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Design Analysis Cover Sheet

Complete only applicable items.

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11. REMARKS

TBV-228 used in this analysis.

Initial Issue

Editorial Change Block 6
See Ref. 5.30 for Electronic Files.
Note Row and Column Headings when reviewing hardcopy of spreadsheet files in Att. II. Electronic copies of spreadsheets are also available from Ref. 5.30. [initials] 2/10/98

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4. Revision No.	5. Description of Revision
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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_{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 ^{235}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_x 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 ±0.003 inches and a fin height of 0.010 ±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 ±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 ^{235}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^3 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^3 (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

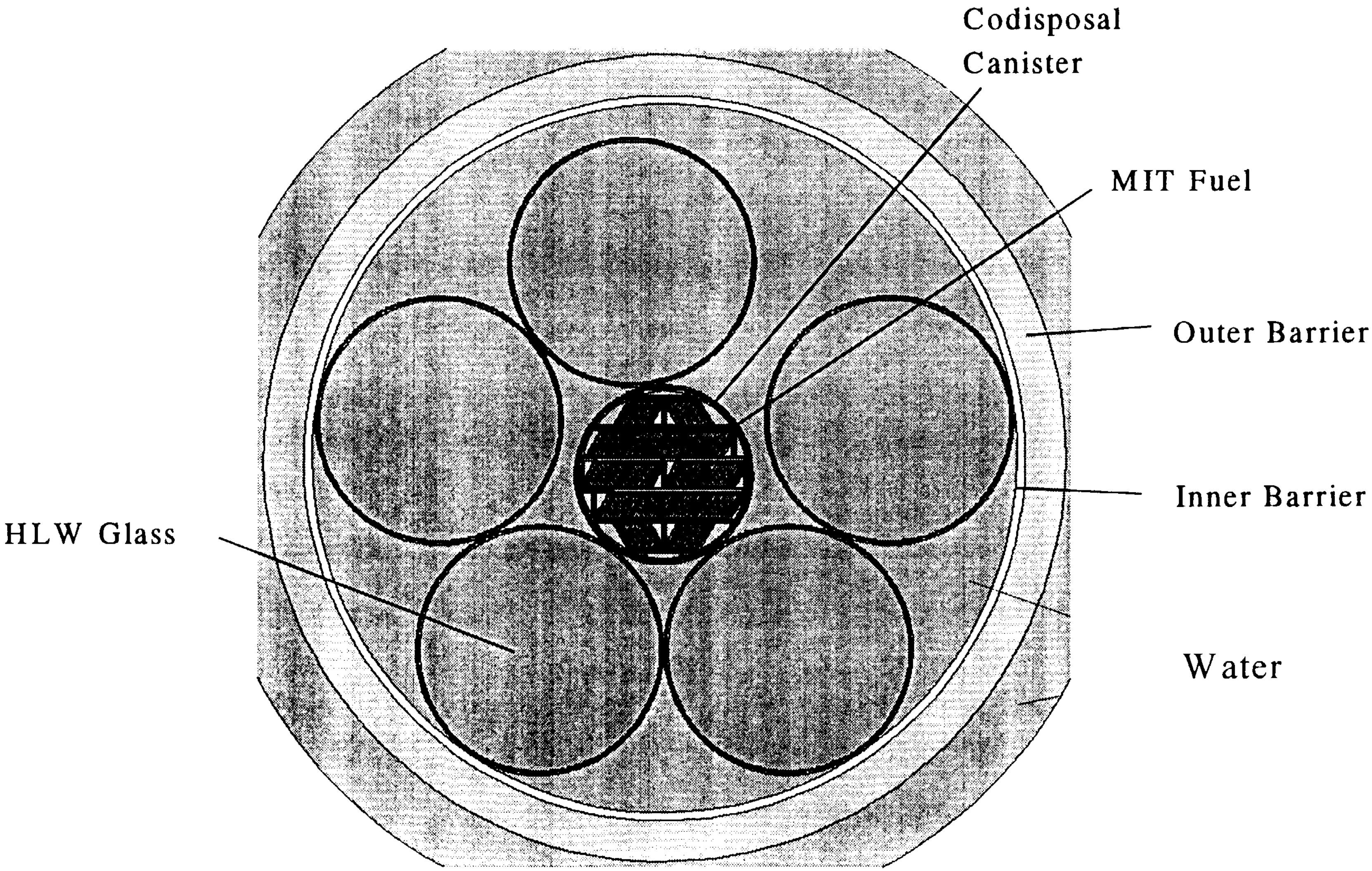

Figure 4.1.5-1. Five-HLW Waste Package with Codisposal Canister

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 ≈30 μm^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 EBDRD 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 UO_2 and Al_2O_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 $\{(UO_2)_2(SiO_4):2H_2O\}$ 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_{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

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.

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$^{\epsilon 1}$, 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_{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_{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_{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 ≈30 μm^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 $\{(UO_2)_2(SiO_4):2H_2O\}$ 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_{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).

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

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_{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_{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_{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_{eff} limit of 0.93 for the degraded DOE-SNF configurations.

Concentrations of ^{235}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 $H/^{235}U$ ratio and the average energy of the neutron causing fission (AENCF). The $H/^{235}U$ ratio is simply the number density for hydrogen divided by that for ^{235}U in the region containing ^{235}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 $H/^{235}U$ 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.

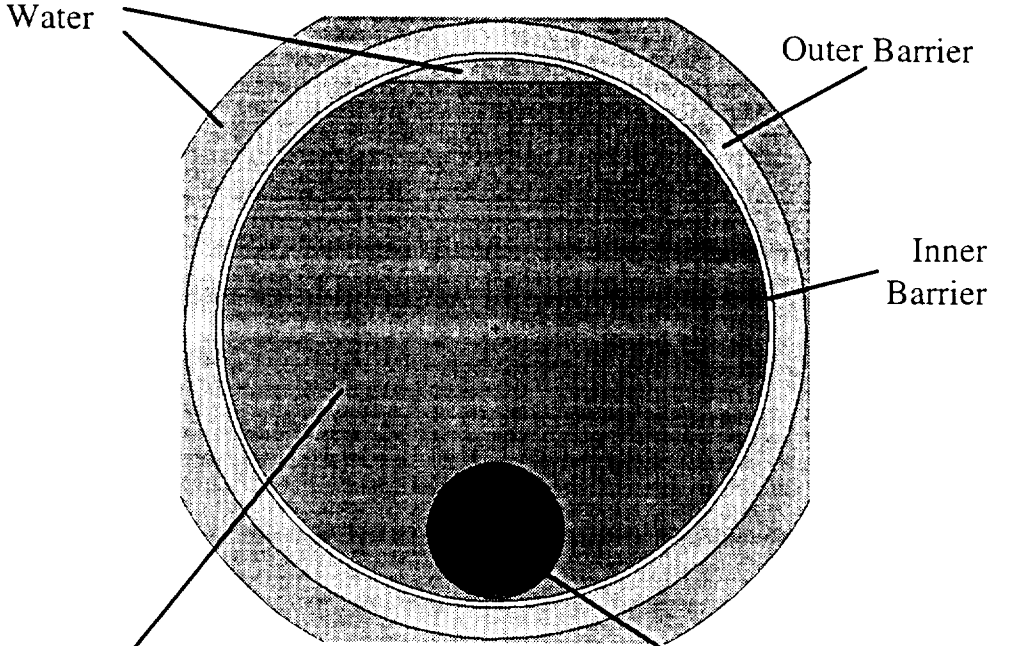

Figure 7.2.1-1. Homogeneous Mixture of Degraded DOE-SNF in DOE-SNF Canister

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.

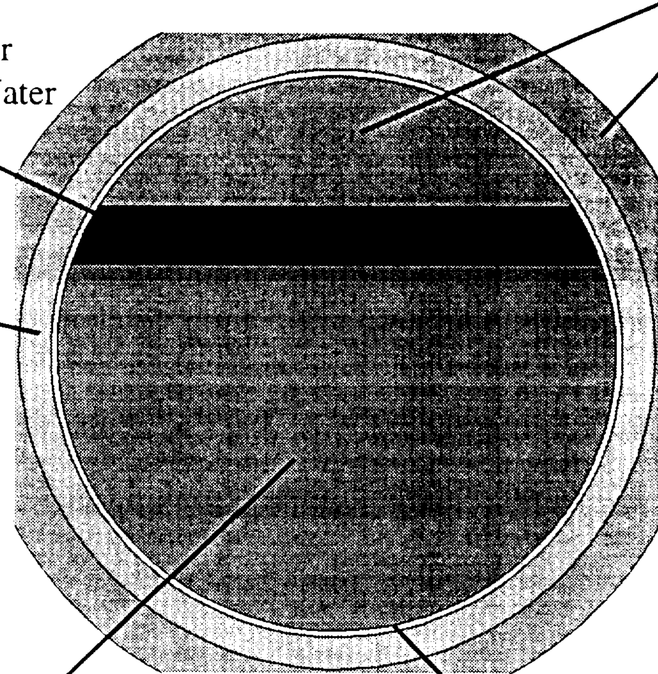

Figure 7.2.2-1.Degraded DOE-SNF on Top of Degraded HLW Glass Clay

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.

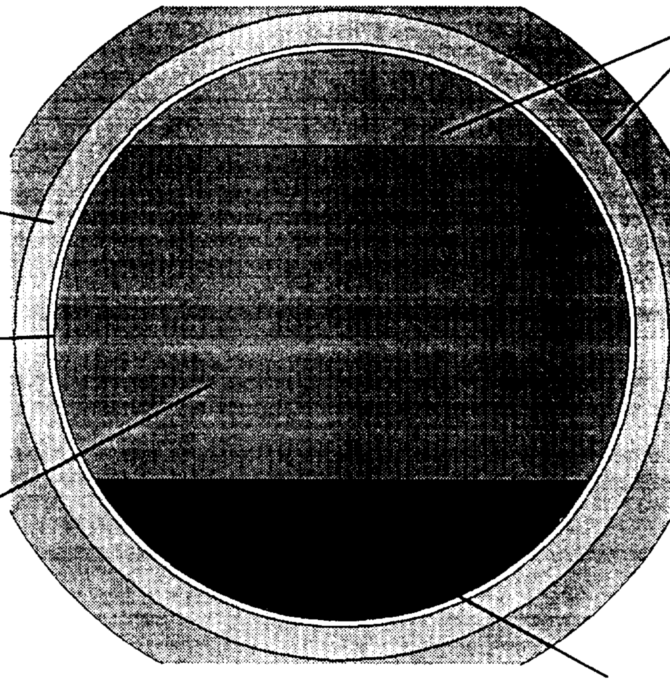

Figure 7.2.3-1. Degraded DOE-SNF Mixed with HLW Glass Clay at Bottom of WP

7.3 Criticality Results

Criticality calculations based on the waste package models described in Section 7.2 are presented in this section. The k_{eff} value and two sigma (approximate 95% confidence interval) are listed for each MCNP calculation. In addition, two spectrum indexes, namely the AENCF and $H/^{235}U$, 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 Fe_2O_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)	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
mitoz3g	0.25	113	0.0210	0.9763 ± 0.0027
mitoz4g	0.50	113	0.0217	0.9458 ± 0.0032
mitoz2g	0.75	113	0.0220	0.9294 ± 0.0027
mitoz5g	1.00	113	0.0221	0.9195 ± 0.0030
mitoz6g	1.50	113	0.0231	0.9020 ± 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_{eff} of 0.9187 ± 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_{eff} of 0.8148 ± 0.0034 (mitbzg1). The case with borated stainless steel (mitbz3, Ref. 5.16) has a value of k_{eff} of 0.8101 ± 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_{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	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
mitoz8g	A516 Absorber Plates, 1.5 kg Gd	113	0.0226	0.9062 ± 0.0031
mitoz9g	A516 replacing all stainless steel in basket, 1.5 kg Gd	113	0.0230	0.9126 ± 0.0029
mitozyg	A516 replacing all stainless steel in basket, 1.25 kg Gd	113	0.0226	0.9216 ± 0.0029
mitozxg	A516 replacing all stainless steel in basket, 1.0 kg Gd	113	0.0219	0.9317 ± 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_2O_3) 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_2O_3), 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)	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
mithom7	1 cm thick degraded canister shell	190	0.0157	0.8982 ± 0.0024
mithom8	80% Fill of the Canister - Total mass of components maintained	132	0.0198	0.8825 ± 0.0025
mithom9	DOE-SNF Canister Centered in Waste Package	190	0.0158	0.8948 ± 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, ≈68 vol% was the 78% degraded fuel/14% integrated basket mixture, and the remaining ≈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 ≈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 $H/^{235}U$	Top Layer $H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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_{eff} 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 ($k_{eff} < 0.93$) as is.

