |
| 441 |             |                   |            |          |   | Ni             | 28000.50C | 1.2854E-04      |   |
| 442 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 3.0622E-06      |   |
| 443 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 5.2723E-05      |   |
| 444 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 5.6630E-07      |   |
| 445 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.4609E-10      |   |
| 446 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 447 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 448 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 449 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 450 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 451 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 452 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 453 |             |                   |            |          |   |                |           |                 |   |
| 454 |             |                   |            |          |   | Total          |           | 6.0754E-02      |   |
| 455 |             |                   |            |          |   |                |           |                 |   |
| 456 |             |                   |            |          |   | H/U-235        |           | 359.266002      |   |
| 457 |             |                   |            |          |   |                |           |                 |   |
| 458 |             |                   |            |          |   |                |           |                 |   |
| 459 |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |

## Inverse

|     | I    | J                 | K          | L        | M | N          | O              | P               | Q |
|-----|------|-------------------|------------|----------|---|------------|----------------|-----------------|---|
| 460 | DHLW |                   |            |          |   |            |                |                 |   |
| 461 |      |                   |            |          |   |            |                |                 |   |
| 462 |      | Degraded MIT Fuel |            |          |   |            | <b>Mixture</b> | (atoms/barn cm) |   |
| 463 |      | Mass(g)           |            | WT       |   |            |                |                 |   |
| 464 |      |                   |            |          |   | H          | 1001.50C       | 1.2637E-02      |   |
| 465 |      | O                 | 3.73E+05   | 15.99492 |   | O          | 8016.50C       | 2.7740E-02      |   |
| 466 |      |                   |            |          |   | F          | 9019.50C       | 4.3071E-07      |   |
| 467 |      |                   |            |          |   | Na         | 11023.50C      | 1.8289E-05      |   |
| 468 |      |                   |            |          |   | Mg         | 12000.50C      | 1.8840E-04      |   |
| 469 |      | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C      | 6.2871E-03      |   |
| 470 |      |                   |            |          |   | Si         | 14000.50C      | 4.5316E-03      |   |
| 471 |      |                   |            |          |   | P          | 15031.50C      | 1.2921E-06      |   |
| 472 |      |                   |            |          |   | K          | 19000.50C      | 3.3620E-04      |   |
| 473 |      |                   |            |          |   | Ca         | 20000.50C      | 9.8675E-05      |   |
| 474 |      |                   |            |          |   | Mn         | 25055.50C      | 1.8322E-04      |   |
| 475 |      | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C      | 1.2267E-03      |   |
| 476 |      |                   |            |          |   | Ni         | 28000.50C      | 1.5073E-04      |   |
| 477 |      | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C      | 2.8726E-06      |   |
| 478 |      | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C      | 4.9459E-05      |   |
| 479 |      | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C      | 5.3124E-07      |   |
| 480 |      |                   |            |          |   | Pu-239     | 94239.55C      | 7.5762E-10      |   |
| 481 |      | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C      | 0.0000E+00      |   |
| 482 |      |                   |            |          |   | Gd-154     | 64154.50C      | 0.0000E+00      |   |
| 483 |      |                   |            |          |   | Gd-155     | 64155.50C      | 0.0000E+00      |   |
| 484 |      |                   |            |          |   | Gd-156     | 64156.50C      | 0.0000E+00      |   |
| 485 |      |                   |            |          |   | Gd-157     | 64157.50C      | 0.0000E+00      |   |
| 486 |      |                   |            |          |   | Gd-158     | 64158.50C      | 0.0000E+00      |   |
| 487 |      |                   |            |          |   | Gd-160     | 64160.50C      | 0.0000E+00      |   |
| 488 |      |                   |            |          |   |            |                |                 |   |
| 489 |      |                   |            |          |   | Total      |                | 5.3452E-02      |   |
| 490 |      |                   |            |          |   |            |                |                 |   |
| 491 |      |                   |            |          |   | H/U-235    |                | 255.509911      |   |
| 492 |      |                   |            |          |   |            |                |                 |   |
| 493 |      |                   |            |          |   |            |                |                 |   |
| 494 |      |                   |            |          |   | Void Frac. |                | 0.2             |   |
| 495 | DHLW |                   |            |          |   |            |                |                 |   |
| 496 |      |                   |            |          |   |            |                |                 |   |
| 497 |      | Degraded MIT Fuel |            |          |   |            | <b>Mixture</b> | (atoms/barn cm) |   |
| 498 |      | Mass(g)           |            | WT       |   |            |                |                 |   |
| 499 |      |                   |            |          |   | H          | 1001.50C       | 1.5828E-02      |   |
| 500 |      | O                 | 3.73E+05   | 15.99492 |   | O          | 8016.50C       | 2.8075E-02      |   |
| 501 |      |                   |            |          |   | F          | 9019.50C       | 4.0537E-07      |   |
| 502 |      |                   |            |          |   | Na         | 11023.50C      | 1.7213E-05      |   |
| 503 |      |                   |            |          |   | Mg         | 12000.50C      | 1.7731E-04      |   |
| 504 |      | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C      | 5.9172E-03      |   |
| 505 |      |                   |            |          |   | Si         | 14000.50C      | 4.2650E-03      |   |
| 506 |      |                   |            |          |   | P          | 15031.50C      | 1.2161E-06      |   |
| 507 |      |                   |            |          |   | K          | 19000.50C      | 3.1643E-04      |   |
| 508 |      |                   |            |          |   | Ca         | 20000.50C      | 9.2871E-05      |   |
| 509 |      |                   |            |          |   | Mn         | 25055.50C      | 1.7244E-04      |   |
| 510 |      | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C      | 1.1545E-03      |   |



## Inverse

|     | I    | J                 | K          | L        | M | N          | O         | P               | Q |
|-----|------|-------------------|------------|----------|---|------------|-----------|-----------------|---|
| 511 |      |                   |            |          |   | Ni         | 28000.50C | 1.4187E-04      |   |
| 512 |      | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 2.7036E-06      |   |
| 513 |      | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 4.6550E-05      |   |
| 514 |      | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 4.9999E-07      |   |
| 515 |      |                   |            |          |   | Pu-239     | 94239.55C | 7.1305E-10      |   |
| 516 |      | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 517 |      |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 518 |      |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 519 |      |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 520 |      |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 521 |      |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 522 |      |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 523 |      |                   |            |          |   |            |           |                 |   |
| 524 |      |                   |            |          |   | Total      |           | 5.6209E-02      |   |
| 525 |      |                   |            |          |   |            |           |                 |   |
| 526 |      |                   |            |          |   | H/U-235    |           | 340.021478      |   |
| 527 |      |                   |            |          |   |            |           |                 |   |
| 528 |      |                   |            |          |   |            |           |                 |   |
| 529 |      |                   |            |          |   | Void Frac. | 0.25      |                 |   |
| 530 | DHLW |                   |            |          |   |            |           |                 |   |
| 531 |      |                   |            |          |   |            |           |                 |   |
| 532 |      | Degraded MIT Fuel |            |          |   | Mixture    |           | (atoms/barn cm) |   |
| 533 |      | Mass(g)           | WT         |          |   |            |           |                 |   |
| 534 |      |                   |            |          |   | H          | 1001.50C  | 1.9019E-02      |   |
| 535 |      | O                 | 3.73E+05   | 15.99492 |   | O          | 8016.50C  | 2.8410E-02      |   |
| 536 |      |                   |            |          |   | F          | 9019.50C  | 3.8004E-07      |   |
| 537 |      |                   |            |          |   | Na         | 11023.50C | 1.6137E-05      |   |
| 538 |      |                   |            |          |   | Mg         | 12000.50C | 1.6623E-04      |   |
| 539 |      | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 5.5474E-03      |   |
| 540 |      |                   |            |          |   | Si         | 14000.50C | 3.9984E-03      |   |
| 541 |      |                   |            |          |   | P          | 15031.50C | 1.1401E-06      |   |
| 542 |      |                   |            |          |   | K          | 19000.50C | 2.9665E-04      |   |
| 543 |      |                   |            |          |   | Ca         | 20000.50C | 8.7066E-05      |   |
| 544 |      |                   |            |          |   | Mn         | 25055.50C | 1.6166E-04      |   |
| 545 |      | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 1.0824E-03      |   |
| 546 |      |                   |            |          |   | Ni         | 28000.50C | 1.3300E-04      |   |
| 547 |      | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 2.5347E-06      |   |
| 548 |      | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 4.3640E-05      |   |
| 549 |      | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 4.6874E-07      |   |
| 550 |      |                   |            |          |   | Pu-239     | 94239.55C | 6.6849E-10      |   |
| 551 |      | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 552 |      |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 553 |      |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 554 |      |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 555 |      |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 556 |      |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 557 |      |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 558 |      |                   |            |          |   |            |           |                 |   |
| 559 |      |                   |            |          |   | Total      |           | 5.8966E-02      |   |
| 560 |      |                   |            |          |   |            |           |                 |   |
| 561 |      |                   |            |          |   | H/U-235    |           | 435.801253      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 562 |             |                   |            |          |   |                |           |                 |   |
| 563 |             |                   |            |          |   |                |           |                 |   |
| 564 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 565 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 566 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 567 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 568 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 569 |             |                   |            |          |   | H              | 1001.50C  | 2.0422E-02      |   |
| 570 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8558E-02      |   |
| 571 |             |                   |            |          |   | F              | 9019.50C  | 3.6889E-07      |   |
| 572 |             |                   |            |          |   | Na             | 11023.50C | 1.5664E-05      |   |
| 573 |             |                   |            |          |   | Mg             | 12000.50C | 1.6136E-04      |   |
| 574 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.3847E-03      |   |
| 575 |             |                   |            |          |   | Si             | 14000.50C | 3.8811E-03      |   |
| 576 |             |                   |            |          |   | P              | 15031.50C | 1.1067E-06      |   |
| 577 |             |                   |            |          |   | K              | 19000.50C | 2.8795E-04      |   |
| 578 |             |                   |            |          |   | Ca             | 20000.50C | 8.4512E-05      |   |
| 579 |             |                   |            |          |   | Mn             | 25055.50C | 1.5692E-04      |   |
| 580 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0506E-03      |   |
| 581 |             |                   |            |          |   | Ni             | 28000.50C | 1.2910E-04      |   |
| 582 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4603E-06      |   |
| 583 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.2360E-05      |   |
| 584 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.5499E-07      |   |
| 585 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.4888E-10      |   |
| 586 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 587 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 588 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 589 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 590 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 591 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 592 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 593 |             |                   |            |          |   |                |           |                 |   |
| 594 |             |                   |            |          |   | Total          |           | 6.0179E-02      |   |
| 595 |             |                   |            |          |   |                |           |                 |   |
| 596 |             |                   |            |          |   | H/U-235        |           | 482.112353      |   |
| 597 |             |                   |            |          |   |                |           |                 |   |
| 598 |             |                   |            |          |   |                |           |                 |   |
| 599 |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |
| 600 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 601 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 602 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 603 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 604 |             |                   |            |          |   | H              | 1001.50C  | 1.2831E-02      |   |
| 605 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.5008E-02      |   |
| 606 |             |                   |            |          |   | F              | 9019.50C  | 4.6280E-07      |   |
| 607 |             |                   |            |          |   | Na             | 11023.50C | 1.9651E-05      |   |
| 608 |             |                   |            |          |   | Mg             | 12000.50C | 2.0243E-04      |   |
| 609 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.8424E-03      |   |
| 610 |             |                   |            |          |   | Si             | 14000.50C | 4.8691E-03      |   |
| 611 |             |                   |            |          |   | P              | 15031.50C | 1.3884E-06      |   |
| 612 |             |                   |            |          |   | K              | 19000.50C | 3.6125E-04      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 613 |             |                   |            |          |   | Ca             | 20000.50C | 1.0603E-04      |   |
| 614 |             |                   |            |          |   | Mn             | 25055.50C | 1.9687E-04      |   |
| 615 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.3180E-03      |   |
| 616 |             |                   |            |          |   | Ni             | 28000.50C | 1.6196E-04      |   |
| 617 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 1.5433E-06      |   |
| 618 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 2.6572E-05      |   |
| 619 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 2.8541E-07      |   |
| 620 |             |                   |            |          |   | Pu-239         | 94239.55C | 8.1406E-10      |   |
| 621 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 622 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 623 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 624 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 625 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 626 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 627 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 628 |             |                   |            |          |   |                |           |                 |   |
| 629 |             |                   |            |          |   | Total          |           | 4.8947E-02      |   |
| 630 |             |                   |            |          |   |                |           |                 |   |
| 631 |             |                   |            |          |   | H/U-235        |           | 482.894823      |   |
| 632 |             |                   |            |          |   |                |           |                 |   |
| 633 |             |                   |            |          |   |                |           |                 |   |
| 634 |             |                   |            |          |   | Void Frac.     | 0.2       |                 |   |
| 635 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 636 |             |                   |            |          |   |                |           |                 |   |
| 637 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 638 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 639 |             |                   |            |          |   | H              | 1001.50C  | 1.6011E-02      |   |
| 640 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.5504E-02      |   |
| 641 |             |                   |            |          |   | F              | 9019.50C  | 4.3557E-07      |   |
| 642 |             |                   |            |          |   | Na             | 11023.50C | 1.8495E-05      |   |
| 643 |             |                   |            |          |   | Mg             | 12000.50C | 1.9052E-04      |   |
| 644 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.6163E-03      |   |
| 645 |             |                   |            |          |   | Si             | 14000.50C | 4.5827E-03      |   |
| 646 |             |                   |            |          |   | P              | 15031.50C | 1.3067E-06      |   |
| 647 |             |                   |            |          |   | K              | 19000.50C | 3.4000E-04      |   |
| 648 |             |                   |            |          |   | Ca             | 20000.50C | 9.9789E-05      |   |
| 649 |             |                   |            |          |   | Mn             | 25055.50C | 1.8529E-04      |   |
| 650 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.2405E-03      |   |
| 651 |             |                   |            |          |   | Ni             | 28000.50C | 1.5244E-04      |   |
| 652 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 1.4525E-06      |   |
| 653 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 2.5009E-05      |   |
| 654 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 2.6862E-07      |   |
| 655 |             |                   |            |          |   | Pu-239         | 94239.55C | 7.6617E-10      |   |
| 656 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 657 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 658 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 659 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 660 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 661 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 662 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 663 |             |                   |            |          |   |                |           |                 |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 664 |             |                   |            |          |   | Total          |           | 5.1969E-02      |   |
| 665 |             |                   |            |          |   |                |           |                 |   |
| 666 |             |                   |            |          |   | H/U-235        |           | 640.199206      |   |
| 667 |             |                   |            |          |   |                |           |                 |   |
| 668 |             |                   |            |          |   |                |           |                 |   |
| 669 |             |                   |            |          |   | Void Frac.     | 0.25      |                 |   |
| 670 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 671 |             |                   |            |          |   |                |           |                 |   |
| 672 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 673 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 674 |             |                   |            |          |   | H              | 1001.50C  | 1.9190E-02      |   |
| 675 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.6000E-02      |   |
| 676 |             |                   |            |          |   | F              | 9019.50C  | 4.0835E-07      |   |
| 677 |             |                   |            |          |   | Na             | 11023.50C | 1.7339E-05      |   |
| 678 |             |                   |            |          |   | Mg             | 12000.50C | 1.7862E-04      |   |
| 679 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.3903E-03      |   |
| 680 |             |                   |            |          |   | Si             | 14000.50C | 4.2963E-03      |   |
| 681 |             |                   |            |          |   | P              | 15031.50C | 1.2250E-06      |   |
| 682 |             |                   |            |          |   | K              | 19000.50C | 3.1875E-04      |   |
| 683 |             |                   |            |          |   | Ca             | 20000.50C | 9.3552E-05      |   |
| 684 |             |                   |            |          |   | Mn             | 25055.50C | 1.7371E-04      |   |
| 685 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.1630E-03      |   |
| 686 |             |                   |            |          |   | Ni             | 28000.50C | 1.4291E-04      |   |
| 687 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 1.3617E-06      |   |
| 688 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 2.3446E-05      |   |
| 689 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 2.5183E-07      |   |
| 690 |             |                   |            |          |   | Pu-239         | 94239.55C | 7.1829E-10      |   |
| 691 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 692 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 693 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 694 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 695 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 696 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 697 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 698 |             |                   |            |          |   |                |           |                 |   |
| 699 |             |                   |            |          |   | Total          |           | 5.4991E-02      |   |
| 700 |             |                   |            |          |   |                |           |                 |   |
| 701 |             |                   |            |          |   | H/U-235        |           | 818.477507      |   |
| 702 |             |                   |            |          |   |                |           |                 |   |
| 703 |             |                   |            |          |   |                |           |                 |   |
| 704 |             |                   |            |          |   | Void Frac.     | 0.15      |                 |   |
| 705 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 706 |             |                   |            |          |   |                |           |                 |   |
| 707 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 708 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 709 |             |                   |            |          |   | H              | 1001.50C  | 1.2903E-02      |   |
| 710 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.4004E-02      |   |
| 711 |             |                   |            |          |   | F              | 9019.50C  | 4.7458E-07      |   |
| 712 |             |                   |            |          |   | Na             | 11023.50C | 2.0151E-05      |   |
| 713 |             |                   |            |          |   | Mg             | 12000.50C | 2.0759E-04      |   |
| 714 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 2.9445E-03      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N          | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|------------|-----------|-----------------|---|
| 715 |             |                   |            |          |   | Si         | 14000.50C | 4.9931E-03      |   |
| 716 |             |                   |            |          |   | P          | 15031.50C | 1.4237E-06      |   |
| 717 |             |                   |            |          |   | K          | 19000.50C | 3.7045E-04      |   |
| 718 |             |                   |            |          |   | Ca         | 20000.50C | 1.0873E-04      |   |
| 719 |             |                   |            |          |   | Mn         | 25055.50C | 2.0188E-04      |   |
| 720 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 1.3516E-03      |   |
| 721 |             |                   |            |          |   | Ni         | 28000.50C | 1.6609E-04      |   |
| 722 |             | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 1.0551E-06      |   |
| 723 |             | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 1.8166E-05      |   |
| 724 |             | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 1.9512E-07      |   |
| 725 |             |                   |            |          |   | Pu-239     | 94239.55C | 8.3479E-10      |   |
| 726 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 727 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 728 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 729 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 730 |             |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 731 |             |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 732 |             |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 733 |             |                   |            |          |   |            |           |                 |   |
| 734 |             |                   |            |          |   | Total      |           | 4.7292E-02      |   |
| 735 |             |                   |            |          |   |            |           |                 |   |
| 736 |             |                   |            |          |   | H/U-235    |           | 710.279735      |   |
| 737 |             |                   |            |          |   |            |           |                 |   |
| 738 |             |                   |            |          |   |            |           |                 |   |
| 739 |             |                   |            |          |   | Void Frac. | 0.2       |                 |   |
| 740 | <b>DHLW</b> |                   |            |          |   |            |           |                 |   |
| 741 |             |                   |            |          |   |            |           |                 |   |
| 742 |             | Degraded MIT Fuel |            |          |   | Mixture    |           | (atoms/barn cm) |   |
| 743 |             | Mass(g)           | WT         |          |   |            |           |                 |   |
| 744 |             |                   |            |          |   | H          | 1001.50C  | 1.6078E-02      |   |
| 745 |             | O                 | 3.73E+05   | 15.99492 |   | O          | 8016.50C  | 2.4559E-02      |   |
| 746 |             |                   |            |          |   | F          | 9019.50C  | 4.4666E-07      |   |
| 747 |             |                   |            |          |   | Na         | 11023.50C | 1.8966E-05      |   |
| 748 |             |                   |            |          |   | Mg         | 12000.50C | 1.9538E-04      |   |
| 749 |             | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 2.7713E-03      |   |
| 750 |             |                   |            |          |   | Si         | 14000.50C | 4.6994E-03      |   |
| 751 |             |                   |            |          |   | P          | 15031.50C | 1.3400E-06      |   |
| 752 |             |                   |            |          |   | K          | 19000.50C | 3.4866E-04      |   |
| 753 |             |                   |            |          |   | Ca         | 20000.50C | 1.0233E-04      |   |
| 754 |             |                   |            |          |   | Mn         | 25055.50C | 1.9001E-04      |   |
| 755 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 1.2721E-03      |   |
| 756 |             |                   |            |          |   | Ni         | 28000.50C | 1.5632E-04      |   |
| 757 |             | U-238             | 1936       | 238.0508 |   | U-238      | 92238.50C | 9.9301E-07      |   |
| 758 |             | U-235             | 32912      | 235.0439 |   | U-235      | 92235.50C | 1.7097E-05      |   |
| 759 |             | U-234             | 352        | 234.0409 |   | U-234      | 92234.50C | 1.8364E-07      |   |
| 760 |             |                   |            |          |   | Pu-239     | 94239.55C | 7.8568E-10      |   |
| 761 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 762 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 763 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 764 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 765 |             |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 766 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 767 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 768 |             |                   |            |          |   |                |           |                 |   |
| 769 |             |                   |            |          |   | Total          |           | 5.0412E-02      |   |
| 770 |             |                   |            |          |   |                |           |                 |   |
| 771 |             |                   |            |          |   | H/U-235        |           | 940.376934      |   |
| 772 |             |                   |            |          |   |                |           |                 |   |
| 773 |             |                   |            |          |   |                |           |                 |   |
| 774 |             |                   |            |          |   | Void Frac.     | 0.25      |                 |   |
| 775 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 776 |             |                   |            |          |   |                |           |                 |   |
| 777 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 778 |             | Mass(g)           |            | WT       |   |                |           |                 |   |
| 779 |             |                   |            |          |   | H              | 1001.50C  | 1.9253E-02      |   |
| 780 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.5114E-02      |   |
| 781 |             |                   |            |          |   | F              | 9019.50C  | 4.1875E-07      |   |
| 782 |             |                   |            |          |   | Na             | 11023.50C | 1.7781E-05      |   |
| 783 |             |                   |            |          |   | Mg             | 12000.50C | 1.8316E-04      |   |
| 784 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 2.5980E-03      |   |
| 785 |             |                   |            |          |   | Si             | 14000.50C | 4.4057E-03      |   |
| 786 |             |                   |            |          |   | P              | 15031.50C | 1.2562E-06      |   |
| 787 |             |                   |            |          |   | K              | 19000.50C | 3.2687E-04      |   |
| 788 |             |                   |            |          |   | Ca             | 20000.50C | 9.5935E-05      |   |
| 789 |             |                   |            |          |   | Mn             | 25055.50C | 1.7813E-04      |   |
| 790 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.1926E-03      |   |
| 791 |             |                   |            |          |   | Ni             | 28000.50C | 1.4655E-04      |   |
| 792 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 9.3095E-07      |   |
| 793 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 1.6029E-05      |   |
| 794 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 1.7216E-07      |   |
| 795 |             |                   |            |          |   | Pu-239         | 94239.55C | 7.3658E-10      |   |
| 796 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 797 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 798 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 799 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 800 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 801 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 802 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 803 |             |                   |            |          |   |                |           |                 |   |
| 804 |             |                   |            |          |   | Total          |           | 5.3531E-02      |   |
| 805 |             |                   |            |          |   |                |           |                 |   |
| 806 |             |                   |            |          |   | H/U-235        |           | 1201.15376      |   |
| 807 |             |                   |            |          |   |                |           |                 |   |
| 808 |             |                   |            |          |   |                |           |                 |   |
| 809 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 810 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 811 | <b>(O3)</b> |                   |            |          |   |                |           |                 |   |
| 812 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 813 |             | Mass(g)           |            | WT       |   |                |           |                 |   |
| 814 |             |                   |            |          |   | H              | 1001.50C  | 2.0422E-02      |   |
| 815 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8557E-02      |   |
| 816 |             |                   |            |          |   | F              | 9019.50C  | 3.6888E-07      |   |

Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 817 |             |                   |            |          |   | Na             | 11023.50C | 1.5663E-05      |   |
| 818 |             |                   |            |          |   | Mg             | 12000.50C | 1.6135E-04      |   |
| 819 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.3846E-03      |   |
| 820 |             |                   |            |          |   | Si             | 14000.50C | 3.8811E-03      |   |
| 821 |             |                   |            |          |   | P              | 15031.50C | 1.1066E-06      |   |
| 822 |             |                   |            |          |   | K              | 19000.50C | 2.8794E-04      |   |
| 823 |             |                   |            |          |   | Ca             | 20000.50C | 8.4511E-05      |   |
| 824 |             |                   |            |          |   | Mn             | 25055.50C | 1.5692E-04      |   |
| 825 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0506E-03      |   |
| 826 |             |                   |            |          |   | Ni             | 28000.50C | 1.2910E-04      |   |
| 827 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4603E-06      |   |
| 828 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.2360E-05      |   |
| 829 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.5499E-07      |   |
| 830 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.4887E-10      |   |
| 831 |             | Gd                | 2.0000E+02 | 157.25   |   | Gd-152         | 64152.50C | 7.6951E-10      |   |
| 832 |             |                   |            |          |   | Gd-154         | 64154.50C | 8.3877E-09      |   |
| 833 |             |                   |            |          |   | Gd-155         | 64155.50C | 5.6944E-08      |   |
| 834 |             |                   |            |          |   | Gd-156         | 64156.50C | 7.8760E-08      |   |
| 835 |             |                   |            |          |   | Gd-157         | 64157.50C | 6.0214E-08      |   |
| 836 |             |                   |            |          |   | Gd-158         | 64158.50C | 9.5574E-08      |   |
| 837 |             |                   |            |          |   | Gd-160         | 64160.50C | 8.4108E-08      |   |
| 838 |             |                   |            |          |   |                |           |                 |   |
| 839 |             |                   |            |          |   | Total          |           | 6.0179E-02      |   |
| 840 |             |                   |            |          |   |                |           |                 |   |
| 841 |             |                   |            |          |   | H/U-235        |           | 482.119854      |   |
| 842 |             |                   |            |          |   |                |           |                 |   |
| 843 |             |                   |            |          |   |                |           |                 |   |
| 844 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 845 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 846 | <b>(O3)</b> |                   |            |          |   |                |           |                 |   |
| 847 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 848 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 849 |             |                   |            |          |   | H              | 1001.50C  | 2.0422E-02      |   |
| 850 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8558E-02      |   |
| 851 |             |                   |            |          |   | F              | 9019.50C  | 3.6889E-07      |   |
| 852 |             |                   |            |          |   | Na             | 11023.50C | 1.5663E-05      |   |
| 853 |             |                   |            |          |   | Mg             | 12000.50C | 1.6135E-04      |   |
| 854 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.3846E-03      |   |
| 855 |             |                   |            |          |   | Si             | 14000.50C | 3.8811E-03      |   |
| 856 |             |                   |            |          |   | P              | 15031.50C | 1.1067E-06      |   |
| 857 |             |                   |            |          |   | K              | 19000.50C | 2.8794E-04      |   |
| 858 |             |                   |            |          |   | Ca             | 20000.50C | 8.4512E-05      |   |
| 859 |             |                   |            |          |   | Mn             | 25055.50C | 1.5692E-04      |   |
| 860 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0506E-03      |   |
| 861 |             |                   |            |          |   | Ni             | 28000.50C | 1.2910E-04      |   |
| 862 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4603E-06      |   |
| 863 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.2360E-05      |   |
| 864 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.5499E-07      |   |
| 865 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.4887E-10      |   |
| 866 |             | Gd                | 1.0000E+02 | 157.25   |   | Gd-152         | 64152.50C | 3.8476E-10      |   |
| 867 |             |                   |            |          |   | Gd-154         | 64154.50C | 4.1939E-09      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 868 |             |                   |            |          |   | Gd-155         | 64155.50C | 2.8472E-08      |   |
| 869 |             |                   |            |          |   | Gd-156         | 64156.50C | 3.9380E-08      |   |
| 870 |             |                   |            |          |   | Gd-157         | 64157.50C | 3.0107E-08      |   |
| 871 |             |                   |            |          |   | Gd-158         | 64158.50C | 4.7787E-08      |   |
| 872 |             |                   |            |          |   | Gd-160         | 64160.50C | 4.2054E-08      |   |
| 873 |             |                   |            |          |   |                |           |                 |   |
| 874 |             |                   |            |          |   | Total          |           | 6.0179E-02      |   |
| 875 |             |                   |            |          |   |                |           |                 |   |
| 876 |             |                   |            |          |   | H/U-235        |           | 482.116104      |   |
| 877 |             |                   |            |          |   |                |           |                 |   |
| 878 |             |                   |            |          |   |                |           |                 |   |
| 879 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 880 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 881 | <b>D3)</b>  |                   |            |          |   |                |           |                 |   |
| 882 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 883 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 884 |             |                   |            |          |   | H              | 1001.50C  | 2.0422E-02      |   |
| 885 |             | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8558E-02      |   |
| 886 |             |                   |            |          |   | F              | 9019.50C  | 3.6889E-07      |   |
| 887 |             |                   |            |          |   | Na             | 11023.50C | 1.5664E-05      |   |
| 888 |             |                   |            |          |   | Mg             | 12000.50C | 1.6136E-04      |   |
| 889 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.3847E-03      |   |
| 890 |             |                   |            |          |   | Si             | 14000.50C | 3.8811E-03      |   |
| 891 |             |                   |            |          |   | P              | 15031.50C | 1.1067E-06      |   |
| 892 |             |                   |            |          |   | K              | 19000.50C | 2.8795E-04      |   |
| 893 |             |                   |            |          |   | Ca             | 20000.50C | 8.4512E-05      |   |
| 894 |             |                   |            |          |   | Mn             | 25055.50C | 1.5692E-04      |   |
| 895 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0506E-03      |   |
| 896 |             |                   |            |          |   | Ni             | 28000.50C | 1.2910E-04      |   |
| 897 |             | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4603E-06      |   |
| 898 |             | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.2360E-05      |   |
| 899 |             | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.5499E-07      |   |
| 900 |             |                   |            |          |   | Pu-239         | 94239.55C | 6.4887E-10      |   |
| 901 |             | Gd                | 5.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 1.9238E-10      |   |
| 902 |             |                   |            |          |   | Gd-154         | 64154.50C | 2.0970E-09      |   |
| 903 |             |                   |            |          |   | Gd-155         | 64155.50C | 1.4236E-08      |   |
| 904 |             |                   |            |          |   | Gd-156         | 64156.50C | 1.9690E-08      |   |
| 905 |             |                   |            |          |   | Gd-157         | 64157.50C | 1.5054E-08      |   |
| 906 |             |                   |            |          |   | Gd-158         | 64158.50C | 2.3894E-08      |   |
| 907 |             |                   |            |          |   | Gd-160         | 64160.50C | 2.1027E-08      |   |
| 908 |             |                   |            |          |   |                |           |                 |   |
| 909 |             |                   |            |          |   | Total          |           | 6.0179E-02      |   |
| 910 |             |                   |            |          |   |                |           |                 |   |
| 911 |             |                   |            |          |   | H/U-235        |           | 482.114228      |   |
| 912 |             |                   |            |          |   |                |           |                 |   |
| 913 |             |                   |            |          |   |                |           |                 |   |
| 914 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 915 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 916 | <b>D3)</b>  |                   |            |          |   |                |           |                 |   |
| 917 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 918 |             | Mass(g)           | WT         |          |   |                |           |                 |   |



## Inverse

|     | I             | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|---------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 919 |               |                   |            |          |   | H              | 1001.50C  | 2.0422E-02      |   |
| 920 |               | O                 | 3.73E+05   | 15.99492 |   | O              | 8016.50C  | 2.8558E-02      |   |
| 921 |               |                   |            |          |   | F              | 9019.50C  | 3.6889E-07      |   |
| 922 |               |                   |            |          |   | Na             | 11023.50C | 1.5664E-05      |   |
| 923 |               |                   |            |          |   | Mg             | 12000.50C | 1.6136E-04      |   |
| 924 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.3847E-03      |   |
| 925 |               |                   |            |          |   | Si             | 14000.50C | 3.8811E-03      |   |
| 926 |               |                   |            |          |   | P              | 15031.50C | 1.1067E-06      |   |
| 927 |               |                   |            |          |   | K              | 19000.50C | 2.8795E-04      |   |
| 928 |               |                   |            |          |   | Ca             | 20000.50C | 8.4512E-05      |   |
| 929 |               |                   |            |          |   | Mn             | 25055.50C | 1.5692E-04      |   |
| 930 |               | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 1.0506E-03      |   |
| 931 |               |                   |            |          |   | Ni             | 28000.50C | 1.2910E-04      |   |
| 932 |               | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4603E-06      |   |
| 933 |               | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.2360E-05      |   |
| 934 |               | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.5499E-07      |   |
| 935 |               |                   |            |          |   | Pu-239         | 94239.55C | 6.4888E-10      |   |
| 936 |               | Gd                | 2.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 7.6953E-11      |   |
| 937 |               |                   |            |          |   | Gd-154         | 64154.50C | 8.3878E-10      |   |
| 938 |               |                   |            |          |   | Gd-155         | 64155.50C | 5.6945E-09      |   |
| 939 |               |                   |            |          |   | Gd-156         | 64156.50C | 7.8761E-09      |   |
| 940 |               |                   |            |          |   | Gd-157         | 64157.50C | 6.0215E-09      |   |
| 941 |               |                   |            |          |   | Gd-158         | 64158.50C | 9.5575E-09      |   |
| 942 |               |                   |            |          |   | Gd-160         | 64160.50C | 8.4109E-09      |   |
| 943 |               |                   |            |          |   |                |           |                 |   |
| 944 |               |                   |            |          |   | Total          |           | 6.0179E-02      |   |
| 945 |               |                   |            |          |   |                |           |                 |   |
| 946 |               |                   |            |          |   | H/U-235        |           | 482.113103      |   |
| 947 |               |                   |            |          |   |                |           |                 |   |
| 948 |               |                   |            |          |   |                |           |                 |   |
| 949 |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 950 | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 951 | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 952 |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 953 |               |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 954 |               |                   |            |          |   | H              | 1001.50C  | 1.9572E-02      |   |
| 955 |               | O                 | 4.62E+05   | 15.99492 |   | O              | 8016.50C  | 2.9378E-02      |   |
| 956 |               |                   |            |          |   | F              | 9019.50C  | 3.6094E-07      |   |
| 957 |               |                   |            |          |   | Na             | 11023.50C | 1.5326E-05      |   |
| 958 |               |                   |            |          |   | Mg             | 12000.50C | 1.5788E-04      |   |
| 959 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.2687E-03      |   |
| 960 |               |                   |            |          |   | Si             | 14000.50C | 3.7975E-03      |   |
| 961 |               |                   |            |          |   | P              | 15031.50C | 1.0828E-06      |   |
| 962 |               |                   |            |          |   | K              | 19000.50C | 2.8175E-04      |   |
| 963 |               |                   |            |          |   | Ca             | 20000.50C | 8.2692E-05      |   |
| 964 |               |                   |            |          |   | Mn             | 25055.50C | 1.5354E-04      |   |
| 965 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.1221E-03      |   |
| 966 |               |                   |            |          |   | Ni             | 28000.50C | 1.2632E-04      |   |
| 967 |               | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4073E-06      |   |
| 968 |               | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.1448E-05      |   |
| 969 |               | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.4519E-07      |   |

## Inverse

|      | I             | J                 | K          | L        | M | N              | O         | P               | Q |
|------|---------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 970  |               |                   |            |          |   | Pu-239         | 94239.55C | 6.3490E-10      |   |
| 971  |               | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 972  |               |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 973  |               |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 974  |               |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 975  |               |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 976  |               |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 977  |               |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 978  |               |                   |            |          |   |                |           |                 |   |
| 979  |               |                   |            |          |   | Total          |           | 6.1002E-02      |   |
| 980  |               |                   |            |          |   |                |           |                 |   |
| 981  |               |                   |            |          |   | H/U-235        |           | 472.202696      |   |
| 982  |               |                   |            |          |   |                |           |                 |   |
| 983  |               |                   |            |          |   |                |           |                 |   |
| 984  |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 985  | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 986  | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 987  |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 988  |               | Mass(g)           | WT         |          |   |                |           |                 |   |
| 989  |               |                   |            |          |   | H              | 1001.50C  | 1.9572E-02      |   |
| 990  |               | O                 | 4.62E+05   | 15.99492 |   | O              | 8016.50C  | 2.9378E-02      |   |
| 991  |               |                   |            |          |   | F              | 9019.50C  | 3.6094E-07      |   |
| 992  |               |                   |            |          |   | Na             | 11023.50C | 1.5326E-05      |   |
| 993  |               |                   |            |          |   | Mg             | 12000.50C | 1.5788E-04      |   |
| 994  |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 5.2687E-03      |   |
| 995  |               |                   |            |          |   | Si             | 14000.50C | 3.7975E-03      |   |
| 996  |               |                   |            |          |   | P              | 15031.50C | 1.0828E-06      |   |
| 997  |               |                   |            |          |   | K              | 19000.50C | 2.8174E-04      |   |
| 998  |               |                   |            |          |   | Ca             | 20000.50C | 8.2692E-05      |   |
| 999  |               |                   |            |          |   | Mn             | 25055.50C | 1.5354E-04      |   |
| 1000 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.1221E-03      |   |
| 1001 |               |                   |            |          |   | Ni             | 28000.50C | 1.2632E-04      |   |
| 1002 |               | U-238             | 1936       | 238.0508 |   | U-238          | 92238.50C | 2.4073E-06      |   |
| 1003 |               | U-235             | 32912      | 235.0439 |   | U-235          | 92235.50C | 4.1448E-05      |   |
| 1004 |               | U-234             | 352        | 234.0409 |   | U-234          | 92234.50C | 4.4519E-07      |   |
| 1005 |               |                   |            |          |   | Pu-239         | 94239.55C | 6.3490E-10      |   |
| 1006 |               | Gd                | 2.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 7.5295E-11      |   |
| 1007 |               |                   |            |          |   | Gd-154         | 64154.50C | 8.2072E-10      |   |
| 1008 |               |                   |            |          |   | Gd-155         | 64155.50C | 5.5718E-09      |   |
| 1009 |               |                   |            |          |   | Gd-156         | 64156.50C | 7.7065E-09      |   |
| 1010 |               |                   |            |          |   | Gd-157         | 64157.50C | 5.8918E-09      |   |
| 1011 |               |                   |            |          |   | Gd-158         | 64158.50C | 9.3517E-09      |   |
| 1012 |               |                   |            |          |   | Gd-160         | 64160.50C | 8.2298E-09      |   |
| 1013 |               |                   |            |          |   |                |           |                 |   |
| 1014 |               |                   |            |          |   | Total          |           | 6.1002E-02      |   |
| 1015 |               |                   |            |          |   |                |           |                 |   |
| 1016 |               |                   |            |          |   | H/U-235        |           | 472.203402      |   |

|    | R           | S         | T               | U |
|----|-------------|-----------|-----------------|---|
| 1  |             |           |                 |   |
| 2  |             |           |                 |   |
| 3  |             |           |                 |   |
| 4  |             |           |                 |   |
| 5  |             |           |                 |   |
| 6  |             |           |                 |   |
| 7  | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 8  |             |           |                 |   |
| 9  | H           | 1001.50C  | 1.3057E-02      |   |
| 10 | O           | 8016.50C  | 2.1836E-02      |   |
| 11 | F           | 9019.50C  | 5.0005E-07      |   |
| 12 | Na          | 11023.50C | 2.1233E-05      |   |
| 13 | Mg          | 12000.50C | 2.1873E-04      |   |
| 14 | Al          | 13027.50C | 1.0041E-03      |   |
| 15 | Si          | 14000.50C | 5.2611E-03      |   |
| 16 | P           | 15031.50C | 1.5001E-06      |   |
| 17 | K           | 19000.50C | 3.9033E-04      |   |
| 18 | Ca          | 20000.50C | 1.1456E-04      |   |
| 19 | Mn          | 25055.50C | 2.1271E-04      |   |
| 20 | Fe          | 26000.55C | 1.4241E-03      |   |
| 21 | Ni          | 28000.50C | 1.7500E-04      |   |
| 22 |             |           |                 |   |
| 23 |             |           |                 |   |
| 24 |             |           |                 |   |
| 25 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 26 | Total       |           | 4.3717E-02      |   |
| 27 |             |           |                 |   |
| 28 |             |           |                 |   |
| 29 |             |           |                 |   |
| 30 |             |           |                 |   |
| 31 |             |           |                 |   |
| 32 |             |           |                 |   |
| 33 |             |           |                 |   |
| 34 |             |           |                 |   |
| 35 |             |           |                 |   |
| 36 |             |           |                 |   |
| 37 |             |           |                 |   |
| 38 |             |           |                 |   |
| 39 |             |           |                 |   |
| 40 |             |           |                 |   |
| 41 |             |           |                 |   |
| 42 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 43 |             |           |                 |   |
| 44 | H           | 1001.50C  | 1.6223E-02      |   |
| 45 | O           | 8016.50C  | 2.2518E-02      |   |
| 46 | F           | 9019.50C  | 4.7063E-07      |   |
| 47 | Na          | 11023.50C | 1.9984E-05      |   |
| 48 | Mg          | 12000.50C | 2.0586E-04      |   |
| 49 | Al          | 13027.50C | 9.4503E-04      |   |
| 50 | Si          | 14000.50C | 4.9516E-03      |   |
| 51 | P           | 15031.50C | 1.4119E-06      |   |

## Inverse

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 52  | K           | 19000.50C | 3.6737E-04      |   |
| 53  | Ca          | 20000.50C | 1.0782E-04      |   |
| 54  | Mn          | 25055.50C | 2.0020E-04      |   |
| 55  | Fe          | 26000.55C | 1.3404E-03      |   |
| 56  | Ni          | 28000.50C | 1.6471E-04      |   |
| 57  |             |           |                 |   |
| 58  |             |           |                 |   |
| 59  |             |           |                 |   |
| 60  | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 61  | Total       |           | 4.7046E-02      |   |
| 62  |             |           |                 |   |
| 63  |             |           |                 |   |
| 64  |             |           |                 |   |
| 65  |             |           |                 |   |
| 66  |             |           |                 |   |
| 67  |             |           |                 |   |
| 68  |             |           |                 |   |
| 69  |             |           |                 |   |
| 70  |             |           |                 |   |
| 71  |             |           |                 |   |
| 72  |             |           |                 |   |
| 73  |             |           |                 |   |
| 74  |             |           |                 |   |
| 75  |             |           |                 |   |
| 76  |             |           |                 |   |
| 77  | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 78  |             |           |                 |   |
| 79  | H           | 1001.50C  | 1.9389E-02      |   |
| 80  | O           | 8016.50C  | 2.3201E-02      |   |
| 81  | F           | 9019.50C  | 4.4122E-07      |   |
| 82  | Na          | 11023.50C | 1.8735E-05      |   |
| 83  | Mg          | 12000.50C | 1.9299E-04      |   |
| 84  | Al          | 13027.50C | 8.8597E-04      |   |
| 85  | Si          | 14000.50C | 4.6421E-03      |   |
| 86  | P           | 15031.50C | 1.3237E-06      |   |
| 87  | K           | 19000.50C | 3.4441E-04      |   |
| 88  | Ca          | 20000.50C | 1.0108E-04      |   |
| 89  | Mn          | 25055.50C | 1.8769E-04      |   |
| 90  | Fe          | 26000.55C | 1.2566E-03      |   |
| 91  | Ni          | 28000.50C | 1.5441E-04      |   |
| 92  |             |           |                 |   |
| 93  |             |           |                 |   |
| 94  |             |           |                 |   |
| 95  | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 96  | Total       |           | 5.0375E-02      |   |
| 97  |             |           |                 |   |
| 98  |             |           |                 |   |
| 99  |             |           |                 |   |
| 100 |             |           |                 |   |
| 101 |             |           |                 |   |
| 102 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 103 |             |           |                 |   |
| 104 |             |           |                 |   |
| 105 |             |           |                 |   |
| 106 |             |           |                 |   |
| 107 |             |           |                 |   |
| 108 |             |           |                 |   |
| 109 |             |           |                 |   |
| 110 |             |           |                 |   |
| 111 |             |           |                 |   |
| 112 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 113 |             |           |                 |   |
| 114 | H           | 1001.50C  | 1.3057E-02      |   |
| 115 | O           | 8016.50C  | 2.1836E-02      |   |
| 116 | F           | 9019.50C  | 5.0005E-07      |   |
| 117 | Na          | 11023.50C | 2.1233E-05      |   |
| 118 | Mg          | 12000.50C | 2.1873E-04      |   |
| 119 | Al          | 13027.50C | 1.0041E-03      |   |
| 120 | Si          | 14000.50C | 5.2611E-03      |   |
| 121 | P           | 15031.50C | 1.5001E-06      |   |
| 122 | K           | 19000.50C | 3.9033E-04      |   |
| 123 | Ca          | 20000.50C | 1.1456E-04      |   |
| 124 | Mn          | 25055.50C | 2.1271E-04      |   |
| 125 | Fe          | 26000.55C | 1.4241E-03      |   |
| 126 | Ni          | 28000.50C | 1.7500E-04      |   |
| 127 |             |           |                 |   |
| 128 |             |           |                 |   |
| 129 |             |           |                 |   |
| 130 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 131 | Total       |           | 4.3717E-02      |   |
| 132 |             |           |                 |   |
| 133 |             |           |                 |   |
| 134 |             |           |                 |   |
| 135 |             |           |                 |   |
| 136 |             |           |                 |   |
| 137 |             |           |                 |   |
| 138 |             |           |                 |   |
| 139 |             |           |                 |   |
| 140 |             |           |                 |   |
| 141 |             |           |                 |   |
| 142 |             |           |                 |   |
| 143 |             |           |                 |   |
| 144 |             |           |                 |   |
| 145 |             |           |                 |   |
| 146 |             |           |                 |   |
| 147 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 148 |             |           |                 |   |
| 149 | H           | 1001.50C  | 1.6223E-02      |   |
| 150 | O           | 8016.50C  | 2.2518E-02      |   |
| 151 | F           | 9019.50C  | 4.7063E-07      |   |
| 152 | Na          | 11023.50C | 1.9984E-05      |   |
| 153 | Mg          | 12000.50C | 2.0586E-04      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 154 | Al          | 13027.50C | 9.4503E-04      |   |
| 155 | Si          | 14000.50C | 4.9516E-03      |   |
| 156 | P           | 15031.50C | 1.4119E-06      |   |
| 157 | K           | 19000.50C | 3.6737E-04      |   |
| 158 | Ca          | 20000.50C | 1.0782E-04      |   |
| 159 | Mn          | 25055.50C | 2.0020E-04      |   |
| 160 | Fe          | 26000.55C | 1.3404E-03      |   |
| 161 | Ni          | 28000.50C | 1.6471E-04      |   |
| 162 |             |           |                 |   |
| 163 |             |           |                 |   |
| 164 |             |           |                 |   |
| 165 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 166 | Total       |           | 4.7046E-02      |   |
| 167 |             |           |                 |   |
| 168 |             |           |                 |   |
| 169 |             |           |                 |   |
| 170 |             |           |                 |   |
| 171 |             |           |                 |   |
| 172 |             |           |                 |   |
| 173 |             |           |                 |   |
| 174 |             |           |                 |   |
| 175 |             |           |                 |   |
| 176 |             |           |                 |   |
| 177 |             |           |                 |   |
| 178 |             |           |                 |   |
| 179 |             |           |                 |   |
| 180 |             |           |                 |   |
| 181 |             |           |                 |   |
| 182 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 183 |             |           |                 |   |
| 184 | H           | 1001.50C  | 1.9389E-02      |   |
| 185 | O           | 8016.50C  | 2.3201E-02      |   |
| 186 | F           | 9019.50C  | 4.4122E-07      |   |
| 187 | Na          | 11023.50C | 1.8735E-05      |   |
| 188 | Mg          | 12000.50C | 1.9299E-04      |   |
| 189 | Al          | 13027.50C | 8.8597E-04      |   |
| 190 | Si          | 14000.50C | 4.6421E-03      |   |
| 191 | P           | 15031.50C | 1.3237E-06      |   |
| 192 | K           | 19000.50C | 3.4441E-04      |   |
| 193 | Ca          | 20000.50C | 1.0108E-04      |   |
| 194 | Mn          | 25055.50C | 1.8769E-04      |   |
| 195 | Fe          | 26000.55C | 1.2566E-03      |   |
| 196 | Ni          | 28000.50C | 1.5441E-04      |   |
| 197 |             |           |                 |   |
| 198 |             |           |                 |   |
| 199 |             |           |                 |   |
| 200 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 201 | Total       |           | 5.0375E-02      |   |
| 202 |             |           |                 |   |
| 203 |             |           |                 |   |
| 204 |             |           |                 |   |