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

Case Name	Water Fraction	y_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)	$H/^{235}U$	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_{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)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_2O_3) gives slightly higher k_{eff} with 83% water content (k_{eff} = 0.8617±0.0021 as opposed to k_{eff} = 0.8566±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_2O_3, 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_{eff} corresponding to various Gd loadings assuming half of the steel (295 kg of Fe_2O_3) 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_2O_3 in Top Layer)

Case Name	Mass of Gd (kg)	y_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
m75t070	0.70	27.4765	41.3598	490	0.0051	0.9973 ± 0.0027
m75t075	0.75	27.4765	44.2344	630	0.0042	1.0361 ± 0.0023
m75t080	0.80	27.4765	48.7462	840	0.0035	1.0522 ± 0.0020
m75t085	0.85	27.4765	56.7528	1190	0.0029	1.0332 ± 0.0020
m75t090	0.90	27.4765	77.0610	1890	0.0021	0.9349 ± 0.0013

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
m75tg12	0.12	27.4765	48.7478	840	0.0044	0.8342 ± 0.0021
m75tg10	0.10	27.4765	48.7476	840	0.0043	0.8641 ± 0.0021
m75tg08	0.08	27.4765	48.7474	840	0.0040	0.8961 ± 0.0023
m75tg06	0.06	27.4765	48.7470	840	0.0040	0.9275 ± 0.0021
m75tg04	0.04	27.4765	48.7466	840	0.0038	0.9679 ± 0.0020
m75tg02	0.02	27.4765	48.7464	840	0.0036	1.0086 ± 0.0020

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_2O_3 in Top Layer, 75% Uranium Loading)

Case Name	Mass of Gd (kg)	y_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_{eff} 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_2O_3 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_1 (cm)[1]	y_2 (cm)[2]	H/^{235}U	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_1 (cm)[1]	y_2 (cm)[2]	H/^{235}U	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_1 (cm)[1]	y_2 (cm)[2]	H/^{235}U	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	$H/^{235}U$	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

[1] 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_2O_3. These cases were run to provide an indication of the margin for the likely configuration. The presence of the Gd or Fe_2O_3 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] Distance from the waste package centerline to the top of the top layer.

The addition of Fe_2O_3 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_{eff} corresponding to various Gd loadings assuming half of the steel (295.105 kg of Fe_2O_3) 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_2O_3 in the Mixture, 0.26 Water Fraction)

Case Name	Gd Mass (kg)	y_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_{eff}) 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_2O_3) 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_{eff} of 0.9265 ± 0.0022, AENCF of 0.0074, and $H/^{235}U$ of 320 (mtxf6g0). As Fe_2O_3 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 ^{235}U is only a function of mixture volume. Therefore, as mixture volume increases total number of H decreases slower than total number of ^{235}U, which results in higher $H/^{235}U$ 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 mtxf6g0 is adjusted so that $H/^{235}U$ is the same as case mitxfg0, then the new k_{eff} 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_2O_3 in the Mixture, 0.26 Water Fraction)

Case Name	Gd Mass (kg)	y_1(cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_{eff} 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_{eff} 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_{eff} 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] Distance from the waste package centerline to the top of the top layer.

Table 7.3.1.3-14 lists the waste package k_{eff} 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_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_2O_3) 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_2O_3, 75% Uranium Loading)

Case Name	Mass of Gd (kg)	y_1 (cm)[1]	y_2 (cm)[2]	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$
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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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_{eff} 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)[1]	y_2 (cm)[2]	$H/^{235}U$	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

[1] Distance from the waste package centerline to the top of the bottom layer.
[2] 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 ($[UO_2]_2[SiO_4]{:}2H_2O$), Al_2O_3, 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_{eff} in this degraded configuration is 0.8861±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_{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_{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_{eff} in this degraded configuration is 0.8390±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_2O_3 Remaining from Basket (kg)	Mass of Gd (kg)	Water Fraction	$H/^{235}U$	AENCF (MeV)	$k_{eff} \pm 2\sigma$	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

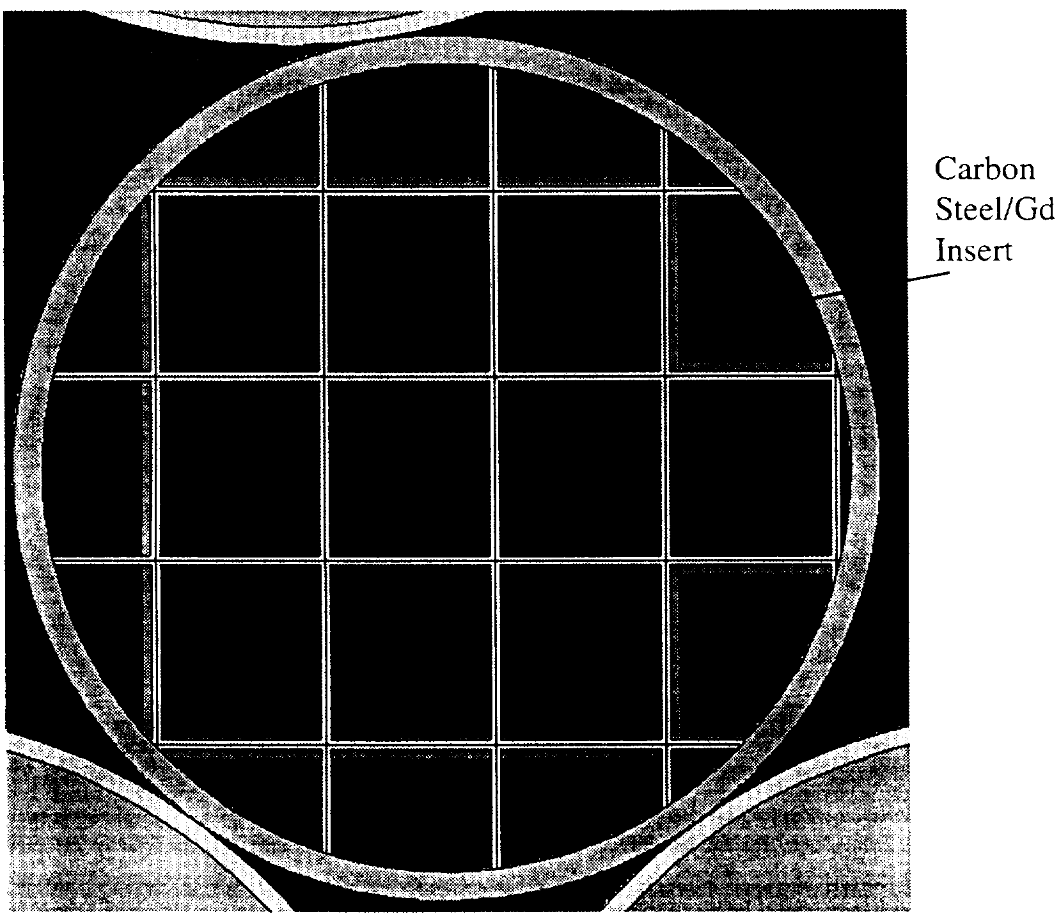

Figure 7.3.2.1-1. Conceptual ORR Basket with Carbon Steel/Gd Inserts

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 Fe_2O_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_{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)	$H/^{235}U$ Ratio	AENCF (MeV)	$k_{eff} \pm 2\sigma$	Case Name
0.6	27.4765	31.8017	250.7	0.02099	0.5770 ± 0.0025	orr060
0.7	27.4765	33.2633	384.7	0.01616	0.6564 ± 0.0022	orr070
0.75	27.4765	34.4407	491.8	0.01383	0.7004 ± 0.0022	orr075
0.8	27.4765	36.2211	652.5	0.01079	0.7526 ± 0.0025	orr080
0.85	27.4765	39.2313	920.4	0.00841	0.8018 ± 0.0020	orr085
0.9	27.4765	45.4458	1456.1	0.00622	0.8172 ± 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 Fe_2O_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_{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)	$H/^{235}U$ Ratio	AENCF (MeV)	$k_{eff} \pm 2\sigma$	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_{eff} 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)	$H/^{235}U$ Ratio	AENCF (MeV)	$k_{eff} \pm 2\sigma$	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 ≈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® 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
```

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	orrh00.O
ORRH10	O	204,792	10-24-97	9:33a	orrh10.O
ORRH15	O	204,977	10-24-97	9:33a	orrh15.O
ORRH20	O	205,040	10-24-97	9:33a	orrh20.O
ORRH25	O	205,281	10-24-97	9:33a	orrh25.O
ORRH29	O	204,239	10-24-97	9:33a	orrh29.O
ORRHOM1	O	228,989	10-24-97	9:33a	orrhom1.O
ORRHOM2	O	229,086	10-24-97	9:33a	orrhom2.O
ORRHOM3	O	227,922	10-24-97	9:33a	orrhom3.O
ORRHOM4	O	232,746	10-24-97	9:33a	orrhom4.O
ORRHOM5	O	231,390	10-24-97	9:33a	orrhom5.O
ORROZ4A	O	289,601	10-24-97	9:33a	orroz4a.O
M50B000O		206,593	10-24-97	9:37a	m50b000o
M50B005O		210,358	10-24-97	9:37a	m50b005o
M50B010O		210,697	10-24-97	9:37a	m50b010o
M50B015O		210,156	10-24-97	9:37a	m50b015o
M50B020O		210,219	10-24-97	9:37a	m50b020o
M50B025O		210,404	10-24-97	9:37a	m50b025o
M50T070O		205,051	10-24-97	9:37a	m50t070o
M50T075O		205,292	10-24-97	9:37a	m50t075o
M50T080O		205,968	10-24-97	9:37a	m50t080o
M50T085O		205,952	10-24-97	9:37a	m50t085o
M50T090O		207,282	10-24-97	9:37a	m50t090o
M75B000O		206,418	10-24-97	9:37a	m75b000o
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M75BF06O		212,828	10-24-97	9:37a	m75bf06o
M75BF08O		213,797	10-24-97	9:37a	m75bf08o
M75BG00O		209,351	10-24-97	9:37a	m75bg00o
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M75BG04O		214,156	10-24-97	9:37a	m75bg04o
M75BG06O		213,706	10-24-97	9:37a	m75bg06o
M75BG08O		213,635	10-24-97	9:37a	m75bg08o
M75T070O		205,827	10-24-97	9:37a	m75t070o
M75T075O		205,834	10-24-97	9:37a	m75t075o
M75T080O		205,984	10-24-97	9:38a	m75t080o
M75T085O		205,047	10-24-97	9:38a	m75t085o

M75T090O	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
M75TF080	210,094	10-24-97	9:38a	m75tf08o
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M75TG040	210,509	10-24-97	9:38a	m75tg04o
M75TG060	209,484	10-24-97	9:38a	m75tg06o
M75TG080	210,789	10-24-97	9:38a	m75tg08o
M75TG100	210,701	10-24-97	9:38a	m75tg10o
M75TG120	209,491	10-24-97	9:38a	m75tg12o
MIT060O	205,501	10-24-97	9:38a	mit060o
MIT070O	205,158	10-24-97	9:38a	mit070o
MIT075O	205,246	10-24-97	9:38a	mit075o
MIT080O	205,183	10-24-97	9:38a	mit080o
MIT085O	205,984	10-24-97	9:38a	mit085o
MIT090O	205,896	10-24-97	9:38a	mit090o
MITB115O	208,945	10-24-97	9:38a	mitb115o
MITB120O	208,945	10-24-97	9:38a	mitb120o
MITB125O	210,236	10-24-97	9:38a	mitb125o
MITB127O	210,016	10-24-97	9:38a	mitb127o
MITB215O	209,963	10-24-97	9:38a	mitb215o
MITB220O	210,156	10-24-97	9:38a	mitb220o
MITB225O	210,306	10-24-97	9:38a	mitb225o
MITB315O	209,373	10-24-97	9:38a	mitb315o
MITB320O	210,368	10-24-97	9:38a	mitb320o
MITB325O	209,152	10-24-97	9:38a	mitb325o
MITB415O	206,115	10-24-97	9:38a	mitb415o
MITB420O	206,114	10-24-97	9:38a	mitb420o
MITB425O	206,178	10-24-97	9:38a	mitb425o
MITB515O	208,858	10-24-97	9:38a	mitb515o
MITB520O	208,945	10-24-97	9:38a	mitb520o
MITB525O	208,833	10-24-97	9:38a	mitb525o
MITB615O	208,858	10-24-97	9:38a	mitb615o
MITB620O	210,243	10-24-97	9:38a	mitb620o
MITB625O	207,952	10-24-97	9:38a	mitb625o
MITB627O	208,841	10-24-97	9:38a	mitb627o
MITB715O	208,945	10-24-97	9:38a	mitb715o
MITB720O	208,857	10-24-97	9:38a	mitb720o
MITB725O	207,952	10-24-97	9:38a	mitb725o
MITFE12O	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
MITFE85O	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
MITFG00O	210,338	10-24-97	9:38a	mitfg00o
MITFG02O	213,540	10-24-97	9:38a	mitfg02o
MITGD02O	213,619	10-24-97	9:38a	mitgd02o
MITGD05O	212,666	10-24-97	9:38a	mitgd05o
MITGD1O	213,722	10-24-97	9:38a	mitgd1o
MITGD2O	213,722	10-24-97	9:38a	mitgd2o
MITH00O	205,303	10-24-97	9:38a	mith00o
MITH01O	205,366	10-24-97	9:38a	mith01o

MITH025O	205,596	10-24-97	9:38a	mith025o
MITH02O	204,408	10-24-97	9:38a	mith02o
MITS100O	207,222	10-24-97	9:38a	mits100o
MITS200O	208,068	10-24-97	9:38a	mits200o
MITS25O	207,688	10-24-97	9:38a	mits25o
MITS30O	206,632	10-24-97	9:38a	mits30o
MITS36O	208,558	10-24-97	9:38a	mits36o
MITS50O	208,471	10-24-97	9:38a	mits50o
MITS74O	208,208	10-24-97	9:38a	mits74o
MITT02O	209,404	10-24-97	9:38a	mitt02o
MITT05O	209,403	10-24-97	9:38a	mitt05o
MITT10O	209,491	10-24-97	9:38a	mitt10o
MITT20O	209,491	10-24-97	9:38a	mitt20o
MITTF02O	211,037	10-24-97	9:38a	mittf02o
MITTF05O	209,334	10-24-97	9:38a	mittf05o
MITTF10O	209,636	10-24-97	9:38a	mittf10o
MITTF20O	209,739	10-24-97	9:38a	mittf20o
MITBZGDO	454,502	10-24-97	9:45a	mitbzgdO
MITOZ4GO	444,008	10-24-97	9:45a	mitoz4gO
MITOZ5GO	443,938	10-24-97	9:45a	mitoz5gO
MITOZ6GO	443,841	10-24-97	9:45a	mitoz6gO
MITOZ3GO	443,158	10-24-97	9:45a	mitoz3gO
MITOZ8GO	438,999	10-24-97	9:46a	mitoz8gO
MITOZ9GO	423,012	10-24-97	9:46a	mitoz9gO
MITHOM8O	232,865	10-24-97	9:46a	mithom8O
MITHOM4O	232,804	10-24-97	9:46a	mithom4O
MITHOMFO	232,416	10-24-97	9:46a	mithomfO
MITHOM3O	232,162	10-24-97	9:46a	mithom3O
MITHOM2O	232,162	10-24-97	9:46a	mithom2O
MITHOM9O	231,960	10-24-97	9:46a	mithom9O
MITHOM7O	231,689	10-24-97	9:46a	mithom7O
MITHOM0O	230,603	10-24-97	9:46a	mithom0O
MITHOM1O	229,359	10-24-97	9:46a	mithom1O
MITHOM6O	229,150	10-24-97	9:46a	mithom6O
MITHOM5O	227,291	10-24-97	9:46a	mithom5O

Files added for Rev 00B:

MITOZ2GO	443,728	11-10-97	4:28p	mitoz2gO
MITBZG1O	474,499	11-10-97	4:28p	mitbzg1O
MITHOMGO	231,446	11-10-97	4:28p	mithomgO
MITHOMHO	231,856	11-10-97	4:28p	mithomhO
MITHOMIO	228,754	11-10-97	4:28p	mithomiO
MIT079O	205,246	11-10-97	4:30p	mit079o
MIT081O	205,984	11-10-97	4:30p	mit081o
MIT082O	205,431	11-10-97	4:30p	mit082o
MIT083O	204,928	11-10-97	4:30p	mit083o
MIT084O	205,547	11-10-97	4:30p	mit084o
ORRHOM7 O	232,090	11-11-97	7:46a	orrhom7.O
ORROZ4C O	343,477	11-11-97	7:47a	orroz4c.O
ORRHOM6 O	227,730	11-11-97	7:59a	orrhom6.O

Files added for Rev 00C:

MTYF6G0O	208,541	12-09-97	9:34a	mtyf6g0o
MITXFG0O	209,015	12-04-97	2:43p	mitxfg0o

```
MTXF6G0O          209,431  12-08-97 12:31p mtxf6g0o
MITXFG2O          213,884  12-04-97  2:43p mitxfg2o
MITXFG4O          212,828  12-04-97  2:43p mitxfg4o
MITXFG5O          213,797  12-04-97  2:43p mitxfg5o
MITXGD1O          212,755  12-04-97  2:43p mitxgd1o
MITXGD5O          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
MITF9G1O          210,245  12-06-97  4:30p mitf9g1o
MITF6G6O          210,982  12-06-97  4:30p mitf6g6o
MITF6G5O          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 CF DEGRADATION OF THE DHLW AND ASSOCIATED METALS PRIOR TO BREACH OF THE MIT FUEL CO-DISPOSAL CANISTER

Run UAlIIb5mm, last printout

```
 Steps completed =     15, iter =  3, ncorr = 0
 Most rapidly changing is zvclg1(Pu++++                    ) =    -37.1988

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                    Reaction progress        = 7.96000000000000E+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^3. This can be used to get volumes.

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

Run UAlIIIb5mm, 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 zvclg1(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 zvclg1(Al+++) = -10.4738

- -

Reaction progress = 2.28750000000000E+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(PO4)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(PO4)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

Mass of U-235 = 514.25 g/Assembly

Mass of U-234 = 514.25x0.01/0.935 = 5.5 g/Assembly

Mass of U-238 = 514.25x0.055/0.935 = 30.25 g/Assembly

Mass of Al in the Fuel = 550x0.305/0.695 = 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 = 15x57.785x5.52958x0.0762 = 365.22 cm3/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 = 15x2x58.42x 6.48208x 0.2032 = 2308.452 cm3/Assembly

Density of Al = 2.6989 g/cm3 (Ref. 5.15)

Mass of Al in the Clad = 2.6989x2308.452 = 6230.281 g/Assembly

Total Mass of Al = 6230.281 + 241.367 = 6471.648 g/Assembly

Total U in the Codisposal Canister = 4x16x550 = 35200 g

Total Al in the Codisposal Canister = 4x16x6471.648 = 414190 g

Density of UO2 = 10.96 g/cm3 (Ref. 5.15)

Density of Al2O3 = 3.965 g/cm3 (Ref. 5.15)

Mass of UO2 = 35200x267/235 = 39993 g

Mass of Al2O3 = 414190x102/54 = 782360 g

Total Volume of UO2 + Al2O3 = 782360/3.965 + 39993/10.96 = 200970 cm3

Density of Fe2O3 = 5.24 g/cm3 (Ref. 5.15)

Density of Gd = 7.9004 g/cm3 (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

	A	B	C	D	E	F	G
1							
2				Degraded DHLW Glass Clayey Material With Degraded C			
3		Total DHLW Vol.	4993264.683	cm^3	from MITCLAY-2.XLS		
4							Degraded DHI
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^3		14000.50C
12		1/2 Cylinder Volume		3.57294E+06			15031.50C
13		DHLW Void Fraction		[redacted]			19000.50C
14		DHLW Volume		6.65769E+06	cm^3		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^3		
22							Degraded DHI
23		Total Volume of WP Contents		7.03808E+06	cm^3		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							

	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		Water Density Multiplier for 100% basket c		
54					Multiplier=(358739.13-175740.0)/358739.1		
55					Water Density Multiplier for 50% basket ca		
56					Multiplier=(358739.13-119393.8)/358739.1		
57							
58					Water Density Multiplier for 0% Basket Ca		
59				Multiplier=(358739.13-(37.0539+3449.758+200.364+735			
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	odisposal Canister					
3						
4	LW Glass Clayey Material Composition from MITCLAY-2.XLS (0 vol% water)					
5	3.5589E-03					
6	1.9788E-02					
7	5.8829E-07					
8	2.4980E-05					
9	2.5732E-04					
10	1.1813E-03					
11	6.1895E-03					
12	1.7649E-06					
13	4.5921E-04					
14	1.3478E-04					
15	2.5025E-04					
16	1.6755E-03					
17	2.0588E-04					
18	1.0348E-09					
19						
20	3.3728E-02					
21						
22	LW 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				
41	1	2.52494E-06		1001.50C	4.4620E-02	
42	1	0.000235074		8016.50C	5.3080E-02	
43	1	1.36532E-05		13027.50C	7.7614E-03	
44	1	0.000480574		26000.55C	1.2417E-02	
45	1	0.003400115		92234.50C	2.5249E-06	
46	0.5	0.000974613		92235.50C	2.3507E-04	
47	0.5	0.005233767		92238.50C	1.3653E-05	
48	119393.7673			TOTAL	1.1813E-01	
49						
50						

	H	I	J	K	L	M
51						
52						
53	ase					
54	3=	0.510117656				
55	se			Water Density Multiplier for 50% basket case		
56	3=	0.667184991		Multiplier=(358739.13*.8-119393.8)/(358739.		
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				

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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^3	
26	1/2 Cylinder Volume		1.90198E+05		
27	Fill Fraction		[redacted]		
28	Degraded Volume		3.04318E+05	cm^3	
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^3	
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	

	N	O	P	Q	R
51					
52				Volume of Fuel Cells = length of side	
53				length of side parallel to y axis=2x3.82	
54				separation between sides parallel to y	
55	in 80% of Canister			Height=64 cm	
56	13*.8)=	0.583981239			
57				Volume of Fuel Cells =	
58					
59					Water Density Multipli
60				Multiplier=(358739.13-(37.0539+3449	
61					
62					
63					
64					
65					
66					
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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	am from MCNP -1.732051x + y -6.625=0 if y=0 x=				3.824945

	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					
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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
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	A	B	C	D	E	F	G	H
1								
2			**Degraded MIT Fuel On Top of Degraded DHLW Clay**					
3								
4								
5		Cylinder Segment Volume Calculation					Degraded MIT Fuel	
6		(Degraded DHLW)						
7								
8		Geometry Calculations					Fraction of UO2 Remainin	
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^3		Mass of Fe2O3	
12		Segment Volume		4.99330E+06	cm^3		Nominal Den of UO2+Al2(	
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+Fe2C	
16							Vol. Occupied by UO2+Al:	
17								
18		Layer of MIT Fuel and Others						
19								
20		1/2 Cylinder Volume		3.57294E+06	cm^3			
21		Segment - 1/2 Cylin.		1.42036E+06	cm^3			
22		Layer Volume		1.00486E+06	cm^3		Atomic Density Calculatio	
23		Target Cell		1.00488E+06				Mass(g)
24		Dis from Center (y2)		4.86524E+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^	1.61843E+00
39								
40							H/U-235 Ration	
41								
42								
43		**DHLW Volume =**		**1/2 Cyl. Volume + lt*(y1*sqrt(r^2-y1^2) + r^2*arccos(sqrt(r^2-**				
44								
45		**MIT Fuel and Othes Volume =**			**Cyl. Volume - DHLW Volume - lt*(y2*sqrt(r^2-y**			
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 / Vo**				
50								
51			**Isotopic Abundance (%)**					

	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		[redacted]		
9			[redacted]	g	
10			7.9004E+00	g/cm^3	
11			0.00E+00	g	
12	)3+Fe2O3		4.09213E+00	g/cm^3	
13	-Fe2O3		8.22403E+05	g	
14			8.00000E-01		
15	)3+Void Used		8.18426E-01	g/cm^3	
16	2O3+Fe2O3+Void		1.00486E+06	cm^3	
17					
18					
19					
20					
21					
22	n (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	**lume**				
50					
51					

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

	A	B	C	D	E	F	G	H
1								
2		**Full Uranium Loading**						
3								
4								
5			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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		5.02414E+05	cm^3		Atomic Density Calculatio	
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^	2.23680E+00
42								
43							H/U-235 Ration	
44								
45								
46			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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		6.69885E+05	cm^3		Atomic Density Calculatio	
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^	1.92760E+00
83								
84							H/U-235 Ration	
85								
86								
87			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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^3			
106		Segment - 1/2 Cylin.		1.42036E+06	cm^3			
107		Layer Volume		8.03862E+05	cm^3		Atomic Density Calculatio	
108		Target Cell		8.03866E+05				Mass(g)
109		Dis from Center (y2)		[illegible]	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^	1.77300E+00
124								
125							H/U-235 Ration	
126								
127								
128			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
129								
130								
131		Cylinder Segment Volume Calculation					Degraded MIT Fuel	
132		(Degraded DHLW)						
133								
134		Geometry Calculations					Fraction of UO2 Remainir	
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^3		Mass of Fe2O3	
138		Segment Volume		4.99330E+06	cm^3		Nominal Den of UO2+Al2(	
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+Fe2C	
142							Vol. Occupied by UO2+Al	
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		1.00483E+06	cm^3		Atomic Density Calculatio	
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 Ration	
167								
168								
169			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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		Atomic Density Calculatio	
190		Target Cell		1.33977E+06				Mass(g)
191		Dis from Center (y2)		5.69060E+01	cm		U-235	32912
192							U-234	352
193							U-238	1936
194							Al	4.14E+05
195							Fe	0.00E+00
196							O	1.39E+06
197							H	1.27E+05
198							Gd-152	
199							Gd-154	
200							Gd-155	
201							Gd-156	
202							Gd-157	
203							Gd-158	
204							Gd-160	

	A	B	C	D	E	F	G	H
205							den (g/cm^	1.46380E+00
206								
207							H/U-235 Ration	
208								
209								
210			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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^3		Mass of Fe2O3	
220		Segment Volume		4.99330E+06	cm^3		Nominal Den of UO2+Al2(	
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+Fe2C	
224							Vol. Occupied by UO2+Al	
225								
226		Layer of MIT Fuel and Others						
227								
228		1/2 Cylinder Volume		3.57294E+06	cm^3			
229		Segment - 1/2 Cylin.		1.42036E+06	cm^3			
230		Layer Volume		2.00966E+06	cm^3		Atomic Density Calculatio	
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^	1.30920E+00
247								
248							H/U-235 Ration	
249								
250								
251								
252								
253								
254								
255								

	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 Volu	
9							(Degraded DHLW)	
10								
11	g		1.00				Geometry Calculations	
12			[redacted]	g			Cylinder Radius (R)	
13			7.9004E+00	g/cm^3			Cylinder Length	
14			0.00E+00	g			Cylinder Volume	
15	)3+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	3+Void Used		1.63680E+00	g/cm^3				
19	2O3+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 Volu	
50							(Degraded DHLW)	
51								

	I	J	K	L	M	N	O	P
52	g		1.00				Geometry Calculations	
53			[redacted]	g			Cylinder Radius (R)	
54			7.9004E+00	g/cm^3			Cylinder Length	
55			0.00E+00	g			Cylinder Volume	
56	)3+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	)3+Void Used		1.22760E+00	g/cm^3				
60	2O3+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	h (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			[redacted]	g			Cylinder Radius (R)	
95			7.9004E+00	g/cm^3			Cylinder Length	
96			0.00E+00	g			Cylinder Volume	
97	)3+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	)3+Void Used		1.02300E+00	g/cm^3				
101	2O3+Fe2O3+Void		8.03862E+05	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	ı (Degraded MIT Fuel)						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	**Fe2O3, Void Fraction 0.8)**							**Degraded**
129								
130								
131							Cylinder Segment Volu	
132							(Degraded DHLW)	
133								
134	g		1.00				Geometry Calculations	
135			[redacted]	g			Cylinder Radius (R)	
136			7.9004E+00	g/cm^3			Cylinder Length	
137			0.00E+00	g			Cylinder Volume	
138	)3+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	)3+Void Used		8.18402E-01	g/cm^3				
142	2O3+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	ı (Degraded MIT Fuel)						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			[redacted]	g				
177			7.9004E+00	g/cm^3				
178			**0.00E+00**	g				
179	)3+Fe2O3		4.09201E+00	g/cm^3				
180	-Fe2O3		8.22353E+05	g				
181			8.50000E-01					
182	3+Void Used		6.13802E-01	g/cm^3				
183	2O3+Fe2O3+Void		1.33977E+06	cm^3				
184								
185								
186								
187								
188								
189	ı (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					

	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			[redacted]	g				
218			7.9004E+00	g/cm^3				
219			0.00E+00	g				
220	)3+Fe2O3		4.09201E+00	g/cm^3				
221	-Fe2O3		8.22353E+05	g				
222			9.00000E-01					
223	3+Void Used		4.09201E-01	g/cm^3				
224	2O3+Fe2O3+Void		2.00966E+06	cm^3				
225								
226								
227								
228								
229								
230	ι (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								

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5	**MIT Fuel On Top of Degraded DHLW Clay (200 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
6								
7								
8	me 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 Densit
27	**4.88547E+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	**MIT Fuel On Top of Degraded DHLW Clay (100 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
47								
48								
49	me Calculation			Degraded MIT Fuel				
50								
51								

	Q	R	S	T	U	V	W	X
52				Fraction of UO2 Remaining				1.00
53	86.5	cm		Mass of Gd				100
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 Densit
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	**MIT Fuel On Top of Degraded DHLW Clay (50 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
88								
89								
90	ıme 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 Densit
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	me 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 Densit
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

	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								
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5					**Degraded MIT Fuel On Top of Degraded DHLW Clay (20**				
6									
7									
8				Cylinder Segment Volume Calculation					Degraded
9				(Degraded DHLW)					
10									
11				Geometry Calculations					Fraction of
12	g			Cylinder Radius (R)		86.5	cm		Mass of G
13	g/cm^3			Cylinder Length		304	cm		Density of
14	g			Cylinder Volume		7.14588E+06	cm^3		Mass of Fe
15	g/cm^3			Segment Volume		4.99330E+06	cm^3		Nominal D
16	g			Target Cell		4.99330E+06			Total Mas
17				Dis. from Center (y1)		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				1/2 Cylinder Volume		3.57294E+06	cm^3		
24				Segment - 1/2 Cylin.		1.42036E+06	cm^3		
25				Layer Volume		1.28654E+06	cm^3		Atomic De
26	/ (#/barn cm)			Target Cell		1.28657E+06			
27				Dis from Center (y2)		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					**Degraded MIT Fuel On Top of Degraded DHLW Clay (10**				
47									
48									
49				Cylinder Segment Volume Calculation					Degraded
50				(Degraded DHLW)					
51									

	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 Der
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^
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									

	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		Atomic De
108	(#/barn cm)			Target Cell		1.28647E+06			
109				Dis from Center (y2)		5.55728E+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^
124									
125									H/U-235 R
126									
127									
128					**Degraded MIT Fuel On Top of Degraded DHLW Clay (20**				
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		Atomic De
149	(#/barn cm)			Target Cell		1.28645E+06			
150				Dis from Center (y2)		5.55718E+01	cm		U-235
151									U-234
152									U-238
153									Al

	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^