## Inverse

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 205 |             |           |                 |   |
| 206 |             |           |                 |   |
| 207 |             |           |                 |   |
| 208 |             |           |                 |   |
| 209 |             |           |                 |   |
| 210 |             |           |                 |   |
| 211 |             |           |                 |   |
| 212 |             |           |                 |   |
| 213 |             |           |                 |   |
| 214 |             |           |                 |   |
| 215 |             |           |                 |   |
| 216 |             |           |                 |   |
| 217 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 218 |             |           |                 |   |
| 219 | H           | 1001.50C  | 1.3057E-02      |   |
| 220 | O           | 8016.50C  | 2.1836E-02      |   |
| 221 | F           | 9019.50C  | 5.0005E-07      |   |
| 222 | Na          | 11023.50C | 2.1233E-05      |   |
| 223 | Mg          | 12000.50C | 2.1873E-04      |   |
| 224 | Al          | 13027.50C | 1.0041E-03      |   |
| 225 | Si          | 14000.50C | 5.2611E-03      |   |
| 226 | P           | 15031.50C | 1.5001E-06      |   |
| 227 | K           | 19000.50C | 3.9033E-04      |   |
| 228 | Ca          | 20000.50C | 1.1456E-04      |   |
| 229 | Mn          | 25055.50C | 2.1271E-04      |   |
| 230 | Fe          | 26000.55C | 1.4241E-03      |   |
| 231 | Ni          | 28000.50C | 1.7500E-04      |   |
| 232 |             |           |                 |   |
| 233 |             |           |                 |   |
| 234 |             |           |                 |   |
| 235 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 236 | Total       |           | 4.3717E-02      |   |
| 237 |             |           |                 |   |
| 238 |             |           |                 |   |
| 239 |             |           |                 |   |
| 240 |             |           |                 |   |
| 241 |             |           |                 |   |
| 242 |             |           |                 |   |
| 243 |             |           |                 |   |
| 244 |             |           |                 |   |
| 245 |             |           |                 |   |
| 246 |             |           |                 |   |
| 247 |             |           |                 |   |
| 248 |             |           |                 |   |
| 249 |             |           |                 |   |
| 250 |             |           |                 |   |
| 251 |             |           |                 |   |
| 252 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 253 |             |           |                 |   |
| 254 | H           | 1001.50C  | 1.6223E-02      |   |
| 255 | O           | 8016.50C  | 2.2518E-02      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 256 | F           | 9019.50C  | 4.7063E-07      |   |
| 257 | Na          | 11023.50C | 1.9984E-05      |   |
| 258 | Mg          | 12000.50C | 2.0586E-04      |   |
| 259 | Al          | 13027.50C | 9.4503E-04      |   |
| 260 | Si          | 14000.50C | 4.9516E-03      |   |
| 261 | P           | 15031.50C | 1.4119E-06      |   |
| 262 | K           | 19000.50C | 3.6737E-04      |   |
| 263 | Ca          | 20000.50C | 1.0782E-04      |   |
| 264 | Mn          | 25055.50C | 2.0020E-04      |   |
| 265 | Fe          | 26000.55C | 1.3404E-03      |   |
| 266 | Ni          | 28000.50C | 1.6471E-04      |   |
| 267 |             |           |                 |   |
| 268 |             |           |                 |   |
| 269 |             |           |                 |   |
| 270 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 271 | Total       |           | 4.7046E-02      |   |
| 272 |             |           |                 |   |
| 273 |             |           |                 |   |
| 274 |             |           |                 |   |
| 275 |             |           |                 |   |
| 276 |             |           |                 |   |
| 277 |             |           |                 |   |
| 278 |             |           |                 |   |
| 279 |             |           |                 |   |
| 280 |             |           |                 |   |
| 281 |             |           |                 |   |
| 282 |             |           |                 |   |
| 283 |             |           |                 |   |
| 284 |             |           |                 |   |
| 285 |             |           |                 |   |
| 286 |             |           |                 |   |
| 287 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 288 |             |           |                 |   |
| 289 | H           | 1001.50C  | 1.9389E-02      |   |
| 290 | O           | 8016.50C  | 2.3201E-02      |   |
| 291 | F           | 9019.50C  | 4.4122E-07      |   |
| 292 | Na          | 11023.50C | 1.8735E-05      |   |
| 293 | Mg          | 12000.50C | 1.9299E-04      |   |
| 294 | Al          | 13027.50C | 8.8597E-04      |   |
| 295 | Si          | 14000.50C | 4.6421E-03      |   |
| 296 | P           | 15031.50C | 1.3237E-06      |   |
| 297 | K           | 19000.50C | 3.4441E-04      |   |
| 298 | Ca          | 20000.50C | 1.0108E-04      |   |
| 299 | Mn          | 25055.50C | 1.8769E-04      |   |
| 300 | Fe          | 26000.55C | 1.2566E-03      |   |
| 301 | Ni          | 28000.50C | 1.5441E-04      |   |
| 302 |             |           |                 |   |
| 303 |             |           |                 |   |
| 304 |             |           |                 |   |
| 305 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 306 | Total       |           | 5.0375E-02      |   |



|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 307 |             |           |                 |   |
| 308 |             |           |                 |   |
| 309 |             |           |                 |   |
| 310 |             |           |                 |   |
| 311 |             |           |                 |   |
| 312 |             |           |                 |   |
| 313 |             |           |                 |   |
| 314 |             |           |                 |   |
| 315 |             |           |                 |   |
| 316 |             |           |                 |   |
| 317 |             |           |                 |   |
| 318 |             |           |                 |   |
| 319 |             |           |                 |   |
| 320 |             |           |                 |   |
| 321 |             |           |                 |   |
| 322 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 323 |             |           |                 |   |
| 324 | H           | 1001.50C  | 2.0782E-02      |   |
| 325 | O           | 8016.50C  | 2.3501E-02      |   |
| 326 | F           | 9019.50C  | 4.2828E-07      |   |
| 327 | Na          | 11023.50C | 1.8185E-05      |   |
| 328 | Mg          | 12000.50C | 1.8733E-04      |   |
| 329 | Al          | 13027.50C | 8.5998E-04      |   |
| 330 | Si          | 14000.50C | 4.5060E-03      |   |
| 331 | P           | 15031.50C | 1.2848E-06      |   |
| 332 | K           | 19000.50C | 3.3430E-04      |   |
| 333 | Ca          | 20000.50C | 9.8118E-05      |   |
| 334 | Mn          | 25055.50C | 1.8218E-04      |   |
| 335 | Fe          | 26000.55C | 1.2197E-03      |   |
| 336 | Ni          | 28000.50C | 1.4988E-04      |   |
| 337 |             |           |                 |   |
| 338 |             |           |                 |   |
| 339 |             |           |                 |   |
| 340 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 341 | Total       |           | 5.1840E-02      |   |
| 342 |             |           |                 |   |
| 343 |             |           |                 |   |
| 344 |             |           |                 |   |
| 345 |             |           |                 |   |
| 346 |             |           |                 |   |
| 347 |             |           |                 |   |
| 348 |             |           |                 |   |
| 349 |             |           |                 |   |
| 350 |             |           |                 |   |
| 351 |             |           |                 |   |
| 352 |             |           |                 |   |
| 353 |             |           |                 |   |
| 354 |             |           |                 |   |
| 355 |             |           |                 |   |
| 356 |             |           |                 |   |
| 357 | <b>DHLW</b> |           | (atoms/barn cm) |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 358 |             |           |                 |   |
| 359 | H           | 1001.50C  | 1.3057E-02      |   |
| 360 | O           | 8016.50C  | 2.1836E-02      |   |
| 361 | F           | 9019.50C  | 5.0005E-07      |   |
| 362 | Na          | 11023.50C | 2.1233E-05      |   |
| 363 | Mg          | 12000.50C | 2.1873E-04      |   |
| 364 | Al          | 13027.50C | 1.0041E-03      |   |
| 365 | Si          | 14000.50C | 5.2611E-03      |   |
| 366 | P           | 15031.50C | 1.5001E-06      |   |
| 367 | K           | 19000.50C | 3.9033E-04      |   |
| 368 | Ca          | 20000.50C | 1.1456E-04      |   |
| 369 | Mn          | 25055.50C | 2.1271E-04      |   |
| 370 | Fe          | 26000.55C | 1.4241E-03      |   |
| 371 | Ni          | 28000.50C | 1.7500E-04      |   |
| 372 |             |           |                 |   |
| 373 |             |           |                 |   |
| 374 |             |           |                 |   |
| 375 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 376 | Total       |           | 4.3717E-02      |   |
| 377 |             |           |                 |   |
| 378 |             |           |                 |   |
| 379 |             |           |                 |   |
| 380 |             |           |                 |   |
| 381 |             |           |                 |   |
| 382 |             |           |                 |   |
| 383 |             |           |                 |   |
| 384 |             |           |                 |   |
| 385 |             |           |                 |   |
| 386 |             |           |                 |   |
| 387 |             |           |                 |   |
| 388 |             |           |                 |   |
| 389 |             |           |                 |   |
| 390 |             |           |                 |   |
| 391 |             |           |                 |   |
| 392 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 393 |             |           |                 |   |
| 394 | H           | 1001.50C  | 1.6223E-02      |   |
| 395 | O           | 8016.50C  | 2.2518E-02      |   |
| 396 | F           | 9019.50C  | 4.7063E-07      |   |
| 397 | Na          | 11023.50C | 1.9984E-05      |   |
| 398 | Mg          | 12000.50C | 2.0586E-04      |   |
| 399 | Al          | 13027.50C | 9.4503E-04      |   |
| 400 | Si          | 14000.50C | 4.9516E-03      |   |
| 401 | P           | 15031.50C | 1.4119E-06      |   |
| 402 | K           | 19000.50C | 3.6737E-04      |   |
| 403 | Ca          | 20000.50C | 1.0782E-04      |   |
| 404 | Mn          | 25055.50C | 2.0020E-04      |   |
| 405 | Fe          | 26000.55C | 1.3404E-03      |   |
| 406 | Ni          | 28000.50C | 1.6471E-04      |   |
| 407 |             |           |                 |   |
| 408 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 409 |             |           |                 |   |
| 410 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 411 | Total       |           | 4.7046E-02      |   |
| 412 |             |           |                 |   |
| 413 |             |           |                 |   |
| 414 |             |           |                 |   |
| 415 |             |           |                 |   |
| 416 |             |           |                 |   |
| 417 |             |           |                 |   |
| 418 |             |           |                 |   |
| 419 |             |           |                 |   |
| 420 |             |           |                 |   |
| 421 |             |           |                 |   |
| 422 |             |           |                 |   |
| 423 |             |           |                 |   |
| 424 |             |           |                 |   |
| 425 |             |           |                 |   |
| 426 |             |           |                 |   |
| 427 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 428 |             |           |                 |   |
| 429 | H           | 1001.50C  | 1.9389E-02      |   |
| 430 | O           | 8016.50C  | 2.3201E-02      |   |
| 431 | F           | 9019.50C  | 4.4122E-07      |   |
| 432 | Na          | 11023.50C | 1.8735E-05      |   |
| 433 | Mg          | 12000.50C | 1.9299E-04      |   |
| 434 | Al          | 13027.50C | 8.8597E-04      |   |
| 435 | Si          | 14000.50C | 4.6421E-03      |   |
| 436 | P           | 15031.50C | 1.3237E-06      |   |
| 437 | K           | 19000.50C | 3.4441E-04      |   |
| 438 | Ca          | 20000.50C | 1.0108E-04      |   |
| 439 | Mn          | 25055.50C | 1.8769E-04      |   |
| 440 | Fe          | 26000.55C | 1.2566E-03      |   |
| 441 | Ni          | 28000.50C | 1.5441E-04      |   |
| 442 |             |           |                 |   |
| 443 |             |           |                 |   |
| 444 |             |           |                 |   |
| 445 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 446 | Total       |           | 5.0375E-02      |   |
| 447 |             |           |                 |   |
| 448 |             |           |                 |   |
| 449 |             |           |                 |   |
| 450 |             |           |                 |   |
| 451 |             |           |                 |   |
| 452 |             |           |                 |   |
| 453 |             |           |                 |   |
| 454 |             |           |                 |   |
| 455 |             |           |                 |   |
| 456 |             |           |                 |   |
| 457 |             |           |                 |   |
| 458 |             |           |                 |   |
| 459 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 460 |             |           |                 |   |
| 461 |             |           |                 |   |
| 462 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 463 |             |           |                 |   |
| 464 | H           | 1001.50C  | 1.3057E-02      |   |
| 465 | O           | 8016.50C  | 2.1836E-02      |   |
| 466 | F           | 9019.50C  | 5.0005E-07      |   |
| 467 | Na          | 11023.50C | 2.1233E-05      |   |
| 468 | Mg          | 12000.50C | 2.1873E-04      |   |
| 469 | Al          | 13027.50C | 1.0041E-03      |   |
| 470 | Si          | 14000.50C | 5.2611E-03      |   |
| 471 | P           | 15031.50C | 1.5001E-06      |   |
| 472 | K           | 19000.50C | 3.9033E-04      |   |
| 473 | Ca          | 20000.50C | 1.1456E-04      |   |
| 474 | Mn          | 25055.50C | 2.1271E-04      |   |
| 475 | Fe          | 26000.55C | 1.4241E-03      |   |
| 476 | Ni          | 28000.50C | 1.7500E-04      |   |
| 477 |             |           |                 |   |
| 478 |             |           |                 |   |
| 479 |             |           |                 |   |
| 480 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 481 | Total       |           | 4.3717E-02      |   |
| 482 |             |           |                 |   |
| 483 |             |           |                 |   |
| 484 |             |           |                 |   |
| 485 |             |           |                 |   |
| 486 |             |           |                 |   |
| 487 |             |           |                 |   |
| 488 |             |           |                 |   |
| 489 |             |           |                 |   |
| 490 |             |           |                 |   |
| 491 |             |           |                 |   |
| 492 |             |           |                 |   |
| 493 |             |           |                 |   |
| 494 |             |           |                 |   |
| 495 |             |           |                 |   |
| 496 |             |           |                 |   |
| 497 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 498 |             |           |                 |   |
| 499 | H           | 1001.50C  | 1.6223E-02      |   |
| 500 | O           | 8016.50C  | 2.2518E-02      |   |
| 501 | F           | 9019.50C  | 4.7063E-07      |   |
| 502 | Na          | 11023.50C | 1.9984E-05      |   |
| 503 | Mg          | 12000.50C | 2.0586E-04      |   |
| 504 | Al          | 13027.50C | 9.4503E-04      |   |
| 505 | Si          | 14000.50C | 4.9516E-03      |   |
| 506 | P           | 15031.50C | 1.4119E-06      |   |
| 507 | K           | 19000.50C | 3.6737E-04      |   |
| 508 | Ca          | 20000.50C | 1.0782E-04      |   |
| 509 | Mn          | 25055.50C | 2.0020E-04      |   |
| 510 | Fe          | 26000.55C | 1.3404E-03      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 511 | Ni          | 28000.50C | 1.6471E-04      |   |
| 512 |             |           |                 |   |
| 513 |             |           |                 |   |
| 514 |             |           |                 |   |
| 515 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 516 | Total       |           | 4.7046E-02      |   |
| 517 |             |           |                 |   |
| 518 |             |           |                 |   |
| 519 |             |           |                 |   |
| 520 |             |           |                 |   |
| 521 |             |           |                 |   |
| 522 |             |           |                 |   |
| 523 |             |           |                 |   |
| 524 |             |           |                 |   |
| 525 |             |           |                 |   |
| 526 |             |           |                 |   |
| 527 |             |           |                 |   |
| 528 |             |           |                 |   |
| 529 |             |           |                 |   |
| 530 |             |           |                 |   |
| 531 |             |           |                 |   |
| 532 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 533 |             |           |                 |   |
| 534 | H           | 1001.50C  | 1.9389E-02      |   |
| 535 | O           | 8016.50C  | 2.3201E-02      |   |
| 536 | F           | 9019.50C  | 4.4122E-07      |   |
| 537 | Na          | 11023.50C | 1.8735E-05      |   |
| 538 | Mg          | 12000.50C | 1.9299E-04      |   |
| 539 | Al          | 13027.50C | 8.8597E-04      |   |
| 540 | Si          | 14000.50C | 4.6421E-03      |   |
| 541 | P           | 15031.50C | 1.3237E-06      |   |
| 542 | K           | 19000.50C | 3.4441E-04      |   |
| 543 | Ca          | 20000.50C | 1.0108E-04      |   |
| 544 | Mn          | 25055.50C | 1.8769E-04      |   |
| 545 | Fe          | 26000.55C | 1.2566E-03      |   |
| 546 | Ni          | 28000.50C | 1.5441E-04      |   |
| 547 |             |           |                 |   |
| 548 |             |           |                 |   |
| 549 |             |           |                 |   |
| 550 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 551 | Total       |           | 5.0375E-02      |   |
| 552 |             |           |                 |   |
| 553 |             |           |                 |   |
| 554 |             |           |                 |   |
| 555 |             |           |                 |   |
| 556 |             |           |                 |   |
| 557 |             |           |                 |   |
| 558 |             |           |                 |   |
| 559 |             |           |                 |   |
| 560 |             |           |                 |   |
| 561 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 562 |             |           |                 |   |
| 563 |             |           |                 |   |
| 564 |             |           |                 |   |
| 565 |             |           |                 |   |
| 566 |             |           |                 |   |
| 567 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 568 |             |           |                 |   |
| 569 | H           | 1001.50C  | 2.0782E-02      |   |
| 570 | O           | 8016.50C  | 2.3501E-02      |   |
| 571 | F           | 9019.50C  | 4.2828E-07      |   |
| 572 | Na          | 11023.50C | 1.8185E-05      |   |
| 573 | Mg          | 12000.50C | 1.8733E-04      |   |
| 574 | Al          | 13027.50C | 8.5998E-04      |   |
| 575 | Si          | 14000.50C | 4.5060E-03      |   |
| 576 | P           | 15031.50C | 1.2848E-06      |   |
| 577 | K           | 19000.50C | 3.3430E-04      |   |
| 578 | Ca          | 20000.50C | 9.8118E-05      |   |
| 579 | Mn          | 25055.50C | 1.8218E-04      |   |
| 580 | Fe          | 26000.55C | 1.2197E-03      |   |
| 581 | Ni          | 28000.50C | 1.4988E-04      |   |
| 582 |             |           |                 |   |
| 583 |             |           |                 |   |
| 584 |             |           |                 |   |
| 585 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 586 | Total       |           | 5.1840E-02      |   |
| 587 |             |           |                 |   |
| 588 |             |           |                 |   |
| 589 |             |           |                 |   |
| 590 |             |           |                 |   |
| 591 |             |           |                 |   |
| 592 |             |           |                 |   |
| 593 |             |           |                 |   |
| 594 |             |           |                 |   |
| 595 |             |           |                 |   |
| 596 |             |           |                 |   |
| 597 |             |           |                 |   |
| 598 |             |           |                 |   |
| 599 |             |           |                 |   |
| 600 |             |           |                 |   |
| 601 |             |           |                 |   |
| 602 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 603 |             |           |                 |   |
| 604 | H           | 1001.50C  | 1.3057E-02      |   |
| 605 | O           | 8016.50C  | 2.1836E-02      |   |
| 606 | F           | 9019.50C  | 5.0005E-07      |   |
| 607 | Na          | 11023.50C | 2.1233E-05      |   |
| 608 | Mg          | 12000.50C | 2.1873E-04      |   |
| 609 | Al          | 13027.50C | 1.0041E-03      |   |
| 610 | Si          | 14000.50C | 5.2611E-03      |   |
| 611 | P           | 15031.50C | 1.5001E-06      |   |
| 612 | K           | 19000.50C | 3.9033E-04      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 613 | Ca          | 20000.50C | 1.1456E-04      |   |
| 614 | Mn          | 25055.50C | 2.1271E-04      |   |
| 615 | Fe          | 26000.55C | 1.4241E-03      |   |
| 616 | Ni          | 28000.50C | 1.7500E-04      |   |
| 617 |             |           |                 |   |
| 618 |             |           |                 |   |
| 619 |             |           |                 |   |
| 620 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 621 | Total       |           | 4.3717E-02      |   |
| 622 |             |           |                 |   |
| 623 |             |           |                 |   |
| 624 |             |           |                 |   |
| 625 |             |           |                 |   |
| 626 |             |           |                 |   |
| 627 |             |           |                 |   |
| 628 |             |           |                 |   |
| 629 |             |           |                 |   |
| 630 |             |           |                 |   |
| 631 |             |           |                 |   |
| 632 |             |           |                 |   |
| 633 |             |           |                 |   |
| 634 |             |           |                 |   |
| 635 |             |           |                 |   |
| 636 |             |           |                 |   |
| 637 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 638 |             |           |                 |   |
| 639 | H           | 1001.50C  | 1.6223E-02      |   |
| 640 | O           | 8016.50C  | 2.2518E-02      |   |
| 641 | F           | 9019.50C  | 4.7063E-07      |   |
| 642 | Na          | 11023.50C | 1.9984E-05      |   |
| 643 | Mg          | 12000.50C | 2.0586E-04      |   |
| 644 | Al          | 13027.50C | 9.4503E-04      |   |
| 645 | Si          | 14000.50C | 4.9516E-03      |   |
| 646 | P           | 15031.50C | 1.4119E-06      |   |
| 647 | K           | 19000.50C | 3.6737E-04      |   |
| 648 | Ca          | 20000.50C | 1.0782E-04      |   |
| 649 | Mn          | 25055.50C | 2.0020E-04      |   |
| 650 | Fe          | 26000.55C | 1.3404E-03      |   |
| 651 | Ni          | 28000.50C | 1.6471E-04      |   |
| 652 |             |           |                 |   |
| 653 |             |           |                 |   |
| 654 |             |           |                 |   |
| 655 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 656 | Total       |           | 4.7046E-02      |   |
| 657 |             |           |                 |   |
| 658 |             |           |                 |   |
| 659 |             |           |                 |   |
| 660 |             |           |                 |   |
| 661 |             |           |                 |   |
| 662 |             |           |                 |   |
| 663 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 664 |             |           |                 |   |
| 665 |             |           |                 |   |
| 666 |             |           |                 |   |
| 667 |             |           |                 |   |
| 668 |             |           |                 |   |
| 669 |             |           |                 |   |
| 670 |             |           |                 |   |
| 671 |             |           |                 |   |
| 672 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 673 |             |           |                 |   |
| 674 | H           | 1001.50C  | 1.9389E-02      |   |
| 675 | O           | 8016.50C  | 2.3201E-02      |   |
| 676 | F           | 9019.50C  | 4.4122E-07      |   |
| 677 | Na          | 11023.50C | 1.8735E-05      |   |
| 678 | Mg          | 12000.50C | 1.9299E-04      |   |
| 679 | Al          | 13027.50C | 8.8597E-04      |   |
| 680 | Si          | 14000.50C | 4.6421E-03      |   |
| 681 | P           | 15031.50C | 1.3237E-06      |   |
| 682 | K           | 19000.50C | 3.4441E-04      |   |
| 683 | Ca          | 20000.50C | 1.0108E-04      |   |
| 684 | Mn          | 25055.50C | 1.8769E-04      |   |
| 685 | Fe          | 26000.55C | 1.2566E-03      |   |
| 686 | Ni          | 28000.50C | 1.5441E-04      |   |
| 687 |             |           |                 |   |
| 688 |             |           |                 |   |
| 689 |             |           |                 |   |
| 690 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 691 | Total       |           | 5.0375E-02      |   |
| 692 |             |           |                 |   |
| 693 |             |           |                 |   |
| 694 |             |           |                 |   |
| 695 |             |           |                 |   |
| 696 |             |           |                 |   |
| 697 |             |           |                 |   |
| 698 |             |           |                 |   |
| 699 |             |           |                 |   |
| 700 |             |           |                 |   |
| 701 |             |           |                 |   |
| 702 |             |           |                 |   |
| 703 |             |           |                 |   |
| 704 |             |           |                 |   |
| 705 |             |           |                 |   |
| 706 |             |           |                 |   |
| 707 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 708 |             |           |                 |   |
| 709 | H           | 1001.50C  | 1.3057E-02      |   |
| 710 | O           | 8016.50C  | 2.1836E-02      |   |
| 711 | F           | 9019.50C  | 5.0005E-07      |   |
| 712 | Na          | 11023.50C | 2.1233E-05      |   |
| 713 | Mg          | 12000.50C | 2.1873E-04      |   |
| 714 | Al          | 13027.50C | 1.0041E-03      |   |