165									
166									H/U-235 R
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5	**) 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 (
12	l			[redacted]	g			Cylinder Ra
13	Gd			7.9004E+00	g/cm^3			Cylinder Le
14	2O3			2.95E+05	g			Cylinder Vo
15	en 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	ied by UO2+Al2O3+Fe2O3+Void			1.28654E+06	cm^3			
20								
21								Layer of M
22								
23								1/2 Cylinde
24								Segment -
25	nsity 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	**) g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)**							
47								
48								
49	MIT Fuel							Cylinder Se
50								(Degraded
51								

	AH	AI	AJ	AK	AL	AM	AN	AO
52	UO2 Remaining			1.00				Geometry
53				[redacted]	g			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	on			8.00000E-01				Dis. from C
59	2+Al2O3+Fe2O3+Void Used			8.68695E-01	g/cm^3			
60	ied by UO2+Al2O3+Fe2O3+Void			1.28648E+06	cm^3			
61								
62								Layer of M
63								
64								1/2 Cylinde
65								Segment -
66	sity 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	**g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)**							
88								
89								
90	MIT Fuel							Cylinder Se
91								(Degraded
92								
93	UO2 Remaining			1.00				Geometry
94				[redacted]	g			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	on			8.00000E-01				Dis. from C
100	2+Al2O3+Fe2O3+Void Used			8.68677E-01	g/cm^3			
101	ied 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	nsity Calculation (Degraded MIT Fuel)							Segment -
108	Mass(g)	WT	MCNP	Atomic Density (#/barn cm)				Layer Volu
109	32912	235.0439	92235.50C	6.5553E-05				Target Cell
110	352	234.0409	92234.50C	7.0410E-07				Dis from C
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				
135				[redacted]	g			Geometry (
136	Gd			7.9004E+00	g/cm^3			Cylinder Ra
137	2O3			2.95E+05	g			Cylinder Le
138	en of UO2+Al2O3+Fe2O3			4.34333E+00	g/cm^3			Cylinder Vo
139	of UO2+Al2O3+Fe2O3			1.11748E+06	g			Segment V
140	on			8.00000E-01				Target Cell
141	2+Al2O3+Fe2O3+Void Used			8.68667E-01	g/cm^3			Dis. from C
142	ied by UO2+Al2O3+Fe2O3+Void			1.28643E+06	cm^3			
143								
144								
145								Layer of M
146								
147								1/2 Cylinde
148	nsity Calculation (Degraded MIT Fuel)							Segment -
149	Mass(g)	WT	MCNP	Atomic Density (#/barn cm)				Layer Volu
150	32912	235.0439	92235.50C	6.5554E-05				Target Cell
151	352	234.0409	92234.50C	7.0411E-07				Dis from C
152	1936	238.0508	92238.50C	3.8074E-06				
153	4.14E+05	26.98154	13027.50C	7.1866E-03				

	AH	AI	AJ	AK	AL	AM	AN	AO
154	2.07E+05	55.847	26000.50C	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 (
176								Cylinder Ra
177								Cylinder Le
178								Cylinder Vo
179								Segment V
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								
214								Cylinder Se
215								(Degraded
216								
217								Geometry (
218								Cylinder Ra
219								Cylinder Le
220								Cylinder Vo
221								Segment V
222								Target Cell
223								Dis. from C
224								
225								
226								
227								Layer of M
228								
229								1/2 Cylinde
230								Segment -
231								Layer Volu
232								Target Cell
233								Dis from C
234								
235								
236								
237								
238								
239								
240								
241								
242								
243								
244								
245								
246								
247								
248								
249								
250								
251								
252								
253								
254								
255								Cylinder Se
								(Degraded

	AH	AI	AJ	AK	AL	AM	AN	AO
256								
257								Geometry (
258								Cylinder Ra
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								
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289								

	AP	AQ	AR	AS	AT	AU	AV	AW
1								
2								
3								
4								
5	**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 150000 g of Fe2O3, Void Fra**							
6								
7								
8	gment Volume Calculation				Degraded MIT Fuel			
9	DHLW)							
10								
11	alculations				Fraction of UO2 Remaining			
12	adius (R)	86.5	cm		Mass of Gd			
13	ngth	304	cm		Density of Gd			
14	lume	7.14588E+06	cm^3		Mass of Fe2O3			
15	olume	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	r 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 Ration			
44								
45								
46	**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 300000 g of Fe2O3, Void Fra**							
47								
48								
49	gment Volume Calculation				Degraded MIT Fuel			
50	DHLW)							
51								

	AP	AQ	AR	AS	AT	AU	AV	AW
52	Calculations				Fraction of UO2 Remaining			
53	adius (R)	86.5	cm		Mass of Gd			
54	ngth	304	cm		Density of Gd			
55	olume	7.14588E+06	cm^3		Mass of Fe2O3			
56	olume	4.99330E+06	cm^3		Nominal Den of UO2+Al2O3+Fe2O3			
57		4.99330E+06			Total Mas of UO2+Al2O3+Fe2O3			
58	enter (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	r Volume	3.57294E+06	cm^3					
65	1/2 Cylin.	1.42036E+06	cm^3					
66	me	1.29109E+06	cm^3		Atomic Density Calculation (Degraded MIT Fuel)			
67		1.29111E+06				Mass(g)	WT	MCNP
68	enter (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^	1.66943E+00		
83								
84					H/U-235 Ration			
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	egment Volume Calculation				Degraded MIT Fuel			
91	DHLW)							
92								
93	Calculations				Fraction of UO2 Remaining			
94	adius (R)	86.5	cm		Mass of Gd			
95	ngth	304	cm		Density of Gd			
96	olume	7.14588E+06	cm^3		Mass of Fe2O3			
97	olume	4.99330E+06	cm^3		Nominal Den of UO2+Al2O3+Fe2O3			
98		4.99330E+06			Total Mas of UO2+Al2O3+Fe2O3			
99	enter (y1)	2.74765E+01	cm		Void Fraction			
100					Den of UO2+Al2O3+Fe2O3+Void Used			
101					Vol. Occupied by UO2+Al2O3+Fe2O3+Void			
102								

	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	ne	1.57735E+06	cm^3		Atomic Density Calculation (Degraded MIT Fuel)			
108		1.57737E+06				Mass(g)	WT	MCNP
109	enter (y2)	6.81877E+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	egment Volume Calculation				Degraded MIT Fuel			
132	DHLW)							
133								
134	Calculations				Fraction of UO2 Remaining			
135	adius (R)	86.5	cm		Mass of Gd			
136	ngth	304	cm		Density of Gd			
137	olume	7.14588E+06	cm^3		Mass of Fe2O3			
138	olume	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	ne	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	gment Volume Calculation				Degraded MIT Fuel			
173	DHLW)							
174								
175	Calculations				Fraction of UO2 Remaining			
176	adius (R)	86.5	cm		Mass of Gd			
177	ngth	304	cm		Density of Gd			
178	lume	7.14588E+06	cm^3		Mass of Fe2O3			
179	olume	4.99330E+06	cm^3		Nominal Den of UO2+Al2O3+Fe2O3			
180		4.99330E+06			Total Mas of UO2+Al2O3+Fe2O3			
181	enter (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	T Fuel and Others							
186								
187	r Volume	3.57294E+06	cm^3					
188	1/2 Cylin.	1.42036E+06	cm^3					
189	me	1.81590E+06	cm^3		Atomic Density Calculation (Degraded MIT Fuel)			
190		1.81592E+06				Mass(g)	WT	MCNP
191	enter (y2)	7.03335E+01	cm		U-235	32912	235.0439	92235.50C
192					U-234	352	234.0409	92234.50C
193					U-238	1936	238.0508	92238.50C
194					Al	4.14E+05	26.98154	13027.50C
195					Fe	5.95E+05	55.847	26000.55C
196					O	1.92E+06	15.99492	8016.50C
197					H	1.61E+05	1.007825	1001.50C
198					Gd-152			64152.50C
199					Gd-154			64154.50C
200					Gd-155			64155.50C
201					Gd-156			64156.50C
202					Gd-157			64157.50C
203					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	**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 900000 g of Fe2O3, Void Fra**							
211								
212								
213	gment Volume Calculation				Degraded MIT Fuel			
214	DHLW)							
215								
216	Calculations				Fraction of UO2 Remaining			
217	adius (R)	86.5	cm		Mass of Gd			
218	ngth	304	cm		Density of Gd			
219	lume	7.14588E+06	cm^3		Mass of Fe2O3			
220	olume	4.99330E+06	cm^3		Nominal Den of UO2+Al2O3+Fe2O3			
221		4.99330E+06			Total Mas of UO2+Al2O3+Fe2O3			
222	enter (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	T Fuel and Others							
227								
228	r Volume	3.57294E+06	cm^3					
229	1/2 Cylin.	1.42036E+06	cm^3					
230	me	1.86361E+06	cm^3		Atomic Density Calculation (Degraded MIT Fuel)			
231		1.86363E+06				Mass(g)	WT	MCNP
232	enter (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	**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 1200000 g of Fe2O3, Void F**							
252								
253								
254	gment Volume Calculation				Degraded MIT Fuel			
255	DHLW)							

	AP	AQ	AR	AS	AT	AU	AV	AW
256								
257	Calculations				Fraction of UO2 Remaining			
258	adius (R)	86.5	cm		Mass of Gd			
259	ngth	304	cm		Density of Gd			
260	olume	7.14588E+06	cm^3		Mass of Fe2O3			
261	olume	4.99330E+06	cm^3		Nominal Den of UO2+Al2O3+Fe2O3			
262		4.99330E+06			Total Mas of UO2+Al2O3+Fe2O3			
263	enter (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	r Volume	3.57294E+06	cm^3					
270	1/2 Cylin.	1.42036E+06	cm^3					
271	me	2.14987E+06	cm^3		Atomic Density Calculation (Degraded MIT Fuel)			
272		2.14989E+06				Mass(g)	WT	MCNP
273	enter (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	[redacted]	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	[redacted] 1.00		
53	[redacted]	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	[redacted]	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	[illegible]1.00		
135	[redacted]	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	[redacted]	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	**ction 0.8)**		
211			
212			
213			
214			
215			
216	**1.00**		
217	[redacted]	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	[redacted]		
258	[redacted]	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		**75% Uranium Loading**						
3								
4								
5			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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		6.66844E+05	cm^3		Atomic Density Calculatio	
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^	1.91821E+00
42								
43							H/U-235 Ration	
44								
45								
46			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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		8.00213E+05	cm^3		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^	1.76517E+00
83								
84							H/U-235 Ration	
85								
86								
87			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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^3			
106		Segment - 1/2 Cylin.		1.42036E+06	cm^3			
107		Layer Volume		1.00027E+06	cm^3		Atomic Density Calculatio	
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^	1.61214E+00
124								
125							H/U-235 Ration	
126								
127								
128			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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^3		Mass of Fe2O3	
138		Segment Volume		4.99330E+06	cm^3		Nominal Den of UO2+Al2(	
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+Fe2C	
142							Vol. Occupied by UO2+Al	
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		1.33369E+06	cm^3		Atomic Density Calculatio	
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

	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			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
170								
171								
172		Cylinder Segment Volume Calculation					Degraded MIT Fuel	
173		(Degraded DHLW)						
174								
175		Geometry Calculations					Fraction of UO2 Remainir	
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+Al2(	
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+Fe2C	
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	

	A	B	C	D	E	F	G	H
205							den (g/cm^	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								

	I	J	K	L	M	N	O	P
1								
2								
3								
4								
5	**Fe2O3, Void Fraction 0.7)**							**Degraded**
6								
7								
8							Cylinder Segment Volu	
9							(Degraded DHLW)	
10								
11	g		0.75				Geometry Calculations	
12			[redacted]	g			Cylinder Radius (R)	
13			7.9004E+00	g/cm^3			Cylinder Length	
14			0.00E+00	g			Cylinder Volume	
15	)3+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	3+Void Used		1.21821E+00	g/cm^3				
19	2O3+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	ı (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 Volu	
50							(Degraded DHLW)	
51								

	I	J	K	L	M	N	O	P
52	g		0.75				Geometry Calculations	
53			[redacted]	g			Cylinder Radius (R)	
54			7.9004E+00	g/cm^3			Cylinder Length	
55			0.00E+00	g			Cylinder Volume	
56	)3+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	3+Void Used		1.01517E+00	g/cm^3				
60	2O3+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			[redacted]	g			Cylinder Radius (R)	
95			7.9004E+00	g/cm^3			Cylinder Length	
96			0.00E+00	g			Cylinder Volume	
97	)3+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	3+Void Used		8.12138E-01	g/cm^3				
101	2O3+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	ı (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			[redacted]	g			Cylinder Radius (R)	
136			7.9004E+00	g/cm^3			Cylinder Length	
137			0.00E+00	g			Cylinder Volume	
138	)3+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	3+Void Used		6.09104E-01	g/cm^3				
142	2O3+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	ı (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 Volu	
173							(Degraded DHLW)	
174								
175	g		**0.75**				Geometry Calculations	
176			0	g			Cylinder Radius (R)	
177			7.9004E+00	g/cm^3			Cylinder Length	
178			**0.00E+00**	g			Cylinder Volume	
179	)3+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	2O3+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	ı (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					

	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 Volu	
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								

	Q	R	S	T	U	V	W	X
1								
2								
3								
4								
5	**MIT Fuel On Top of Degraded DHLW Clay (120 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
6								
7								
8	ıme 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 Densit
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	**MIT Fuel On Top of Degraded DHLW Clay (100 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
47								
48								
49	ıme Calculation			Degraded MIT Fuel				
50								
51								

	Q	R	S	T	U	V	W	X
52				Fraction of UO2 Remaining				0.75
53	86.5	cm		Mass of Gd				00
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 Densit
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^	1.61219E+00			1.0320E-01
83								
84				H/U-235 Ration				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	me 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								

	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 Densit
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	me 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 Densit
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

	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	**MIT Fuel On Top of Degraded DHLW Clay (40 g of Gd, 0 g of Fe2O3, Void Fraction 0.8)**							
170								
171								
172	me 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 Densit
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

	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	me 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 Densit
232	4.87464E+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

	Y	Z	AA	AB	AC	AD	AE	AF	AG
1									
2									
3									
4									
5					**Degraded MIT Fuel On Top of Degraded DHLW Clay (12**				
6									
7									
8				Cylinder Segment Volume Calculation					Degraded
9				(Degraded DHLW)					
10									
11				Geometry Calculations					Fraction of
12	g			Cylinder Radius (R)		86.5	cm		Mass of Gd
13	g/cm^3			Cylinder Length		304	cm		Density of
14	g			Cylinder Volume		7.14588E+06	cm^3		Mass of Fe
15	g/cm^3			Segment Volume		4.99330E+06	cm^3		Nominal D