## Inverse

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 715 | Si          | 14000.50C | 5.2611E-03      |   |
| 716 | P           | 15031.50C | 1.5001E-06      |   |
| 717 | K           | 19000.50C | 3.9033E-04      |   |
| 718 | Ca          | 20000.50C | 1.1456E-04      |   |
| 719 | Mn          | 25055.50C | 2.1271E-04      |   |
| 720 | Fe          | 26000.55C | 1.4241E-03      |   |
| 721 | Ni          | 28000.50C | 1.7500E-04      |   |
| 722 |             |           |                 |   |
| 723 |             |           |                 |   |
| 724 |             |           |                 |   |
| 725 | Pu-239      | 94239.55C | 8.7958E-10      |   |
| 726 | Total       |           | 4.3717E-02      |   |
| 727 |             |           |                 |   |
| 728 |             |           |                 |   |
| 729 |             |           |                 |   |
| 730 |             |           |                 |   |
| 731 |             |           |                 |   |
| 732 |             |           |                 |   |
| 733 |             |           |                 |   |
| 734 |             |           |                 |   |
| 735 |             |           |                 |   |
| 736 |             |           |                 |   |
| 737 |             |           |                 |   |
| 738 |             |           |                 |   |
| 739 |             |           |                 |   |
| 740 |             |           |                 |   |
| 741 |             |           |                 |   |
| 742 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 743 |             |           |                 |   |
| 744 | H           | 1001.50C  | 1.6223E-02      |   |
| 745 | O           | 8016.50C  | 2.2518E-02      |   |
| 746 | F           | 9019.50C  | 4.7063E-07      |   |
| 747 | Na          | 11023.50C | 1.9984E-05      |   |
| 748 | Mg          | 12000.50C | 2.0586E-04      |   |
| 749 | Al          | 13027.50C | 9.4503E-04      |   |
| 750 | Si          | 14000.50C | 4.9516E-03      |   |
| 751 | P           | 15031.50C | 1.4119E-06      |   |
| 752 | K           | 19000.50C | 3.6737E-04      |   |
| 753 | Ca          | 20000.50C | 1.0782E-04      |   |
| 754 | Mn          | 25055.50C | 2.0020E-04      |   |
| 755 | Fe          | 26000.55C | 1.3404E-03      |   |
| 756 | Ni          | 28000.50C | 1.6471E-04      |   |
| 757 |             |           |                 |   |
| 758 |             |           |                 |   |
| 759 |             |           |                 |   |
| 760 | Pu-239      | 94239.55C | 8.2784E-10      |   |
| 761 | Total       |           | 4.7046E-02      |   |
| 762 |             |           |                 |   |
| 763 |             |           |                 |   |
| 764 |             |           |                 |   |
| 765 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 766 |             |           |                 |   |
| 767 |             |           |                 |   |
| 768 |             |           |                 |   |
| 769 |             |           |                 |   |
| 770 |             |           |                 |   |
| 771 |             |           |                 |   |
| 772 |             |           |                 |   |
| 773 |             |           |                 |   |
| 774 |             |           |                 |   |
| 775 |             |           |                 |   |
| 776 |             |           |                 |   |
| 777 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 778 |             |           |                 |   |
| 779 | H           | 1001.50C  | 1.9389E-02      |   |
| 780 | O           | 8016.50C  | 2.3201E-02      |   |
| 781 | F           | 9019.50C  | 4.4122E-07      |   |
| 782 | Na          | 11023.50C | 1.8735E-05      |   |
| 783 | Mg          | 12000.50C | 1.9299E-04      |   |
| 784 | Al          | 13027.50C | 8.8597E-04      |   |
| 785 | Si          | 14000.50C | 4.6421E-03      |   |
| 786 | P           | 15031.50C | 1.3237E-06      |   |
| 787 | K           | 19000.50C | 3.4441E-04      |   |
| 788 | Ca          | 20000.50C | 1.0108E-04      |   |
| 789 | Mn          | 25055.50C | 1.8769E-04      |   |
| 790 | Fe          | 26000.55C | 1.2566E-03      |   |
| 791 | Ni          | 28000.50C | 1.5441E-04      |   |
| 792 |             |           |                 |   |
| 793 |             |           |                 |   |
| 794 |             |           |                 |   |
| 795 | Pu-239      | 94239.55C | 7.7610E-10      |   |
| 796 | Total       |           | 5.0375E-02      |   |
| 797 |             |           |                 |   |
| 798 |             |           |                 |   |
| 799 |             |           |                 |   |
| 800 |             |           |                 |   |
| 801 |             |           |                 |   |
| 802 |             |           |                 |   |
| 803 |             |           |                 |   |
| 804 |             |           |                 |   |
| 805 |             |           |                 |   |
| 806 |             |           |                 |   |
| 807 |             |           |                 |   |
| 808 |             |           |                 |   |
| 809 |             |           |                 |   |
| 810 |             |           |                 |   |
| 811 |             |           |                 |   |
| 812 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 813 |             |           |                 |   |
| 814 | H           | 1001.50C  | 2.0782E-02      |   |
| 815 | O           | 8016.50C  | 2.3501E-02      |   |
| 816 | F           | 9019.50C  | 4.2828E-07      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 817 | Na          | 11023.50C | 1.8185E-05      |   |
| 818 | Mg          | 12000.50C | 1.8733E-04      |   |
| 819 | Al          | 13027.50C | 8.5998E-04      |   |
| 820 | Si          | 14000.50C | 4.5060E-03      |   |
| 821 | P           | 15031.50C | 1.2848E-06      |   |
| 822 | K           | 19000.50C | 3.3430E-04      |   |
| 823 | Ca          | 20000.50C | 9.8118E-05      |   |
| 824 | Mn          | 25055.50C | 1.8218E-04      |   |
| 825 | Fe          | 26000.55C | 1.2197E-03      |   |
| 826 | Ni          | 28000.50C | 1.4988E-04      |   |
| 827 |             |           |                 |   |
| 828 |             |           |                 |   |
| 829 |             |           |                 |   |
| 830 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 831 | Total       |           | 5.1840E-02      |   |
| 832 |             |           |                 |   |
| 833 |             |           |                 |   |
| 834 |             |           |                 |   |
| 835 |             |           |                 |   |
| 836 |             |           |                 |   |
| 837 |             |           |                 |   |
| 838 |             |           |                 |   |
| 839 |             |           |                 |   |
| 840 |             |           |                 |   |
| 841 |             |           |                 |   |
| 842 |             |           |                 |   |
| 843 |             |           |                 |   |
| 844 |             |           |                 |   |
| 845 |             |           |                 |   |
| 846 |             |           |                 |   |
| 847 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 848 |             |           |                 |   |
| 849 | H           | 1001.50C  | 2.0782E-02      |   |
| 850 | O           | 8016.50C  | 2.3501E-02      |   |
| 851 | F           | 9019.50C  | 4.2828E-07      |   |
| 852 | Na          | 11023.50C | 1.8185E-05      |   |
| 853 | Mg          | 12000.50C | 1.8733E-04      |   |
| 854 | Al          | 13027.50C | 8.5998E-04      |   |
| 855 | Si          | 14000.50C | 4.5060E-03      |   |
| 856 | P           | 15031.50C | 1.2848E-06      |   |
| 857 | K           | 19000.50C | 3.3430E-04      |   |
| 858 | Ca          | 20000.50C | 9.8118E-05      |   |
| 859 | Mn          | 25055.50C | 1.8218E-04      |   |
| 860 | Fe          | 26000.55C | 1.2197E-03      |   |
| 861 | Ni          | 28000.50C | 1.4988E-04      |   |
| 862 |             |           |                 |   |
| 863 |             |           |                 |   |
| 864 |             |           |                 |   |
| 865 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 866 | Total       |           | 5.1840E-02      |   |
| 867 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 868 |             |           |                 |   |
| 869 |             |           |                 |   |
| 870 |             |           |                 |   |
| 871 |             |           |                 |   |
| 872 |             |           |                 |   |
| 873 |             |           |                 |   |
| 874 |             |           |                 |   |
| 875 |             |           |                 |   |
| 876 |             |           |                 |   |
| 877 |             |           |                 |   |
| 878 |             |           |                 |   |
| 879 |             |           |                 |   |
| 880 |             |           |                 |   |
| 881 |             |           |                 |   |
| 882 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 883 |             |           |                 |   |
| 884 | H           | 1001.50C  | 2.0782E-02      |   |
| 885 | O           | 8016.50C  | 2.3501E-02      |   |
| 886 | F           | 9019.50C  | 4.2828E-07      |   |
| 887 | Na          | 11023.50C | 1.8185E-05      |   |
| 888 | Mg          | 12000.50C | 1.8733E-04      |   |
| 889 | Al          | 13027.50C | 8.5998E-04      |   |
| 890 | Si          | 14000.50C | 4.5060E-03      |   |
| 891 | P           | 15031.50C | 1.2848E-06      |   |
| 892 | K           | 19000.50C | 3.3430E-04      |   |
| 893 | Ca          | 20000.50C | 9.8118E-05      |   |
| 894 | Mn          | 25055.50C | 1.8218E-04      |   |
| 895 | Fe          | 26000.55C | 1.2197E-03      |   |
| 896 | Ni          | 28000.50C | 1.4988E-04      |   |
| 897 |             |           |                 |   |
| 898 |             |           |                 |   |
| 899 |             |           |                 |   |
| 900 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 901 | Total       |           | 5.1840E-02      |   |
| 902 |             |           |                 |   |
| 903 |             |           |                 |   |
| 904 |             |           |                 |   |
| 905 |             |           |                 |   |
| 906 |             |           |                 |   |
| 907 |             |           |                 |   |
| 908 |             |           |                 |   |
| 909 |             |           |                 |   |
| 910 |             |           |                 |   |
| 911 |             |           |                 |   |
| 912 |             |           |                 |   |
| 913 |             |           |                 |   |
| 914 |             |           |                 |   |
| 915 |             |           |                 |   |
| 916 |             |           |                 |   |
| 917 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 918 |             |           |                 |   |

## Inverse

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 919 | H           | 1001.50C  | 2.0782E-02      |   |
| 920 | O           | 8016.50C  | 2.3501E-02      |   |
| 921 | F           | 9019.50C  | 4.2828E-07      |   |
| 922 | Na          | 11023.50C | 1.8185E-05      |   |
| 923 | Mg          | 12000.50C | 1.8733E-04      |   |
| 924 | Al          | 13027.50C | 8.5998E-04      |   |
| 925 | Si          | 14000.50C | 4.5060E-03      |   |
| 926 | P           | 15031.50C | 1.2848E-06      |   |
| 927 | K           | 19000.50C | 3.3430E-04      |   |
| 928 | Ca          | 20000.50C | 9.8118E-05      |   |
| 929 | Mn          | 25055.50C | 1.8218E-04      |   |
| 930 | Fe          | 26000.55C | 1.2197E-03      |   |
| 931 | Ni          | 28000.50C | 1.4988E-04      |   |
| 932 |             |           |                 |   |
| 933 |             |           |                 |   |
| 934 |             |           |                 |   |
| 935 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 936 | Total       |           | 5.1840E-02      |   |
| 937 |             |           |                 |   |
| 938 |             |           |                 |   |
| 939 |             |           |                 |   |
| 940 |             |           |                 |   |
| 941 |             |           |                 |   |
| 942 |             |           |                 |   |
| 943 |             |           |                 |   |
| 944 |             |           |                 |   |
| 945 |             |           |                 |   |
| 946 |             |           |                 |   |
| 947 |             |           |                 |   |
| 948 |             |           |                 |   |
| 949 |             |           |                 |   |
| 950 |             |           |                 |   |
| 951 |             |           |                 |   |
| 952 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 953 |             |           |                 |   |
| 954 | H           | 1001.50C  | 2.0022E-02      |   |
| 955 | O           | 8016.50C  | 2.3337E-02      |   |
| 956 | F           | 9019.50C  | 4.3534E-07      |   |
| 957 | Na          | 11023.50C | 1.8485E-05      |   |
| 958 | Mg          | 12000.50C | 1.9042E-04      |   |
| 959 | Al          | 13027.50C | 8.7415E-04      |   |
| 960 | Si          | 14000.50C | 4.5802E-03      |   |
| 961 | P           | 15031.50C | 1.3060E-06      |   |
| 962 | K           | 19000.50C | 3.3981E-04      |   |
| 963 | Ca          | 20000.50C | 9.9735E-05      |   |
| 964 | Mn          | 25055.50C | 1.8519E-04      |   |
| 965 | Fe          | 26000.55C | 1.2398E-03      |   |
| 966 | Ni          | 28000.50C | 1.5235E-04      |   |
| 967 |             |           |                 |   |
| 968 |             |           |                 |   |
| 969 |             |           |                 |   |

|      | R           | S         | T               | U |
|------|-------------|-----------|-----------------|---|
| 970  | Pu-239      | 94239.55C | 7.6576E-10      |   |
| 971  | Total       |           | 5.1041E-02      |   |
| 972  |             |           |                 |   |
| 973  |             |           |                 |   |
| 974  |             |           |                 |   |
| 975  |             |           |                 |   |
| 976  |             |           |                 |   |
| 977  |             |           |                 |   |
| 978  |             |           |                 |   |
| 979  |             |           |                 |   |
| 980  |             |           |                 |   |
| 981  |             |           |                 |   |
| 982  |             |           |                 |   |
| 983  |             |           |                 |   |
| 984  |             |           |                 |   |
| 985  |             |           |                 |   |
| 986  |             |           |                 |   |
| 987  | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 988  |             |           |                 |   |
| 989  | H           | 1001.50C  | 2.0022E-02      |   |
| 990  | O           | 8016.50C  | 2.3337E-02      |   |
| 991  | F           | 9019.50C  | 4.3534E-07      |   |
| 992  | Na          | 11023.50C | 1.8485E-05      |   |
| 993  | Mg          | 12000.50C | 1.9042E-04      |   |
| 994  | Al          | 13027.50C | 8.7415E-04      |   |
| 995  | Si          | 14000.50C | 4.5802E-03      |   |
| 996  | P           | 15031.50C | 1.3060E-06      |   |
| 997  | K           | 19000.50C | 3.3981E-04      |   |
| 998  | Ca          | 20000.50C | 9.9735E-05      |   |
| 999  | Mn          | 25055.50C | 1.8519E-04      |   |
| 1000 | Fe          | 26000.55C | 1.2398E-03      |   |
| 1001 | Ni          | 28000.50C | 1.5235E-04      |   |
| 1002 |             |           |                 |   |
| 1003 |             |           |                 |   |
| 1004 |             |           |                 |   |
| 1005 | Pu-239      | 94239.55C | 7.6576E-10      |   |
| 1006 | Total       |           | 5.1041E-02      |   |
| 1007 |             |           |                 |   |
| 1008 |             |           |                 |   |
| 1009 |             |           |                 |   |
| 1010 |             |           |                 |   |
| 1011 |             |           |                 |   |
| 1012 |             |           |                 |   |
| 1013 |             |           |                 |   |
| 1014 |             |           |                 |   |
| 1015 |             |           |                 |   |
| 1016 |             |           |                 |   |

## Inverse

|    | A       | B                                   | C | D  | E                 | F | G              | H           |
|----|---------|-------------------------------------|---|--|-------------------|---|----------------|-------------|
| 1  |         |                                     |   |  |                   |   |                |             |
| 2  |         | <b>75% Uranium Loading</b>          |   |  |                   |   |                |             |
| 3  |         |                                     |   |  |                   |   |                |             |
| 4  |         |                                     |   |  |                   |   |                |             |
| 5  |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 6  |         |                                     |   | <b>(0% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O3</b> |                   |   |                |             |
| 7  |         |                                     |   |  |                   |   | DHLW Clay      |             |
| 8  |         | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |
| 9  |         |                                     |   |  |                   |   | H              | 3.55893E-03 |
| 10 |         | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |
| 11 |         |                                     |   |  |                   |   | F              | 5.88292E-07 |
| 12 |         | UO2 Frac. Remaing                   |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 13 |         | Cylinder Radius                     |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 14 |         | Cylinder Length                     |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 15 |         | Cylinder Volume                     |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 16 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 17 |         | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 18 |         | Degraded MIT Volume                 |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 19 |         | Mass of Gd                          |   | 0.0000E+00   | g                 |   | Mn             | 2.50252E-04 |
| 20 |         | Den. of Gd                          |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 21 |         | Vol. of Gd                          |   | 0.0000E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 22 |         | Mass of Fe2O3                       |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 23 |         | Den. of Fe2O3                       |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 24 |         | Vol. of Fe2O3                       |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 25 | Total   | Void Fraction                       |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 26 |         | Total Volume                        |   | 7.1337E+06   | cm <sup>3</sup>   |   |                |             |
| 27 |         | Calculated Volume                   |   | 7.1337E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 28 | Mixture | Distance from Center                |   | 8.47600E+01  | cm                |   |                |             |
| 29 |         | Frac. of DHLW Mixed                 |   |  |                   |   |                |             |
| 30 |         | with MIT Fuel                       |   | 0.0000E+00   |                   |   |                |             |
| 31 |         | Mixture Volume                      |   | 2.7480E+05   | cm <sup>3</sup>   |   |                |             |
| 32 |         | Calculated Volume                   |   | 2.7480E+05   | cm <sup>3</sup>   |   |                |             |
| 33 |         | Distance from Center                |   | 7.24160E+01  | cm                |   |                |             |
| 34 |         |                                     |   |  |                   |   |                |             |
| 35 |         |                                     |   |  |                   |   |                |             |
| 36 |         |                                     |   |  |                   |   |                |             |
| 37 |         |                                     |   |  |                   |   |                |             |
| 38 |         |                                     |   |  |                   |   |                |             |
| 39 |         |                                     |   |  |                   |   |                |             |
| 40 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 41 |         |                                     |   | <b>(5% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O3</b> |                   |   |                |             |
| 42 |         |                                     |   |  |                   |   | DHLW Clay      |             |
| 43 |         | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |
| 44 |         |                                     |   |  |                   |   | H              | 3.55893E-03 |
| 45 |         | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |
| 46 |         |                                     |   |  |                   |   | F              | 5.88292E-07 |
| 47 |         | UO2 Frac. Remaing                   |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 48 |         | Cylinder Radius                     |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 49 |         | Cylinder Length                     |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 50 |         | Cylinder Volume                     |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 51 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |

## Inverse

|     | A       | B                                      | C | D  | E                 | F | G              | H           |
|-----|---------|--|---|--|-------------------|---|----------------|-------------|
| 52  |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 53  |         | Degraded MIT Volume                    |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 54  |         | Mass of Gd                             |   | 0.0000E+00   | g                 |   | Mn             | 2.50252E-04 |
| 55  |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 56  |         | Vol. of Gd                             |   | 0.0000E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 57  |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 58  |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 59  |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 60  | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 61  |         | Total Volume                           |   | 7.1337E+06   | cm <sup>3</sup>   |   |                |             |
| 62  |         | Calculated Volume                      |   | 7.1337E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 63  | Mixture | Distance from Center                   |   | 8.47600E+01  | cm                |   |                |             |
| 64  |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 65  |         | with MIT Fuel                          |   | 5.0000E-02   |                   |   |                |             |
| 66  |         | Mixture Volume                         |   | 6.1774E+05   | cm <sup>3</sup>   |   |                |             |
| 67  |         | Calculated Volume                      |   | 6.1774E+05   | cm <sup>3</sup>   |   |                |             |
| 68  |         | Distance from Center                   |   | 6.20159E+01  | cm                |   |                |             |
| 69  |         |  |   |  |                   |   |                |             |
| 70  |         |  |   |  |                   |   |                |             |
| 71  |         |  |   |  |                   |   |                |             |
| 72  |         |  |   |  |                   |   |                |             |
| 73  |         |  |   |  |                   |   |                |             |
| 74  |         |  |   |  |                   |   |                |             |
| 75  |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                                |                   |   |                |             |
| 76  |         |  |   | <b>(10% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 77  |         |  |   |  |                   |   | DHLW Clay      |             |
| 78  |         | Cylinder Segment Volume Calculation    |   |  |                   |   | (atom/barn/cm) |             |
| 79  |         |  |   |  |                   |   | H              | 3.55893E-03 |
| 80  |         | Geometry Calculations                  |   |  |                   |   | O              | 1.97883E-02 |
| 81  |         |  |   |  |                   |   | F              | 5.88292E-07 |
| 82  |         | UO <sub>2</sub> Frac. Remaing          |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 83  |         | Cylinder Radius                        |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 84  |         | Cylinder Length                        |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 85  |         | Cylinder Volume                        |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 86  |         | 1/2 Cylinder Volume                    |   | 3.5729E+06   | cm <sup>3</sup>   |   | P              | 1.76488E-06 |
| 87  |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 88  |         | Degraded MIT Volume                    |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 89  |         | Mass of Gd                             |   | 0.0000E+00   | g                 |   | Mn             | 2.50252E-04 |
| 90  |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 91  |         | Vol. of Gd                             |   | 0.0000E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 92  |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 93  |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 94  |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 95  | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 96  |         | Total Volume                           |   | 7.1337E+06   | cm <sup>3</sup>   |   |                |             |
| 97  |         | Calculated Volume                      |   | 7.1337E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 98  | Mixture | Distance from Center                   |   | 8.47600E+01  | cm                |   |                |             |
| 99  |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 100 |         | with MIT Fuel                          |   | 1.0000E-01   |                   |   |                |             |
| 101 |         | Mixture Volume                         |   | 9.6069E+05   | cm <sup>3</sup>   |   |                |             |
| 102 |         | Calculated Volume                      |   | 9.6069E+05   | cm <sup>3</sup>   |   |                |             |