16	g			Target Cell		4.99330E+06			Total Mas
17				Dis. from Center (y1)		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				1/2 Cylinder Volume		3.57294E+06	cm^3		
24				Segment - 1/2 Cylin.		1.42036E+06	cm^3		
25				Layer Volume		1.28193E+06	cm^3		Atomic Den
26	(#/barn cm)			Target Cell		1.28193E+06			
27				Dis from Center (y2)		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^
42									
43									H/U-235 R
44									
45									
46					**Degraded MIT Fuel On Top of Degraded DHLW Clay (10**				
47									
48									
49				Cylinder Segment Volume Calculation					Degraded
50				(Degraded DHLW)					
51									

	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					**Degraded MIT Fuel On Top of Degraded DHLW Clay (80**				
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									

	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 Der
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^
124									
125									H/U-235 R
126									
127									
128					**Degraded MIT Fuel On Top of Degraded DHLW Clay (60**				
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		1.28189E+06	cm^3		Atomic Der
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

	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^
165									
166									H/U-235 R
167									
168									
169					**Degraded MIT Fuel On Top of Degraded DHLW Clay (40**				
170									
171									
172				Cylinder Segment Volume Calculation					Degraded
173				(Degraded DHLW)					
174									
175				Geometry Calculations					Fraction of
176	g			Cylinder Radius (R)		86.5	cm		Mass of G
177	g/cm^3			Cylinder Length		304	cm		Density of
178	g			Cylinder Volume		7.14588E+06	cm^3		Mass of Fe
179	g/cm^3			Segment Volume		4.99330E+06	cm^3		Nominal D
180	g			Target Cell		4.99330E+06			Total Mas
181				Dis. from Center (y1)		2.74765E+01	cm		Void Fracti
182	g/cm^3								Den of UO
183	cm^3								Vol. Occup
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		1.28188E+06	cm^3		Atomic Den
190	(#/barn cm)			Target Cell		1.28188E+06			
191				Dis from Center (y2)		5.54584E+01	cm		U-235
192									U-234
193									U-238
194									Al
195									Fe
196									O
197									H
198									Gd-152
199									Gd-154
200									Gd-155
201									Gd-156
202									Gd-157
203									Gd-158
204									Gd-160

	Y	Z	AA	AB	AC	AD	AE	AF	AG
205									den (g/cm^
206									
207									H/U-235 R
208									
209									
210					**Degraded MIT Fuel On Top of Degraded DHLW Clay (20**				
211									
212									
213				Cylinder Segment Volume Calculation					Degraded
214				(Degraded DHLW)					
215									
216				Geometry Calculations					Fraction of
217	g			Cylinder Radius (R)		86.5	cm		Mass of G
218	g/cm^3			Cylinder Length		304	cm		Density of
219	g			Cylinder Volume		7.14588E+06	cm^3		Mass of Fe
220	g/cm^3			Segment Volume		4.99330E+06	cm^3		Nominal D
221	g			Target Cell		4.99330E+06			Total Mas
222				Dis. from Center (y1)		**2.74765E+01**	cm		Void Fracti
223	g/cm^3								Den of UO
224	cm^3								Vol. Occup
225									
226				Layer of MIT Fuel and Others					
227									
228				1/2 Cylinder Volume		3.57294E+06	cm^3		
229				Segment - 1/2 Cylin.		1.42036E+06	cm^3		
230				Layer Volume		1.28187E+06	cm^3		Atomic De
231	(#/barn cm)			Target Cell		1.28187E+06			
232				Dis from Center (y2)		5.54582E+01	cm		U-235
233									U-234
234									U-238
235									Al
236									Fe
237									O
238									H
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^
247									
248									H/U-235 R

	AH	AI	AJ	AK	AL	AM
1						
2						
3						
4						
5	**) g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)**					
6						
7						
8	MIT Fuel					
9						
10						
11	UO2 Remaining			**0.75**		
12	l			120	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	on			8.00000E-01		
18	2+Al2O3+Fe2O3+Void Used			8.63993E-01	g/cm^3	
19	ied by UO2+Al2O3+Fe2O3+Void			1.28193E+06	cm^3	
20						
21						
22						
23						
24						
25	nsity 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	**) g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)**					
47						
48						
49	MIT Fuel					
50						
51						

	AH	AI	AJ	AK	AL	AM
52	UO2 Remaining			0.75		
53				[redacted]	g	
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	on			8.00000E-01		
59	2+Al2O3+Fe2O3+Void Used			8.63986E-01	g/cm^3	
60	ied by UO2+Al2O3+Fe2O3+Void			1.28192E+06	cm^3	
61						
62						
63						
64						
65						
66	nsity 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				80	g	
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	on			8.00000E-01		
100	2+Al2O3+Fe2O3+Void Used			8.63979E-01	g/cm^3	
101	ied by UO2+Al2O3+Fe2O3+Void			1.28191E+06	cm^3	
102						

	AH	AI	AJ	AK	AL	AM
103						
104						
105						
106						
107	sity 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	**g of Gd, 295105 g of Fe2O3, Void Fraction 0.8)**					
129						
130						
131	MIT Fuel					
132						
133						
134	UO2 Remaining			**0.75**		
135				[redacted]	g	
136	Gd			7.9004E+00	g/cm^3	
137	2O3			**2.95E+05**	g	
138	n of UO2+Al2O3+Fe2O3			4.31986E+00	g/cm^3	
139	of UO2+Al2O3+Fe2O3			1.10752E+06	g	
140	on			8.00000E-01		
141	2+Al2O3+Fe2O3+Void Used			8.63972E-01	g/cm^3	
142	ied by UO2+Al2O3+Fe2O3+Void			1.28189E+06	cm^3	
143						
144						
145						
146						
147						
148	sity 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		

	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	l			[redacted]	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	ied by UO2+Al2O3+Fe2O3+Void			1.28188E+06	cm^3	
184						
185						
186						
187						
188						
189	nsity 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		

	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	I			[redacted]	g	
218	Gd			7.9004E+00	g/cm^3	
219	2O3			**2.95E+05**	g	
220	en of UO2+Al2O3+Fe2O3			4.31979E+00	g/cm^3	
221	of UO2+Al2O3+Fe2O3			1.10748E+06	g	
222	on			8.00000E-01		
223	2+Al2O3+Fe2O3+Void Used			8.63958E-01	g/cm^3	
224	ied by UO2+Al2O3+Fe2O3+Void			1.28187E+06	cm^3	
225						
226						
227						
228						
229						
230	nsity 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		**50% Uranium Loading**						
3								
4								
5			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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 Calculatio	
67		Target Cell		7.96563E+05				Mass(g)
68		Dis from Center (y2)		4.41536E+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			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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+Al2(	
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+Fe2C	
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^3			
106		Segment - 1/2 Cylin.		1.42036E+06	cm^3			
107		Layer Volume		9.95705E+05	cm^3		Atomic Density Calculatio	
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^	1.60582E+00
124								
125							H/U-235 Ration	
126								
127								
128			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
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^3		Mass of Fe2O3	
138		Segment Volume		4.99330E+06	cm^3		Nominal Den of UO2+Al2(	
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+Fe2C	
142							Vol. Occupied by UO2+Al:	
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		1.32761E+06	cm^3		Atomic Density Calculatio	
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

	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			**Degraded MIT Fuel On Top of Degraded DHLW Clay (0 g of Gd, 0 g of**					
170								
171								
172		Cylinder Segment Volume Calculation					Degraded MIT Fuel	
173		(Degraded DHLW)						
174								
175		Geometry Calculations					Fraction of UO2 Remainir	
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+Al2(	
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+Fe2C	
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		1.99141E+06	cm^3		Atomic Density Calculatio	
190		Target Cell		1.99141E+06				Mass(g)
191		Dis from Center (y2)		7.66830E+01	cm		U-235	16456
192							U-234	176
193							U-238	968
194							Al	4.14E+05
195							Fe	0.00E+00
196							O	1.96E+06
197							H	1.99E+05
198							Gd-152	
199							Gd-154	
200							Gd-155	
201							Gd-156	
202							Gd-157	
203							Gd-158	
204							Gd-160	

	A	B	C	D	E	F	G	H
205							den (g/cm^	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			[redacted]	g	
13			7.9004E+00	g/cm^3	
14			0.00E+00	g	
15	)3+Fe2O3		4.02909E+00	g/cm^3	
16	-Fe2O3		8.02357E+05	g	
17			7.00000E-01		
18	)3+Void Used		1.20873E+00	g/cm^3	
19	2O3+Fe2O3+Void		6.63803E+05	cm^3	
20					
21					
22					
23					
24					
25	ו (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			[redacted]	g	
54			7.9004E+00	g/cm^3	
55			0.00E+00	g	
56	)3+Fe2O3		4.02909E+00	g/cm^3	
57	-Fe2O3		8.02357E+05	g	
58			7.50000E-01		
59	)3+Void Used		1.00727E+00	g/cm^3	
60	2O3+Fe2O3+Void		7.96564E+05	cm^3	
61					
62					
63					
64					
65					
66	1 (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	**Fe2O3, Void Fraction 0.80)**				
88					
89					
90					
91					
92					
93	g		0.50		
94			[redacted]	g	
95			7.9004E+00	g/cm^3	
96			0.00E+00	g	
97	)3+Fe2O3		4.02909E+00	g/cm^3	
98	-Fe2O3		8.02357E+05	g	
99			8.00000E-01		
100	)3+Void Used		8.05817E-01	g/cm^3	
101	2O3+Fe2O3+Void		9.95705E+05	cm^3	
102					

	I	J	K	L	M
103					
104					
105					
106					
107	ı (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	)3+Fe2O3		4.02909E+00	g/cm^3	
139	-Fe2O3		8.02357E+05	g	
140			**8.50000E-01**		
141	)3+Void Used		6.04363E-01	g/cm^3	
142	2O3+Fe2O3+Void		1.32761E+06	cm^3	
143					
144					
145					
146					
147					
148	ı (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		

	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	**Fe2O3, Void Fraction 0.9)**				
170					
171					
172					
173					
174					
175	g		**0.50**		
176			[redacted]	g	
177			7.9004E+00	g/cm^3	
178			**0.00E+00**	g	
179	)3+Fe2O3		4.02909E+00	g/cm^3	
180	-Fe2O3		8.02357E+05	g	
181			9.00000E-01		
182	3+Void Used		4.02909E-01	g/cm^3	
183	?O3+Fe2O3+Void		1.99141E+06	cm^3	
184					
185					
186					
187					
188					
189	ı (Degraded MIT Fuel)				
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		

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

	A	B	C	D	E	F
1						
2				**DHLW and Degraded MIT Fuel Hom**		
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^3	
12		1/2 Cylinder Volume		3.57294E+06		
13		DHLW Volume		4.9933E+06	cm^3	
14		Degraded MIT Volume		2.00970E+05	cm^3	
15		Mass of Fe2O3		0.00000E+00	g	
16		Den. of Fe2O3		5.24000E+00	g/cm^3	
17		Vol. of Fe2O3		0.00000E+00		
18		Void Fraction		[redacted]		
19		Total Volume		6.49284E+06	cm^3	
20		Calculated Volume		6.49284E+06	cm^3	
21		Dis. from Center (y)		6.10608E+01	cm	
22						
23						
24						
25						
26						
27						
28						
29						
30						
31		**Total Volume =**		**(DHLW Volume + Degraded MIT Vo**		
32						
33		**Calculated Volume = Total Volume =**				**1/2 Cyl. Vo**
34						
35		**DHLW Clay Atomic Number Densities are from mitclay-2.**				
36						
37		**Mixture Atomic Numbers Den =**			**DHLW Clay Atomic N**	
38						
39					**+ MIT Isotope Mass ***	
40						
41					**+ Void Fraction * 0.06**	
42						
43					**+ Void Fraction * 0.03**	
44						
45						
46						

	G	H	I	J	K	L	M
1							
2	**ogeneous Mixture**						
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 + lt*(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							

	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			

	A	B	C	D	E	F	G	H	I	J	K
1											
2				**DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.0)**							
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^3		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^3		P	1.76488E-06			
14		Degraded MIT Volume		2.00970E+05	cm^3		K	4.59207E-04			
15		Mass of Fe2O3		0.00000E+00	g		Ca	1.34777E-04			
16		Den. of Fe2O3		5.24000E+00	g/cm^3		Mn	2.50252E-04			
17		Vol. of Fe2O3		0.00000E+00			Fe	1.67546E-03		Fe	0.00E+00
18		Void Fraction		[redacted]			Ni	2.05882E-04			
19		Total Volume		5.19427E+06	cm^3		U-238	0.00000E+00		U-238	1936
20		Calculated Volume		5.19427E+06	cm^3					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				**DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.1)**							
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^3		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^3		P	1.76488E-06			
43		Degraded MIT Volume		2.00970E+05	cm^3		K	4.59207E-04			
44		Mass of Fe2O3		0.00000E+00	g		Ca	1.34777E-04			
45		Den. of Fe2O3		5.24000E+00	g/cm^3		Mn	2.50252E-04			
46		Vol. of Fe2O3		0.00000E+00			Fe	1.67546E-03		Fe	0.00E+00
47		Void Fraction		[redacted]			Ni	2.05882E-04			
48		Total Volume		5.77141E+06	cm^3		U-238	0.00000E+00		U-238	1936
49		Calculated Volume		5.77141E+06	cm^3					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											

	A	B	C	D	E	F	G	H	I	J	K
56											
57											
58											
59				**DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.2)**							
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^3		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^3		P	1.76488E-06			
71		Degraded MIT Volume		2.00970E+05	cm^3		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^3		Mn	2.50252E-04			
74		Vol. of Fe2O3		0.00000E+00			Fe	1.67546E-03		Fe	0.00E+00
75		Void Fraction		[redacted]			Ni	2.05882E-04			
76		Total Volume		6.49284E+06	cm^3		U-238	0.00000E+00		U-238	1936
77		Calculated Volume		6.49284E+06	cm^3					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				**DHLW and Degraded MIT Fuel Homogeneous Mixture (Void Fraction 0.25)**							
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^3		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^3		P	1.76488E-06			
101		Degraded MIT Volume		2.00970E+05	cm^3		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^3		Mn	2.50252E-04			
104		Vol. of Fe2O3		0.00000E+00			Fe	1.67546E-03		Fe	0.00E+00
105		Void Fraction		[redacted]			Ni	2.05882E-04			
106		Total Volume		6.92569E+06	cm^3		U-238	0.00000E+00		U-238	1936
107		Calculated Volume		6.92569E+06	cm^3					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											

	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	

	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				DHLW and Degraded MIT Fuel Homogeneous Mixture below				
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^3		Si	6.18950E-03
13		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
14		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
15		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
18		Vol. of Gd		0.0000E+00	cm^3		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^3			
21		Vol. of Fe2O3		0.0000E+00	cm^3			
22	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
23		Total Volume		7.1337E+06	cm^3			
24		Calculated Volume		7.1337E+06	cm^3		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^3			
29		Calculated Volume		1.3036E+06	cm^3			
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 Fe2C**				
38								
39		**Total Volume =**		**1/2 Cyl. Volume + lt*(y2*sqrt(r^2-y2^2) + r^2*arccos(sqrt(r^2**				
40								
41		**DHLW Atomic Number Densities are from mitclay-2.xls spreadsheet**						
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								

	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)				

	I	J	K	L	M	N	O	P
1						Void Frac.	0.272	
2	**DHLW**							
3								
4		Degraded MIT Fuel				**Mixture**		(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	**)en. / Mixture Volume**							
44								
45	**Volume**							
46								
47								
48								
49								
50								
51								

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

	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					
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51					

	Q	R	S	T	U
52					
53					
54					
55					
56					

	A	B	C	D	E	F	G	H
1								
2		**Full Uranium Loading**						
3								
4								
5				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
6				**(0% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3)**				
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^3		Si	6.18950E-03
16		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
17		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
18		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
21		Vol. of Gd		0.0000E+00	cm^3		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^3			
24		Vol. of Fe2O3		0.0000E+00	cm^3			
25	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
26		Total Volume		6.1109E+06	cm^3			
27		Calculated Volume		6.1109E+06	cm^3		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^3			
32		Calculated Volume		2.3644E+05	cm^3			
33		Distance from Center		-7.37805E+01	cm			
34								
35								
36								
37								
38								
39								
40				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
41				**(0% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3)**				
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^3		Si	6.18950E-03
51		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06

	A	B	C	D	E	F	G	H
52		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
53		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
56		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
57		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
58		Den. of Fe2O3		5.2400E+00	g/cm^3			
59		Vol. of Fe2O3		0.0000E+00	cm^3			
60	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
61		Total Volume		6.4928E+06	cm^3			
62		Calculated Volume		6.4928E+06	cm^3		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^3			
67		Calculated Volume		2.5121E+05	cm^3			
68		Distance from Center		-7.32477E+01	cm			
69								
70								
71								
72								
73								
74								
75				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
76				**(0% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3)**				
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		UO2 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^3		Si	6.18950E-03
86		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
87		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
88		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
91		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
92		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
93		Den. of Fe2O3		5.2400E+00	g/cm^3			
94		Vol. of Fe2O3		0.0000E+00	cm^3			
95	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
96		Total Volume		6.9257E+06	cm^3			
97		Calculated Volume		6.9257E+06	cm^3		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^3			
102		Calculated Volume		2.6796E+05	cm^3			

	A	B	C	D	E	F	G	H
103		Distance from Center		7.26550E+01	cm			
104								
105								
106								
107								
108								
109								
110				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
111				**(10% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		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^3		Si	6.18950E-03
121		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
122		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
123		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
126		Vol. of Gd		0.0000E+00	cm^3		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^3			
129		Vol. of Fe2O3		0.0000E+00	cm^3			
130	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
131		Total Volume		6.1109E+06	cm^3			
132		Calculated Volume		6.1109E+06	cm^3		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^3			
137		Calculated Volume		8.2388E+05	cm^3			
138		Distance from Center		-5.66270E+01	cm			
139								
140								
141								
142								
143								
144								
145				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
146				**(10% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		1.00			Na	2.49797E-05
153		Cylinder Radius		86.5	cm		Mg	2.57324E-04

	A	B	C	D	E	F	G	H
154		Cylinder Length		304	cm		Al	1.18129E-03
155		Cylinder Volume		7.1459E+06	cm^3		Si	6.18950E-03
156		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
157		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
158		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
161		Vol. of Gd		0.0000E+00	cm^3		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^3			
164		Vol. of Fe2O3		0.0000E+00	cm^3			
165	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
166		Total Volume		6.4928E+06	cm^3			
167		Calculated Volume		6.4928E+06	cm^3		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^3			
172		Calculated Volume		8.7538E+05	cm^3			
173		Distance from Center		-5.53425E+01	cm			
174								
175								
176								
177								
178								
179								
180				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
181				**(10% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		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^3		Si	6.18950E-03
191		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
192		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
193		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
196		Vol. of Gd		0.0000E+00	cm^3		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^3			
199		Vol. of Fe2O3		0.0000E+00	cm^3			
200	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
201		Total Volume		6.9257E+06	cm^3			
202		Calculated Volume		6.9257E+06	cm^3		Total	3.37283E-02
203	Mixture	Distance from Center		7.43800E+01	cm			
204		Frac. of DHLW Mixed						

	A	B	C	D	E	F	G	H
205		with MIT Fuel		1.0000E-01				
206		Mixture Volume		9.3373E+05	cm^3			
207		Calculated Volume		9.3373E+05	cm^3			
208		Distance from Center		5.39115E+01	cm			
209								
210								
211								
212								
213								
214								
215				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
216				**(15% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		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^3		Si	6.18950E-03
226		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
227		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
228		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
231		Vol. of Gd		0.0000E+00	cm^3		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^3			
234		Vol. of Fe2O3		0.0000E+00	cm^3			
235	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
236		Total Volume		6.1109E+06	cm^3			
237		Calculated Volume		6.1109E+06	cm^3		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^3			
242		Calculated Volume		1.1176E+06	cm^3			
243		Distance from Center		4.95490E+01	cm			
244								
245								
246								
247								
248								
249								
250				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
251				**(15% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
252							DHLW Clay	
253		Cylinder Segment Volume Calculation					(atom/barn/cm)	
254							H	3.55893E-03
255		Geometry Calculations					O	1.97883E-02

	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^3		Si	6.18950E-03
261		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
262		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
263		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
266		Vol. of Gd		0.0000E+00	cm^3		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^3			
269		Vol. of Fe2O3		0.0000E+00	cm^3			
270	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
271		Total Volume		6.4928E+06	cm^3			
272		Calculated Volume		6.4928E+06	cm^3		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^3			
277		Calculated Volume		1.1875E+06	cm^3			
278		Distance from Center		-4.79400E+01	cm			
279								
280								
281								
282								
283								
284								
285				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
286				**(15% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
296		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
297		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
298		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
301		Vol. of Gd		0.0000E+00	cm^3		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^3			
304		Vol. of Fe2O3		0.0000E+00	cm^3			
305	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
306		Total Volume		6.9257E+06	cm^3			

	A	B	C	D	E	F	G	H
307		Calculated Volume		6.9257E+06	cm^3		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^3			
312		Calculated Volume		1.2666E+06	cm^3			
313		Distance from Center		-4.61470E+01	cm			
314								
315								
316								
317								
318								
319								
320				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
321				**(15% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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. Remaing		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^3		Si	6.18950E-03
331		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
332		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
333		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
336		Vol. of Gd		0.0000E+00	cm^3		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^3			
339		Vol. of Fe2O3		0.0000E+00	cm^3			
340	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
341		Total Volume		7.1350E+06	cm^3			
342		Calculated Volume		7.1350E+06	cm^3		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^3			
347		Calculated Volume		1.3049E+06	cm^3			
348		Distance from Center		-4.52900E+01	cm			
349								
350								
351								
352								
353								
354								
355				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
356				**(20% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
357							DHLW Clay	

	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^3		Si	6.18950E-03
366		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
367		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
368		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
371		Vol. of Gd		0.0000E+00	cm^3		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^3			
374		Vol. of Fe2O3		0.0000E+00	cm^3			
375	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
376		Total Volume		6.1109E+06	cm^3			
377		Calculated Volume		6.1109E+06	cm^3		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^3			
382		Calculated Volume		1.4113E+06	cm^3			
383		Distance from Center		-4.29370E+01	cm			
384								
385								
386								
387								
388								
389								
390				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
391				**(20% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
401		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
402		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
403		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
406		Vol. of Gd		0.0000E+00	cm^3		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^3			

	A	B	C	D	E	F	G	H
409		Vol. of Fe2O3		0.0000E+00	cm^3			
410	Total	Void Fraction		[redacted]			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				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
426				**(20% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		[redacted]			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			
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	A	B	C	D	E	F	G	H
460				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
461				**(25% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		[redacted]			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								
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495				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
496				**(25% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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

	A	B	C	D	E	F	G	H
511		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
512		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
513		Den. of Fe2O3		5.2400E+00	g/cm^3			
514		Vol. of Fe2O3		0.0000E+00	cm^3			
515	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
516		Total Volume		6.4928E+06	cm^3			
517		Calculated Volume		6.4928E+06	cm^3		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^3			
522		Calculated Volume		1.8116E+06	cm^3			
523		Distance from Center		-3.44230E+01	cm			
524								
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530				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
531				**(25% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		UO2 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^3		Si	6.18950E-03
541		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
542		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
543		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
546		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
547		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
548		Den. of Fe2O3		5.2400E+00	g/cm^3			
549		Vol. of Fe2O3		0.0000E+00	cm^3			
550	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
551		Total Volume		6.9257E+06	cm^3			
552		Calculated Volume		6.9257E+06	cm^3		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^3			
557		Calculated Volume		1.9324E+06	cm^3			
558		Distance from Center		-3.19350E+01	cm			
559								
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	A	B	C	D	E	F	G	H
562								
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565				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
566				**(25% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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^3		Si	6.18950E-03
576		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
577		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
578		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
581		Vol. of Gd		0.0000E+00	cm^3		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^3			
584		Vol. of Fe2O3		0.0000E+00	cm^3			
585	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
586		Total Volume		7.1350E+06	cm^3			
587		Calculated Volume		7.1350E+06	cm^3		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^3			
592		Calculated Volume		1.9908E+06	cm^3			
593		Distance from Center		-3.07430E+01	cm			
594								
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600				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
601				**(50% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
611		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
612		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04

	A	B	C	D	E	F	G	H
613		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
616		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
617		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
618		Den. of Fe2O3		5.2400E+00	g/cm^3			
619		Vol. of Fe2O3		0.0000E+00	cm^3			
620	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
621		Total Volume		6.1109E+06	cm^3			
622		Calculated Volume		6.1109E+06	cm^3		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^3			
627		Calculated Volume		3.1737E+06	cm^3			
628		Distance from Center		-7.60100E+00	cm			
629								
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631								
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634								
635				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
636				**(50% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
646		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
647		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
648		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
651		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
652		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
653		Den. of Fe2O3		5.2400E+00	g/cm^3			
654		Vol. of Fe2O3		0.0000E+00	cm^3			
655	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
656		Total Volume		6.4928E+06	cm^3			
657		Calculated Volume		6.4928E+06	cm^3		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^3			
662		Calculated Volume		3.3720E+06	cm^3			
663		Distance from Center		-3.82200E+00	cm			

	A	B	C	D	E	F	G	H
664								
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670				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
671				**(50% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		UO2 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^3		Si	6.18950E-03