## Inverse

|     | A       | B                                   | C | D   | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|---|-------------------|---|----------------|-------------|
| 103 |         | Distance from Center                |   | 6.32585E+01   | cm                |   |                |             |
| 104 |         |                                     |   |   |                   |   |                |             |
| 105 |         |                                     |   |   |                   |   |                |             |
| 106 |         |                                     |   |   |                   |   |                |             |
| 107 |         |                                     |   |   |                   |   |                |             |
| 108 |         |                                     |   |   |                   |   |                |             |
| 109 |         |                                     |   |   |                   |   |                |             |
| 110 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 111 |         |                                     |   | <b>(15% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O)</b> |                   |   |                |             |
| 112 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 113 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 114 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 115 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 116 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 117 |         | UO2 Frac. Remaing                   |   | 0.75  |                   |   | Na             | 2.49797E-05 |
| 118 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 119 |         | Cylinder Length                     |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 120 |         | Cylinder Volume                     |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 121 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 122 |         | DHLW Volume                         |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 123 |         | Degraded MIT Volume                 |   | 2.0005E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 124 |         | Mass of Gd                          |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 125 |         | Den. of Gd                          |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 126 |         | Vol. of Gd                          |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 127 |         | Mass of Fe2O3                       |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 128 |         | Den. of Fe2O3                       |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 129 |         | Vol. of Fe2O3                       |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 130 | Total   | Void Fraction                       |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 131 |         | Total Volume                        |   | 7.1337E+06  | cm <sup>3</sup>   |   |                |             |
| 132 |         | Calculated Volume                   |   | 7.1337E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 133 | Mixture | Distance from Center                |   | 8.47600E+01   | cm                |   |                |             |
| 134 |         | Frac. of DHLW Mixed                 |   |   |                   |   |                |             |
| 135 |         | with MIT Fuel                       |   | 1.5000E-01  |                   |   |                |             |
| 136 |         | Mixture Volume                      |   | 1.3036E+06  | cm <sup>3</sup>   |   |                |             |
| 137 |         | Calculated Volume                   |   | 1.3036E+06  | cm <sup>3</sup>   |   |                |             |
| 138 |         | Distance from Center                |   | 4.53190E+01   | cm                |   |                |             |
| 139 |         |                                     |   |   |                   |   |                |             |
| 140 |         |                                     |   |   |                   |   |                |             |
| 141 |         |                                     |   |   |                   |   |                |             |
| 142 |         |                                     |   |   |                   |   |                |             |
| 143 |         |                                     |   |   |                   |   |                |             |
| 144 |         |                                     |   |   |                   |   |                |             |
| 145 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |                   |   |                |             |
| 146 |         |                                     |   | <b>(20% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O)</b> |                   |   |                |             |
| 147 |         |                                     |   |   |                   |   | DHLW Clay      |             |
| 148 |         | Cylinder Segment Volume Calculation |   |   |                   |   | (atom/barn/cm) |             |
| 149 |         |                                     |   |   |                   |   | H              | 3.55893E-03 |
| 150 |         | Geometry Calculations               |   |   |                   |   | O              | 1.97883E-02 |
| 151 |         |                                     |   |   |                   |   | F              | 5.88292E-07 |
| 152 |         | UO2 Frac. Remaing                   |   | 0.75  |                   |   | Na             | 2.49797E-05 |
| 153 |         | Cylinder Radius                     |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |

## Inverse

|     | A       | B                                   | C | D  | E | F | G              | H           |
|-----|---------|-------------------------------------|---|--|---|---|----------------|-------------|
| 154 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |
| 155 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |
| 156 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |
| 157 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |
| 158 |         | Degraded MIT Volume                 |   | 2.0005E+05 cm <sup>3</sup>   |   |   | Ca             | 1.34777E-04 |
| 159 |         | Mass of Gd                          |   | 0.0000E+00 g   |   |   | Mn             | 2.50252E-04 |
| 160 |         | Den. of Gd                          |   | 7.9004E+00 g/cm <sup>3</sup>                                       |   |   | Fe             | 1.67546E-03 |
| 161 |         | Vol. of Gd                          |   | 0.0000E+00 cm <sup>3</sup>   |   |   | Ni             | 2.05882E-04 |
| 162 |         | Mass of Fe2O3                       |   | 0.0000E+00 g   |   |   | U-238          | 0.00000E+00 |
| 163 |         | Den. of Fe2O3                       |   | 5.2400E+00 g/cm <sup>3</sup>                                       |   |   |                |             |
| 164 |         | Vol. of Fe2O3                       |   | 0.0000E+00 cm <sup>3</sup>   |   |   |                |             |
| 165 | Total   | Void Fraction                       |   |  |   |   | Pu-239         | 1.03481E-09 |
| 166 |         | Total Volume                        |   | 7.1337E+06 cm <sup>3</sup>   |   |   |                |             |
| 167 |         | Calculated Volume                   |   | 7.1337E+06 cm <sup>3</sup>   |   |   | Total          | 3.37283E-02 |
| 168 | Mixture | Distance from Center                |   | 8.47600E+01 cm   |   |   |                |             |
| 169 |         | Frac. of DHLW Mixed                 |   |  |   |   |                |             |
| 170 |         | with MIT Fuel                       |   | 2.0000E-01   |   |   |                |             |
| 171 |         | Mixture Volume                      |   | 1.6466E+06 cm <sup>3</sup>   |   |   |                |             |
| 172 |         | Calculated Volume                   |   | 1.6466E+06 cm <sup>3</sup>   |   |   |                |             |
| 173 |         | Distance from Center                |   | 3.78750E+01 cm   |   |   |                |             |
| 174 |         |                                     |   |  |   |   |                |             |
| 175 |         |                                     |   |  |   |   |                |             |
| 176 |         |                                     |   |  |   |   |                |             |
| 177 |         |                                     |   |  |   |   |                |             |
| 178 |         |                                     |   |  |   |   |                |             |
| 179 |         |                                     |   |  |   |   |                |             |
| 180 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |   |   |                |             |
| 181 |         |                                     |   | <b>(25% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O</b> |   |   |                |             |
| 182 |         |                                     |   |  |   |   | DHLW Clay      |             |
| 183 |         | Cylinder Segment Volume Calculation |   |  |   |   | (atom/barn/cm) |             |
| 184 |         |                                     |   |  |   |   | H              | 3.55893E-03 |
| 185 |         | Geometry Calculations               |   |  |   |   | O              | 1.97883E-02 |
| 186 |         |                                     |   |  |   |   | F              | 5.88292E-07 |
| 187 |         | UO2 Frac. Remaing                   |   | 0.75   |   |   | Na             | 2.49797E-05 |
| 188 |         | Cylinder Radius                     |   | 86.5 cm  |   |   | Mg             | 2.57324E-04 |
| 189 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |
| 190 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |
| 191 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |
| 192 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |
| 193 |         | Degraded MIT Volume                 |   | 2.0005E+05 cm <sup>3</sup>   |   |   | Ca             | 1.34777E-04 |
| 194 |         | Mass of Gd                          |   | 0.0000E+00 g   |   |   | Mn             | 2.50252E-04 |
| 195 |         | Den. of Gd                          |   | 7.9004E+00 g/cm <sup>3</sup>                                       |   |   | Fe             | 1.67546E-03 |
| 196 |         | Vol. of Gd                          |   | 0.0000E+00 cm <sup>3</sup>   |   |   | Ni             | 2.05882E-04 |
| 197 |         | Mass of Fe2O3                       |   | 0.0000E+00 g   |   |   | U-238          | 0.00000E+00 |
| 198 |         | Den. of Fe2O3                       |   | 5.2400E+00 g/cm <sup>3</sup>                                       |   |   |                |             |
| 199 |         | Vol. of Fe2O3                       |   | 0.0000E+00 cm <sup>3</sup>   |   |   |                |             |
| 200 | Total   | Void Fraction                       |   |  |   |   | Pu-239         | 1.03481E-09 |
| 201 |         | Total Volume                        |   | 7.1337E+06 cm <sup>3</sup>   |   |   |                |             |
| 202 |         | Calculated Volume                   |   | 7.1337E+06 cm <sup>3</sup>   |   |   | Total          | 3.37283E-02 |
| 203 | Mixture | Distance from Center                |   | 8.47600E+01 cm   |   |   |                |             |
| 204 |         | Frac. of DHLW Mixed                 |   |  |   |   |                |             |

## Inverse

|     | A       | B   | C | D           | E                 | F | G              | H           |
|-----|---------|---|---|-------------|-------------------|---|----------------|-------------|
| 205 |         | with MIT Fuel   |   | 2.5000E-01  |                   |   |                |             |
| 206 |         | Mixture Volume  |   | 1.9895E+06  | cm <sup>3</sup>   |   |                |             |
| 207 |         | Calculated Volume   |   | 1.9895E+06  | cm <sup>3</sup>   |   |                |             |
| 208 |         | Distance from Center  |   | 3.07700E+01 | cm                |   |                |             |
| 209 |         |   |   |             |                   |   |                |             |
| 210 |         |   |   |             |                   |   |                |             |
| 211 |         |   |   |             |                   |   |                |             |
| 212 |         |   |   |             |                   |   |                |             |
| 213 |         |   |   |             |                   |   |                |             |
| 214 |         |   |   |             |                   |   |                |             |
| 215 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |   |             |                   |   |                |             |
| 216 |         | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 80 g Gd, 0 g Fe2O)</b> |   |             |                   |   |                |             |
| 217 |         |   |   |             |                   |   | DHLW Clay      |             |
| 218 |         | Cylinder Segment Volume Calculation:                                |   |             |                   |   | (atom/barn/cm) |             |
| 219 |         |   |   |             |                   |   | H              | 3.55893E-03 |
| 220 |         | Geometry Calculations   |   |             |                   |   | O              | 1.97883E-02 |
| 221 |         |   |   |             |                   |   | F              | 5.88292E-07 |
| 222 |         | UO2 Frac. Remaing   |   | 0.75        |                   |   | Na             | 2.49797E-05 |
| 223 |         | Cylinder Radius   |   | 86.5        | cm                |   | Mg             | 2.57324E-04 |
| 224 |         | Cylinder Length   |   | 304         | cm                |   | Al             | 1.18129E-03 |
| 225 |         | Cylinder Volume   |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 226 |         | 1/2 Cylinder Volume   |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 227 |         | DHLW Volume   |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 228 |         | Degraded MIT Volume   |   | 2.0005E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 229 |         | Mass of Gd  |   | 8.0000E+01  | g                 |   | Mn             | 2.50252E-04 |
| 230 |         | Den. of Gd  |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 231 |         | Vol. of Gd  |   | 1.0126E+01  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 232 |         | Mass of Fe2O3   |   | 0.0000E+00  | g                 |   | U-238          | 0.00000E+00 |
| 233 |         | Den. of Fe2O3   |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 234 |         | Vol. of Fe2O3   |   | 0.0000E+00  | cm <sup>3</sup>   |   |                |             |
| 235 | Total   | Void Fraction   |   |             |                   |   | Pu-239         | 1.03481E-09 |
| 236 |         | Total Volume  |   | 7.0181E+06  | cm <sup>3</sup>   |   |                |             |
| 237 |         | Calculated Volume   |   | 7.0181E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 238 | Mixture | Distance from Center  |   | 7.81050E+01 | cm                |   |                |             |
| 239 |         | Frac. of DHLW Mixed   |   |             |                   |   |                |             |
| 240 |         | with MIT Fuel   |   | 1.0000E-01  |                   |   |                |             |
| 241 |         | Mixture Volume  |   | 9.4513E+05  | cm <sup>3</sup>   |   |                |             |
| 242 |         | Calculated Volume   |   | 9.4513E+05  | cm <sup>3</sup>   |   |                |             |
| 243 |         | Distance from Center  |   | 5.36348E+01 | cm                |   |                |             |
| 244 |         |   |   |             |                   |   |                |             |
| 245 |         |   |   |             |                   |   |                |             |
| 246 |         |   |   |             |                   |   |                |             |
| 247 |         |   |   |             |                   |   |                |             |
| 248 |         |   |   |             |                   |   |                |             |
| 249 |         |   |   |             |                   |   |                |             |
| 250 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>         |   |             |                   |   |                |             |
| 251 |         | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 60 g Gd, 0 g Fe2O)</b> |   |             |                   |   |                |             |
| 252 |         |   |   |             |                   |   | DHLW Clay      |             |
| 253 |         | Cylinder Segment Volume Calculation:                                |   |             |                   |   | (atom/barn/cm) |             |
| 254 |         |   |   |             |                   |   | H              | 3.55893E-03 |
| 255 |         | Geometry Calculations   |   |             |                   |   | O              | 1.97883E-02 |

## Inverse

|     | A       | B                                   | C | D  | E | F | G              | H           |
|-----|---------|-------------------------------------|---|--|---|---|----------------|-------------|
| 256 |         |                                     |   |  |   |   | F              | 5.88292E-07 |
| 257 |         | UO2 Frac. Remaing                   |   | 0.75   |   |   | Na             | 2.49797E-05 |
| 258 |         | Cylinder Radius                     |   | 86.5 cm  |   |   | Mg             | 2.57324E-04 |
| 259 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |
| 260 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |
| 261 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |
| 262 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |
| 263 |         | Degraded MIT Volume                 |   | 2.0005E+05 cm <sup>3</sup>   |   |   | Ca             | 1.34777E-04 |
| 264 |         | Mass of Gd                          |   | 6.0000E+01 g   |   |   | Mn             | 2.50252E-04 |
| 265 |         | Den. of Gd                          |   | 7.9004E+00 g/cm <sup>3</sup>                                       |   |   | Fe             | 1.67546E-03 |
| 266 |         | Vol. of Gd                          |   | 7.5946E+00 cm <sup>3</sup>   |   |   | Ni             | 2.05882E-04 |
| 267 |         | Mass of Fe2O3                       |   | 0.0000E+00 g   |   |   | U-238          | 0.00000E+00 |
| 268 |         | Den. of Fe2O3                       |   | 5.2400E+00 g/cm <sup>3</sup>                                       |   |   |                |             |
| 269 |         | Vol. of Fe2O3                       |   | 0.0000E+00 cm <sup>3</sup>   |   |   |                |             |
| 270 | Total   | Void Fraction                       |   |  |   |   | Pu-239         | 1.03481E-09 |
| 271 |         | Total Volume                        |   | 7.0181E+06 cm <sup>3</sup>   |   |   |                |             |
| 272 |         | Calculated Volume                   |   | 7.0181E+06 cm <sup>3</sup>   |   |   | Total          | 3.37283E-02 |
| 273 | Mixture | Distance from Center                |   | 7.81050E+01 cm   |   |   |                |             |
| 274 |         | Frac. of DHLW Mixed                 |   |  |   |   |                |             |
| 275 |         | with MIT Fuel                       |   | 1.0000E-01   |   |   |                |             |
| 276 |         | Mixture Volume                      |   | 9.4512E+05 cm <sup>3</sup>   |   |   |                |             |
| 277 |         | Calculated Volume                   |   | 9.4512E+05 cm <sup>3</sup>   |   |   |                |             |
| 278 |         | Distance from Center                |   | 5.36350E+01 cm   |   |   |                |             |
| 279 |         |                                     |   |  |   |   |                |             |
| 280 |         |                                     |   |  |   |   |                |             |
| 281 |         |                                     |   |  |   |   |                |             |
| 282 |         |                                     |   |  |   |   |                |             |
| 283 |         |                                     |   |  |   |   |                |             |
| 284 |         |                                     |   |  |   |   |                |             |
| 285 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |   |   |                |             |
| 286 |         |                                     |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 40 g Gd, 0 g Fe2O</b> |   |   |                |             |
| 287 |         |                                     |   |  |   |   | DHLW Clay      |             |
| 288 |         | Cylinder Segment Volume Calculation |   |  |   |   | (atom/barn/cm) |             |
| 289 |         |                                     |   |  |   |   | H              | 3.55893E-03 |
| 290 |         | Geometry Calculations               |   |  |   |   | O              | 1.97883E-02 |
| 291 |         |                                     |   |  |   |   | F              | 5.88292E-07 |
| 292 |         | UO2 Frac. Remaing                   |   | 0.75   |   |   | Na             | 2.49797E-05 |
| 293 |         | Cylinder Radius                     |   | 86.5 cm  |   |   | Mg             | 2.57324E-04 |
| 294 |         | Cylinder Length                     |   | 304 cm   |   |   | Al             | 1.18129E-03 |
| 295 |         | Cylinder Volume                     |   | 7.1459E+06 cm <sup>3</sup>   |   |   | Si             | 6.18950E-03 |
| 296 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |   |   | P              | 1.76488E-06 |
| 297 |         | DHLW Volume                         |   | 4.9933E+06 cm <sup>3</sup>   |   |   | K              | 4.59207E-04 |
| 298 |         | Degraded MIT Volume                 |   | 2.0005E+05 cm <sup>3</sup>   |   |   | Ca             | 1.34777E-04 |
| 299 |         | Mass of Gd                          |   | 4.0000E+01 g   |   |   | Mn             | 2.50252E-04 |
| 300 |         | Den. of Gd                          |   | 7.9004E+00 g/cm <sup>3</sup>                                       |   |   | Fe             | 1.67546E-03 |
| 301 |         | Vol. of Gd                          |   | 5.0630E+00 cm <sup>3</sup>   |   |   | Ni             | 2.05882E-04 |
| 302 |         | Mass of Fe2O3                       |   | 0.0000E+00 g   |   |   | U-238          | 0.00000E+00 |
| 303 |         | Den. of Fe2O3                       |   | 5.2400E+00 g/cm <sup>3</sup>                                       |   |   |                |             |
| 304 |         | Vol. of Fe2O3                       |   | 0.0000E+00 cm <sup>3</sup>   |   |   |                |             |
| 305 | Total   | Void Fraction                       |   |  |   |   | Pu-239         | 1.03481E-09 |
| 306 |         | Total Volume                        |   | 7.0181E+06 cm <sup>3</sup>   |   |   |                |             |

## Inverse

|     | A       | B                                      | C | D  | E                 | F | G              | H           |
|-----|---------|--|---|--|-------------------|---|----------------|-------------|
| 307 |         | Calculated Volume                      |   | 7.0181E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 308 | Mixture | Distance from Center                   |   | 7.81050E+01  | cm                |   |                |             |
| 309 |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 310 |         | with MIT Fuel                          |   | 1.0000E-01   |                   |   |                |             |
| 311 |         | Mixture Volume                         |   | 9.4512E+05   | cm <sup>3</sup>   |   |                |             |
| 312 |         | Calculated Volume                      |   | 9.4512E+05   | cm <sup>3</sup>   |   |                |             |
| 313 |         | Distance from Center                   |   | 5.36350E+01  | cm                |   |                |             |
| 314 |         |  |   |  |                   |   |                |             |
| 315 |         |  |   |  |                   |   |                |             |
| 316 |         |  |   |  |                   |   |                |             |
| 317 |         |  |   |  |                   |   |                |             |
| 318 |         |  |   |  |                   |   |                |             |
| 319 |         |  |   |  |                   |   |                |             |
| 320 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                                |                   |   |                |             |
| 321 |         |  |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b> |                   |   |                |             |
| 322 |         |  |   |  |                   |   | DHLW Clay      |             |
| 323 |         | Cylinder Segment Volume Calculation    |   |  |                   |   | (atom/barn/cm) |             |
| 324 |         |  |   |  |                   |   | H              | 3.55893E-03 |
| 325 |         | Geometry Calculations                  |   |  |                   |   | O              | 1.97883E-02 |
| 326 |         |  |   |  |                   |   | F              | 5.88292E-07 |
| 327 |         | UO <sub>2</sub> Frac. Remaining        |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 328 |         | Cylinder Radius                        |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 329 |         | Cylinder Length                        |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 330 |         | Cylinder Volume                        |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 331 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 332 |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 333 |         | Degraded MIT Volume                    |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 334 |         | Mass of Gd                             |   | 2.0000E+01   | g                 |   | Mn             | 2.50252E-04 |
| 335 |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 336 |         | Vol. of Gd                             |   | 2.5315E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 337 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | g                 |   | U-238          | 0.00000E+00 |
| 338 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 339 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 0.0000E+00   | cm <sup>3</sup>   |   |                |             |
| 340 | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 341 |         | Total Volume                           |   | 7.0180E+06   | cm <sup>3</sup>   |   |                |             |
| 342 |         | Calculated Volume                      |   | 7.0180E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 343 | Mixture | Distance from Center                   |   | 7.81010E+01  | cm                |   |                |             |
| 344 |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 345 |         | with MIT Fuel                          |   | 1.0000E-01   |                   |   |                |             |
| 346 |         | Mixture Volume                         |   | 9.4512E+05   | cm <sup>3</sup>   |   |                |             |
| 347 |         | Calculated Volume                      |   | 9.4512E+05   | cm <sup>3</sup>   |   |                |             |
| 348 |         | Distance from Center                   |   | 5.36350E+01  | cm                |   |                |             |
| 349 |         |  |   |  |                   |   |                |             |
| 350 |         |  |   |  |                   |   |                |             |
| 351 |         |  |   |  |                   |   |                |             |
| 352 |         |  |   |  |                   |   |                |             |
| 353 |         |  |   |  |                   |   |                |             |
| 354 |         |  |   |  |                   |   |                |             |
| 355 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>                                |                   |   |                |             |
| 356 |         |  |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 0 g Fe<sub>2</sub>O<sub>3</sub>)</b>  |                   |   |                |             |
| 357 |         |  |   |  |                   |   | DHLW Clay      |             |

## Inverse

|     | A       | B  | C | D           | E                 | F | G         | H              |
|-----|---------|--|---|-------------|-------------------|---|-----------|----------------|
| 358 |         | Cylinder Segment Volume Calculation                                |   |             |                   |   |           | (atom/barn/cm) |
| 359 |         |  |   |             |                   |   | H         | 3.55893E-03    |
| 360 |         | Geometry Calculations  |   |             |                   |   |           | O              |
| 361 |         |  |   |             |                   |   | F         | 5.88292E-07    |
| 362 |         | UO2 Frac. Remaing  |   | 0.75        |                   |   | Na        | 2.49797E-05    |
| 363 |         | Cylinder Radius  |   | 86.5        | cm                |   | Mg        | 2.57324E-04    |
| 364 |         | Cylinder Length  |   | 304         | cm                |   | Al        | 1.18129E-03    |
| 365 |         | Cylinder Volume  |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si        | 6.18950E-03    |
| 366 |         | 1/2 Cylinder Volume  |   | 3.5729E+06  |                   |   | P         | 1.76488E-06    |
| 367 |         | DHLW Volume  |   | 4.9933E+06  | cm <sup>3</sup>   |   | K         | 4.59207E-04    |
| 368 |         | Degraded MIT Volume  |   | 2.0005E+05  | cm <sup>3</sup>   |   | Ca        | 1.34777E-04    |
| 369 |         | Mass of Gd   |   | 0.0000E+00  | g                 |   | Mn        | 2.50252E-04    |
| 370 |         | Den. of Gd   |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe        | 1.67546E-03    |
| 371 |         | Vol. of Gd   |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni        | 2.05882E-04    |
| 372 |         | Mass of Fe2O3  |   | 0.0000E+00  | g                 |   | U-238     | 0.00000E+00    |
| 373 |         | Den. of Fe2O3  |   | 5.2400E+00  | g/cm <sup>3</sup> |   |           |                |
| 374 |         | Vol. of Fe2O3  |   | 0.0000E+00  | cm <sup>3</sup>   |   |           |                |
| 375 | Total   | Void Fraction  |   |             |                   |   | Pu-239    | 1.03481E-09    |
| 376 |         | Total Volume   |   | 7.0180E+06  | cm <sup>3</sup>   |   |           |                |
| 377 |         | Calculated Volume  |   | 7.0180E+06  | cm <sup>3</sup>   |   | Total     | 3.37283E-02    |
| 378 | Mixture | Distance from Center   |   | 7.81010E+01 | cm                |   |           |                |
| 379 |         | Frac. of DHLW Mixed  |   |             |                   |   |           |                |
| 380 |         | with MIT Fuel  |   | 1.0000E-01  |                   |   |           |                |
| 381 |         | Mixture Volume   |   | 9.4511E+05  | cm <sup>3</sup>   |   |           |                |
| 382 |         | Calculated Volume  |   | 9.4511E+05  | cm <sup>3</sup>   |   |           |                |
| 383 |         | Distance from Center   |   | 5.96352E+01 | cm                |   |           |                |
| 384 |         |  |   |             |                   |   |           |                |
| 385 |         |  |   |             |                   |   |           |                |
| 386 |         |  |   |             |                   |   |           |                |
| 387 |         |  |   |             |                   |   |           |                |
| 388 |         |  |   |             |                   |   |           |                |
| 389 |         |  |   |             |                   |   |           |                |
| 390 |         | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |   |             |                   |   |           |                |
| 391 |         | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 80 g Gd, 295105 g</b> |   |             |                   |   |           |                |
| 392 |         |  |   |             |                   |   | DHLW Clay |                |
| 393 |         | Cylinder Segment Volume Calculation                                |   |             |                   |   |           | (atom/barn/cm) |
| 394 |         |  |   |             |                   |   | H         | 3.55893E-03    |
| 395 |         | Geometry Calculations  |   |             |                   |   |           | O              |
| 396 |         |  |   |             |                   |   | F         | 5.88292E-07    |
| 397 |         | UO2 Frac. Remaing  |   | 0.75        |                   |   | Na        | 2.49797E-05    |
| 398 |         | Cylinder Radius  |   | 86.5        | cm                |   | Mg        | 2.57324E-04    |
| 399 |         | Cylinder Length  |   | 304         | cm                |   | Al        | 1.18129E-03    |
| 400 |         | Cylinder Volume  |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si        | 6.18950E-03    |
| 401 |         | 1/2 Cylinder Volume  |   | 3.5729E+06  |                   |   | P         | 1.76488E-06    |
| 402 |         | DHLW Volume  |   | 4.9933E+06  | cm <sup>3</sup>   |   | K         | 4.59207E-04    |
| 403 |         | Degraded MIT Volume  |   | 2.0005E+05  | cm <sup>3</sup>   |   | Ca        | 1.34777E-04    |
| 404 |         | Mass of Gd   |   | 8.0000E+01  | g                 |   | Mn        | 2.50252E-04    |
| 405 |         | Den. of Gd   |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe        | 1.67546E-03    |
| 406 |         | Vol. of Gd   |   | 1.0126E+01  | cm <sup>3</sup>   |   | Ni        | 2.05882E-04    |
| 407 |         | Mass of Fe2O3  |   | 0.0000E+00  | g                 |   | U-238     | 0.00000E+00    |
| 408 |         | Den. of Fe2O3  |   | 5.2400E+00  | g/cm <sup>3</sup> |   |           |                |