681		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
682		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
683		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
686		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
687		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
688		Den. of Fe2O3		5.2400E+00	g/cm^3			
689		Vol. of Fe2O3		0.0000E+00	cm^3			
690	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
691		Total Volume		6.9257E+06	cm^3			
692		Calculated Volume		6.9257E+06	cm^3		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^3			
697		Calculated Volume		3.5968E+06	cm^3			
698		Distance from Center		4.54000E-01	cm			
699								
700								
701								
702								
703								
704								
705				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
706				**(75% DHLW in Mixture, 0.15 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		UO2 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

	A	B	C	D	E	F	G	H
715		Cylinder Volume		7.1459E+06	cm^3		Si	6.18950E-03
716		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
717		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
718		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
721		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
722		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
723		Den. of Fe2O3		5.2400E+00	g/cm^3			
724		Vol. of Fe2O3		0.0000E+00	cm^3			
725	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
726		Total Volume		6.1109E+06	cm^3			
727		Calculated Volume		6.1109E+06	cm^3		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^3			
732		Calculated Volume		4.6423E+06	cm^3			
733		Distance from Center		2.05270E+01	cm			
734								
735								
736								
737								
738								
739								
740				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
741				**(75% DHLW in Mixture, 0.20 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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		UO2 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^3		Si	6.18950E-03
751		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
752		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
753		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
756		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
757		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
758		Den. of Fe2O3		5.2400E+00	g/cm^3			
759		Vol. of Fe2O3		0.0000E+00	cm^3			
760	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
761		Total Volume		6.4928E+06	cm^3			
762		Calculated Volume		6.4928E+06	cm^3		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				

	A	B	C	D	E	F	G	H
766		Mixture Volume		4.9324E+06	cm^3			
767		Calculated Volume		4.9324E+06	cm^3			
768		Distance from Center		2.62580E+01	cm			
769								
770								
771								
772								
773								
774								
775				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
776				**(75% DHLW in Mixture, 0.25 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
786		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
787		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
788		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
791		Vol. of Gd		0.0000E+00	cm^3		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^3			
794		Vol. of Fe2O3		0.0000E+00	cm^3			
795	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
796		Total Volume		6.9257E+06	cm^3			
797		Calculated Volume		6.9257E+06	cm^3		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^3			
802		Calculated Volume		5.2613E+06	cm^3			
803		Distance from Center		3.29150E+01	cm			
804								
805								
806								
807								
808								
809								
810				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
811				**(25% DHLW in Mixture, 0.272 Void Fraction, 200 g Gd, 0 g Fe**				
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

	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		[redacted]			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				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
846				**(25% DHLW in Mixture, 0.272 Void Fraction, 100 g Gd, 0 g Fe**				
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		[redacted]			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

	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^3			
872		Calculated Volume		1.9908E+06	cm^3			
873		Distance from Center		-3.07430E+01	cm			
874								
875								
876								
877								
878								
879								
880				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
881				**(25% DHLW in Mixture, 0.272 Void Fraction, 50 g Gd, 0 g Fe2(**				
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. Remaing		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^3		Si	6.18950E-03
891		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
892		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
893		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
896		Vol. of Gd		6.3288E+00	cm^3		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^3			
899		Vol. of Fe2O3		0.0000E+00	cm^3			
900	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
901		Total Volume		7.1350E+06	cm^3			
902		Calculated Volume		7.1350E+06	cm^3		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^3			
907		Calculated Volume		1.9908E+06	cm^3			
908		Distance from Center		-3.07430E+01	cm			
909								
910								
911								
912								
913								
914								
915				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
916				**(25% DHLW in Mixture, 0.272 Void Fraction, 20 g Gd, 0 g Fe2(**				
917							DHLW Clay	
918		Cylinder Segment Volume Calculation					(atom/barn/cm)	

	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^3		Si	6.18950E-03
926		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
927		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
928		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
931		Vol. of Gd		2.5315E+00	cm^3		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^3			
934		Vol. of Fe2O3		0.0000E+00	cm^3			
935	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
936		Total Volume		7.1350E+06	cm^3			
937		Calculated Volume		7.1350E+06	cm^3		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^3			
942		Calculated Volume		1.9908E+06	cm^3			
943		Distance from Center		3.07430E+01	cm			
944								
945								
946								
947								
948								
949								
950				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
951				**(25% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 295105 g**				
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^3		Si	6.18950E-03
961		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
962		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
963		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
966		Vol. of Gd		0.0000E+00	cm^3		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^3			
969		Vol. of Fe2O3		5.6318E+04	cm^3			

	A	B	C	D	E	F	G	H
970	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
971		Total Volume		7.0954E+06	cm^3			
972		Calculated Volume		7.0954E+06	cm^3		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^3			
977		Calculated Volume		2.0346E+06	cm^3			
978		Distance from Center		-2.98550E+01	cm			
979								
980								
981								
982								
983								
984								
985				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
986				**(25% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 295105 g**				
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^3		Si	6.18950E-03
996		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
997		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
998		Degraded MIT Volume		2.0097E+05	cm^3		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^3		Fe	1.67546E-03
1001		Vol. of Gd		2.5315E+00	cm^3		Ni	2.05882E-04
1002		Mass of Fe2O3		2.9511E+05	g		U-238	0.00000E+00
1003		Den. of Fe2O3		5.2400E+00	g/cm^3			
1004		Vol. of Fe2O3		5.6318E+04	cm^3			
1005	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
1006		Total Volume		7.0954E+06	cm^3			
1007		Calculated Volume		7.0954E+06	cm^3		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^3			
1012		Calculated Volume		2.0346E+06	cm^3			
1013		Distance from Center		-2.98550E+01	cm			
1014								
1015								
1016								

	I	J	K	L	M	N	O	P	Q
1									
2									
3									
4						Void Frac.	0.15		
5	**DHLW**								
6									
7		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
41									
42		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
76									
77		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
111	)								
112		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
146	)								
147		Degraded MIT Fuel				**Mixture**		(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	

	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	DHLW								
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	

	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	DHLW								
216	)								
217		Degraded MIT Fuel				**Mixture**		(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	DHLW								
251	)								
252		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
286	)								
287		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
321	**3)**								
322		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
356	)								
357		Degraded MIT Fuel				**Mixture**		(atoms/barn cm)	

	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	**DHLW**								
391	)								
392		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
426	)								
427		Degraded MIT Fuel				**Mixture**		(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		

	I	J	K	L	M	N	O	P	Q
460	**DHLW**								
461	)								
462		Degraded MIT Fuel				**Mixture**		(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				**Mixture**		(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	

	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	

	I	J	K	L	M	N	O	P	Q
562									
563									
564						Void Frac.	0.272		
565	**DHLW**								
566	**3)**								
567		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
601	**)**								
602		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
636	)								
637		Degraded MIT Fuel				**Mixture**		(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									

	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	DHLW								
671	)								
672		Degraded MIT Fuel				**Mixture**		(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	DHLW								
706	)								
707		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
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	

	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	**DHLW**								
776	**)**								
777		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
811	**?O3)**								
812		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
846	**2O3)**								
847		Degraded MIT Fuel				**Mixture**		(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	

	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	DHLW								
881	3)								
882		Degraded MIT Fuel				**Mixture**		(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	DHLW								
916	3)								
917		Degraded MIT Fuel				**Mixture**		(atoms/barn cm)	
918			Mass(g)	WT					

	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	**DHLW**								
951	**e2O3)**								
952		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
986	**Fe2O3)**								
987		Degraded MIT Fuel				**Mixture**		(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	**DHLW**		(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	**DHLW**		(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	

	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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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				

	R	S	T	U
205				
206				
207				
208				
209				
210				
211				
212				
213				
214				
215				
216				
217	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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				
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493				
494				
495				
496				
497	**DHLW**		(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				
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528				
529				
530				
531				
532	**DHLW**		(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				
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556				
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558				
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561				

	R	S	T	U
562				
563				
564				
565				
566				
567	**DHLW**		(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				
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593				
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596				
597				
598				
599				
600				
601				
602	**DHLW**		(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	**DHLW**		(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				
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667				
668				
669				
670				
671				
672	**DHLW**		(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				
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694				
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698				
699				
700				
701				
702				
703				
704				
705				
706				
707	**DHLW**		(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	

	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	**DHLW**		(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				
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769				
770				
771				
772				
773				
774				
775				
776				
777	**DHLW**		(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				
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806				
807				
808				
809				
810				
811				
812	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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				
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909				
910				
911				
912				
913				
914				
915				
916				
917	**DHLW**		(atoms/barn cm)	
918				

	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	**DHLW**		(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	**DHLW**		(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				

	A	B	C	D	E	F	G	H
1								
2		**75% Uranium Loading**						
3								
4								
5				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
6				**(0% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
16		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
17		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
18		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
21		Vol. of Gd		0.0000E+00	cm^3		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^3			
24		Vol. of Fe2O3		0.0000E+00	cm^3			
25	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
26		Total Volume		7.1337E+06	cm^3			
27		Calculated Volume		7.1337E+06	cm^3		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^3			
32		Calculated Volume		2.7480E+05	cm^3			
33		Distance from Center		7.24160E+01	cm			
34								
35								
36								
37								
38								
39								
40				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
41				**(5% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O3**				
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^3		Si	6.18950E-03
51		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06

	A	B	C	D	E	F	G	H
52		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
53		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
56		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
57		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
58		Den. of Fe2O3		5.2400E+00	g/cm^3			
59		Vol. of Fe2O3		0.0000E+00	cm^3			
60	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
61		Total Volume		7.1337E+06	cm^3			
62		Calculated Volume		7.1337E+06	cm^3		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^3			