## Inverse

|     | A       | B                                      | C | D  | E                 | F | G              | H           |
|-----|---------|--|---|--|-------------------|---|----------------|-------------|
| 409 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.6318E+04   | cm <sup>3</sup>   |   |                |             |
| 410 | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 411 |         | Total Volume                           |   | 7.0942E+06   | cm <sup>3</sup>   |   |                |             |
| 412 |         | Calculated Volume                      |   | 7.0942E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 413 | Mixture | Distance from Center                   |   | 8.19300E+01  | cm                |   |                |             |
| 414 |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 415 |         | with MIT Fuel                          |   | 1.0000E-01   |                   |   |                |             |
| 416 |         | Mixture Volume                         |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 417 |         | Calculated Volume                      |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 418 |         | Distance from Center                   |   | 5.18100E+01  | cm                |   |                |             |
| 419 |         |  |   |  |                   |   |                |             |
| 420 |         |  |   |  |                   |   |                |             |
| 421 |         |  |   |  |                   |   |                |             |
| 422 |         |  |   |  |                   |   |                |             |
| 423 |         |  |   |  |                   |   |                |             |
| 424 |         |  |   |  |                   |   |                |             |
| 425 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 426 |         |  |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 60 g Gd, 295105 g</b> |                   |   |                |             |
| 427 |         |  |   |  |                   |   | DHLW Clay      |             |
| 428 |         | Cylinder Segment Volume Calculation    |   |  |                   |   | (atom/barn/cm) |             |
| 429 |         |  |   |  |                   |   | H              | 3.55893E-03 |
| 430 |         | Geometry Calculations                  |   |  |                   |   | O              | 1.97883E-02 |
| 431 |         |  |   |  |                   |   | F              | 5.88292E-07 |
| 432 |         | UO <sub>2</sub> Frac. Remaining        |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 433 |         | Cylinder Radius                        |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 434 |         | Cylinder Length                        |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 435 |         | Cylinder Volume                        |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 436 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 437 |         | DHLW Volume                            |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 438 |         | Degraded MIT Volume                    |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 439 |         | Mass of Gd                             |   | 6.0000E+01   | g                 |   | Mn             | 2.50252E-04 |
| 440 |         | Den. of Gd                             |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 441 |         | Vol. of Gd                             |   | 7.5946E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 442 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   | 5.6318E+05   | g                 |   | U-238          | 0.00000E+00 |
| 443 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 444 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.6318E+04   | cm <sup>3</sup>   |   |                |             |
| 445 | Total   | Void Fraction                          |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 446 |         | Total Volume                           |   | 7.0942E+06   | cm <sup>3</sup>   |   |                |             |
| 447 |         | Calculated Volume                      |   | 7.0942E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 448 | Mixture | Distance from Center                   |   | 8.19300E+01  | cm                |   |                |             |
| 449 |         | Frac. of DHLW Mixed                    |   |  |                   |   |                |             |
| 450 |         | with MIT Fuel                          |   | 1.0000E-01   |                   |   |                |             |
| 451 |         | Mixture Volume                         |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 452 |         | Calculated Volume                      |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 453 |         | Distance from Center                   |   | 5.18100E+01  | cm                |   |                |             |
| 454 |         |  |   |  |                   |   |                |             |
| 455 |         |  |   |  |                   |   |                |             |
| 456 |         |  |   |  |                   |   |                |             |
| 457 |         |  |   |  |                   |   |                |             |
| 458 |         |  |   |  |                   |   |                |             |
| 459 |         |  |   |  |                   |   |                |             |

## Inverse

|     | A       | B                                   | C | D  | E                 | F | G              | H           |
|-----|---------|-------------------------------------|---|--|-------------------|---|----------------|-------------|
| 460 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 461 |         |                                     |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 40 g Gd, 295105 g</b> |                   |   |                |             |
| 462 |         |                                     |   |  |                   |   | DHLW Clay      |             |
| 463 |         | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |
| 464 |         |                                     |   |  |                   |   | H              | 3.55893E-03 |
| 465 |         | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |
| 466 |         |                                     |   |  |                   |   | F              | 5.88292E-07 |
| 467 |         | UO2 Frac. Remaing                   |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 468 |         | Cylinder Radius                     |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 469 |         | Cylinder Length                     |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 470 |         | Cylinder Volume                     |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 471 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 472 |         | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 473 |         | Degraded MIT Volume                 |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 474 |         | Mass of Gd                          |   | 4.0000E+01   | g                 |   | Mn             | 2.50252E-04 |
| 475 |         | Den. of Gd                          |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 476 |         | Vol. of Gd                          |   | 5.0630E+00   | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 477 |         | Mass of Fe2O3                       |   | 5.6318E+04   | g                 |   | U-238          | 0.00000E+00 |
| 478 |         | Den. of Fe2O3                       |   | 5.2400E+00   | g/cm <sup>3</sup> |   |                |             |
| 479 |         | Vol. of Fe2O3                       |   | 5.6318E+04   | cm <sup>3</sup>   |   |                |             |
| 480 | Total   | Void Fraction                       |   |  |                   |   | Pu-239         | 1.03481E-09 |
| 481 |         | Total Volume                        |   | 7.0942E+06   | cm <sup>3</sup>   |   |                |             |
| 482 |         | Calculated Volume                   |   | 7.0942E+06   | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 483 | Mixture | Distance from Center                |   | 8.19300E+01  | cm                |   |                |             |
| 484 |         | Frac. of DHLW Mixed                 |   |  |                   |   |                |             |
| 485 |         | with MIT Fuel                       |   | 1.0000E-01   |                   |   |                |             |
| 486 |         | Mixture Volume                      |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 487 |         | Calculated Volume                   |   | 1.0212E+06   | cm <sup>3</sup>   |   |                |             |
| 488 |         | Distance from Center                |   | 5.18100E+01  | cm                |   |                |             |
| 489 |         |                                     |   |  |                   |   |                |             |
| 490 |         |                                     |   |  |                   |   |                |             |
| 491 |         |                                     |   |  |                   |   |                |             |
| 492 |         |                                     |   |  |                   |   |                |             |
| 493 |         |                                     |   |  |                   |   |                |             |
| 494 |         |                                     |   |  |                   |   |                |             |
| 495 |         |                                     |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>        |                   |   |                |             |
| 496 |         |                                     |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 295105 g</b> |                   |   |                |             |
| 497 |         |                                     |   |  |                   |   | DHLW Clay      |             |
| 498 |         | Cylinder Segment Volume Calculation |   |  |                   |   | (atom/barn/cm) |             |
| 499 |         |                                     |   |  |                   |   | H              | 3.55893E-03 |
| 500 |         | Geometry Calculations               |   |  |                   |   | O              | 1.97883E-02 |
| 501 |         |                                     |   |  |                   |   | F              | 5.88292E-07 |
| 502 |         | UO2 Frac. Remaing                   |   | 0.75   |                   |   | Na             | 2.49797E-05 |
| 503 |         | Cylinder Radius                     |   | 86.5   | cm                |   | Mg             | 2.57324E-04 |
| 504 |         | Cylinder Length                     |   | 304  | cm                |   | Al             | 1.18129E-03 |
| 505 |         | Cylinder Volume                     |   | 7.1459E+06   | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 506 |         | 1/2 Cylinder Volume                 |   | 3.5729E+06   |                   |   | P              | 1.76488E-06 |
| 507 |         | DHLW Volume                         |   | 4.9933E+06   | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 508 |         | Degraded MIT Volume                 |   | 2.0005E+05   | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 509 |         | Mass of Gd                          |   | 2.0000E+01   | g                 |   | Mn             | 2.50252E-04 |
| 510 |         | Den. of Gd                          |   | 7.9004E+00   | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |



## Inverse

|     | A       | B                                      | C | D   | E                 | F | G              | H           |
|-----|---------|--|---|---|-------------------|---|----------------|-------------|
| 511 |         | Vol. of Gd                             |   | 2.5315E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 512 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   |   | g                 |   | U-238          | 0.00000E+00 |
| 513 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 514 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.6318E+04  | cm <sup>3</sup>   |   |                |             |
| 515 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 516 |         | Total Volume                           |   | 7.0942E+06  | cm <sup>3</sup>   |   |                |             |
| 517 |         | Calculated Volume                      |   | 7.0942E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 518 | Mixture | Distance from Center                   |   | 8.19300E+01   | cm                |   |                |             |
| 519 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |
| 520 |         | with MIT Fuel                          |   | 1.0000E-01  |                   |   |                |             |
| 521 |         | Mixture Volume                         |   | 1.0212E+06  | cm <sup>3</sup>   |   |                |             |
| 522 |         | Calculated Volume                      |   | 1.0212E+06  | cm <sup>3</sup>   |   |                |             |
| 523 |         | Distance from Center                   |   | 5.18100E+01   | cm                |   |                |             |
| 524 |         |  |   |   |                   |   |                |             |
| 525 |         |  |   |   |                   |   |                |             |
| 526 |         |  |   |   |                   |   |                |             |
| 527 |         |  |   |   |                   |   |                |             |
| 528 |         |  |   |   |                   |   |                |             |
| 529 |         |  |   |   |                   |   |                |             |
| 530 |         |  |   | <b>DHLW and Degraded MIT Fuel Homogeneous Mixture below</b>             |                   |   |                |             |
| 531 |         |  |   | <b>(10% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 295105 g Fuel)</b> |                   |   |                |             |
| 532 |         |  |   |   |                   |   | DHLW Clay      |             |
| 533 |         | Cylinder Segment Volume Calculation    |   |   |                   |   | (atom/barn/cm) |             |
| 534 |         |  |   |   |                   |   | H              | 3.55893E-03 |
| 535 |         | Geometry Calculations                  |   |   |                   |   | O              | 1.97883E-02 |
| 536 |         |  |   |   |                   |   | F              | 5.88292E-07 |
| 537 |         | UO <sub>2</sub> Frac. Remaining        |   | 0.75  |                   |   | Na             | 2.49797E-05 |
| 538 |         | Cylinder Radius                        |   | 86.5  | cm                |   | Mg             | 2.57324E-04 |
| 539 |         | Cylinder Length                        |   | 304   | cm                |   | Al             | 1.18129E-03 |
| 540 |         | Cylinder Volume                        |   | 7.1459E+06  | cm <sup>3</sup>   |   | Si             | 6.18950E-03 |
| 541 |         | 1/2 Cylinder Volume                    |   | 3.5729E+06  |                   |   | P              | 1.76488E-06 |
| 542 |         | DHLW Volume                            |   | 4.9933E+06  | cm <sup>3</sup>   |   | K              | 4.59207E-04 |
| 543 |         | Degraded MIT Volume                    |   | 2.0005E+05  | cm <sup>3</sup>   |   | Ca             | 1.34777E-04 |
| 544 |         | Mass of Gd                             |   | 0.0000E+00  | g                 |   | Mn             | 2.50252E-04 |
| 545 |         | Den. of Gd                             |   | 7.9004E+00  | g/cm <sup>3</sup> |   | Fe             | 1.67546E-03 |
| 546 |         | Vol. of Gd                             |   | 0.0000E+00  | cm <sup>3</sup>   |   | Ni             | 2.05882E-04 |
| 547 |         | Mass of Fe <sub>2</sub> O <sub>3</sub> |   |   | g                 |   | U-238          | 0.00000E+00 |
| 548 |         | Den. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.2400E+00  | g/cm <sup>3</sup> |   |                |             |
| 549 |         | Vol. of Fe <sub>2</sub> O <sub>3</sub> |   | 5.6318E+04  | cm <sup>3</sup>   |   |                |             |
| 550 | Total   | Void Fraction                          |   |   |                   |   | Pu-239         | 1.03481E-09 |
| 551 |         | Total Volume                           |   | 7.0941E+06  | cm <sup>3</sup>   |   |                |             |
| 552 |         | Calculated Volume                      |   | 7.0941E+06  | cm <sup>3</sup>   |   | Total          | 3.37283E-02 |
| 553 | Mixture | Distance from Center                   |   | 8.19250E+01   | cm                |   |                |             |
| 554 |         | Frac. of DHLW Mixed                    |   |   |                   |   |                |             |
| 555 |         | with MIT Fuel                          |   | 1.0000E-01  |                   |   |                |             |
| 556 |         | Mixture Volume                         |   | 1.0212E+06  | cm <sup>3</sup>   |   |                |             |
| 557 |         | Calculated Volume                      |   | 1.0212E+06  | cm <sup>3</sup>   |   |                |             |
| 558 |         | Distance from Center                   |   | 5.18100E+01   | cm                |   |                |             |
| 559 |         |  |   |   |                   |   |                |             |
| 560 |         |  |   |   |                   |   |                |             |
| 561 |         |  |   |   |                   |   |                |             |