67		Calculated Volume		6.1774E+05	cm^3			
68		Distance from Center		-6.20159E+01	cm			
69								
70								
71								
72								
73								
74								
75				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
76				**(10% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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		UO2 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^3		Si	6.18950E-03
86		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
87		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
88		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
91		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
92		Mass of Fe2O3		0.0000E+00	g		U-238	0.00000E+00
93		Den. of Fe2O3		5.2400E+00	g/cm^3			
94		Vol. of Fe2O3		0.0000E+00	cm^3			
95	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
96		Total Volume		7.1337E+06	cm^3			
97		Calculated Volume		7.1337E+06	cm^3		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^3			
102		Calculated Volume		9.6069E+05	cm^3			

	A	B	C	D	E	F	G	H
103		Distance from Center		5.32585E+01	cm			
104								
105								
106								
107								
108								
109								
110				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
111				**(15% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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^3		Si	6.18950E-03
121		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
122		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
123		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
126		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
127		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
128		Den. of Fe2O3		5.2400E+00	g/cm^3			
129		Vol. of Fe2O3		0.0000E+00	cm^3			
130	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
131		Total Volume		7.1337E+06	cm^3			
132		Calculated Volume		7.1337E+06	cm^3		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^3			
137		Calculated Volume		1.3036E+06	cm^3			
138		Distance from Center		-4.53190E+01	cm			
139								
140								
141								
142								
143								
144								
145				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
146				**(20% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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

	A	B	C	D	E	F	G	H
154		Cylinder Length		304	cm		Al	1.18129E-03
155		Cylinder Volume		7.1459E+06	cm^3		Si	6.18950E-03
156		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
157		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
158		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
161		Vol. of Gd		0.0000E+00	cm^3		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^3			
164		Vol. of Fe2O3		0.0000E+00	cm^3			
165	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
166		Total Volume		7.1337E+06	cm^3			
167		Calculated Volume		7.1337E+06	cm^3		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^3			
172		Calculated Volume		1.6466E+06	cm^3			
173		Distance from Center		-3.78750E+01	cm			
174								
175								
176								
177								
178								
179								
180				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
181				**(25% DHLW in Mixture, 0.272 Void Fraction, 0 g Gd, 0 g Fe2O**				
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^3		Si	6.18950E-03
191		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
192		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
193		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
196		Vol. of Gd		0.0000E+00	cm^3		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^3			
199		Vol. of Fe2O3		0.0000E+00	cm^3			
200	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
201		Total Volume		7.1337E+06	cm^3			
202		Calculated Volume		7.1337E+06	cm^3		Total	3.37283E-02
203	Mixture	Distance from Center		8.47600E+01	cm			
204		Frac. of DHLW Mixed						

	A	B	C	D	E	F	G	H
205		with MIT Fuel		2.5000E-01				
206		Mixture Volume		1.9895E+06	cm^3			
207		Calculated Volume		1.9895E+06	cm^3			
208		Distance from Center		3.07700E+01	cm			
209								
210								
211								
212								
213								
214								
215				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
216				**(10% DHLW in Mixture, 0.26 Void Fraction, 80 g Gd, 0 g Fe2O**				
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^3		Si	6.18950E-03
226		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
227		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
228		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
231		Vol. of Gd		1.0126E+01	cm^3		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^3			
234		Vol. of Fe2O3		0.0000E+00	cm^3			
235	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
236		Total Volume		7.0181E+06	cm^3			
237		Calculated Volume		7.0181E+06	cm^3		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^3			
242		Calculated Volume		9.4513E+05	cm^3			
243		Distance from Center		5.36348E+01	cm			
244								
245								
246								
247								
248								
249								
250				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
251				**(10% DHLW in Mixture, 0.26 Void Fraction, 60 g Gd, 0 g Fe2O**				
252							DHLW Clay	
253		Cylinder Segment Volume Calculation					(atom/barn/cm)	
254							H	3.55893E-03
255		Geometry Calculations					O	1.97883E-02

	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^3		Si	6.18950E-03
261		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
262		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
263		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
266		Vol. of Gd		7.5946E+00	cm^3		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^3			
269		Vol. of Fe2O3		0.0000E+00	cm^3			
270	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
271		Total Volume		7.0181E+06	cm^3			
272		Calculated Volume		7.0181E+06	cm^3		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^3			
277		Calculated Volume		9.4512E+05	cm^3			
278		Distance from Center		5.36350E+01	cm			
279								
280								
281								
282								
283								
284								
285				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
286				**(10% DHLW in Mixture, 0.26 Void Fraction, 40 g Gd, 0 g Fe2O**				
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^3		Si	6.18950E-03
296		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
297		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
298		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
301		Vol. of Gd		5.0630E+00	cm^3		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^3			
304		Vol. of Fe2O3		0.0000E+00	cm^3			
305	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
306		Total Volume		7.0181E+06	cm^3			

	A	B	C	D	E	F	G	H
307		Calculated Volume		7.0181E+06	cm^3		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^3			
312		Calculated Volume		9.4512E+05	cm^3			
313		Distance from Center		-5.36350E+01	cm			
314								
315								
316								
317								
318								
319								
320				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
321				**(10% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 0 g Fe2O**				
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. Remaing		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^3		Si	6.18950E-03
331		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
332		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
333		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
336		Vol. of Gd		2.5315E+00	cm^3		Ni	2.05882E-04
337		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
338		Den. of Fe2O3		5.2400E+00	g/cm^3			
339		Vol. of Fe2O3		0.0000E+00	cm^3			
340	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
341		Total Volume		7.0180E+06	cm^3			
342		Calculated Volume		7.0180E+06	cm^3		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^3			
347		Calculated Volume		9.4512E+05	cm^3			
348		Distance from Center		-5.36350E+01	cm			
349								
350								
351								
352								
353								
354								
355				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
356				**(10% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 0 g Fe2O3**				
357							DHLW Clay	

	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		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^3		Si	6.18950E-03
366		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
367		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
368		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
371		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
372		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
373		Den. of Fe2O3		5.2400E+00	g/cm^3			
374		Vol. of Fe2O3		0.0000E+00	cm^3			
375	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
376		Total Volume		7.0180E+06	cm^3			
377		Calculated Volume		7.0180E+06	cm^3		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^3			
382		Calculated Volume		9.4511E+05	cm^3			
383		Distance from Center		5.36352E+01	cm			
384								
385								
386								
387								
388								
389								
390				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
391				**(10% DHLW in Mixture, 0.26 Void Fraction, 80 g Gd, 295105 g**				
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		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^3		Si	6.18950E-03
401		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
402		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
403		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
406		Vol. of Gd		1.0126E+01	cm^3		Ni	2.05882E-04
407		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
408		Den. of Fe2O3		5.2400E+00	g/cm^3			

	A	B	C	D	E	F	G	H
409		Vol. of Fe2O3		5.6318E+04	cm^3			
410	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
411		Total Volume		7.0942E+06	cm^3			
412		Calculated Volume		7.0942E+06	cm^3		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^3			
417		Calculated Volume		1.0212E+06	cm^3			
418		Distance from Center		-5.18100E+01	cm			
419								
420								
421								
422								
423								
424								
425				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
426				**(10% DHLW in Mixture, 0.26 Void Fraction, 60 g Gd, 295105 g**				
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		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^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		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
441		Vol. of Gd		7.5946E+00	cm^3		Ni	2.05882E-04
442		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
443		Den. of Fe2O3		5.2400E+00	g/cm^3			
444		Vol. of Fe2O3		5.6318E+04	cm^3			
445	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
446		Total Volume		7.0942E+06	cm^3			
447		Calculated Volume		7.0942E+06	cm^3		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^3			
452		Calculated Volume		1.0212E+06	cm^3			
453		Distance from Center		-5.18100E+01	cm			
454								
455								
456								
457								
458								
459								

	A	B	C	D	E	F	G	H
460				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
461				**(10% DHLW in Mixture, 0.26 Void Fraction, 40 g Gd, 295105 g**				
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^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		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
476		Vol. of Gd		5.0630E+00	cm^3		Ni	2.05882E-04
477		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
478		Den. of Fe2O3		5.2400E+00	g/cm^3			
479		Vol. of Fe2O3		5.6318E+04	cm^3			
480	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
481		Total Volume		7.0942E+06	cm^3			
482		Calculated Volume		7.0942E+06	cm^3		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^3			
487		Calculated Volume		1.0212E+06	cm^3			
488		Distance from Center		-5.18100E+01	cm			
489								
490								
491								
492								
493								
494								
495				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
496				**(10% DHLW in Mixture, 0.26 Void Fraction, 20 g Gd, 295105 g**				
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^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		2.0005E+05	cm^3		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^3		Fe	1.67546E-03

	A	B	C	D	E	F	G	H
511		Vol. of Gd		2.5315E+00	cm^3		Ni	2.05882E-04
512		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
513		Den. of Fe2O3		5.2400E+00	g/cm^3			
514		Vol. of Fe2O3		5.6318E+04	cm^3			
515	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
516		Total Volume		7.0942E+06	cm^3			
517		Calculated Volume		7.0942E+06	cm^3		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^3			
522		Calculated Volume		1.0212E+06	cm^3			
523		Distance from Center		5.18100E+01	cm			
524								
525								
526								
527								
528								
529								
530				**DHLW and Degraded MIT Fuel Homogeneous Mixture below**				
531				**(10% DHLW in Mixture, 0.26 Void Fraction, 0 g Gd, 295105 g F**				
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		UO2 Frac. Remaing		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^3		Si	6.18950E-03
541		1/2 Cylinder Volume		3.5729E+06			P	1.76488E-06
542		DHLW Volume		4.9933E+06	cm^3		K	4.59207E-04
543		Degraded MIT Volume		2.0005E+05	cm^3		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^3		Fe	1.67546E-03
546		Vol. of Gd		0.0000E+00	cm^3		Ni	2.05882E-04
547		Mass of Fe2O3		[redacted]	g		U-238	0.00000E+00
548		Den. of Fe2O3		5.2400E+00	g/cm^3			
549		Vol. of Fe2O3		5.6318E+04	cm^3			
550	Total	Void Fraction		[redacted]			Pu-239	1.03481E-09
551		Total Volume		7.0941E+06	cm^3			
552		Calculated Volume		7.0941E+06	cm^3		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^3			
557		Calculated Volume		1.0212E+06	cm^3			
558		Distance from Center		5.18100E+01	cm			
559								
560								
561								

	I	J	K	L	M	N	O	P	Q
1									
2									
3									
4						Void Frac.	0.272		
5	DHLW								
6	)								
7		Degraded MIT Fuel				**Mixture**		(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	DHLW								
41	)								
42		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
76	**3)**								
77		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
111	**3)**								
112		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
146	**3)**								
147		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
181	**3)**								
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	

	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	DHLW								
216	3)								
217		Degraded MIT Fuel				**Mixture**		(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	DHLW								
251	3)								
252		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
286	**3)**								
287		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
321	**3)**								
322		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
356	**)**								
357		Degraded MIT Fuel				**Mixture**		(atoms/barn cm)	

	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	**DHLW**								
391	**Fe2O3)**								
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	

	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	**DHLW**								
426	**Fe2O3)**								
427		Degraded MIT Fuel				**Mixture**		(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		

	I	J	K	L	M	N	O	P	Q
460	**DHLW**								
461	**Fe2O3)**								
462		Degraded MIT Fuel				**Mixture**		(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	**DHLW**								
496	**Fe2O3)**								
497		Degraded MIT Fuel				**Mixture**		(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	

	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	**DHLW**								
531	**e2O3)**								
532		Degraded MIT Fuel				**Mixture**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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				

	R	S	T	U
205				
206				
207				
208				
209				
210				
211				
212				
213				
214				
215				
216				
217	**DHLW**		(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	**DHLW**		(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	**DHLW**		(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	