## Inverse

|    | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 1  |             |                   |            |          |   |                |           |                 |   |
| 2  |             |                   |            |          |   |                |           |                 |   |
| 3  |             |                   |            |          |   |                |           |                 |   |
| 4  |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 5  | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 6  |             |                   |            |          |   |                |           |                 |   |
| 7  |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 8  |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 9  |             |                   |            |          |   | H              | 1001.50C  | 1.8191E-02      |   |
| 10 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 6.0034E-02      |   |
| 11 |             |                   |            |          |   | F              | 9019.50C  | 0.0000E+00      |   |
| 12 |             |                   |            |          |   | Na             | 11023.50C | 0.0000E+00      |   |
| 13 |             |                   |            |          |   | Mg             | 12000.50C | 0.0000E+00      |   |
| 14 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 3.3643E-02      |   |
| 15 |             |                   |            |          |   | Si             | 14000.50C | 0.0000E+00      |   |
| 16 |             |                   |            |          |   | P              | 15031.50C | 0.0000E+00      |   |
| 17 |             |                   |            |          |   | K              | 19000.50C | 0.0000E+00      |   |
| 18 |             |                   |            |          |   | Ca             | 20000.50C | 0.0000E+00      |   |
| 19 |             |                   |            |          |   | Mn             | 25055.50C | 0.0000E+00      |   |
| 20 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 0.0000E+00      |   |
| 21 |             |                   |            |          |   | Ni             | 28000.50C | 0.0000E+00      |   |
| 22 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 1.3368E-05      |   |
| 23 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 2.3016E-04      |   |
| 24 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 2.4722E-06      |   |
| 25 |             |                   |            |          |   | Pu-239         | 94239.55C | 0.0000E+00      |   |
| 26 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 27 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 28 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 29 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 30 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 31 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 32 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 33 |             |                   |            |          |   |                |           |                 |   |
| 34 |             |                   |            |          |   | Total          |           | 1.1211E-01      |   |
| 35 |             |                   |            |          |   |                |           |                 |   |
| 36 |             |                   |            |          |   | H/U-235        |           | 79.035199       |   |
| 37 |             |                   |            |          |   |                |           |                 |   |
| 38 |             |                   |            |          |   |                |           |                 |   |
| 39 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 40 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 41 |             |                   |            |          |   |                |           |                 |   |
| 42 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 43 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 44 |             |                   |            |          |   | H              | 1001.50C  | 1.9629E-02      |   |
| 45 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.9753E-02      |   |
| 46 |             |                   |            |          |   | F              | 9019.50C  | 2.3776E-07      |   |
| 47 |             |                   |            |          |   | Na             | 11023.50C | 1.0096E-05      |   |
| 48 |             |                   |            |          |   | Mg             | 12000.50C | 1.0400E-04      |   |
| 49 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.5443E-02      |   |
| 50 |             |                   |            |          |   | Si             | 14000.50C | 2.5015E-03      |   |
| 51 |             |                   |            |          |   | P              | 15031.50C | 7.1328E-07      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 52  |             |                   |            |          |   | K              | 19000.50C | 1.8559E-04      |   |
| 53  |             |                   |            |          |   | Ca             | 20000.50C | 5.4471E-05      |   |
| 54  |             |                   |            |          |   | Mn             | 25055.50C | 1.0114E-04      |   |
| 55  |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 6.7715E-04      |   |
| 56  |             |                   |            |          |   | Ni             | 28000.50C | 8.3208E-05      |   |
| 57  |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 5.9466E-06      |   |
| 58  |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 1.0238E-04      |   |
| 59  |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 1.0997E-06      |   |
| 60  |             |                   |            |          |   | Pu-239         | 94239.55C | 4.1822E-10      |   |
| 61  |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 62  |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 63  |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 64  |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 65  |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 66  |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 67  |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 68  |             |                   |            |          |   |                |           |                 |   |
| 69  |             |                   |            |          |   | Total          |           | 7.8653E-02      |   |
| 70  |             |                   |            |          |   |                |           |                 |   |
| 71  |             |                   |            |          |   | H/U-235        |           | 191.719373      |   |
| 72  |             |                   |            |          |   |                |           |                 |   |
| 73  |             |                   |            |          |   |                |           |                 |   |
| 74  |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 75  | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 76  | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 77  |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 78  |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 79  |             |                   |            |          |   | H              | 1001.50C  | 2.0041E-02      |   |
| 80  |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.3951E-02      |   |
| 81  |             |                   |            |          |   | F              | 9019.50C  | 3.0577E-07      |   |
| 82  |             |                   |            |          |   | Na             | 11023.50C | 1.2983E-05      |   |
| 83  |             |                   |            |          |   | Mg             | 12000.50C | 1.3375E-04      |   |
| 84  |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.0237E-02      |   |
| 85  |             |                   |            |          |   | Si             | 14000.50C | 3.2171E-03      |   |
| 86  |             |                   |            |          |   | P              | 15031.50C | 9.1731E-07      |   |
| 87  |             |                   |            |          |   | K              | 19000.50C | 2.3868E-04      |   |
| 88  |             |                   |            |          |   | Ca             | 20000.50C | 7.0052E-05      |   |
| 89  |             |                   |            |          |   | Mn             | 25055.50C | 1.3007E-04      |   |
| 90  |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 8.7084E-04      |   |
| 91  |             |                   |            |          |   | Ni             | 28000.50C | 1.0701E-04      |   |
| 92  |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.8238E-06      |   |
| 93  |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.5836E-05      |   |
| 94  |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 7.0714E-07      |   |
| 95  |             |                   |            |          |   | Pu-239         | 94239.55C | 5.3785E-10      |   |
| 96  |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 97  |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 98  |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 99  |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 100 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 101 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 102 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 103 |             |                   |            |          |   |                |           |                 |   |
| 104 |             |                   |            |          |   | Total          |           | 6.9081E-02      |   |
| 105 |             |                   |            |          |   |                |           |                 |   |
| 106 |             |                   |            |          |   | H/U-235        |           | 304.403546      |   |
| 107 |             |                   |            |          |   |                |           |                 |   |
| 108 |             |                   |            |          |   |                |           |                 |   |
| 109 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 110 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 111 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 112 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 113 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 114 |             |                   |            |          |   | H              | 1001.50C  | 2.0236E-02      |   |
| 115 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.1202E-02      |   |
| 116 |             |                   |            |          |   | F              | 9019.50C  | 3.3800E-07      |   |
| 117 |             |                   |            |          |   | Na             | 11023.50C | 1.4352E-05      |   |
| 118 |             |                   |            |          |   | Mg             | 12000.50C | 1.4784E-04      |   |
| 119 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 7.7705E-03      |   |
| 120 |             |                   |            |          |   | Si             | 14000.50C | 3.5561E-03      |   |
| 121 |             |                   |            |          |   | P              | 15031.50C | 1.0140E-06      |   |
| 122 |             |                   |            |          |   | K              | 19000.50C | 2.6383E-04      |   |
| 123 |             |                   |            |          |   | Ca             | 20000.50C | 7.7435E-05      |   |
| 124 |             |                   |            |          |   | Mn             | 25055.50C | 1.4378E-04      |   |
| 125 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 9.6262E-04      |   |
| 126 |             |                   |            |          |   | Ni             | 28000.50C | 1.1829E-04      |   |
| 127 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 2.8179E-06      |   |
| 128 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 4.8516E-05      |   |
| 129 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 5.2112E-07      |   |
| 130 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.9454E-10      |   |
| 131 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 132 |             |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 133 |             |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 134 |             |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 135 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 136 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 137 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 138 |             |                   |            |          |   |                |           |                 |   |
| 139 |             |                   |            |          |   | Total          |           | 6.4546E-02      |   |
| 140 |             |                   |            |          |   |                |           |                 |   |
| 141 |             |                   |            |          |   | H/U-235        |           | 417.08772       |   |
| 142 |             |                   |            |          |   |                |           |                 |   |
| 143 |             |                   |            |          |   |                |           |                 |   |
| 144 |             |                   |            |          |   | Void Frac.     | 0.272     |                 |   |
| 145 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 146 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 147 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 148 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 149 |             |                   |            |          |   | H              | 1001.50C  | 2.0349E-02      |   |
| 150 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 2.9598E-02      |   |
| 151 |             |                   |            |          |   | F              | 9019.50C  | 3.5680E-07      |   |
| 152 |             |                   |            |          |   | Na             | 11023.50C | 1.5150E-05      |   |
| 153 |             |                   |            |          |   | Mg             | 12000.50C | 1.5607E-04      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N          | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|------------|-----------|-----------------|---|
| 154 |             | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 6.3312E-03      |   |
| 155 |             |                   |            |          |   | Si         | 14000.50C | 3.7540E-03      |   |
| 156 |             |                   |            |          |   | P          | 15031.50C | 1.0704E-06      |   |
| 157 |             |                   |            |          |   | K          | 19000.50C | 2.7851E-04      |   |
| 158 |             |                   |            |          |   | Ca         | 20000.50C | 8.1743E-05      |   |
| 159 |             |                   |            |          |   | Mn         | 25055.50C | 1.5178E-04      |   |
| 160 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 1.0162E-03      |   |
| 161 |             |                   |            |          |   | Ni         | 28000.50C | 1.2487E-04      |   |
| 162 |             | U-238             | 1452       | 238.0508 |   | U-238      | 92238.50C | 2.2310E-06      |   |
| 163 |             | U-235             | 24684      | 235.0439 |   | U-235      | 92235.50C | 3.8411E-05      |   |
| 164 |             | U-234             | 264        | 234.0409 |   | U-234      | 92234.50C | 4.1258E-07      |   |
| 165 |             |                   |            |          |   | Pu-239     | 94239.55C | 6.2761E-10      |   |
| 166 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 167 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 168 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 169 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 170 |             |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 171 |             |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 172 |             |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 173 |             |                   |            |          |   |            |           |                 |   |
| 174 |             |                   |            |          |   | Total      |           | 6.1900E-02      |   |
| 175 |             |                   |            |          |   |            |           |                 |   |
| 176 |             |                   |            |          |   | H/U-235    |           | 529.771893      |   |
| 177 |             |                   |            |          |   |            |           |                 |   |
| 178 |             |                   |            |          |   |            |           |                 |   |
| 179 |             |                   |            |          |   | Void Frac. |           | 0.272           |   |
| 180 | <b>DHLW</b> |                   |            |          |   |            |           |                 |   |
| 181 | <b>B)</b>   |                   |            |          |   |            |           |                 |   |
| 182 |             | Degraded MIT Fuel |            |          |   | Mixture    |           | (atoms/barn cm) |   |
| 183 |             | Mass(g)           | WT         |          |   |            |           |                 |   |
| 184 |             |                   |            |          |   | H          | 1001.50C  | 2.0424E-02      |   |
| 185 |             | O                 | 3.72E+05   | 15.99492 |   | O          | 8016.50C  | 2.8547E-02      |   |
| 186 |             |                   |            |          |   | F          | 9019.50C  | 3.6912E-07      |   |
| 187 |             |                   |            |          |   | Na         | 11023.50C | 1.5673E-05      |   |
| 188 |             |                   |            |          |   | Mg         | 12000.50C | 1.6146E-04      |   |
| 189 |             | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 5.3881E-03      |   |
| 190 |             |                   |            |          |   | Si         | 14000.50C | 3.8836E-03      |   |
| 191 |             |                   |            |          |   | P          | 15031.50C | 1.1074E-06      |   |
| 192 |             |                   |            |          |   | K          | 19000.50C | 2.8813E-04      |   |
| 193 |             |                   |            |          |   | Ca         | 20000.50C | 8.4565E-05      |   |
| 194 |             |                   |            |          |   | Mn         | 25055.50C | 1.5702E-04      |   |
| 195 |             | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 1.0513E-03      |   |
| 196 |             |                   |            |          |   | Ni         | 28000.50C | 1.2918E-04      |   |
| 197 |             | U-238             | 1452       | 238.0508 |   | U-238      | 92238.50C | 1.8464E-06      |   |
| 198 |             | U-235             | 24684      | 235.0439 |   | U-235      | 92235.50C | 3.1790E-05      |   |
| 199 |             | U-234             | 264        | 234.0409 |   | U-234      | 92234.50C | 3.4146E-07      |   |
| 200 |             |                   |            |          |   | Pu-239     | 94239.55C | 6.4929E-10      |   |
| 201 |             | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 202 |             |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 203 |             |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 204 |             |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 205 |             |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 206 |             |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 207 |             |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 208 |             |                   |            |          |   |                |           |                 |   |
| 209 |             |                   |            |          |   | Total          |           | 6.0166E-02      |   |
| 210 |             |                   |            |          |   |                |           |                 |   |
| 211 |             |                   |            |          |   | H/U-235        |           | 642.456067      |   |
| 212 |             |                   |            |          |   |                |           |                 |   |
| 213 |             |                   |            |          |   |                |           |                 |   |
| 214 |             |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 215 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 216 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 217 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 218 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 219 |             |                   |            |          |   | H              | 1001.50C  | 1.9269E-02      |   |
| 220 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.3959E-02      |   |
| 221 |             |                   |            |          |   | F              | 9019.50C  | 3.1081E-07      |   |
| 222 |             |                   |            |          |   | Na             | 11023.50C | 1.3197E-05      |   |
| 223 |             |                   |            |          |   | Mg             | 12000.50C | 1.3595E-04      |   |
| 224 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.0406E-02      |   |
| 225 |             |                   |            |          |   | Si             | 14000.50C | 3.2700E-03      |   |
| 226 |             |                   |            |          |   | P              | 15031.50C | 9.3242E-07      |   |
| 227 |             |                   |            |          |   | K              | 19000.50C | 2.4261E-04      |   |
| 228 |             |                   |            |          |   | Ca             | 20000.50C | 7.1206E-05      |   |
| 229 |             |                   |            |          |   | Mn             | 25055.50C | 1.3221E-04      |   |
| 230 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 8.8518E-04      |   |
| 231 |             |                   |            |          |   | Ni             | 28000.50C | 1.0877E-04      |   |
| 232 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.8867E-06      |   |
| 233 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.6920E-05      |   |
| 234 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 7.1879E-07      |   |
| 235 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.4671E-10      |   |
| 236 |             | Gd                | 8.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 6.4836E-10      |   |
| 237 |             |                   |            |          |   | Gd-154         | 64154.50C | 7.0672E-09      |   |
| 238 |             |                   |            |          |   | Gd-155         | 64155.50C | 4.7979E-08      |   |
| 239 |             |                   |            |          |   | Gd-156         | 64156.50C | 6.6360E-08      |   |
| 240 |             |                   |            |          |   | Gd-157         | 64157.50C | 5.0734E-08      |   |
| 241 |             |                   |            |          |   | Gd-158         | 64158.50C | 8.0527E-08      |   |
| 242 |             |                   |            |          |   | Gd-160         | 64160.50C | 7.0866E-08      |   |
| 243 |             |                   |            |          |   |                |           |                 |   |
| 244 |             |                   |            |          |   | Total          |           | 6.8566E-02      |   |
| 245 |             |                   |            |          |   |                |           |                 |   |
| 246 |             |                   |            |          |   | H/U-235        |           | 287.934351      |   |
| 247 |             |                   |            |          |   |                |           |                 |   |
| 248 |             |                   |            |          |   |                |           |                 |   |
| 249 |             |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 250 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 251 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 252 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 253 |             |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 254 |             |                   |            |          |   | H              | 1001.50C  | 1.9269E-02      |   |
| 255 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.3959E-02      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 256 |             |                   |            |          |   | F              | 9019.50C  | 3.1081E-07      |   |
| 257 |             |                   |            |          |   | Na             | 11023.50C | 1.3197E-05      |   |
| 258 |             |                   |            |          |   | Mg             | 12000.50C | 1.3595E-04      |   |
| 259 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.0406E-02      |   |
| 260 |             |                   |            |          |   | Si             | 14000.50C | 3.2701E-03      |   |
| 261 |             |                   |            |          |   | P              | 15031.50C | 9.3242E-07      |   |
| 262 |             |                   |            |          |   | K              | 19000.50C | 2.4261E-04      |   |
| 263 |             |                   |            |          |   | Ca             | 20000.50C | 7.1206E-05      |   |
| 264 |             |                   |            |          |   | Mn             | 25055.50C | 1.3221E-04      |   |
| 265 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 8.8519E-04      |   |
| 266 |             |                   |            |          |   | Ni             | 28000.50C | 1.0877E-04      |   |
| 267 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.8868E-06      |   |
| 268 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.6920E-05      |   |
| 269 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 7.1879E-07      |   |
| 270 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.4671E-10      |   |
| 271 |             | Gd                | 6.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 4.8627E-10      |   |
| 272 |             |                   |            |          |   | Gd-154         | 64154.50C | 5.3004E-09      |   |
| 273 |             |                   |            |          |   | Gd-155         | 64155.50C | 3.5984E-08      |   |
| 274 |             |                   |            |          |   | Gd-156         | 64156.50C | 4.9770E-08      |   |
| 275 |             |                   |            |          |   | Gd-157         | 64157.50C | 3.8051E-08      |   |
| 276 |             |                   |            |          |   | Gd-158         | 64158.50C | 6.0395E-08      |   |
| 277 |             |                   |            |          |   | Gd-160         | 64160.50C | 5.3150E-08      |   |
| 278 |             |                   |            |          |   |                |           |                 |   |
| 279 |             |                   |            |          |   | Total          |           | 6.8566E-02      |   |
| 280 |             |                   |            |          |   |                |           |                 |   |
| 281 |             |                   |            |          |   | H/U-235        |           | 287.933411      |   |
| 282 |             |                   |            |          |   |                |           |                 |   |
| 283 |             |                   |            |          |   |                |           |                 |   |
| 284 |             |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 285 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 286 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 287 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 288 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 289 |             |                   |            |          |   | H              | 1001.50C  | 1.9269E-02      |   |
| 290 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.3960E-02      |   |
| 291 |             |                   |            |          |   | F              | 9019.50C  | 3.1081E-07      |   |
| 292 |             |                   |            |          |   | Na             | 11023.50C | 1.3197E-05      |   |
| 293 |             |                   |            |          |   | Mg             | 12000.50C | 1.3595E-04      |   |
| 294 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.0406E-02      |   |
| 295 |             |                   |            |          |   | Si             | 14000.50C | 3.2701E-03      |   |
| 296 |             |                   |            |          |   | P              | 15031.50C | 9.3243E-07      |   |
| 297 |             |                   |            |          |   | K              | 19000.50C | 2.4261E-04      |   |
| 298 |             |                   |            |          |   | Ca             | 20000.50C | 7.1206E-05      |   |
| 299 |             |                   |            |          |   | Mn             | 25055.50C | 1.3221E-04      |   |
| 300 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 8.8519E-04      |   |
| 301 |             |                   |            |          |   | Ni             | 28000.50C | 1.0877E-04      |   |
| 302 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.8868E-06      |   |
| 303 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.6920E-05      |   |
| 304 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 7.1879E-07      |   |
| 305 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.4671E-10      |   |
| 306 |             | Gd                | 4.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 3.2418E-10      |   |

## Inverse

|     | I           | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|-------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 307 |             |                   |            |          |   | Gd-154         | 64154.50C | 3.5336E-09      |   |
| 308 |             |                   |            |          |   | Gd-155         | 64155.50C | 2.3990E-08      |   |
| 309 |             |                   |            |          |   | Gd-156         | 64156.50C | 3.3180E-08      |   |
| 310 |             |                   |            |          |   | Gd-157         | 64157.50C | 2.5367E-08      |   |
| 311 |             |                   |            |          |   | Gd-158         | 64158.50C | 4.0264E-08      |   |
| 312 |             |                   |            |          |   | Gd-160         | 64160.50C | 3.5433E-08      |   |
| 313 |             |                   |            |          |   |                |           |                 |   |
| 314 |             |                   |            |          |   | Total          |           | 6.8566E-02      |   |
| 315 |             |                   |            |          |   |                |           |                 |   |
| 316 |             |                   |            |          |   | H/U-235        |           | 287.93247       |   |
| 317 |             |                   |            |          |   |                |           |                 |   |
| 318 |             |                   |            |          |   |                |           |                 |   |
| 319 |             |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 320 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 321 | <b>3)</b>   |                   |            |          |   |                |           |                 |   |
| 322 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 323 |             | Mass(g)           | WT         |          |   |                |           |                 |   |
| 324 |             |                   |            |          |   | H              | 1001.50C  | 1.9269E-02      |   |
| 325 |             | O                 | 3.72E+05   | 15.99492 |   | O              | 8016.50C  | 3.3960E-02      |   |
| 326 |             |                   |            |          |   | F              | 9019.50C  | 3.1081E-07      |   |
| 327 |             |                   |            |          |   | Na             | 11023.50C | 1.3197E-05      |   |
| 328 |             |                   |            |          |   | Mg             | 12000.50C | 1.3595E-04      |   |
| 329 |             | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 1.0406E-02      |   |
| 330 |             |                   |            |          |   | Si             | 14000.50C | 3.2701E-03      |   |
| 331 |             |                   |            |          |   | P              | 15031.50C | 9.3243E-07      |   |
| 332 |             |                   |            |          |   | K              | 19000.50C | 2.4261E-04      |   |
| 333 |             |                   |            |          |   | Ca             | 20000.50C | 7.1206E-05      |   |
| 334 |             |                   |            |          |   | Mn             | 25055.50C | 1.3222E-04      |   |
| 335 |             | Fe                | 0.00E+00   | 55.847   |   | Fe             | 26000.55C | 8.8519E-04      |   |
| 336 |             |                   |            |          |   | Ni             | 28000.50C | 1.0877E-04      |   |
| 337 |             | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.8868E-06      |   |
| 338 |             | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.6921E-05      |   |
| 339 |             | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 7.1880E-07      |   |
| 340 |             |                   |            |          |   | Pu-239         | 94239.55C | 5.4672E-10      |   |
| 341 |             | Gd                | 2.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 1.6209E-10      |   |
| 342 |             |                   |            |          |   | Gd-154         | 64154.50C | 1.7668E-09      |   |
| 343 |             |                   |            |          |   | Gd-155         | 64155.50C | 1.1995E-08      |   |
| 344 |             |                   |            |          |   | Gd-156         | 64156.50C | 1.6590E-08      |   |
| 345 |             |                   |            |          |   | Gd-157         | 64157.50C | 1.2684E-08      |   |
| 346 |             |                   |            |          |   | Gd-158         | 64158.50C | 2.0132E-08      |   |
| 347 |             |                   |            |          |   | Gd-160         | 64160.50C | 1.7717E-08      |   |
| 348 |             |                   |            |          |   |                |           |                 |   |
| 349 |             |                   |            |          |   | Total          |           | 6.8566E-02      |   |
| 350 |             |                   |            |          |   |                |           |                 |   |
| 351 |             |                   |            |          |   | H/U-235        |           | 287.93153       |   |
| 352 |             |                   |            |          |   |                |           |                 |   |
| 353 |             |                   |            |          |   |                |           |                 |   |
| 354 |             |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 355 | <b>DHLW</b> |                   |            |          |   |                |           |                 |   |
| 356 | <b>)</b>    |                   |            |          |   |                |           |                 |   |
| 357 |             | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |



## Inverse

|     | I             | J                 | K          | L        | M | N          | O         | P               | Q |
|-----|---------------|-------------------|------------|----------|---|------------|-----------|-----------------|---|
| 358 |               |                   | Mass(g)    | WT       |   |            |           |                 |   |
| 359 |               |                   |            |          |   | H          | 1001.50C  | 1.9269E-02      |   |
| 360 |               | O                 | 3.72E+05   | 15.99492 |   | O          | 8016.50C  | 3.3960E-02      |   |
| 361 |               |                   |            |          |   | F          | 9019.50C  | 3.1081E-07      |   |
| 362 |               |                   |            |          |   | Na         | 11023.50C | 1.3197E-05      |   |
| 363 |               |                   |            |          |   | Mg         | 12000.50C | 1.3595E-04      |   |
| 364 |               | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 1.0406E-02      |   |
| 365 |               |                   |            |          |   | Si         | 14000.50C | 3.2701E-03      |   |
| 366 |               |                   |            |          |   | P          | 15031.50C | 9.3243E-07      |   |
| 367 |               |                   |            |          |   | K          | 19000.50C | 2.4261E-04      |   |
| 368 |               |                   |            |          |   | Ca         | 20000.50C | 7.1207E-05      |   |
| 369 |               |                   |            |          |   | Mn         | 25055.50C | 1.3222E-04      |   |
| 370 |               | Fe                | 0.00E+00   | 55.847   |   | Fe         | 26000.55C | 8.8520E-04      |   |
| 371 |               |                   |            |          |   | Ni         | 28000.50C | 1.0877E-04      |   |
| 372 |               | U-238             | 1452       | 238.0508 |   | U-238      | 92238.50C | 3.8868E-06      |   |
| 373 |               | U-235             | 24684      | 235.0439 |   | U-235      | 92235.50C | 6.6921E-05      |   |
| 374 |               | U-234             | 264        | 234.0409 |   | U-234      | 92234.50C | 7.1880E-07      |   |
| 375 |               |                   |            |          |   | Pu-239     | 94239.55C | 5.4672E-10      |   |
| 376 |               | Gd                | 0.0000E+00 | 157.25   |   | Gd-152     | 64152.50C | 0.0000E+00      |   |
| 377 |               |                   |            |          |   | Gd-154     | 64154.50C | 0.0000E+00      |   |
| 378 |               |                   |            |          |   | Gd-155     | 64155.50C | 0.0000E+00      |   |
| 379 |               |                   |            |          |   | Gd-156     | 64156.50C | 0.0000E+00      |   |
| 380 |               |                   |            |          |   | Gd-157     | 64157.50C | 0.0000E+00      |   |
| 381 |               |                   |            |          |   | Gd-158     | 64158.50C | 0.0000E+00      |   |
| 382 |               |                   |            |          |   | Gd-160     | 64160.50C | 0.0000E+00      |   |
| 383 |               |                   |            |          |   |            |           |                 |   |
| 384 |               |                   |            |          |   | Total      |           | 6.8566E-02      |   |
| 385 |               |                   |            |          |   |            |           |                 |   |
| 386 |               |                   |            |          |   | H/U-235    |           | 287.930589      |   |
| 387 |               |                   |            |          |   |            |           |                 |   |
| 388 |               |                   |            |          |   |            |           |                 |   |
| 389 |               |                   |            |          |   | Void Frac. | 0.26      |                 |   |
| 390 | <b>DHLW</b>   |                   |            |          |   |            |           |                 |   |
| 391 | <b>Fe2O3)</b> |                   |            |          |   |            |           |                 |   |
| 392 |               | Degraded MIT Fuel |            |          |   | Mixture    |           | (atoms/barn cm) |   |
| 393 |               |                   | Mass(g)    | WT       |   |            |           |                 |   |
| 394 |               |                   |            |          |   | H          | 1001.50C  | 1.9128E-02      |   |
| 395 |               | O                 | 4.60E+05   | 15.99492 |   | O          | 8016.50C  | 3.5346E-02      |   |
| 396 |               |                   |            |          |   | F          | 9019.50C  | 2.8764E-07      |   |
| 397 |               |                   |            |          |   | Na         | 11023.50C | 1.2214E-05      |   |
| 398 |               |                   |            |          |   | Mg         | 12000.50C | 1.2582E-04      |   |
| 399 |               | Al                | 4.14E+05   | 26.98154 |   | Al         | 13027.50C | 9.6305E-03      |   |
| 400 |               |                   |            |          |   | Si         | 14000.50C | 3.0264E-03      |   |
| 401 |               |                   |            |          |   | P          | 15031.50C | 8.6293E-07      |   |
| 402 |               |                   |            |          |   | K          | 19000.50C | 2.2453E-04      |   |
| 403 |               |                   |            |          |   | Ca         | 20000.50C | 6.5899E-05      |   |
| 404 |               |                   |            |          |   | Mn         | 25055.50C | 1.2236E-04      |   |
| 405 |               | Fe                | 2.06E+05   | 55.847   |   | Fe         | 26000.55C | 2.9990E-03      |   |
| 406 |               |                   |            |          |   | Ni         | 28000.50C | 1.0067E-04      |   |
| 407 |               | U-238             | 1452       | 238.0508 |   | U-238      | 92238.50C | 3.5971E-06      |   |
| 408 |               | U-235             | 24684      | 235.0439 |   | U-235      | 92235.50C | 6.1933E-05      |   |

## Inverse

|     | I             | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|---------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 409 |               | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 6.6522E-07      |   |
| 410 |               |                   |            |          |   | Pu-239         | 94239.55C | 5.0597E-10      |   |
| 411 |               | Gd                | 8.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 6.0004E-10      |   |
| 412 |               |                   |            |          |   | Gd-154         | 64154.50C | 6.5405E-09      |   |
| 413 |               |                   |            |          |   | Gd-155         | 64155.50C | 4.4403E-08      |   |
| 414 |               |                   |            |          |   | Gd-156         | 64156.50C | 6.1415E-08      |   |
| 415 |               |                   |            |          |   | Gd-157         | 64157.50C | 4.6954E-08      |   |
| 416 |               |                   |            |          |   | Gd-158         | 64158.50C | 7.4526E-08      |   |
| 417 |               |                   |            |          |   | Gd-160         | 64160.50C | 6.5585E-08      |   |
| 418 |               |                   |            |          |   |                |           |                 |   |
| 419 |               |                   |            |          |   | Total          |           | 7.0850E-02      |   |
| 420 |               |                   |            |          |   |                |           |                 |   |
| 421 |               |                   |            |          |   | H/U-235        |           | 308.857421      |   |
| 422 |               |                   |            |          |   |                |           |                 |   |
| 423 |               |                   |            |          |   |                |           |                 |   |
| 424 |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 425 | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 426 | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 427 |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 428 |               |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 429 |               |                   |            |          |   | H              | 1001.50C  | 1.9128E-02      |   |
| 430 |               | O                 | 4.60E+05   | 15.99492 |   | O              | 8016.50C  | 3.5346E-02      |   |
| 431 |               |                   |            |          |   | F              | 9019.50C  | 2.8765E-07      |   |
| 432 |               |                   |            |          |   | Na             | 11023.50C | 1.2214E-05      |   |
| 433 |               |                   |            |          |   | Mg             | 12000.50C | 1.2582E-04      |   |
| 434 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 9.6305E-03      |   |
| 435 |               |                   |            |          |   | Si             | 14000.50C | 3.0264E-03      |   |
| 436 |               |                   |            |          |   | P              | 15031.50C | 8.6294E-07      |   |
| 437 |               |                   |            |          |   | K              | 19000.50C | 2.2453E-04      |   |
| 438 |               |                   |            |          |   | Ca             | 20000.50C | 6.5899E-05      |   |
| 439 |               |                   |            |          |   | Mn             | 25055.50C | 1.2236E-04      |   |
| 440 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.9990E-03      |   |
| 441 |               |                   |            |          |   | Ni             | 28000.50C | 1.0067E-04      |   |
| 442 |               | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.5971E-06      |   |
| 443 |               | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.1933E-05      |   |
| 444 |               | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 6.6522E-07      |   |
| 445 |               |                   |            |          |   | Pu-239         | 94239.55C | 5.0597E-10      |   |
| 446 |               | Gd                | 6.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 4.5004E-10      |   |
| 447 |               |                   |            |          |   | Gd-154         | 64154.50C | 4.9054E-09      |   |
| 448 |               |                   |            |          |   | Gd-155         | 64155.50C | 3.3303E-08      |   |
| 449 |               |                   |            |          |   | Gd-156         | 64156.50C | 4.6061E-08      |   |
| 450 |               |                   |            |          |   | Gd-157         | 64157.50C | 3.5215E-08      |   |
| 451 |               |                   |            |          |   | Gd-158         | 64158.50C | 5.5894E-08      |   |
| 452 |               |                   |            |          |   | Gd-160         | 64160.50C | 4.9189E-08      |   |
| 453 |               |                   |            |          |   |                |           |                 |   |
| 454 |               |                   |            |          |   | Total          |           | 7.0850E-02      |   |
| 455 |               |                   |            |          |   |                |           |                 |   |
| 456 |               |                   |            |          |   | H/U-235        |           | 308.856481      |   |
| 457 |               |                   |            |          |   |                |           |                 |   |
| 458 |               |                   |            |          |   |                |           |                 |   |
| 459 |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |

## Inverse

|     | I             | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|---------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 460 | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 461 | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 462 |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 463 |               |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 464 |               |                   |            |          |   | H              | 1001.50C  | 1.9128E-02      |   |
| 465 |               | O                 | 4.60E+05   | 15.99492 |   | O              | 8016.50C  | 3.5346E-02      |   |
| 466 |               |                   |            |          |   | F              | 9019.50C  | 2.8765E-07      |   |
| 467 |               |                   |            |          |   | Na             | 11023.50C | 1.2214E-05      |   |
| 468 |               |                   |            |          |   | Mg             | 12000.50C | 1.2582E-04      |   |
| 469 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 9.6305E-03      |   |
| 470 |               |                   |            |          |   | Si             | 14000.50C | 3.0264E-03      |   |
| 471 |               |                   |            |          |   | P              | 15031.50C | 8.6294E-07      |   |
| 472 |               |                   |            |          |   | K              | 19000.50C | 2.2453E-04      |   |
| 473 |               |                   |            |          |   | Ca             | 20000.50C | 6.5900E-05      |   |
| 474 |               |                   |            |          |   | Mn             | 25055.50C | 1.2236E-04      |   |
| 475 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.9990E-03      |   |
| 476 |               |                   |            |          |   | Ni             | 28000.50C | 1.0067E-04      |   |
| 477 |               | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.5971E-06      |   |
| 478 |               | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.1933E-05      |   |
| 479 |               | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 6.6523E-07      |   |
| 480 |               |                   |            |          |   | Pu-239         | 94239.55C | 5.0597E-10      |   |
| 481 |               | Gd                | 4.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 3.0002E-10      |   |
| 482 |               |                   |            |          |   | Gd-154         | 64154.50C | 3.2703E-09      |   |
| 483 |               |                   |            |          |   | Gd-155         | 64155.50C | 2.2202E-08      |   |
| 484 |               |                   |            |          |   | Gd-156         | 64156.50C | 3.0708E-08      |   |
| 485 |               |                   |            |          |   | Gd-157         | 64157.50C | 2.3477E-08      |   |
| 486 |               |                   |            |          |   | Gd-158         | 64158.50C | 3.7263E-08      |   |
| 487 |               |                   |            |          |   | Gd-160         | 64160.50C | 3.2793E-08      |   |
| 488 |               |                   |            |          |   |                |           |                 |   |
| 489 |               |                   |            |          |   | Total          |           | 7.0850E-02      |   |
| 490 |               |                   |            |          |   |                |           |                 |   |
| 491 |               |                   |            |          |   | H/U-235        |           | 308.85554       |   |
| 492 |               |                   |            |          |   |                |           |                 |   |
| 493 |               |                   |            |          |   |                |           |                 |   |
| 494 |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 495 | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 496 | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 497 |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 498 |               |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 499 |               |                   |            |          |   | H              | 1001.50C  | 1.9128E-02      |   |
| 500 |               | O                 | 4.60E+05   | 15.99492 |   | O              | 8016.50C  | 3.5347E-02      |   |
| 501 |               |                   |            |          |   | F              | 9019.50C  | 2.8765E-07      |   |
| 502 |               |                   |            |          |   | Na             | 11023.50C | 1.2214E-05      |   |
| 503 |               |                   |            |          |   | Mg             | 12000.50C | 1.2582E-04      |   |
| 504 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 9.6306E-03      |   |
| 505 |               |                   |            |          |   | Si             | 14000.50C | 3.0264E-03      |   |
| 506 |               |                   |            |          |   | P              | 15031.50C | 8.6294E-07      |   |
| 507 |               |                   |            |          |   | K              | 19000.50C | 2.2453E-04      |   |
| 508 |               |                   |            |          |   | Ca             | 20000.50C | 6.5900E-05      |   |
| 509 |               |                   |            |          |   | Mn             | 25055.50C | 1.2236E-04      |   |
| 510 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.9990E-03      |   |

## Inverse

|     | I             | J                 | K          | L        | M | N              | O         | P               | Q |
|-----|---------------|-------------------|------------|----------|---|----------------|-----------|-----------------|---|
| 511 |               |                   |            |          |   | Ni             | 28000.50C | 1.0067E-04      |   |
| 512 |               | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.5971E-06      |   |
| 513 |               | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.1933E-05      |   |
| 514 |               | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 6.6523E-07      |   |
| 515 |               |                   |            |          |   | Pu-239         | 94239.55C | 5.0597E-10      |   |
| 516 |               | Gd                | 2.0000E+01 | 157.25   |   | Gd-152         | 64152.50C | 1.5001E-10      |   |
| 517 |               |                   |            |          |   | Gd-154         | 64154.50C | 1.6351E-09      |   |
| 518 |               |                   |            |          |   | Gd-155         | 64155.50C | 1.1101E-08      |   |
| 519 |               |                   |            |          |   | Gd-156         | 64156.50C | 1.5354E-08      |   |
| 520 |               |                   |            |          |   | Gd-157         | 64157.50C | 1.1738E-08      |   |
| 521 |               |                   |            |          |   | Gd-158         | 64158.50C | 1.8632E-08      |   |
| 522 |               |                   |            |          |   | Gd-160         | 64160.50C | 1.6396E-08      |   |
| 523 |               |                   |            |          |   |                |           |                 |   |
| 524 |               |                   |            |          |   | Total          |           | 7.0850E-02      |   |
| 525 |               |                   |            |          |   |                |           |                 |   |
| 526 |               |                   |            |          |   | H/U-235        |           | 308.8546        |   |
| 527 |               |                   |            |          |   |                |           |                 |   |
| 528 |               |                   |            |          |   |                |           |                 |   |
| 529 |               |                   |            |          |   | Void Frac.     | 0.26      |                 |   |
| 530 | <b>DHLW</b>   |                   |            |          |   |                |           |                 |   |
| 531 | <b>Fe2O3)</b> |                   |            |          |   |                |           |                 |   |
| 532 |               | Degraded MIT Fuel |            |          |   | <b>Mixture</b> |           | (atoms/barn cm) |   |
| 533 |               |                   | Mass(g)    | WT       |   |                |           |                 |   |
| 534 |               |                   |            |          |   | H              | 1001.50C  | 1.9128E-02      |   |
| 535 |               | O                 | 4.60E+05   | 15.99492 |   | O              | 8016.50C  | 3.5347E-02      |   |
| 536 |               |                   |            |          |   | F              | 9019.50C  | 2.8765E-07      |   |
| 537 |               |                   |            |          |   | Na             | 11023.50C | 1.2214E-05      |   |
| 538 |               |                   |            |          |   | Mg             | 12000.50C | 1.2582E-04      |   |
| 539 |               | Al                | 4.14E+05   | 26.98154 |   | Al             | 13027.50C | 9.6306E-03      |   |
| 540 |               |                   |            |          |   | Si             | 14000.50C | 3.0264E-03      |   |
| 541 |               |                   |            |          |   | P              | 15031.50C | 8.6295E-07      |   |
| 542 |               |                   |            |          |   | K              | 19000.50C | 2.2453E-04      |   |
| 543 |               |                   |            |          |   | Ca             | 20000.50C | 6.5900E-05      |   |
| 544 |               |                   |            |          |   | Mn             | 25055.50C | 1.2236E-04      |   |
| 545 |               | Fe                | 2.06E+05   | 55.847   |   | Fe             | 26000.55C | 2.9990E-03      |   |
| 546 |               |                   |            |          |   | Ni             | 28000.50C | 1.0067E-04      |   |
| 547 |               | U-238             | 1452       | 238.0508 |   | U-238          | 92238.50C | 3.5971E-06      |   |
| 548 |               | U-235             | 24684      | 235.0439 |   | U-235          | 92235.50C | 6.1934E-05      |   |
| 549 |               | U-234             | 264        | 234.0409 |   | U-234          | 92234.50C | 6.6523E-07      |   |
| 550 |               |                   |            |          |   | Pu-239         | 94239.55C | 5.0597E-10      |   |
| 551 |               | Gd                | 0.0000E+00 | 157.25   |   | Gd-152         | 64152.50C | 0.0000E+00      |   |
| 552 |               |                   |            |          |   | Gd-154         | 64154.50C | 0.0000E+00      |   |
| 553 |               |                   |            |          |   | Gd-155         | 64155.50C | 0.0000E+00      |   |
| 554 |               |                   |            |          |   | Gd-156         | 64156.50C | 0.0000E+00      |   |
| 555 |               |                   |            |          |   | Gd-157         | 64157.50C | 0.0000E+00      |   |
| 556 |               |                   |            |          |   | Gd-158         | 64158.50C | 0.0000E+00      |   |
| 557 |               |                   |            |          |   | Gd-160         | 64160.50C | 0.0000E+00      |   |
| 558 |               |                   |            |          |   |                |           |                 |   |
| 559 |               |                   |            |          |   | Total          |           | 7.0850E-02      |   |
| 560 |               |                   |            |          |   |                |           |                 |   |
| 561 |               |                   |            |          |   | H/U-235        |           | 308.853659      |   |

|    | R           | S         | T               | U |
|----|-------------|-----------|-----------------|---|
| 1  |             |           |                 |   |
| 2  |             |           |                 |   |
| 3  |             |           |                 |   |
| 4  |             |           |                 |   |
| 5  |             |           |                 |   |
| 6  |             |           |                 |   |
| 7  | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 8  |             |           |                 |   |
| 9  | H           | 1001.50C  | 2.0782E-02      |   |
| 10 | O           | 8016.50C  | 2.3501E-02      |   |
| 11 | F           | 9019.50C  | 4.2828E-07      |   |
| 12 | Na          | 11023.50C | 1.8185E-05      |   |
| 13 | Mg          | 12000.50C | 1.8733E-04      |   |
| 14 | Al          | 13027.50C | 8.5998E-04      |   |
| 15 | Si          | 14000.50C | 4.5060E-03      |   |
| 16 | P           | 15031.50C | 1.2848E-06      |   |
| 17 | K           | 19000.50C | 3.3430E-04      |   |
| 18 | Ca          | 20000.50C | 9.8118E-05      |   |
| 19 | Mn          | 25055.50C | 1.8218E-04      |   |
| 20 | Fe          | 26000.55C | 1.2197E-03      |   |
| 21 | Ni          | 28000.50C | 1.4988E-04      |   |
| 22 |             |           |                 |   |
| 23 |             |           |                 |   |
| 24 |             |           |                 |   |
| 25 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 26 | Total       |           | 5.1840E-02      |   |
| 27 |             |           |                 |   |
| 28 |             |           |                 |   |
| 29 |             |           |                 |   |
| 30 |             |           |                 |   |
| 31 |             |           |                 |   |
| 32 |             |           |                 |   |
| 33 |             |           |                 |   |
| 34 |             |           |                 |   |
| 35 |             |           |                 |   |
| 36 |             |           |                 |   |
| 37 |             |           |                 |   |
| 38 |             |           |                 |   |
| 39 |             |           |                 |   |
| 40 |             |           |                 |   |
| 41 |             |           |                 |   |
| 42 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 43 |             |           |                 |   |
| 44 | H           | 1001.50C  | 2.0782E-02      |   |
| 45 | O           | 8016.50C  | 2.3501E-02      |   |
| 46 | F           | 9019.50C  | 4.2828E-07      |   |
| 47 | Na          | 11023.50C | 1.8185E-05      |   |
| 48 | Mg          | 12000.50C | 1.8733E-04      |   |
| 49 | Al          | 13027.50C | 8.5998E-04      |   |
| 50 | Si          | 14000.50C | 4.5060E-03      |   |
| 51 | P           | 15031.50C | 1.2848E-06      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 52  | K           | 19000.50C | 3.3430E-04      |   |
| 53  | Ca          | 20000.50C | 9.8118E-05      |   |
| 54  | Mn          | 25055.50C | 1.8218E-04      |   |
| 55  | Fe          | 26000.55C | 1.2197E-03      |   |
| 56  | Ni          | 28000.50C | 1.4988E-04      |   |
| 57  |             |           |                 |   |
| 58  |             |           |                 |   |
| 59  |             |           |                 |   |
| 60  | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 61  | Total       |           | 5.1840E-02      |   |
| 62  |             |           |                 |   |
| 63  |             |           |                 |   |
| 64  |             |           |                 |   |
| 65  |             |           |                 |   |
| 66  |             |           |                 |   |
| 67  |             |           |                 |   |
| 68  |             |           |                 |   |
| 69  |             |           |                 |   |
| 70  |             |           |                 |   |
| 71  |             |           |                 |   |
| 72  |             |           |                 |   |
| 73  |             |           |                 |   |
| 74  |             |           |                 |   |
| 75  |             |           |                 |   |
| 76  |             |           |                 |   |
| 77  | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 78  |             |           |                 |   |
| 79  | H           | 1001.50C  | 2.0782E-02      |   |
| 80  | O           | 8016.50C  | 2.3501E-02      |   |
| 81  | F           | 9019.50C  | 4.2828E-07      |   |
| 82  | Na          | 11023.50C | 1.8185E-05      |   |
| 83  | Mg          | 12000.50C | 1.8733E-04      |   |
| 84  | Al          | 13027.50C | 8.5998E-04      |   |
| 85  | Si          | 14000.50C | 4.5060E-03      |   |
| 86  | P           | 15031.50C | 1.2848E-06      |   |
| 87  | K           | 19000.50C | 3.3430E-04      |   |
| 88  | Ca          | 20000.50C | 9.8118E-05      |   |
| 89  | Mn          | 25055.50C | 1.8218E-04      |   |
| 90  | Fe          | 26000.55C | 1.2197E-03      |   |
| 91  | Ni          | 28000.50C | 1.4988E-04      |   |
| 92  |             |           |                 |   |
| 93  |             |           |                 |   |
| 94  |             |           |                 |   |
| 95  | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 96  | Total       |           | 5.1840E-02      |   |
| 97  |             |           |                 |   |
| 98  |             |           |                 |   |
| 99  |             |           |                 |   |
| 100 |             |           |                 |   |
| 101 |             |           |                 |   |
| 102 |             |           |                 |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 103 |             |           |                 |   |
| 104 |             |           |                 |   |
| 105 |             |           |                 |   |
| 106 |             |           |                 |   |
| 107 |             |           |                 |   |
| 108 |             |           |                 |   |
| 109 |             |           |                 |   |
| 110 |             |           |                 |   |
| 111 |             |           |                 |   |
| 112 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 113 |             |           |                 |   |
| 114 | H           | 1001.50C  | 2.0782E-02      |   |
| 115 | O           | 8016.50C  | 2.3501E-02      |   |
| 116 | F           | 9019.50C  | 4.2828E-07      |   |
| 117 | Na          | 11023.50C | 1.8185E-05      |   |
| 118 | Mg          | 12000.50C | 1.8733E-04      |   |
| 119 | Al          | 13027.50C | 8.5998E-04      |   |
| 120 | Si          | 14000.50C | 4.5060E-03      |   |
| 121 | P           | 15031.50C | 1.2848E-06      |   |
| 122 | K           | 19000.50C | 3.3430E-04      |   |
| 123 | Ca          | 20000.50C | 9.8118E-05      |   |
| 124 | Mn          | 25055.50C | 1.8218E-04      |   |
| 125 | Fe          | 26000.55C | 1.2197E-03      |   |
| 126 | Ni          | 28000.50C | 1.4988E-04      |   |
| 127 |             |           |                 |   |
| 128 |             |           |                 |   |
| 129 |             |           |                 |   |
| 130 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 131 | Total       |           | 5.1840E-02      |   |
| 132 |             |           |                 |   |
| 133 |             |           |                 |   |
| 134 |             |           |                 |   |
| 135 |             |           |                 |   |
| 136 |             |           |                 |   |
| 137 |             |           |                 |   |
| 138 |             |           |                 |   |
| 139 |             |           |                 |   |
| 140 |             |           |                 |   |
| 141 |             |           |                 |   |
| 142 |             |           |                 |   |
| 143 |             |           |                 |   |
| 144 |             |           |                 |   |
| 145 |             |           |                 |   |
| 146 |             |           |                 |   |
| 147 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 148 |             |           |                 |   |
| 149 | H           | 1001.50C  | 2.0782E-02      |   |
| 150 | O           | 8016.50C  | 2.3501E-02      |   |
| 151 | F           | 9019.50C  | 4.2828E-07      |   |
| 152 | Na          | 11023.50C | 1.8185E-05      |   |
| 153 | Mg          | 12000.50C | 1.8733E-04      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 154 | Al          | 13027.50C | 8.5998E-04      |   |
| 155 | Si          | 14000.50C | 4.5060E-03      |   |
| 156 | P           | 15031.50C | 1.2848E-06      |   |
| 157 | K           | 19000.50C | 3.3430E-04      |   |
| 158 | Ca          | 20000.50C | 9.8118E-05      |   |
| 159 | Mn          | 25055.50C | 1.8218E-04      |   |
| 160 | Fe          | 26000.55C | 1.2197E-03      |   |
| 161 | Ni          | 28000.50C | 1.4988E-04      |   |
| 162 |             |           |                 |   |
| 163 |             |           |                 |   |
| 164 |             |           |                 |   |
| 165 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 166 | Total       |           | 5.1840E-02      |   |
| 167 |             |           |                 |   |
| 168 |             |           |                 |   |
| 169 |             |           |                 |   |
| 170 |             |           |                 |   |
| 171 |             |           |                 |   |
| 172 |             |           |                 |   |
| 173 |             |           |                 |   |
| 174 |             |           |                 |   |
| 175 |             |           |                 |   |
| 176 |             |           |                 |   |
| 177 |             |           |                 |   |
| 178 |             |           |                 |   |
| 179 |             |           |                 |   |
| 180 |             |           |                 |   |
| 181 |             |           |                 |   |
| 182 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 183 |             |           |                 |   |
| 184 | H           | 1001.50C  | 2.0782E-02      |   |
| 185 | O           | 8016.50C  | 2.3501E-02      |   |
| 186 | F           | 9019.50C  | 4.2828E-07      |   |
| 187 | Na          | 11023.50C | 1.8185E-05      |   |
| 188 | Mg          | 12000.50C | 1.8733E-04      |   |
| 189 | Al          | 13027.50C | 8.5998E-04      |   |
| 190 | Si          | 14000.50C | 4.5060E-03      |   |
| 191 | P           | 15031.50C | 1.2848E-06      |   |
| 192 | K           | 19000.50C | 3.3430E-04      |   |
| 193 | Ca          | 20000.50C | 9.8118E-05      |   |
| 194 | Mn          | 25055.50C | 1.8218E-04      |   |
| 195 | Fe          | 26000.55C | 1.2197E-03      |   |
| 196 | Ni          | 28000.50C | 1.4988E-04      |   |
| 197 |             |           |                 |   |
| 198 |             |           |                 |   |
| 199 |             |           |                 |   |
| 200 | Pu-239      | 94239.55C | 7.5334E-10      |   |
| 201 | Total       |           | 5.1840E-02      |   |
| 202 |             |           |                 |   |
| 203 |             |           |                 |   |
| 204 |             |           |                 |   |



## Inverse

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 205 |             |           |                 |   |
| 206 |             |           |                 |   |
| 207 |             |           |                 |   |
| 208 |             |           |                 |   |
| 209 |             |           |                 |   |
| 210 |             |           |                 |   |
| 211 |             |           |                 |   |
| 212 |             |           |                 |   |
| 213 |             |           |                 |   |
| 214 |             |           |                 |   |
| 215 |             |           |                 |   |
| 216 |             |           |                 |   |
| 217 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 218 |             |           |                 |   |
| 219 | H           | 1001.50C  | 2.0022E-02      |   |
| 220 | O           | 8016.50C  | 2.3337E-02      |   |
| 221 | F           | 9019.50C  | 4.3534E-07      |   |
| 222 | Na          | 11023.50C | 1.8485E-05      |   |
| 223 | Mg          | 12000.50C | 1.9042E-04      |   |
| 224 | Al          | 13027.50C | 8.7415E-04      |   |
| 225 | Si          | 14000.50C | 4.5802E-03      |   |
| 226 | P           | 15031.50C | 1.3060E-06      |   |
| 227 | K           | 19000.50C | 3.3981E-04      |   |
| 228 | Ca          | 20000.50C | 9.9735E-05      |   |
| 229 | Mn          | 25055.50C | 1.8519E-04      |   |
| 230 | Fe          | 26000.55C | 1.2398E-03      |   |
| 231 | Ni          | 28000.50C | 1.5235E-04      |   |
| 232 |             |           |                 |   |
| 233 |             |           |                 |   |
| 234 |             |           |                 |   |
| 235 | Pu-239      | 94239.55C | 7.6576E-10      |   |
| 236 | Total       |           | 5.1041E-02      |   |
| 237 |             |           |                 |   |
| 238 |             |           |                 |   |
| 239 |             |           |                 |   |
| 240 |             |           |                 |   |
| 241 |             |           |                 |   |
| 242 |             |           |                 |   |
| 243 |             |           |                 |   |
| 244 |             |           |                 |   |
| 245 |             |           |                 |   |
| 246 |             |           |                 |   |
| 247 |             |           |                 |   |
| 248 |             |           |                 |   |
| 249 |             |           |                 |   |
| 250 |             |           |                 |   |
| 251 |             |           |                 |   |
| 252 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 253 |             |           |                 |   |
| 254 | H           | 1001.50C  | 2.0022E-02      |   |
| 255 | O           | 8016.50C  | 2.3337E-02      |   |

|     | R           | S         | T               | U |
|-----|-------------|-----------|-----------------|---|
| 256 | F           | 9019.50C  | 4.3534E-07      |   |
| 257 | Na          | 11023.50C | 1.8485E-05      |   |
| 258 | Mg          | 12000.50C | 1.9042E-04      |   |
| 259 | Al          | 13027.50C | 8.7415E-04      |   |
| 260 | Si          | 14000.50C | 4.5802E-03      |   |
| 261 | P           | 15031.50C | 1.3060E-06      |   |
| 262 | K           | 19000.50C | 3.3981E-04      |   |
| 263 | Ca          | 20000.50C | 9.9735E-05      |   |
| 264 | Mn          | 25055.50C | 1.8519E-04      |   |
| 265 | Fe          | 26000.55C | 1.2398E-03      |   |
| 266 | Ni          | 28000.50C | 1.5235E-04      |   |
| 267 |             |           |                 |   |
| 268 |             |           |                 |   |
| 269 |             |           |                 |   |
| 270 | Pu-239      | 94239.55C | 7.6576E-10      |   |
| 271 | Total       |           | 5.1041E-02      |   |
| 272 |             |           |                 |   |
| 273 |             |           |                 |   |
| 274 |             |           |                 |   |
| 275 |             |           |                 |   |
| 276 |             |           |                 |   |
| 277 |             |           |                 |   |
| 278 |             |           |                 |   |
| 279 |             |           |                 |   |
| 280 |             |           |                 |   |
| 281 |             |           |                 |   |
| 282 |             |           |                 |   |
| 283 |             |           |                 |   |
| 284 |             |           |                 |   |
| 285 |             |           |                 |   |
| 286 |             |           |                 |   |
| 287 | <b>DHLW</b> |           | (atoms/barn cm) |   |
| 288 |             |           |                 |   |
| 289 | H           | 1001.50C  | 2.0022E-02      |   |
| 290 | O           | 8016.50C  | 2.3337E-02      |   |
| 291 | F           | 9019.50C  | 4.3534E-07      |   |
| 292 | Na          | 11023.50C | 1.8485E-05      |   |
| 293 | Mg          | 12000.50C | 1.9042E-04      |   |
| 294 | Al          | 13027.50C | 8.7415E-04      |   |
| 295 | Si          | 14000.50C | 4.5802E-03      |   |
| 296 | P           | 15031.50C | 1.3060E-06      |   |
| 297 | K           | 19000.50C | 3.3981E-04      |   |
| 298 | Ca          | 20000.50C | 9.9735E-05      |   |
| 299 | Mn          | 25055.50C | 1.8519E-04      |   |
| 300 | Fe          | 26000.55C | 1.2398E-03      |   |
| 301 | Ni          | 28000.50C | 1.5235E-04      |   |
| 302 |             |           |                 |   |
| 303 |             |           |                 |   |
| 304 |             |           |                 |   |
| 305 | Pu-239      | 94239.55C | 7.6576E-10      |   |
| 306 | Total       |           | 5.1041E-02      |   |